Economic Impact Analysis for the New Source Performance Standards Review for Stationary Combustion Turbines: Final Rule

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Economic Impact Analysis for the New Source Performance Standards Review for Stationary Combustion Turbines: Final Rule

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1 INTRODUCTION

1.1 Background

The U.S. Environmental Protection Agency (EPA) is finalizing amendments to the new source performance standards for stationary combustion turbines and stationary gas turbines pursuant to the technology review required by the Clean Air Act (CAA). As a result of this review of available control technologies for limiting emissions of certain criteria air pollutants, specifically nitrogen oxide (NO_X) and sulfur dioxide (SO_2), the EPA is establishing size-based subcategories for new, modified, and reconstructed stationary combustion turbines that recognize distinctions between those that operate at varying rates of utilization, those with different design efficiencies, those firing natural gas or non-natural gas fuels, and those that operate in certain locations. In general, the EPA determines that the continued use of combustion controls is the best system of emission reduction (BSER) for limiting NO_X emissions from most new stationary combustion turbines in this source category. Specifically, the BSER of combustion controls applies to all new medium and small stationary combustion turbines and certain new large combustion turbines. However, for new large combustion turbines with high rates of utilization, the EPA determines that combustion controls with the addition of post-combustion selective catalytic reduction (SCR) is the BSER. Lower utilization large turbines are further divided according to efficiency with separate BSER determinations and associated NO_X standards. For large, low utilization turbines that are more efficient, the EPA determines the BSER is combustion controls alone, and for lower efficiency designs the BSER is the use of advanced combustion controls. Based on the application of a particular BSER and other updates in technical information, the EPA is proposing to adjust the NO_X standards of performance for certain stationary combustion turbines in this source category. Combustion controls remain the BSER for modified and reconstructed units. In addition, the EPA is maintaining the current standards for SO_2 emissions, because after reviewing the current SO_2 standards, we find that the use of low-sulfur fuels remains the BSER. Finally, the Agency includes a subcategory for temporary stationary combustion turbines as well as amendments to address specific technical and editorial issues to clarify the existing regulations.

1.2 Legal Basis for this Rulemaking

The EPA's authority for this rule is CAA section 111, which governs the establishment of standards of performance for stationary sources. Section 111(b)(1)(A) of the CAA requires the EPA Administrator to list categories of stationary sources that in the Administrator's judgment cause or contribute significantly to air pollution that may reasonably be anticipated to endanger public health or welfare. The EPA must then issue performance standards for new (and modified or reconstructed) sources in each source category pursuant to CAA section 111(b)(1)(B). These standards are referred to as new source performance standards (NSPS). The EPA has the authority to define the scope of the source categories, determine the pollutants for which standards should be developed, set the emission level of the standards, and distinguish among classes, types, and sizes within categories in establishing the standards.

CAA section 111(b)(1)(B) requires the EPA to "at least every 8 years review and, if appropriate, revise" new source performance standards. However, the Administrator need not review any such standard if the "Administrator determines that such review is not appropriate in light of readily available information on the efficacy" of the standard.

In setting or revising a performance standard, CAA section 111(a)(1) provides that performance standards are to reflect "the degree of emission limitation achievable through the application of the BSER which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated." The term "standard of performance" in CAA section 111(a)(1) makes clear that the EPA is to determine both the BSER for the regulated sources in the source category and the degree of emission limitation achievable through application of the BSER. The EPA must then, under CAA section 111(b)(1)(B), promulgate standards of performance for new sources that reflect that level of stringency. CAA section 111(b)(5) generally precludes the EPA from prescribing a particular technological system that must be used to comply with a standard of performance. Rather, sources can select any measure or combination of measures that will achieve the standard.

Pursuant to the definition of new source in CAA section 111(a)(2), standards of performance apply to facilities that begin construction, reconstruction, or modification after the date of publication of the proposed standards in the *Federal Register*. Under CAA section 111(a)(4), “modification” means any physical change in, or change in the method of operation of, a stationary source which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted. Changes to an existing facility that do not result in an increase in emissions are not considered modifications. Under the provisions in 40 CFR 60.15 (subject to any variation in the category-specific NSPS regulations), reconstruction means the replacement of components of an existing facility such that: (1) the fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable entirely new facility; and (2) it is technologically and economically feasible to meet the applicable standards. Pursuant to CAA section 111(b)(1)(B), the standards of performance or revisions thereof shall become effective upon promulgation.

1.3 Economic Basis for this Rulemaking

This rulemaking weighs several economic considerations in determining how and whether to update combustion turbine emission standards for the protection of human health and the environment. Executive Order 12866 directs that, *“Each agency shall identify the problem that it intends to address (including, where applicable, the failures of private markets or public institutions that warrant new agency action) as well as assess the significance of that problem.”* Economic efficiency can generally be achieved from private competition in free markets, but E.O. 12866 recognizes that some markets may not achieve economic efficiency when there exists some form of market failure. The Office of Management and Budget’s (OMB) Circular A-4 (2003) notes that *“the major types of market failure include: externality, market power, and inadequate or asymmetric information.”* An externality occurs *“when one party's actions impose uncompensated benefits or costs on another party. Environmental problems are a classic case of externality.”* The human health impacts of NO_X emissions from combustion turbines are an example of an externality where private firms (e.g., the operators of combustion turbines) do not fully account for the human health impacts of their operations.[1] In the presence of such an externality, Federal intervention may be warranted. Circular A-4 states, *"If the regulation is designed to correct a significant market failure, you should describe the failure both qualitatively and (where feasible) quantitatively. You should show that a government intervention is likely to do more good than harm."*[2]

For this final rule, EPA has followed the directions of E.O. 12866 and Circular A-4 in publishing an impact analysis characterizing the costs and benefits of the proposed rule, soliciting public comment, and now providing an updated analysis in this EIA comparing the costs of the final rule to a no action alternative in the baseline. Specifically, EPA's analysis considers the increased compliance costs for the turbine types for which this rule increases regulatory requirements and cost-savings from the components of this rule that decrease regulatory requirements. This EIA also describes the broader economic impacts of this rulemaking, employment effects, and various unquantified impacts. As detailed later in this EIA, combustion turbines have applications across several sectors, including electricity, oil and gas, and data centers.

1.4 Regulatory History

A stationary combustion turbine is defined as all equipment, including but not limited to the combustion turbine; the fuel, air, lubrication, and exhaust gas systems; control systems (except emission control equipment); heat recovery system (including heat recovery steam generators (HRSG) and duct burners); and any ancillary components

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1 Private firms may account for some of the human health or other impacts of their emissions, but they are not necessarily incentivized to fully internalize these external costs. For example, some private firms may be required to address pollution under state or local regulations or as the result of litigation. Some private firms may also voluntarily control emissions in response to community concerns or other societal pressures. However, these considerations are not necessarily sufficient to achieve economic efficiency.

2 In addition to the directive that Federal rulemakings establish a justification for intervention, Circular A-4 and E.O. 12866 also direct agencies to consider benefits and costs in the rulemaking process. Specifically, E.O. 12866 states, *"In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach."*

and sub-components comprising any simple cycle, regenerative/recuperative cycle, and combined cycle stationary combustion turbine, and any combined heat and power (CHP) stationary combustion turbine-based system. Stationary means that the combustion turbine is not self-propelled or intended to be propelled while performing its function. Certain combustion turbines may, however, be mounted on a vehicle for portability and still be considered stationary.

Standards of performance for the source category of stationary gas turbines were originally promulgated in 1979 in subpart GG of 40 CFR part 60 (44 FR 52792). As promulgated in 1979, the sources subject to the NSPS are stationary combustion turbines with a heat input at peak load equal to or greater than 10.7 gigajoules (GJ) (10 million British thermal units per hour (MMBtu/h)), based on the lower heating value of the fuel, that commenced construction, modification, or reconstruction after October 3, 1977.

The EPA last revised the NSPS on July 6, 2006, and subpart KKKK is applicable to stationary combustion turbines with a heat input at peak load equal to or greater than 10.7 GJ (10 MMBtu/h), based on the higher heating value (HHV) of the fuel, for which construction, modification, or reconstruction was commenced after February 18, 2005 (71 FR 38482).

The NO_X standards in subparts GG and KKKK are based on the application of combustion controls (as the BSER) and allow the turbine owner or operator the choice of meeting a concentration-based emission standard or an output-based emission standard. The concentration-based emission limits are in units of parts per million by volume dry (ppmvd) at 15 percent oxygen (O_2). The output-based emission limits are in units of mass per unit of useful recovered energy, nanograms per Joule (ng/J) or pounds per megawatt-hour (lb/MWh). All of the NO_X limits in subpart KKKK are based on the application of combustion controls but individual standards may differ for individual subcategories of combustion turbines based on the following factors: the fuel input rating at peak load, the fuel used, the application, the load, and the location of the turbine. The fuel input rating of the turbine does not include any supplemental fuel input to the heat recovery system and refers to the rating of the combustion turbine itself.

Specifically, in subpart KKKK, the EPA identifies 14 subcategories of stationary combustion turbines and establishes NO_X emission limits for each. The size-based subcategories include less than or equal to 50 MMBtu/h of heat input, greater than 50 MMBtu/h of heat input and less than or equal to 850 MMBtu/h of heat input, and greater than 850 MMBtu/h of heat input. There are separate subcategories for combustion turbines operating at part load, for modified and reconstructed combustion turbines, heat recovery units operating independent of the combustion turbine, and turbines operating at low ambient temperatures. A specific NO_X performance standard ranging from 15 to 150 ppmvd is identified for each of the 14 subcategories and these standards are shown in Table 1.

Table 1 Current NO_X Emission Standards for Stationary Combustion Turbines

Combustion Turbine Type	Combustion Turbine Heat Input at Peak Load (HHV)	NO_X Emission Standard
New turbine firing natural gas, electric generating	≤ 50 MMBtu/h	42 ppm at 15 percent oxygen (O_2) or 290 ng/J of useful output (2.3 lb/MWh)
New turbine firing natural gas, mechanical drive	≤ 50 MMBtu/h	100 ppm at 15 percent O_2 or 690 ng/J of useful output (5.5 lb/MWh)
New turbine firing natural gas	> 50 MMBtu/h and ≤850 MMBtu/h	25 ppm at 15 percent O_2 or 150 ng/J of useful output (1.2 lb/MWh)
New, modified, or reconstructed turbine firing natural gas	> 850 MMBtu/h	15 ppm at 15 percent O_2 or 54 ng/J of useful output (0.43 lb/MWh)
New turbine firing fuels other than natural gas, electric generating	≤ 50 MMBtu/h	96 ppm at 15 percent O_2 or 700 ng/J of useful output (5.5 lb/MWh)
New turbine firing fuels other than natural gas, mechanical drive	≤ 50 MMBtu/h	150 ppm at 15 percent O_2 or 1,100 ng/J of useful output (8.7 lb/MWh)
New turbine firing fuels other than natural gas	> 50 MMBtu/h and ≤ 850 MMBtu/h	74 ppm at 15 percent O_2 or 460 ng/J of useful output (3.6 lb/MWh)
New, modified, or reconstructed turbine firing fuels other than natural gas	> 850 MMBtu/h	42 ppm at 15 percent O_2 or 160 ng/J of useful output (1.3 lb/MWh)
Modified or reconstructed turbine	≤ 50 MMBtu/h	150 ppm at 15 percent O_2 or 1,100 ng/J of useful output (8.7 lb/MWh)
Modified or reconstructed turbine firing natural gas	> 50 MMBtu/h and ≤ 850 MMBtu/h	42 ppm at 15 percent O_2 or 250 ng/J of useful output (2.0 lb/MWh)
Modified or reconstructed turbine firing fuels other than natural gas	> 50 MMBtu/h and ≤ 850 MMBtu/h	96 ppm at 15 percent O_2 or 590 ng/J of useful output (4.7 lb/MWh)

Combustion Turbine Type	Combustion Turbine Heat Input at Peak Load (HHV)	NO_X Emission Standard
Turbines located north of the Arctic Circle (latitude 66.5 degrees north), turbines operating at less than 75 percent of peak load, modified and reconstructed offshore turbines, and turbines operating at temperatures less than 0 °F	≤ 30 MW output	150 ppm at 15 percent O_2 or 1,100 ng/J of useful output (8.7 lb/MWh)
Turbines located north of the Arctic Circle (latitude 66.5 degrees north), turbines operating at less than 75 percent of peak load, modified and reconstructed offshore turbines, and turbines operating at temperatures less than 0 °F	> 30 MW output	96 ppm at 15 percent O_2 or 590 ng/J of useful output (4.7 lb/MWh)
Heat recovery units operating independent of the combustion turbine	All sizes	54 ppm at 15 percent O_2 or 110 ng/J of useful output (0.86 lb/MWh)

Regarding SO_2, the standards of performance in subpart KKKK reflect the use of low-sulfur fuels. The fuel sulfur content limit is 26 ng/J (0.060 lb SO_2/MMBtu) heat input for combustion turbines located in continental areas and 180 ng/J (0.42 lb SO_2/MMBtu) heat input in noncontinental areas. This is approximately equivalent to 0.05 percent sulfur by weight (500 parts per million by weight (ppmw)) for fuel oil in continental areas and 0.4 percent sulfur by weight (4,000 ppmw) for fuel oil in noncontinental areas, respectively. Subpart KKKK also includes an optional output based SO_2 standard.

In subpart GG in 1979, the EPA determined that it was appropriate to exempt emergency combustion turbines from the NO_X limits. These included emergency-standby combustion turbines, military combustion turbines, and firefighting combustion turbines. Emergency combustion turbines are further defined in subpart KKKK as units that operate in emergency situations, such as turbines used to supply electric power when the local utility service is interrupted. Subpart KKKK also includes exemptions for stationary combustion turbine test cells/stands and integrated gasification combined cycle (IGCC) combustion turbine facilities covered by subpart Da of 40 CFR part 60 (the Utility Boiler NSPS). Furthermore, under subpart KKKK, the HRSG and duct burners continue to be exempt from subparts Da, Db, and Dc (the Utility Boiler and Industrial, Commercial, and Institutional Boiler NSPS) while combustion turbines used by manufacturers in research and development of equipment for both combustion turbine emissions control techniques and combustion turbine efficiency improvements are exempt from the NO_X limits on a case-by-case basis only.

On September 5, 2006, a petition for reconsideration of the revised NSPS was filed by the Utility Air Regulatory Group (UARG). The EPA granted reconsideration of subpart KKKK and on August 29, 2012, proposed to amend subparts KKKK and GG to address specific issues identified by the petitioners (77 FR 52554) as well as other technical and editorial issues.

The 2012 proposed amendments to subparts KKKK and GG of 40 CFR part 60 were in response to issues raised in the UARG petition for reconsideration discussed above. Specifically, the EPA proposed to clarify the intent in applying and implementing specific rule requirements, to correct unintentional technical omissions and editorial errors, and address various other issues that were identified since promulgation of subpart KKKK. The EPA did not finalize that rule, but reproposed applicable clarifications and technical corrections from those proposed amendments in the 2024 NSPS Proposal.

1.5 Final Requirements

Sources subject to the NSPS are stationary combustion turbines with a heat input at peak load equal to or greater than 10.7 gigajoules per hour (GJ/h) (10 million British thermal units per hour (MMBtu/h)), based on the higher heating value (HHV) of the fuel, that commence construction, modification, or reconstruction after December 13, 2024, the date of publication of the proposed standards in the *Federal Register*. The applicability of sources that are subject to subpart KKKKa is similar to that for sources subject to the existing 40 CFR part 60, subpart KKKK. Stationary combustion turbines subject to the standards in the new subpart KKKKa are not subject to the requirements of subparts GG or KKKK; the HRSG and duct burners subject to these standards continue to be exempt from the requirements of 40 CFR part 60, subpart Da (the Utility Boiler NSPS) as well as subparts Db and Dc (the Industrial/Commercial/Institutional Boiler NSPS) as previously established in subpart KKKK. Subpart KKKKa maintains the NO_X exemptions promulgated previously in subparts GG and KKKK. The EPA is amending the applicability of subparts KKKK and KKKKa to provide that owners and operators of portable combustion turbines that have been properly certified as meeting the standards that would be applicable to such combustion turbines under the appropriate mobile source provisions are not required to meet any other provisions under subparts KKKK or KKKKa.

After considering comments critical of the proposed size-based subcategory threshold between small and medium units, the EPA has decided to retain in subpart KKKKa the general size-based subcategories from subpart KKKK. This includes subcategories for new, modified, and reconstructed stationary combustion turbines with base load ratings greater than 850 MMBtu/h of heat input (i.e., large), base load ratings greater than 50 MMBtu/h and less than or equal to 850 MMBtu/h of heat input (i.e., medium), and base load ratings less than or equal to 50 MMBtu/h of heat input (i.e., small). In addition, certain subcategories of new stationary combustion turbines in subpart KKKKa reflect the correlation between the utilization of a combustion turbine and the performance of available control technologies in limiting NO_X emissions. Specifically, manufacturers have continuously strived to increase the efficiency of new turbine designs, but manufacturer specification sheets show that some models of large, high-efficiency turbines cannot meet the 15 ppm NO_X standard established in subpart KKKK. A review of power sector data reported to EPA's CAMPD—as well as BACT permits under the NSR program—shows that many owners/operators of high-efficiency combustion turbines subject to a NO_X limit of 15 ppm have installed SCR. This correlation between high-efficiency combustion turbines and increased NO_X emissions has led to SCR becoming a more utilized control technology for the source category. Also, for certain large combustion turbines, the design efficiency of the combustion turbine is also considered—depending on the utilization of the turbine according to its rolling 12-calendar-month capacity factor. The EPA subcategorizes large and medium combustion turbines further according to how they are operated—either at high rates of utilization or low rates of utilization. A new large or medium combustion turbine with a 12-calendar-month capacity factor greater than 45 percent is subcategorized as a high-utilization source. A new large or medium combustion turbine with a 12-calendar-month capacity factor less than or equal to 45 percent is subcategorized as a low-utilization source. Small combustion turbines are not being further subcategorized based on utilization.

In addition, taking into consideration public comments in response to the EPA's discussion of the unique challenges faced by new large, higher efficiency turbines in the proposal, the EPA is finalizing two subcategories based on the design efficiency of the combustion turbine, which account for different levels of emissions performance that can be achieved by combustion controls alone (i.e., without SCR). Specifically, for new large turbines with low rates of utilization (i.e., a 12-calendar-month capacity factor less than or equal to 45 percent) and design efficiencies equal to or greater than 38 percent on a higher heating value (HHV) basis, the EPA is finalizing a determination that the BSER is the use of combustion controls alone, and for new large turbines with low rates of utilization (i.e., a 12-calendar-month capacity factor less than or equal to 45 percent) and design efficiencies less than 38 percent, the EPA is finalizing a determination that the BSER is the use of advanced combustion controls.

In subpart KKKKa, the EPA is finalizing a determination that the BSER is the use of combustion controls (i.e., without SCR) for all but one subcategory of new, modified, or reconstructed stationary combustion turbines. For that one subcategory—new large turbines with high rates of utilization (i.e., a 12-calendar-month capacity factor greater than 45 percent)—the BSER is combustion controls with SCR. The standards of performance for each subcategory of stationary combustion turbine in subpart KKKKa reflect the degree of emission limitation achievable based upon application of the BSER. For new large, high-utilization turbines firing natural gas with a BSER of combustion controls with SCR, the NO_X standard is 5 ppm. For new natural gas-fired large turbines with low rates of utilization, the NO_X standard is 25 ppm for higher efficiency classes of turbines and 9 ppm for lower efficiency classes. The different NO_X standards reflect the performance of available control technologies and are based on the application of the appropriate BSER for each subcategory, either combustion controls with SCR, combustion controls without SCR, or advanced combustion controls without SCR, respectively.

Similarly, for new medium, high-utilization combustion turbines firing natural gas, the NO_X standard is 15 ppm based on the performance of the BSER of dry combustion controls. For new medium, low-utilization turbines firing natural gas, the NO_X standard is 25 ppm based on the performance of water- or steam-injection combustion controls. And for all new natural gas-fired small combustion turbines, the NO_X standard is 25 ppm based on the BSER of combustion controls. Subpart KKKKa does not distinguish between electrical and mechanical drive applications for new sources.

This action also maintains subcategories for modified and reconstructed stationary combustion turbines that are generally consistent with the subcategories in subpart KKKK. These subcategories are based on a BSER of combustion controls with associated NO_X standards of performance. The EPA is not finalizing the proposed, category-specific definition of "reconstruction" for combustion turbines.

Other final determinations reflected in subpart KKKKa include: the creation of a new subcategory for stationary temporary combustion turbines; lowering the threshold that defines part-load operations to any hour when the heat input of the combustion turbine is less than or equal to 70 percent of the base load rating; allowing owners and operators to petition the Administrator for a site-specific NO_X standard when burning by-product fuels; an exclusion of heat input from utilization-level calculations during periods of Energy Emergency Alert levels 1, 2, and 3; an exemption from Title V permitting for certain combustion turbines that are not major sources or located at major sources under CAA section 502(a) (also added to subparts GG and KKKK); and retention of the SO_2 standards from subpart KKKK for all new, modified, and reconstructed stationary combustion turbines.

The EPA is finalizing corresponding amendments in subparts GG and KKKK with respect to several of these ancillary issues, which will be applicable to combustion turbines subject to those subparts as of the effective date of this final rule. In subpart GG, the EPA is finalizing that turbines subject to subparts Da, KKKK, or KKKKa are not subject to subpart GG. In subpart KKKK, the EPA is finalizing a clarification that only the heat input to the combustion turbine engine is used for applicability purposes and that combustion turbines regulated under subpart KKKK are exempt from subparts KKKKa and GG. The EPA is also finalizing that emergency, military, and firefighting combustion turbines are exempt from the NO_X emissions standards in subpart KKKK and KKKKa, carrying over exemptions that were originally included in subpart GG. Additionally, the EPA is finalizing flexibilities regarding when performance tests must be conducted after long periods of non-operation and that owners and operators can use fuel records to comply with their SO_2 standard. The EPA is finalizing a low-Btu alternative to the SO_2 standard in subpart KKKK, as well as a concentration-based alternate SO_2 standard. Finally, the EPA is finalizing the requirement for state approval for certain monitoring and compliance tasks that are already covered under Part 75 and specifications about including duct burners in performance tests. In both subparts GG and KKKK, the EPA is finalizing that as an alternative to being subject to either of those subparts, owners or operators of combustion turbines that otherwise meet the applicability criteria of each may petition the Administrator to become subject to subpart KKKKa instead. The EPA is also finalizing in both subparts GG and KKKK that turbines subject to subparts J or Ja are not subject to the respective SO_2 standard in subparts GG or KKKK and that NO_X continuous emissions monitoring systems (CEMS) installed and certified according to Part 75 can be used to monitor NO_X emissions. The EPA is finalizing standard electronic reporting requirements for turbines subject to subparts GG or KKKK and that an additional test method (EPA Method 320) can be used to determine NO_X and diluent concentration in subparts GG and KKKK. It is the EPA's understanding and intention that none of these changes alter the stringency or increase any regulatory burdens with respect to the existing combustion turbines subject to these subparts.

This action finalizes standards of performance in subpart KKKKa that apply at all times, including during periods of startup, shutdown, and malfunction (SSM), and other changes such as electronic reporting that also apply to previous NSPS subparts GG and KKKK. These standards are summarized in Table 2.[3]

[3] The removal of the SSM exemption is a legal change from the baseline in that, under subpart KKKK, the SSM exemption continues to be available. However, this NSPS provides for startup and shutdown through part-load and blended hourly standards. Generally, the EPA does not believe SSM changes will lead to quantifiable changes in cost and emissions impacts.

Table 2 Subcategories and NO_X Standards for Subpart KKKKa

Combustion turbine type	Combustion turbine base load rated heat input (HHV)	NO_X emission standard (lb/MMBtu)	NO_X emission rate equivalent (ppm at 15 percent O_2)
New, firing natural gas with utilization rate > 45 percent	> 850 MMBtu/h	0.018	5
New, firing natural gas with utilization rate ≤ 45 percent and with design efficiency ≥ 38 percent		0.092	25
New, firing natural gas with utilization rate ≤ 45 percent and with design efficiency < 38 percent		0.035	9
Modified or reconstructed, firing natural gas, at all utilization rates with design efficiency ≥ 38 percent		0.092	25
Modified or reconstructed, firing natural gas, at all utilization rates with design efficiency < 38 percent		0.055	15
New, modified, or reconstructed, firing non-natural gas		0.160	42
New, firing natural gas at utilization rates > 45 percent	> 50 MMBtu/h and ≤ 850 MMBtu/h	0.055	15
New, firing natural gas at utilization rates ≤ 45 percent		0.092	25
New, firing non-natural gas		0.290	74
Modified or reconstructed, firing natural gas	> 20 MMBtu/h and ≤ 850 MMBtu/h	0.150	42
Modified or reconstructed, firing non-natural gas		0.370	96
New, firing natural gas	≤ 50 MMBtu/h	0.092	25
New, firing non-natural gas		0.370	96
Modified or reconstructed, all fuels	≤ 20 MMBtu/h	0.550	150
New, firing natural gas, either offshore turbines, turbines bypassing the heat recovery unit, and/or temporary turbines	> 50 MMBtu/h	0.092	25
Located north of the Arctic Circle (latitude 66.5 degrees north), operating at ambient temperatures less than 0 °F (-18 °C), modified or reconstructed offshore turbines, operated during periods of turbine tuning, byproduct-fired turbines, and/or turbines operating at less than 70 percent of the base load rating	≤ 300 MMBtu/h	0.55	150
Located north of the Arctic Circle (latitude 66.5 degrees north), operating at ambient temperatures less than 0 °F (-18 °C), modified or reconstructed offshore turbines, operated during periods of turbine tuning, byproduct-fired turbines, and/or turbines operating at less than 70 percent of the base load rating	> 300 MMBtu/h	0.35	96

Combustion turbine type	Combustion turbine base load rated heat input (HHV)	NO_X emission standard (lb/MMBtu)	NO_X emission rate equivalent (ppm at 15 percent O_2)
Heat recovery units operating independent of the combustion turbine	All sizes	0.20	54

Several statutes and executive orders (EO) apply analytical requirements to federal rulemakings. This Regulatory Impact Analysis (RIA) presents several of the analyses required by these statutes and EOs, such as EO 12866 and the Regulatory Flexibility Act (RFA). The guidance document associated with EO 12866 is OMB's Circular A-4 (U.S. OMB, 2003).

This action is not significant under 3(f)(1) of Executive Order 12866, which specifies that a rule is significant if it is likely to result in an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, territorial, or tribal governments or communities.[4] However, because this rule was submitted to OMB for review, in accordance with EO 12866 and the guidelines of OMB Circular A-4, this EIA analyzes the costs of complying with the requirements in this final rule for regulated facilities.

1.6 Organization of this EIA

The remainder of this report details the methodology and the results of the EIA. Chapter 2 presents an overview of combustion turbine types and their installation costs, as well as a brief description of the industries in which they are most prevalent. Chapter 3 describes the emissions and cost analysis prepared for this final rule. Chapter 4 describes the health effects associated with exposure to NO_X and SO_2. Chapter 5 presents a discussion of potential economic impacts, impacts on small businesses and a discussion of potential employment impacts. Chapter 6 contains the references for this EIA.

[4] EO 12866 can be found at https://www.archives.gov/files/federal-register/executive-orders/pdf/12866.pdf.

2 COMBUSTION TURBINE TECHNOLOGIES AND COSTS

2.1 Introduction

This section provides background information on combustion turbine technologies. Included is a discussion of simple-cycle combustion turbines (SCCTs) and combined-cycle combustion turbines (CCCTs), along with a comparison of fuel efficiency and capital costs between the two classes of turbines.

2.2 Simple-Cycle Combustion Turbine Technologies

Most stationary combustion turbines use natural gas to generate shaft power that is converted into electricity by a generator or used to power a mechanical drive device such as a gas compressor or pump.

Combustion turbines have four basic components, as shown in Figure 1.

1. The compressor raises the air pressure up to thirty times atmospheric pressure.
2. A fuel compressor is used to pressurize the fuel.
3. The compressed air is heated in the combustion chamber at which point fuel is added and ignited.
4. The hot, high pressure gases are then expanded through a power turbine, producing shaft power, which is used to drive the air and fluid compressors of the combustion turbine as well as a generator or other mechanical drive device. Approximately one-third of the power developed by the power turbine can be required by the compressors.

Electric utilities primarily use simple-cycle combustion turbines as peaking or backup units. Their relatively low capital costs and quick start-up capabilities make them ideal for partial operation to generate power at periods of high demand or to provide ancillary services. The disadvantage of simple-cycle systems is that they are relatively inefficient, thus making them less attractive as base load generating units.

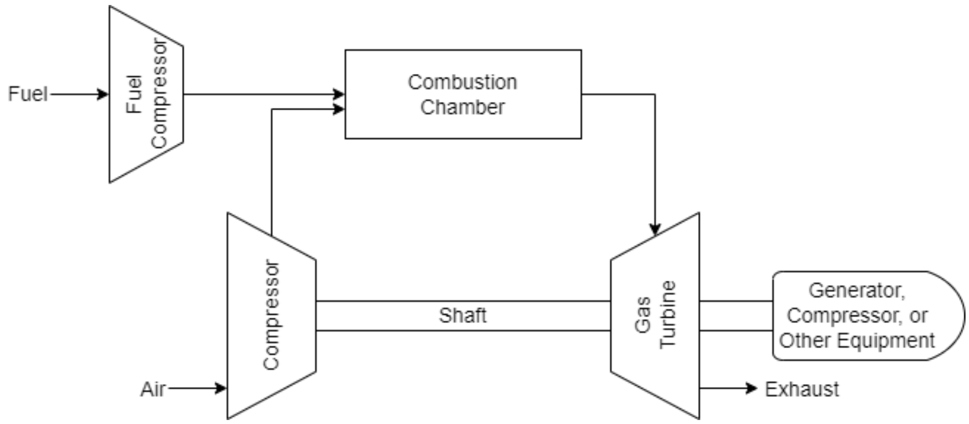

Figure 1 Simple-Cycle Gas Turbine

2.3 Combined-Cycle Combustion Turbine Technologies

The combined-cycle system incorporates two simple-cycle systems into one generation unit to maximize energy efficiency. Energy is produced in the first cycle using a gas turbine; then the heat that remains is used to create steam, which is run through a steam turbine, which is the second cycle. Thus, two single units, gas and steam, are combined to minimize lost potential energy. In a CCCT, the waste heat remaining from the gas turbine cycle is used in a boiler to produce steam. The steam is then put through a steam turbine, producing power. The remaining steam is recondensed and either returned to the boiler where it is sent through the process again or sold to a nearby industrial site to be used in a production process. Figure 2 shows a gas-fired CCCT.

There are significant efficiency gains in using a combined-cycle turbine compared to simple-cycle systems. With SCCTs, adding a second stage allows for heat that otherwise would have been emitted and completely wasted to be used to create additional power or steam for industrial purposes. While SCCTs typically range from 30-40 percent efficiency, CCCTs typically range from 50-60 percent efficiency (Gas Turbine World, 2023). In addition to energy efficiency gains, CCCTs also offer environmental efficiency gains compared to existing coal plants. In addition, efficiency gains associated with the CCCT lead to lower emissions compared to SCCTs.

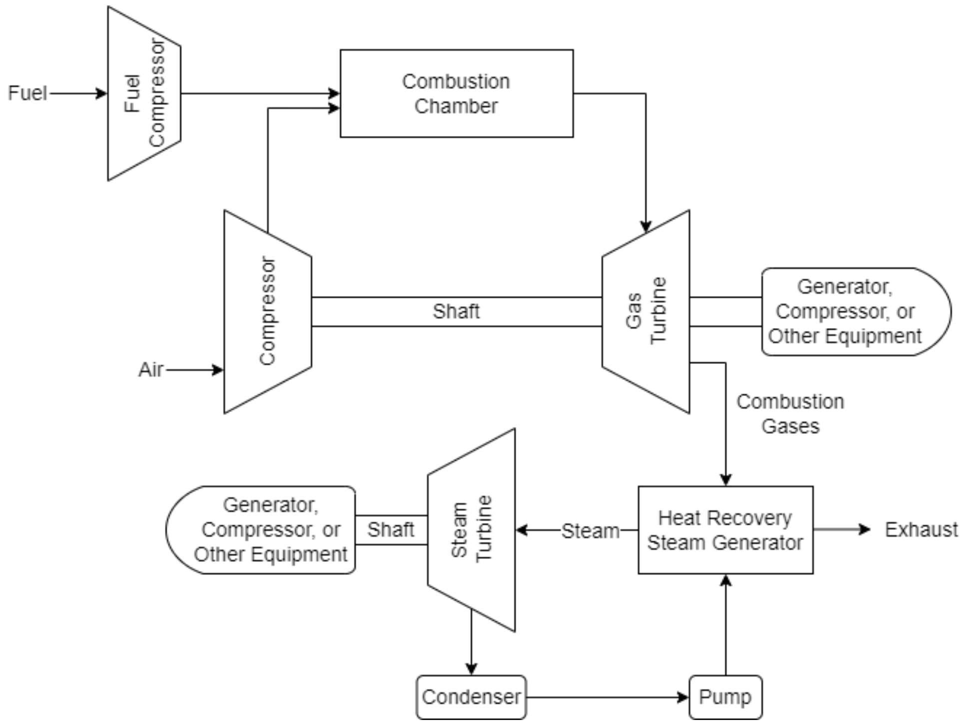

Figure 2 Combined-Cycle Gas Turbine

2.4 Capital and Installation Costs

Table 3 presents capital cost estimates for several types of utility-scale gas turbine power plants. These estimates are discussed in more detail in Gas Turbine World (2023) and are based on estimates in U.S. EIA (2020a). Because these estimates are for power plants, they include the cost of generators, natural gas pipelines, and electrical grid hookups that are not applicable for all combustion turbine uses. However, these estimates provide some insight as to the overall cost of combustion turbines.

The first industrial gas turbine began operation in 1939, and the technology has undergone constant improvement since then. Table 3 shows the capital cost for three types of turbines, under the broader categories of simple cycle and combined cycle turbines discussed previously: Aeroderivative, F-Class, and H-Class. Aeroderivative turbines are lightweight and compact designs adapted from aircraft jet engines. The F-Class turbine was developed during the 1980s and began to be used in commercial operations in the early 1990s (Eldrid et al., 2001). The H-Class turbine is a more efficient design with a higher pressure ratio and higher firing temperature that was introduced in 1995 (Matta et al., 2000).

Table 3 Utility-scale Gas Turbine Power Plant Capital Cost Estimates (million 2022$ unless otherwise noted)

	Simple Cycle		Combined Cycle	
	100 MW Aeroderivative	**240 MW F-Class**	**430 MW H-Class**	**1100 MW H-Class**
Engineering, Procurement, and Construction Costs (EPC)				
Civil/Structural/Architectural	7.7	15.0	38.1	73.6
Mechanical - Major Equipment	52.8	65.7	159.7	360.8
Mechanical - Balance of Plant	12.0	20.9	89.7	240.5
Electrical	18.7	24.6	34.4	114.1
Project Indirect Costs	18.3	23.0	98.2	184.1
EPC Contracting Fee	10.9	14.9	42.0	97.3
Owner's Costs				
Owner's Services	8.4	11.5	32.4	74.9
Land Acquisition	0.7	0.7	2.1	2.1
Electrical Interconnection	1.5	1.5	2.2	3.0
Gas Pipeline Interconnection	5.5	5.5	7.2	7.2
Project Contingency	13.6	18.3	50.6	115.8
Total Plant Cost	150.1	201.6	556.4	1,273.3
Net Plant Rating (kW)	105,100	232,600	418,399	1,083,300
Net Plant Efficiency	41.5%	38.2%	58.9%	59.4%
Installed $/kW	1,428	867	1,330	1,175

Source: Gas Turbine World 2023 Handbook

The capital cost estimates presented in Table 3 are intended to represent a complete power plant facility on a generic site at a non-specific U.S. location. The civil/structural/architectural cost includes labor and material for site preparation, foundations, piling, structural steel, and buildings. The major mechanical equipment cost includes all costs associated with the supply and installation of the turbines and boilers (where applicable), while the balance of plant mechanical cost includes costs associated with the supply and installation of pumps and tanks, piping, valves, and other necessary equipment. The electrical cost includes all costs associated with the supply and installation of generators, transformers, control systems, and other necessary electrical equipment. Project indirect costs include plant engineering, construction management, and start-up and commissioning, as well as contractor fees, overhead, and profit. Owner's costs include project development, land acquisition, and utility interconnections. A project contingency is included to account for cost uncertainties (Gas Turbine World, 2023; U.S. EIA, 2020a).

2.5 Affected Producers

As discussed in Section 1.5, the sources subject to the NSPS are stationary combustion turbines with a heat input at peak load equal to or greater than 10.7 GJ/h (10 MMBtu/h), based on the higher heating value (HHV) of the fuel, that commence construction, modification, or reconstruction after the publication of the proposed rule in the Federal Register. This rule applied to any industry using a new stationary combustion turbine as defined in Section 1.4.

To understand the industries likely to be impacted by this rule, current turbines in the National Emission Inventory (NEI) were identified. While the design capacity is not always reported in the National Emission Inventory (NEI), the units identified as combustion turbines in the 2020 NEI and having a valid design capacity of greater than 10 MMBtu/h or equivalent are summarized in Table 4 by North American Industry Classification System (NAICS) code (U.S. OMB, 2022).

Table 4 Combustion Turbines over 10 MMBtu/h or equivalent by NAICS code

NAICS	Description	# of Units	# of Facilities
2111	Oil and Gas Extraction	433	132
2211	Electric Power Generation, Transmission and Distribution	2711	968
2212	Natural Gas Distribution	100	26
2213	Water, Sewage and Other Systems	25	15
3112	Grain and Oilseed Milling	7	5
3221	Pulp, Paper, and Paperboard Mills	20	15
3241	Petroleum and Coal Products Manufacturing	38	13
3251	Basic Chemical Manufacturing	93	26
3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing	29	11
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	9	6
3254	Pharmaceutical and Medicine Manufacturing	9	7
3259	Other Chemical Product and Preparation Manufacturing	8	4
4861	Pipeline Transportation of Crude Oil	7	4
4862	Pipeline Transportation of Natural Gas	650	329
4869	Other Pipeline Transportation	7	4
4881	Support Activities for Air Transportation	5	3

NAICS	Description	# of Units	# of Facilities
5171	Wired and Wireless Telecommunications (except Satellite)	20	18
5182	Computing Infrastructure Providers, Data Processing, Web Hosting, and Related Services	5	3
5241	Insurance Carriers	8	2
5311	Lessors of Real Estate	11	3
5622	Waste Treatment and Disposal	22	9
6113	Colleges, Universities, and Professional Schools	52	36
6221	General Medical and Surgical Hospitals	17	14
9241	Administration of Environmental Quality Programs	5	2
9281	National Security and International Affairs	7	7
-	Other industries with fewer than 5 turbines per industry	67	53
Total		**4365**	**1715**

Five of these NAICS codes account for over 90 percent of the turbines in the 2020 NEI. They are 2111 (Oil and Gas Extraction), 2211 (Electric Power Generation, Transmission and Distribution), 2212 (Natural Gas Distribution), 3251 (Basic Chemical Manufacturing), and 4862 (Pipeline Transportation of Natural Gas). The NAICS codes serve as a guide for readers outlining the entities that this action is likely to affect. The standards, once promulgated, will be directly applicable to affected facilities that begin construction, reconstruction, or modification after the date of publication of the proposed standards in the Federal Register.

NAICS 2111 comprises establishments that operate and/or develop oil and gas field properties. Operation and development activities include exploration for crude petroleum and natural gas; drilling, completing, and equipping wells; operating separators, emulsion breakers, desilting equipment, and field gathering lines for crude petroleum and natural gas; and all other activities in the preparation of oil and gas up to the point of shipment from the producing property. This subsector includes the production of crude petroleum, the mining and extraction of oil from oil shale and oil sands, the production of natural gas, sulfur recovery from natural gas, and recovery of hydrocarbon liquids. Establishments in this subsector include those that operate oil and gas wells on their own account or for others on a contract or fee basis.

NAICS 2211 comprises establishments primarily engaged in generating, transmitting, and/or distributing electric power. Establishments in this industry group may perform one or more of the following activities: (1) operate generation facilities that produce electric energy; (2) operate transmission systems that convey the electricity from the generation facility to the distribution system; and (3) operate distribution systems that convey electric power received from the generation facility or the transmission system to the final consumer.

NAICS 2212 comprises: (1) establishments primarily engaged in operating gas distribution systems (e.g., mains, meters); (2) establishments known as gas marketers that buy gas from the well and sell it to a distribution system; (3) establishments known as gas brokers or agents that arrange the sale of gas over gas distribution systems operated by others; and (4) establishments primarily engaged in transmitting and distributing gas to final consumers.

NAICS 3251 comprises establishments primarily engaged in manufacturing chemicals using basic processes, such as thermal cracking and distillation. Chemicals manufactured in this industry group are usually separate chemical elements or separate chemically-defined compounds.

NAICS 4862 comprises establishments primarily engaged in the pipeline transportation of natural gas from processing plants to local distribution systems. This industry includes the storage of natural gas because the storage is usually done by the pipeline establishment and because a pipeline is inherently a network in which all the nodes are interdependent.

The total number of firms and establishments in these five NAICS, as well as their employment and annual payroll are summarized in Table 5 below. The information in Table 5 is not meant to serve as an exhaustive presentation for each affected industry but is instead meant to serve as a high-level summary of potentially relevant information for these industries.

Table 5 Number of Firms and Establishments, Employment, and Annual Payroll for Affected Industries: 2021

NAICS	NAICS Description	Firms	Establishments	Employment	Annual Payroll ($1,000)
2111	Oil and Gas Extraction	4,337	5,444	88,532	13,164,547
2211	Electric Power Generation, Transmission and Distribution	2,227	12,481	497,375	61,888,671
2212	Natural Gas Distribution	429	2,441	89,775	9,682,205
3251	Basic Chemical Manufacturing	1,245	2,438	154,491	15,922,408
4862	Pipeline Transportation of Natural Gas	117	2,068	26,263	3,274,407

Source: U.S. Census Bureau, 2021 Statistics of U.S. Businesses (U.S. Census Bureau, 2023).

2.6 Projected Growth of Combustion Turbines

Because the date of construction is not available in the NEI and is often not reported to the EPA Emissions Inventory System (EIS), a separate turbine dataset was created to assess the number of new turbines constructed within the past five years. This dataset was created using Form EIA-860 survey data from the Energy Information Administration, the EPA's Clean Air Markets Program Data (CAMPD), the EPA's National Electric Energy Data System (NEEDS) database, and existing major sources subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) for stationary combustion turbines. A permit review was also conducted to confirm the construction date and installed emissions controls for these units. Form EIA-860 collects unit-level information about existing and planned units and associated environmental equipment at electric power plants with 1 megawatt or greater of combined nameplate capacity. Combustion turbines that are connected to a generator larger than 250 MMBtu/h generally report emissions and control technology information to the EPA. The EPA reviewed the reported NO_X control technology from the CAMPD for combustion turbines that commenced operation between 2020 and 2024. NEEDS is an EPA database of electric generators that serves as a resource for modeling the sector. NEEDS includes source information about existing and planned units, information about the combustion turbines themselves, and data about their air emissions. The list of sources compiled for the EPA's review of the NESHAP only includes combustion turbines that are major sources of toxic air emissions, including industrial sources that do not appear in NEEDS, CAMPD, or the Form EIA-860 survey data. This dataset was supplemented with an estimate of the number of new stationary combustion turbines at non-major sources, for which we have limited information. The development of this dataset is discussed in greater detail in the Technical Support Document titled, *Combustion Turbine Inventory and NO_X Control Technology Baseline*, available in the docket for this rule.

Based on this combined dataset, 221 combustion turbines that would have been subject to this rule if constructed after this NSPS proposal were constructed within the past 5 years. Electricity Generating Units (EGU) account for approximately 60 percent of the new units over this timeframe, while industrial sources comprise the remaining installations. The types of these units and their installed controls are summarized in Table 6.

Table 6 Types of Combustion Turbines Constructed 2020-2024 and Installed Controls

	Turbine Type		Number of Turbines	Number of Turbines with SCR	Number of Turbines with DLN	Number of Turbines with WI
Electricity Generating Units	≤ 850 MMBtu/h	Simple Cycle	77	69	8	52
		Combined Cycle	5	5	5	0
	> 850 MMBtu/h	Simple Cycle	21	4	20	7
		Combined Cycle	29	29	27	0
Industrial Sources	≤ 25 MW	Simple Cycle	20	2	2	5
		Combined Cycle	10	5	8	0
	> 25 MW	Simple Cycle	4	1	2	0
		Combined Cycle	3	3	0	0
	Direct Mechanical Drive	Simple Cycle	52	0	5	0
Total		Simple Cycle	174	76	37	64
		Combined Cycle	47	42	40	0

Note: Number of controls likely underestimated for industrial sources due to incomplete information. SCR = Selective Catalytic Reduction, DLN = Dry Low NO_X Burners, and WI = Water Injection.

The EPA has used this combined dataset to estimate the potential number of new combustion turbines that would be affected by this rule and the additional NO_X controls they may be required to adopt. This distribution of new units is assumed to continue in future years, with the number of new units in each future year calculated as the average of new units over the 2020-2024 period. However, this combined dataset is a selected sample, which may not be representative of the entire population of combustion turbines in the future. In particular, it has greater representation of larger combustion turbines and those in the electricity sector relative to the general population of combustion turbines. Also, using this recent historical data to project future turbine construction may not fully reflect projected trends, such as recent increases in turbine demand from data centers and the electric power sector broadly. For example, in the 2025 Annual Energy Outlook, the U.S. Energy Information Administration projects over 200 GW of new combustion turbine capacity by 2050 (U.S. EIA, 2025), and industry sources have indicated large increases in turbine demand since 2022 (e.g., Anderson, 2025).

Nonetheless, because these data sets provide the best information regarding turbines to date, the following analysis assumes that the units in this dataset are representative of the population of combustion turbines that the EPA has limited installation and pollution control information on—in particular smaller combustion turbines and those used in industrial sectors—as sectors that employ turbines evolve in the future. These data limitations and assumptions are potentially a notable source of uncertainty in the following analysis of the benefits, costs, and other impacts of this final rule.

3 ENGINEERING COST ANALYSIS

3.1 Introduction

This chapter provides a summary of the cost analysis conducted for this rulemaking. Section 3.2 describes the affected sources. Section 3.3 briefly describes the methodology employed in the cost analysis and presents the results of that analysis. Section 3.4 discusses the secondary impacts of the final rule, and Section 3.5 characterizes the uncertainty in the cost estimates.

3.2 Affected Sources

As discussed in Section 1.5, sources subject to the NSPS are stationary combustion turbines with a heat input at peak load equal to or greater than 10.7 GJ/h (10 MMBtu/h), based on the higher heating value (HHV) of the fuel, that commence construction, modification, or reconstruction after December 13, 2024, the date of publication of the proposed standards in the *Federal Register*. To estimate the projected number of affected combustion turbines in each year, the dataset described in Section 2.6 was used. Based on this dataset and assuming the same distribution of units in future years, the number of new, modified, or reconstructed stationary combustion turbines in each subcategory that are expected in each year is presented in Table 7. These values were calculated by rounding the per year estimates of new units over 2020-2024, which were reported in Table 6. The number of combustion turbines that are expected to incur increased costs relative to the baseline is estimated by comparing the emissions rates of units constructed during 2020-2024 to the emissions limits that will be required under this final rule. In this comparison, units that are unable to meet the revised limit under the final rule are estimated to need emissions controls if the same type of unit is constructed in the future under the revised NSPS. We do not expect additional investment above the average rate from 2020-2024 as a result of this rule. Uncertainties and limitations of this approach are discussed in Section 2.6 above.

Table 7 Estimated Number of New, Modified, or Reconstructed Turbines in Each Year

	Turbine Type		New Units per Year	New Units per Year Expected to Incur Increased Costs Relative to Baseline
Electricity Generating Units	≤ 850 MMBtu/h	Simple Cycle	15	0
		Combined Cycle	1	0
	> 850 MMBtu/h	Simple Cycle	4	0
		Combined Cycle	6	1
Industrial Sources	≤ 25 MW	Simple Cycle	4	1
		Combined Cycle	2	0
	> 25 MW	Simple Cycle	1	1
		Combined Cycle	1	0
	Direct Mechanical Drive	Simple Cycle	10	0
Total		Simple Cycle	35	2
		Combined Cycle	9	1

For these affected combustion turbines, the NSPS BSER discussed in Section 1.5 is the use of combustion controls (i.e., without SCR) for all but one subcategory of new, modified, or reconstructed stationary combustion turbines. For that one subcategory—new large turbines with high rates of utilization (i.e., a 12-calendar-month capacity factor greater than 45 percent)—the BSER is combustion controls with SCR. The SCR process is based on the chemical reduction of the NO_X molecule via a nitrogen-based reducing agent (reagent) and a solid catalyst. To remove NO_X, the reagent, commonly ammonia (NH_3, anhydrous and aqueous) or urea-derived ammonia, is injected into the post-combustion flue gas of the combustion turbine. The reagent reacts selectively with the flue gas NO_X within a specific temperature range and in the presence of the catalyst and oxygen to reduce the NO_X into molecular nitrogen (N_2) and water vapor (H_2O). SCR employs a ceramic honeycomb or metal-based surface with activated catalytic sites to increase the rate of the reduction reaction. Over time, however, the catalyst activity decreases, requiring replacement, washing/cleaning, rejuvenation, or regeneration to extend the life of the catalyst. Catalyst designs and formulations are generally proprietary. The primary components of the SCR include the ammonia storage and delivery system, ammonia injection grid, and the catalyst reactor.

3.3 Capital Investment, Annual Costs, and Emissions Reductions

To comply with the requirements of this rule, some units will incur capital costs associated with the installation of advanced combustion controls or upgrades to the controls that would have been installed, while some units are expected to incur increased operating costs of their controls to meet the requirements. Because SCR has been nearly universally adopted in recent years within the subcategory for which the BSER is combustion controls with SCR, affected units in this subcategory are not expected to incur additional capital costs associated with the installation of SCR as a result of this rule.

The capital and increased operating costs were estimated based on model plants from NETL (2023). The development of these cost estimates is discussed in detail in the Technical Support Document titled *NO_X Mitigation Measures - Selective Catalytic Reduction for Combustion Turbines*, available in the docket for this rule. While the NSPS BSER for smaller turbines is the use of combustion controls, data limitations did not permit the calculation of the costs of advanced combustion controls for these units. As a result, the costs for these units presented in this EIA instead are representative of the costs associated with the application of SCR on these units. For this reason, the costs and related secondary impacts for each affected turbine are likely over-estimated.

For the proposed rule, we selected an 8-year analysis period to align with the NSPS review timing in CAA Section 111(B)(1)(b) and estimated compliance would begin in 2027, reflecting the time required to complete the construction of a new, modified, or reconstructed turbine.[5] For this final rule, we maintain these assumptions for the sake of comparability, while acknowledging that this methodology does not account for the entire stream of operation and maintenance costs over the lifetime of the equipment, or emission reductions that continue beyond the analysis period. Table 8 summarizes for the period 2025-2032 the number of units expected to be subject to the NSPS, the number of units expected to incur increased costs relative to the baseline, and the annual NO_X emission changes. The NO_X emission decreases from subcategories with increased stringency are

[5] Note the EPA used a 30-year useful life when evaluating the BSER and in the consideration of capital expenditures.

expected to be partially offset by NO_X emission increases from subcategories with decreased stringency.

Table 8 Summary of Estimated Affected Units and Emission Reductions in First 8 Years After the Rule is Final

Year	Cumulative New Units Subject to NSPS	Cumulative Units with Increased Costs Relative to Baseline	Annual NO_X Emission Changes Relative to Baseline (tons) in Subcategories with Increased Stringency	Annual NO_X Emission Changes Relative to Baseline (tons) in Subcategories with Decreased Stringency	Net Annual NO_X Emission Changes Relative to Baseline (tons)
2025	0	0	0	0 to 0	0 to 0
2026	0	0	0	0 to 0	0 to 0
2027	16	1	-6	47 to 94	41 to 88
2028	61	3	-120	94 to 188	-26 to 68
2029	105	5	-235	141 to 282	-94 to 47
2030	149	8	-349	188 to 376	-161 to 27
2031	193	10	-464	235 to 469	-229 to 5
2032	237	12	-578	282 to 563	-296 to -15

Note: Values may not sum due to rounding. The ranges reflect the assumption of 2 to 4 high efficiency turbines constructed during the analysis period.

Table 9 summarizes the undiscounted and discounted total annual cost over the period 2025-2032. For this analysis, it is assumed that the capital cost is completely incurred in the first year of operation. This is a conservative approach, as capital costs are often financed over several years.

Table 9 Summary of Estimated Costs for Subcategories with Increased Stringency in First 8 Years After the Rule is Final

	Undiscounted Costs			Total Annual Cost Discounted to 2024	
Year	Unannualized Capital Cost (million 2024$)	O&M Cost (million 2024$)	Total Annual Cost (million 2024$)	3% Discount Rate	7% Discount Rate
2025	$0	$0	$0	$0	$0
2026	$0	$0	$0	$0	$0
2027	$0.96	$0.05	$1.01	$0.93	$0.83
2028	$2.55	$0.67	$3.22	$2.86	$2.46
2029	$2.55	$1.28	$3.84	$3.31	$2.74
2030	$2.55	$1.90	$4.45	$3.73	$2.97
2031	$2.55	$2.52	$5.07	$4.12	$3.16
2032	$2.55	$3.13	$5.68	$4.49	$3.31

Note: Values rounded to three significant figures.

Table 10 reports the 2024 present value and equivalent annualized value of the costs shown in Table 9 at 3 percent and 7 percent discount rates.

Table 10 2024 Present Value and Equivalent Annualized Value of Estimated Costs for Subcategories with Increased Stringency in First 8 Years After the Rule is Final (million 2024$)

	3% Discount Rate	7% Discount Rate
Present Value	$19.4	$15.5
Equivalent Annualized Value	$2.77	$2.59

Note: Values rounded to three significant figures.

Additionally, there is a deregulatory aspect of this rule. Under this final rule, new natural gas-fired combustion turbines with a base load rated heat input of greater than 850 MMBtu/h, operating at low levels of utilization (i.e., less than or equal to a 12-calendar-month capacity factor of 45 percent), and with a design efficiency greater than or equal to 38 percent will face a less stringent NO_X emission limit than they would have faced under the existing standard. While the standard is less stringent in subpart KKKKa than in the existing subpart KKKK for these specific types of turbines, when subpart KKKK was promulgated in 2006, these types of turbines did not exist. They are a newer technology that is now commercially available, and the new NSPS seeks to recognize this fact along with the fact that they are highly efficient.

To account for the rule accommodating these high-efficiency turbines, we conduct an additional analysis where we compare the construction and operations of these high-efficiency turbines under the final rule to a baseline where low-efficiency turbines compliant with the current 2006 standards are constructed instead. However, this analysis also takes into account improvements in combustion turbines that have occurred since the promulgation of the 2006 NSPS. Based on EPA's market research, we use a 9-ppm low-efficiency combustion turbine as the baseline, which is better performing than the 15 ppm NO_X emission standard required under the 2006 NSPS. How many new turbines will take advantage of this subcategory in the future is uncertain, so we assume two to four turbines are constructed for each 5-year period beginning in 2027. Specifically, EPA has identified 28 frame-type combustion turbines that have commenced operation in the previous 5 years. One of these turbines was a large high-efficiency combustion turbine with SCR controls. An additional six large turbines completed during this period have comparable or higher utilization rates. EPA presumes that a subset of these turbines would have considered the new large, high-efficiency subcategory had it been available. Therefore, EPA identified two to four turbines per 5-year period as a likely range for the rate of new turbines availing themselves of this high-efficiency subcategory. We also assume that each turbine has a capacity of 370 MW; high-efficiency turbines have 2 percent higher capital costs; there is no difference in non-fuel operating and maintenance costs; high-efficiency turbines have 38.8 percent efficiency; and low-efficiency turbines have 34.4 percent efficiency; and delivered natural gas prices are $3.43/MMBtu.[6] We also assume that the turbines are utilized at 15 percent capacity factor over a 30-year turbine lifespan. While many simple cycle turbines operate at capacity factors below 10 percent, the subcategory for high-efficiency turbines in the final rule accommodates utilization up to 45 percent, and presumably, operators installing large, high-efficiency turbines plan to operate them more than the typical simple cycle. Other assumptions and methodology are documented in the Excel workbook titled *Turbines NSPS Final Cost Summary 122225.xlsx*, available in the docket for this rule.

Although we assume that the higher-efficiency turbines have more expensive capital costs, the fuel savings lead to overall cost savings for the turbine operators as shown in Table 11. However, the higher-efficiency turbines also have higher NO_X emissions relative to the baseline with low-efficiency turbines. More turbines constructed in this subcategory or higher utilization than assumed in this analysis could increase the avoided costs of this subcategory above the regulatory costs associated presented in Table 10.

[6] As discussed in the preamble, available models of high-efficiency turbines have capacities ranging from 330 to 450 MW. The 2 percent higher capital costs are based on the difference in capital costs in year 2028 of the NREL ATB projection between F-class and H-class turbine configurations. EPA found an average efficiency of 34.5 percent among 9 models of low-efficiency turbines and an average efficiency of 38.8 percent among 8 models of high-efficiency turbines. This $3.43/MMBtu natural gas price is based on the AEO 2025 projection of delivered prices to the power sector in 2030.

Table 11 Summary of Estimated Costs Associated with Large, High-Efficiency Turbines in First 8 Years After the Rule is Final

Year	Capital and Avoided Fuel Costs									Net Avoided Costs Discounted to 2024					
	Unannualized Capital Costs (million 2024$)			Avoided Fuel Costs (million 2024$, present values, 3% discount rate)			Avoided Fuel Costs (million 2024$, present values, 7% discount rate)			3% Discount Rate (million 2024$)			7% Discount Rate (million 2024$)		
2025	$0.00	to	$0.00	$0.00	to	$0.00	$0.00	to	$0.00	$0.00	to	$0.00	$0.00	to	$0.00
2026	$0.00	to	$0.00	$0.00	to	$0.00	$0.00	to	$0.00	$0.00	to	$0.00	$0.00	to	$0.00
2027	$3.91	to	$7.83	$14.33	to	$28.66	$9.07	to	$18.14	$9.53	to	$19.07	$4.21	to	$8.42
2028	$3.91	to	$7.83	$14.33	to	$28.66	$9.07	to	$18.14	$9.26	to	$18.51	$3.94	to	$7.87
2029	$3.91	to	$7.83	$14.33	to	$28.66	$9.07	to	$18.14	$8.99	to	$17.97	$3.68	to	$7.36
2030	$3.91	to	$7.83	$14.33	to	$28.66	$9.07	to	$18.14	$8.72	to	$17.45	$3.44	to	$6.88
2031	$3.91	to	$7.83	$14.33	to	$28.66	$9.07	to	$18.14	$8.47	to	$16.94	$3.21	to	$6.43
2032	$3.91	to	$7.83	$14.33	to	$28.66	$9.07	to	$18.14	$8.22	to	$16.45	$3.00	to	$6.01

Note: Values are rounded to three significant figures. Ranges reflect the assumption of 2 to 4 high efficiency turbines constructed during the analysis period. The avoided fuel costs account for fuel savings over an entire 30-year lifespan for each of the turbines constructed between 2025 and 2032. The present values of these fuel savings in the third and fourth columns are the present values in the year each turbine is constructed. The fifth and sixth columns then discount the net costs back to 2024, the year of analysis.

Table 12 reports the 2024 present value and equivalent annualized value of the costs shown in Table 11 at 3 percent and 7 percent discount rates.

Table 12 2024 Present Value and Equivalent Annualized Value of Net Avoided Costs Associated with Large, High-Efficiency Turbines in First 8 Years After the Rule is Final (million 2024$)

	3% Discount Rate	7% Discount Rate
Present Value	$53.2 to $106	$21.5 to $43.0
Equivalent Annualized Value	$7.58 to $15.2	$3.60 to $7.19

Note: Values rounded to three significant figures. The range reflects the assumption of 2 to 4 high efficiency turbines constructed during the analysis period.

Table 13 summarizes the estimated costs and cost savings associated with this rule. Using both 3 and 7 percent discount rates, this rule is estimated to be cost saving.

Table 13 Summary of Estimated Costs for the Final NSPS for Combustion Turbines from 2025 to 2032 (millions, 2024$)

		3% Discount Rate		7% Discount Rate	
		PV	EAV	PV	EAV
Impacts associated with subcategories with increased stringency	Costs	$19.4	$2.77	$15.5	$2.59
Impacts associated with subcategories with decreased stringency	Avoided Costs	$53.2 to $106.4	$7.58 to $15.2	$21.5 to $43.0	$3.60 to $7.19
Net Costs		-$87.0 to -$33.8	-$12.4 to -$4.81	-$27.5 to -$5.98	-$4.60 to -$1.01

Note: Values rounded to three significant figures. The range reflects the assumption of 2 to 4 high efficiency turbines constructed during the analysis period.

3.4 Secondary Impacts

SCR uses ammonia as a reactant and some ammonia is emitting either by passing through the catalyst bed without reacting with NO_X (unreacted ammonia) or passing around the catalyst bed through leaks in the seals around the catalysts bed. Both of these combined are referred to ammonia slip. Ammonia is a precursor to fine particulate matter. Ammonia slip increases as catalysts beds age and is often limited to 10 ppm or less in operating permits. Ammonia catalysts are available to reduce emissions of ammonia. The ammonia catalyst consists of an additional catalysts bed after the SCR catalyst that reacts with the ammonia that passes through and around the catalyst to reduce overall ammonia slip. In the NETL (2023) model plants used in the EPA's analysis, no additional ammonia catalyst was included, and ammonia emissions were limited to 10 ppm at the end of the catalysts' life. For estimating secondary impacts, the EPA assumed average ammonia emissions of 3.5 ppm based on information from the EPA Air Pollution Control Cost Manual (U.S. EPA, 2017a).[7] The EPA estimates that for each ton of NO_X controlled 0.10 tons of ammonia are emitted.

7 The EPA Control Cost Manual (U.S. EPA, 2017a) notes that ammonia slip refers to the excess reagent passing through the reactor. Ammonia in the flue gas causes a number of problems, including health effects, visibility of the stack effluent, salability of the fly ash, and the formation of ammonium sulfates. Limits on acceptable ammonia slip, imposed by either regulatory limits or by design requirements, place constraints on SCR performance. Ammonia slip does not remain constant as the SCR system operates but increases as the catalyst activity decreases. Properly designed SCR systems, which operate close to the theoretical stoichiometry and supply adequate catalyst volume, maintain low ammonia slip levels, approximately 2 to 5 ppm. The 3.5 ppm value used in this analysis reflects the midpoint of this range.

SCR also reduces the efficiency of a combustion turbine through the auxiliary/parasitic load requirements to run the SCR and the backpressure created from the catalyst bed. The EPA used the auxiliary load required by the SCR that was directly provided in the NETL (2023) report and estimated the loss in output from operation of the SCR due to backpressure as 0.3 percent of the gross output. The overall result is a reduction in efficiency of 0.3 percent.

Table 14 summarizes the estimated increases in ammonia emissions with applied SCR. As previously noted, for purposes of this analysis the estimated reductions on industrial sources are assumed to be achieved through the application of SCR, given the lack of data on combustion control costs. Compliance in many cases will likely be achieved through combustion controls, which would lead to reduced ammonia emissions compared to these estimates.

Table 14 Estimated Increased Ammonia Emissions Associated with NO_X Emission Reductions with Applied SCR

Year	Ammonia (tons)
2025	0
2026	0
2027	1
2028	12
2029	22
2030	33
2031	44
2032	54

3.5 Characterization of Uncertainty

It is important to note that the cost estimates presented in this chapter are subject to multiple sources of uncertainty. The rule does not dictate that any particular controls must be installed to control pollutants, but rather that new, modified, and reconstructed combustion turbines must meet emission standards consistent with the BSER for that unit. If the owners of affected units are able to find alternative, less costly methods to comply, then the costs presented in this EIA may be overestimated. Further uncertainties and limitations around the projections of future turbine demand are discussed in Section 2.6.

4 BENEFITS OF EMISSIONS REDUCTIONS

4.1 Introduction

The pollutants regulated by the combustion turbines NSPS are NO_X and SO_2. The health effects of exposure to these pollutants are briefly discussed in this section. Section 3.4 discusses the secondary impacts of this rule, and the projected increases in emissions of ammonia.

The EPA is obligated to present the Agency's best scientific understanding when developing policies and regulations and to ensure the public is not misled regarding the level of scientific understanding. Historically, however, the EPA's analytical practices often provided the public with a false sense of precision and more confidence regarding the monetized impacts of fine particulate matter ($PM_{2.5}$) and ozone than the underlying science could fully support, especially as overall emissions have significantly decreased, and impacts have become more uncertain. The EPA has seen the uncertainties expand even further with the use of benefit-per-ton (BPT) monetized values. Although intended as a screening tool when full-form photochemical modeling was not feasible, the BPT approach reduces complex spatial and atmospheric relationships into an average value per ton, which magnifies uncertainty in the resulting monetized estimates. Examples of uncertainties include but are not limited to: epidemiological uncertainty (*e.g.*, concentration-response functions, mortality valuation); economic factors (*e.g.*, discount rates, income growth); and methodological assumptions (*e.g.*, health thresholds, linear relationships, spatial relationships).

However, the EPA historically provided point estimates instead of just ranges or only quantifying emissions, which leads the public to believe the Agency has a better understanding of the monetized impacts of exposure to $PM_{2.5}$ and ozone than in reality. Therefore, to rectify this error, the EPA is no longer monetizing benefits from $PM_{2.5}$ and ozone but will continue to quantify the emissions until the Agency is confident enough in the modeling to properly monetize those impacts.

Historically, the EPA estimated the monetized benefits of avoided $PM_{2.5}$- and ozone-related impacts, which accounted for most, if not all, of the monetized benefits of many air regulations–even when the regulation was not regulating $PM_{2.5}$ or ozone–within Regulatory Impact Analyses (RIAs).[8] Throughout these analyses, the EPA acknowledged significant uncertainties related to monetized $PM_{2.5}$ and ozone impacts. The EPA has and is considering various techniques for characterizing the uncertainty in such estimates, such as estimating the fraction of avoided health effects occurring at various concentration ranges, sensitivity analyses, and alternate concentration-response assumptions. Because of the significant impacts of environmental regulations on the U.S. economy, it is essential that the Agency have confidence in the estimated benefits of an action prior to utilizing these estimates in a regulatory context.

In particular, the EPA is interested in evaluating the validity of estimating the benefits of air quality improvements relative to the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and ozone. These standards, which have been set at a level which the Administrator judges to be requisite to protect public health or welfare with an adequate margin of safety, are widely understood to represent the divide between clean air and air with an unacceptable level of pollution.

The limitations of the BPT approach are even more pronounced due to the compounding effects of emissions reductions typically occurring across many geographic areas simultaneously, with varying proximity to population centers; differing atmospheric transformation pathways for nitrous oxides (NO_X), Volatile Organic Compounds (VOCs), and secondary $PM_{2.5}$; and region-specific photochemical and meteorological conditions. Using a national BPT estimate implicitly assumes uniform marginal health benefits for each ton of reduced emissions, an assumption not supported given heterogeneity in exposure patterns and atmospheric chemistry. As more areas achieve or maintain attainment with the NAAQS, the uncertainties associated with low-concentration health effects grow, and marginal benefits become more difficult to characterize with precision.

[8] See OMB's 2017 Report to Congress on Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act for fuller discussion on uncertainties, available at https://trumpwhitehouse.archives.gov/wp-content/uploads/2019/12/2019-CATS-5885-REV_DOC-2017Cost_BenefitReport11_18_2019.docx.pdf.

Therefore, it may be appropriate for the EPA to separate exposures and impacts above the level of the standard from those occurring at lower ambient concentrations. The EPA will investigate this prior to estimating these impacts in a regulatory analysis even for informational purposes. The EPA will seek peer review for new methods developed from this work consistent with the OMB's Peer Review Guidance.[9]

4.2 Benefits of Nitrogen Oxide Reductions

Nitrogen dioxide (NO_2) is the criteria pollutant that is central to the formation of nitrogen oxides (NO_X), and NO_X emissions are a precursor to ozone and fine particulate matter. Based on many recent studies discussed in the ozone Integrated Science Assessment (ISA), the EPA has identified several key health effects that may be associated with exposure to elevated levels of ozone (U.S. EPA, 2020a). Exposures to high ambient ozone concentrations have been linked to increased hospital admissions and emergency room visits for respiratory problems. Repeated exposure to ozone may increase susceptibility to respiratory infection and lung inflammation and can aggravate preexisting respiratory disease, such as asthma. Prolonged exposures can lead to inflammation of the lung, impairment of lung defense mechanisms, and irreversible changes in lung structure, which could in turn lead to premature aging of the lungs and/or chronic respiratory illnesses such as emphysema, chronic bronchitis, and asthma.

Children typically have the highest ozone exposures since they are active outside during the summer when ozone levels are the highest. Further, children are more at risk than adults from the effects of ozone exposure because their respiratory systems are still developing. Adults who are outdoors and moderately active during the summer months, such as construction workers and other outdoor workers, also are among those with the highest exposures. These individuals, as well as people with respiratory illnesses such as asthma, especially children with asthma, experience reduced lung function and increased

[9] OMB Memorandum M-05-03, Memorandum for the Heads of Executive Departments and Agencies: Issuance of OMB's "Final Information Quality Bulletin for Peer Review" (2005), available at https://www.federalregister.gov/documents/2005/01/14/05-769/final-information-quality-bulletin-for-peer-review.

respiratory symptoms, such as chest pain and cough, when exposed to relatively low ozone levels during periods of moderate exertion.

NO_X emissions can react with ammonia, VOCs, and other compounds to form $PM_{2.5}$ (U.S. EPA, 2019). Studies have linked $PM_{2.5}$ (alone or in combination with other air pollutants) with a series of negative health effects. Short-term exposure to $PM_{2.5}$ has been associated with premature mortality, increased hospital admissions, bronchitis, asthma attacks, and other cardiovascular outcomes. Long-term exposure to $PM_{2.5}$ has been associated with premature death, particularly in people with chronic heart or lung disease. Children, the elderly, and people with cardiopulmonary disease, such as asthma, are most at risk from these health effects.

Reducing the emissions of NO_X from stationary combustion turbines can help to improve some of the effects mentioned above, either those directly related to NO_X emissions, or the effects of ozone and $PM_{2.5}$ resulting from the combination of NO_X with other pollutants.

4.3 Benefits of Sulfur Dioxide Reductions

High concentrations of sulfur dioxide (SO_2) can cause inflammation and irritation of the respiratory system, especially during physical activity. Exposure to very high levels of SO_2 can lead to burning of the nose and throat, breathing difficulties, severe airway obstruction, and can be life threatening. Long term exposure to persistent levels of SO_2 can lead to changes in lung function. Sensitive populations include asthmatics, individuals with bronchitis or emphysema, children, and the elderly (U.S. EPA, 2017b). PM can also be formed from SO_2 emissions. Secondary PM is formed in the atmosphere through a number of physical and chemical processes that transform gases, such as SO_2, into particles. Overall, emissions of SO_2 can lead to some of the effects discussed in this section—either those directly related to SO_2 emissions, or the effects of PM resulting from the combination of SO_2 with other pollutants. Further, SO_2 emissions can lead to acid deposition, with adverse effects on aquatic and terrestrial ecosystems (U.S. EPA, 2020b). Proposing to maintain the standards of performance for emissions of SO_2 from all stationary combustion turbines would continue to protect human health and the environment from the adverse effects mentioned above.

4.4 Disbenefits from Increased Ammonia and NO_X Emissions

Ammonia is a precursor to $PM_{2.5}$ formation and an increase in NH_3 formation may lead to an increase in $PM_{2.5}$. An increase in $PM_{2.5}$ is associated with significant mortality and morbidity health outcomes such as premature mortality, stroke, lung cancer, metabolic and reproductive effects, among others.

There are also potential NO_X disbenefits associated with the use of higher efficiency combustion turbines. As previously noted, new natural gas-fired combustion turbines in the large, low-utilization subcategory that are higher efficiency (*i.e.*, with a base load rated heat input greater than 850 MMBtu/h, operating at a 12-calendar-month capacity factor less than or equal to 45 percent, and with a design efficiency greater than or equal to 38 percent) are subject to a less stringent NO_X emission limit than otherwise applicable under the previous NSPS (subpart KKKK). These higher NO_X emissions create disbenefits relative to the baseline with lower efficiency turbines.

5 ECONOMIC AND SMALL BUSINESS IMPACTS

5.1 Introduction

This chapter presents the economic and small business impact analyses performed for this rulemaking. Section 5.2 describes the screening analysis that was performed to determine the impacts to small entities impacted by this final rule. Section 5.3 discusses the potential economic impacts of this final rule, while Section 5.4 concludes with a discussion of potential employment impacts of the final rule.

5.2 Screening Analysis

This section investigates characteristics of businesses and government entities that are likely to install new combustion turbines affected by this final rule and provides a screening-level analysis to assist in determining whether this final rule is likely to impose a significant impact on a substantial number of the small businesses within this industry. The analysis compares compliance costs to revenues at the ultimate parent company level. This is known as the cost-to-revenue or cost-to-sales test, or the "sales test." The sales test is an impact methodology the EPA employs in analyzing entity impacts as opposed to a "profits test," in which annualized compliance costs are calculated as a share of profits. The sales test is frequently used because revenues or sales data are commonly available for entities impacted by the EPA regulations, and profits data normally made available are often not the true profit earned by firms because of accounting and tax considerations. Also, the use of a sales test for estimating small business impacts for a rulemaking is consistent with guidance offered by the EPA on compliance with the Regulatory Flexibility Act (U.S. EPA, 2017c).

In this analysis, a small entity is defined as: (1) a small business as defined by the Small Business Administration's (SBA) regulations at 13 CFR § 121.201; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise that is independently owned and operated and is not dominant in its field. For the purposes of the RFA, States and tribal governments are not considered small governments.

Section 5.2.1 describes the process for identification of small entities, and the small business impacts analysis is presented and discussed in Section 5.2.2.

5.2.1 Identification of Small Entities

As described in Section 3.2, the EPA projects that approximately 44 new, modified, or reconstructed combustion turbines will begin operation each year. Approximately 3 sources are expected to incur additional costs associated with running their controls more. No existing combustion turbines will be affected by the regulation. Because it is not possible to project specific companies or government organizations that will purchase combustion turbines in the future, the small entity screening analysis for the combustion turbine rule is based on the evaluation of owners of combustion turbines constructed within the past five years. It is assumed that the existing size and ownership distribution of combustion turbines in this dataset is representative of the future growth in new combustion turbines.

Excluding turbines with an ultimate owner of a state, local, or foreign government, the ultimate owners of combustion turbines constructed within the past five years fall into one of the NAICS codes in Table 15, which also presents the associated SBA small entity size threshold for each NAICS code.[10] These NAICS differ from the broader groups shown in Table 4 because the NAICS code of the ultimate owner is based on the primary activity of the company as a whole, while the NAICS code reported in the NEI is for a particular facility.

[10] The table of SBA's Small Business Size Standards is available at https://www.sba.gov/document/support-table-size-standards (U.S. SBA, 2023).

Table 15 Affected NAICS Codes and SBA Small Entity Size Standards

NAICS Code	NAICS Industry Description	Size standards in millions of dollars	Size standards in number of employees
211120	Crude Petroleum Extraction		1,250
221112	Fossil Fuel Electric Power Generation		950
221118	Other Electric Power Generation		650
221122	Electric Power Distribution		1,100
221210	Natural Gas Distribution		1,150
237990	Other Heavy and Civil Engineering Construction	$45.0	
322120	Paper Mills		1,250
322291	Sanitary Paper Product Manufacturing		1,500
322299	All Other Converted Paper Product Manufacturing		500
325193	Ethyl Alcohol Manufacturing		1,000
325211	Plastics Material and Resin Manufacturing		1,250
325412	Pharmaceutical Preparation Manufacturing		1,300
325520	Adhesive Manufacturing		550
424690	Other Chemical and Allied Products Merchant Wholesalers		175
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)		200
523910	Miscellaneous Intermediation	$47.0	
524126	Direct Property and Casualty Insurance Carriers		1,500
525910	Open-End Investment Funds	$40.0	
532411	Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing	$45.5	
541330	Engineering Services	$25.5	
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)		1,000
551112	Offices of Other Holding Companies	$45.5	
611310	Colleges, Universities and Professional Schools	$34.5	
622110	General Medical and Surgical Hospitals	$47.0	
813110	Religious Organizations	$13.0	

Source: U.S. SBA Table of Size Standards (March 17, 2023) (U.S. SBA, 2023).

5.2.2 Small Business Impacts Analysis

Based on SBA criteria, 12 of the ultimate parent companies, owning 16 turbines (8.9 percent of the turbines constructed within the past 5 years), are small entities. One of the municipalities owning turbines constructed within the past five years is considered small. As shown in Table 7, three new affected units each year are expected to incur additional costs. If we assume that 8.9 percent of these units expected to incur increased costs will be owned by small entities, this implies that at most one of the three new affected units each year that are expected to incur additional costs will be owned by a small entity. The 11 small entities have an average sales value of approximately $478 million and a median sales value of approximately $123 million. We compared the average annual total compliance cost per unit in 2027 from Table 9 ($1.01 million) with the average sales for a typical small entity and estimate that the cost to sales ratio for the potentially affected small entity is 0.21 percent. Comparing the average annual total compliance cost per unit in 2027 from Table 9 ($1.01 million) with the median sales for a typical small entity, we estimate that the cost to sales ratio for the potentially affected small entity is 0.82 percent. The average sales value and median sales value are used due to uncertainty in the individual values. Many of the small entities that have constructed turbines within the past five years are privately held, and there is considerable uncertainty surrounding the sales estimates provided for them by D&B Hoovers. There is also uncertainty regarding the implicit assumption that the same types of small entities will construct turbines in the future. Because the final rule would affect new sources, any additional costs should factor into the decision to proceed with a project and could lead to a different type of project being undertaken. Based on our analysis, there are no significant economic impacts on a substantial number of small entities (SISNOSE) from this final rule.

It is important to note that the cost-to-sales ratio estimated in this analysis may be overstated or understated depending on the accuracy of the information in the underlying data on parent company ownership and parent company revenues in addition to the accuracy of the estimate of increased operating costs. The annual sales values for ultimate parent companies were derived from multiple sources, including D&B Hoovers, company reports, and Securities and Exchange Commission (SEC) filings. However, as previously noted, many of the small entities in this industry are privately held and do not publicly report their sales, so there is considerable uncertainty regarding the accuracy of this data. Furthermore, the assumption that the average sales of any new affected small entity will be equal to the average sales of the existing small entities is a source of uncertainty.

5.3 Economic Impacts

Economic impact analyses focus on changes in market prices and output levels. If changes in market prices and output levels in the primary markets are significant enough, impacts on other markets may also be examined. Both the magnitude of costs needed to comply with a rule and the distribution of these costs among affected facilities can have a role in determining how the market will change in response to a rule.

This final rule requires new, modified, or reconstructed stationary combustion turbines to meet emission standards for the release of NO_X into the environment. While the units impacted by these requirements are expected to already have installed any required emissions control devices, some units are expected to incur increased operating costs of their controls to meet the final requirements. These changes may result in higher costs of production for affected producers and impact broader markets these entities serve. As shown in section 2.5, the types of turbines affected by this rulemaking are primarily used in the power sector and in oil and natural gas transmission but are located in smaller numbers in many economic sectors.

5.4 Employment Impacts

This section discusses employment impacts related to the rule. Employment impacts of environmental regulations are generally composed of a mix of potential declines and gains in different areas of the economy over time. Regulatory employment impacts can vary across occupations, regions, and industries; by labor and product demand and supply elasticities; and in response to other labor market conditions. Isolating such impacts is a challenge, as they are difficult to disentangle from employment impacts caused by a wide variety of ongoing, concurrent economic changes.

Economic theory indicates that the effect of environmental regulation on labor demand is difficult to predict ex-ante: plants that face increased costs to comply with a new environmental regulation may reduce output, which means fewer inputs are required than previously, including labor; may make changes to their production process in a way that favors or disfavors labor compared to other inputs such as capital; and may need labor to engage in new compliance activities. As a result, plants affected by environmental regulation may increase their demand for some types of labor, decrease demand for other types, or may even absorb compliance costs in a way that minimizes effects on labor. (Berman and Bui, 2001; Deschenes, 2018; Morgenstern et al., 2002). To study the impacts of environmental regulation on firms' demand for labor empirically, a growing literature has compared employment levels at facilities subject to an environmental regulation to employment levels at similar facilities not subject to that environmental regulation; some studies find no employment effects, and others find significant differences. Employment effects have been found to manifest in different ways across affected plants, such as shifting workers across plants owned by the same firm, wage changes, job loss, and reduced hiring (e.g., Ferris et al., 2014; Curtis, 2018). A recent discussion of labor demand channels and a review of empirical literature is presented in Gray et al. (2023).

Considered across the economy and over the long run, environmental regulation is expected to cause a shift of workers among employers rather than affect the general employment level (Arrow et al., 1996, Hafstead and Williams, 2020). Employers facing a new environmental rule are more likely to see reduced employment due to cost pressure, while a movement of labor can occur towards jobs associated with pollution control or production techniques unimpacted by the regulation. Even if net impacts on employment are small after long-run market adjustments to full employment across the economy, regulatory actions move workers in and out of locations, jobs and industries, which has an important distributional impact (U.S. OMB, 2015; Walker, 2013). Transitional job losses in the near term may also have greater consequences for workers that operate in declining industries or occupations, have limited capacity to migrate, or live in communities or regions with high unemployment rates.

As indicated by the potential impacts on industries using combustion turbines discussed in Section 5.3, this final rule is not projected to cause large changes in those industries. As a result, the labor employed in those industries, their upstream suppliers, and their downstream customers are not expected to experience significant impacts due to this final rule.

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