

Out of Step

CHINA IS DRIVING THE CONTINUED GROWTH
OF THE GLOBAL COAL FLEET

by Christine Shearer, Aiqun Yu, and Ted Nace



COVER

The cover shows construction at the [Shentou power station](#) in Shanxi, China. In July 2017, China's National Energy Administration ordered the plant's owners to stop construction of two 1,000 megawatt units at the plant; in September 2017 the order was changed to "postpone." Construction on the two units officially resumed on March 28, 2019. Satellite photo from Google (accessed November 7, 2019).



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[Global Energy Monitor](#) is a network of researchers developing collaborative informational

resources on fossil fuels and alternatives. Current projects include the Global Coal Plant Tracker, the Global Coal Mine Tracker, the Global Gas Plant Tracker, the Global Fossil Infrastructure Tracker, and the CoalWire newsletter.

GLOBAL COAL PLANT TRACKER

The [Global Coal Plant Tracker](#) is an online database that identifies, maps, describes, and categorizes every known coal-fired generating unit and every new unit proposed since January 1, 2010 (30 MW and larger). Developed by Global Energy Monitor, the tracker uses footnoted wiki pages to document each plant and is updated biannually. For further details, see Tracker Methodology at [EndCoal.org](#).

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FURTHER RESOURCES

For additional data on proposed and existing coal plants, see Summary Statistics at [EndCoal.org](#), which provides over 25 tables providing results from the Global Coal Plant Tracker (GPCT), broken down by province, nation, and region. For links to reports based on GPCT data, see Reports at [EndCoal.org](#). To obtain primary data from the GCPT, contact Ted Nace (ted@tednace.com).

EXECUTIVE SUMMARY

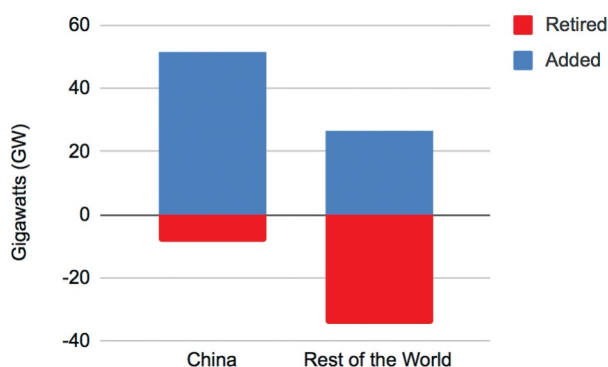
The year 2018 marked a milestone: for the first time since China's coal-building boom began in the 1980s, the coal fleet outside of China shrank. From January 2018 to June 2019, countries outside of China decreased their total coal power capacity by 8.1 gigawatts (GW), due to steady retirements and an ongoing decline in the commissioning of new coal plants.¹ Yet over the same period China increased its coal fleet by 42.9 GW, and as a result the global coal fleet overall grew by 34.9 GW (Figure 1). As more countries turn away from coal and retire their plants, China's continued pursuit of coal is increasingly out of step with the rest of the world, and is now effectively driving the ongoing expansion of the global coal fleet.

China's recent growth is due to a brief but massive spree of project permitting that occurred from September 2014 to March 2016, a period when the central government delegated permitting to provincial authorities who had strong incentives to approve and

build coal plants to hit province-level economic targets. The permitting spree brought a cohort of 245 GW of new projects nearly equivalent to the U.S. coal fleet (254 GW) into the developmental pipeline, inflating what was already an overbuilt coal power fleet, with the average running hours for China's coal plants hovering around 50% since 2015. Today, 147.7 GW of coal plants are either under active construction or under suspension and likely to be revived—an amount nearly equal to the existing coal power capacity of the European Union (150 GW).

Given the amount of capacity under development, China's central government looks ready to increase—perhaps significantly—its 1,100 GW coal power cap, as set by its 13th Five-Year Plan (FYP 2016–2020). Coal and power industry groups are proposing the central government increase total coal power capacity by 20 to 40% to between 1,200 and 1,400 GW as part of China's 2035 infrastructure plan. The 2035 infrastructure plan is expected to be released next year, and the 14th FYP in 2021.

Figure 1: From January 2018 to June 2019, countries outside of China decreased their total coal power capacity by 8.1 GW, while China increased its coal fleet by 42.9 GW.



Source: GEM, Global Coal Plant Tracker, July 2019.

The continued growth of China's coal fleet and consideration of plans to significantly raise the nation's coal power cap show that while the country is often hailed as a clean energy leader, the momentum of coal power expansion has yet to be halted. In July 2018, Global Energy Monitor (GEM) noted the central government was either unable or unwilling to slow the development of new coal plants permitted by provincial authorities in 2014–16. While the central government had issued measures slowing or stopping development on hundreds of coal plants in 2017, GEM found in 2018 that over a third of the restricted capacity had advanced in development or commissioning. Those trends have since continued, with about half of the capacity now moving forward in development.

1. A typical coal-fired generating unit is 300 to 1,000 megawatts (0.3–1.0 GW) in size, with most power stations having two or more such units.

Yet while the central government has allowed most of the plants from the permitting boom to continue into construction and commissioning, it has also introduced measures that have significantly slowed the rate of new coal proposals and permits since the boom, with only 8.5 GW of newly proposed coal power capacity and 2.6 GW permitted for construction over the past year. However, the country's proposal to increase total coal power capacity by up to 1,400 GW suggests these measures are at risk of being weakened or reversed.

An increase in China's coal power capacity is not compatible with the Paris climate agreement to hold warming well below 2°C, and almost certainly forecloses the possibility of China achieving greater emission reductions under the Paris agreement—currently pegged at peaking carbon dioxide emissions by 2030. The UN's Intergovernmental Panel on Climate Change (IPCC) has found keeping warming well below 2°C requires a 58 to 70% reduction in global coal power generation by 2030 below current levels, ramping up to between 85 and 90% by 2035. We find that China needs to have phased out most of its coal power capacity by 2035 to meet the IPCC scenario, with an average retirement age of 17 to 21 years for all its coal plants.

This report, based on GEM's [Global Coal Plant Tracker](#), analyzes trends in China's coal plant development to help determine its future, including plant-by-plant assessments of proposed, operating, and retired plants from July 2015 through July 2019.²

Key findings include:

- 121.3 GW of coal power capacity in China are under construction. An additional 26.4 GW of construction projects are under suspension and likely to be revived, based on recent trends and project-by-project analysis of satellite photos and permits.
- The large amount of capacity under development is due to the ineffectiveness of restrictions imposed after a permitting surge that occurred from 2014 to 2016, with nearly half (83.9 GW) of 169.5 GW of coal power capacity restricted in 2017 now advancing, mainly into construction or commissioning.
- China added 42.9 GW of net new coal power capacity from 2018 to June 2019, while the rest of the world decreased coal power capacity by 8.1 GW.
- By 2030, China needs to reduce its coal power capacity over 40% from the current 1,027 GW to 600 GW or less, in order to meet the reductions required in coal power used outlined by the IPCC for holding global warming well below 2°C, according to GEM's analysis. Such reductions will be difficult even in the absence of any further expansion, and are certainly incompatible with the coal fleet expansions of 20 to 40% proposed by industry groups.
- If China continues to increase total coal power capacity through 2035, its coal power generation alone will be more than three times as large as the global limit on coal power use determined by the IPCC to keep warming well below 2°C.

2. Includes all coal-fired units size 30 megawatts and above.

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INTRODUCTION

While much of the world is moving away from coal, China continues to grow its coal fleet. China's coal fleet expanded by net 25.5 GW in 2018 and 17.4 GW in the first half of 2019, while in the rest of the world net capacity decreased by 8.1 GW over the same period, as retirements exceeded new capacity. The divergence between China and the rest of the world looks set to continue: China currently has 121.3 GW of coal plants under active construction, more than the amount under construction in the rest of the world combined (105.2 GW). China also has an additional 26.4 GW of construction projects under suspension that are likely to be revived, meaning a total of 147.7 GW could soon be added to the country's coal fleet.

The fact that a large amount of capacity remains in advanced stages of development is due to weak coal plant restrictions imposed after a permitting surge. From September 2014 to March 2016, permitting authority was delegated to provincial leaders, who quickly accelerated the rate of new coal plant permits and construction to boost economic growth in their regions. In 2016, the central government responded to the provincial permitting spree by issuing a series of edicts aimed at restricting the development of new coal-fired power plants in the country, including suspending or stopping development on 169.5 GW of coal plants by name in 2017. By mid-2019, however, analysis of satellite photos and permits shows nearly half of the restricted capacity actively under development or commissioned, including capacity that had been told to stop all development through 2020.

Although the central government has largely failed to rein in coal plant construction that has already started—primarily delaying rather than canceling the capacity—it has introduced measures that have markedly slowed the rate of new proposals initiated after the 2014–16 permitting surge: new coal plants no longer automatically receive the guaranteed operating hours they once enjoyed, and new coal permits have been broadly prohibited in many provinces. Since the permitting boom, newly proposed capacity have fallen by 80% and permits for new coal plants by 98%, while the level of cancellations has increased nearly 300%. However, there are still enough projects under development to continue growing China's coal fleet for years, even with no new proposals.

While the country continues to pursue coal, the UN's Intergovernmental Panel on Climate Change (IPCC) has found holding warming well below 2°C requires a virtual phaseout of coal power generation by 2050, with the vast majority of those reductions reached by 2035. UN Secretary-General António Guterres has said no new coal plants should be built after 2020 in order to prevent catastrophic impacts from climate change. If China continues to increase total coal power capacity through 2035, its coal power generation alone will far exceed the total coal power generation allotted to the entire world to keep warming well below 2°C, according to reductions in coal power use outlined by the IPCC.

CHINA'S COAL POWER CAPACITY

At the end of 2018, China's coal fleet stood at **1,010 GW**, according to the China Electricity Council.³ An estimated **17 GW** were added in the first six months of 2019, net of **0.5 GW** of retirements, putting total coal power capacity at 1,027 GW by July 2019. This is more than **four times** the total coal fleets of the US or India, which stand at 254 GW and 226 GW, respectively.

China also has more coal power capacity under development than any country. In total, 195.6 GW is under active development, including 121.3 GW under construction and 22.6 GW permitted for construction (Table 1). (For proposed capacity by province, see Appendix 1).

China's continued development of new coal plants is now driving the expansion of the global coal fleet (Figure 2). In 2018, the rest of the world decreased its combined coal power capacity by 7.8 GW, as more

coal power capacity was retired than commissioned (brown bars). China, however, increased its coal power capacity by 25.5 GW (blue bars), resulting in global coal power capacity growing by 17.7 GW in 2018. From January to June 2019, China increased coal power capacity by 17.4 GW, while the rest of the world decreased its coal capacity by 0.3 GW.

Table 1: Coal power capacity currently under development in China by status.

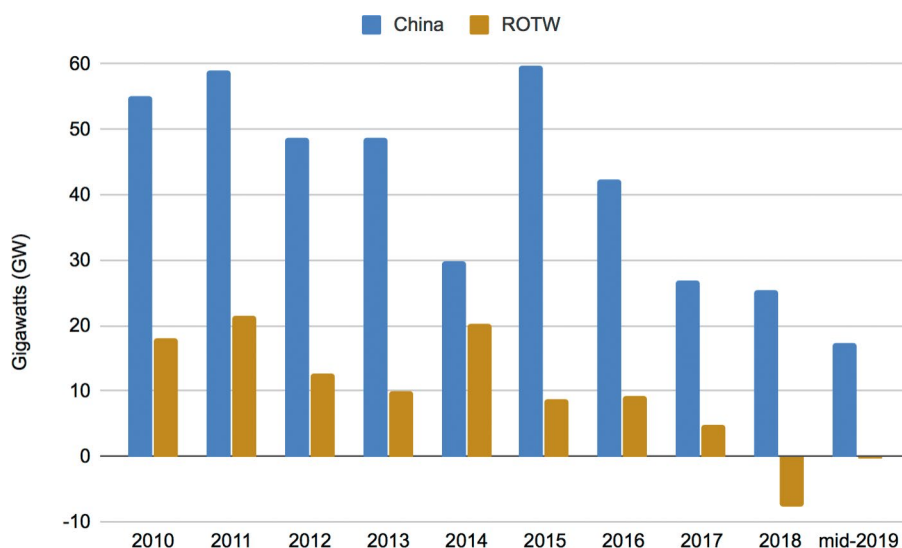
Status	Capacity (GW)
Announced	18.9
Pre-permit	32.8
Permitted	22.6
Construction	121.3
Total	195.6

Source: GEM, Global Coal Plant Tracker, July 2019.

For definitions of status categories, go to

<https://endcoal.org/global-coal-plant-tracker/methodology/>

Figure 2: Net coal power capacity additions continue in China (blue bars), but in the rest of the world capacity shrank by 2.8 GW in 2018 and by 0.3 GW in the first half of 2019 (brown bars).



Source: GEM, Global Coal Plant Tracker, July 2019.

3. GEM's Global Coal Plant Tracker estimated China's operating coal power capacity to be 973.6 GW at the end of 2018, not including units under 30 MW.

CHINA'S COAL POWER CAP

China's Power Sector 13th Five-Year Plan (2016–2020) capped total coal power capacity at 1,100 GW through 2020. Industry groups have proposed raising the country's coal power cap, as part of both the country's 14th Five-Year Plan (2021–2025) and the industry infrastructure plan through 2035.

China's State Grid Energy Research Institute, part of state-owned electric utility monopoly State Grid Corporation of China, has projected that [1,200 GW](#) of coal-fired capacity is needed in 2030 and perhaps beyond to maintain grid stability. The China Electricity Council—the industry body representing China's power sector—has recommended coal power capacity peak at [1,300 GW](#) in 2030. The Electric Power Planning and Design Institute, part of state-owned power company China Energy Engineering Corporation, has suggested coal power capacity may need to be [1,400 GW](#) by 2035 to meet power demand.

In short, these projections argue that a 100 to 300 GW expansion of the coal fleet beyond the 1,100 GW cap is necessary to maintain stability and meet demand. The Environment Ministry's National Center for Climate Change Strategy [projects](#) China's current Paris pledge of peaking emissions by 2030 will not be reached unless absolute limits on carbon emissions are included in the nation's 2021–2025 five-year plan.

China's National Development and Reform Commission (NDRC) is currently considering these proposals. While the ultimate size of the cap is still unknown, continued coal plant growth through the 14th FYP looks likely: the nation's highest energy decision-making body known as the National Energy Commission, directed by Premier Li Keqiang, recently [said](#) China should continue “the clean and efficient development of coal power” over the 14th FYP (2021–2025).

THE PERMITTING BOOM AND RESTRICTED CAPACITY

In addition to the currently proposed capacity (Table 1), there are a large amount of restricted capacity that may potentially be revived and developed if the coal power cap is raised—due to a province-level permitting spree.

In September 2014, authority over coal plant construction approvals was moved from the National Development and Reform Commission (NDRC) to the provincial DRCs, reportedly to help provinces make investment decisions that better aligned their local power demand with supply. In practice, local authorities raced to approve projects they believed would stimulate local economies and employment.

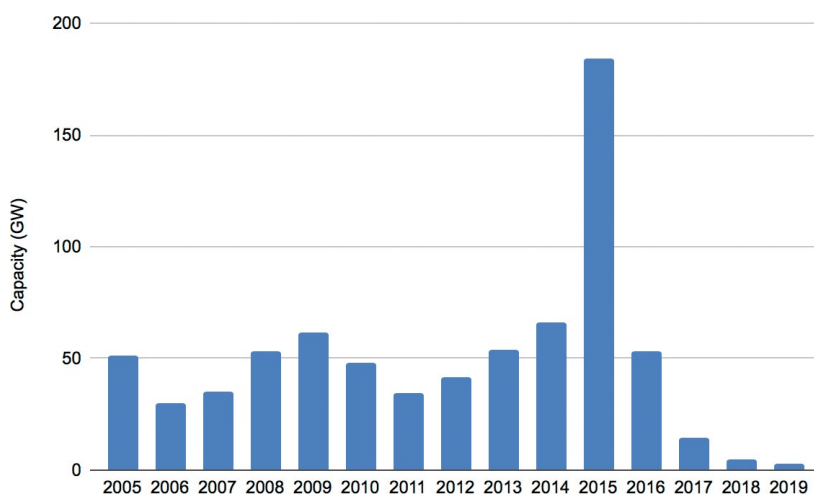
Overall, DRC permits for construction increased from a 2005–2014 average of 47.5 GW a year to 184.3 GW in 2015, a four-fold increase (Figure 3). By the time the central government began restricting new permitting in March 2016, the provinces had given construction approval to over 245 GW of new coal-fired capacity.

In 2016, the NDRC and its energy branch, the National Energy Administration (NEA), began laying out a

[series of measures](#) aimed at reducing the amount of coal power capacity permitted or entering construction. In 2017, the central government named [specific projects](#) in its restrictions, mainly projects in advanced stages of permitting or construction:

- In January 2017, China's NEA sent letters to provincial authorities that proposed the postponement of 95 GW of coal capacity for development after 2020. An additional 3 GW of pre-construction capacity was cancelled altogether.
- In September 2017, the NEA ordered an additional 43.5 GW of coal-fired capacity by name to slow down construction progress from 2017 to 2020, and prohibited the plants from connecting to the grid in 2017.
- Also in September 2017, the NEA ordered the owners of 28 GW of coal power capacity to stop development or operation until problems with permitting or regulation were resolved.

Figure 3: DRC permits for coal-fired capacity construction in China, before and after authority was transferred from the central government to the provinces from September 2014 to March 2016.



Source: China national and provincial DRC permits, 2005–2019.

Altogether, owners of 169.5 GW of coal power capacity were told to suspend or stop development of their plants. News reports suggested the coal plants would ultimately be **cancelled**, particularly the 95 GW of capacity told to suspend development through 2020. However, a July 2018 **analysis** by Global Energy Monitor (GEM) of permit records and satellite photos found 56.9 GW (34%) of the restricted capacity were moving forward in development.

As of July 2019, 83.9 GW (49%) of the 169.5 GW of restricted capacity have now advanced in permitting or construction since the restriction, or have been

commissioned—an increase of 27 GW from July 2018. While the majority of the capacity advancing are those from the September 2017 edicts, 37.5 GW (38%) of the capacity named in January 2017 is also moving forward in development, despite being advised to stop all development through 2020 (Table 2).

For the remaining 85.6 GW (51%) of the 169.5 GW of restricted capacity that remains suspended in development (Table 3), 26.4 GW were under construction at the time of the restriction and will likely be revived. Only 25.5 GW (30%) was in the more preliminary announced or pre-permit stage when restricted.

Table 2: Coal power capacity restricted by the central government in 2017, and the amount and percentage that has since advanced in development.

	Capacity affected (GW)	July 2018 advancing		July 2019 advancing	
		Capacity (GW)	Percentage	Capacity (GW)	Percentage
January 2017 stop development through 2020	98.0	18.6	19%	37.5	38%
September 2017 slow development through 2020	43.5	27.5	63%	33.7	77%
September 2017 halt until permit/regulation problems addressed	28.0	10.8	39%	12.7	45%
Total	169.5	56.9	34%	83.9	49%

Source: GEM, Global Coal Plant Tracker, July 2019. For details on the restrictions, go to https://www.sourcewatch.org/index.php/China's_Restrictions_on_Development_of_Coal-Fired_Power_Capacity

Table 3: Status of coal-fired capacity when development was suspended.

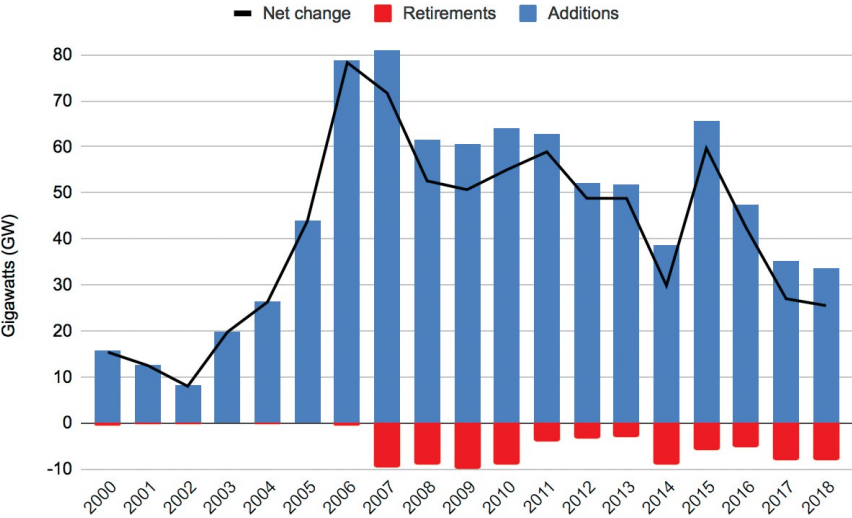
Status when restricted	Capacity (GW)
Announced	2.0
Pre-permit development	23.5
Permitted	33.3
Construction	26.4
Operating	0.4
Total	85.6

Source: GEM, Global Coal Plant Tracker, July 2019. For definitions of status categories, go to <https://endcoal.org/global-coal-plant-tracker/methodology/>

As part of its restrictions, the central government has also been regulating the amount of coal plants allowed to come online since 2017. Net additions to the coal fleet—newly commissioned capacity minus retired capacity—were 25.5 GW in 2018, the lowest annual increase in China’s coal fleet since 2004 (26.3 GW), before its coal-building boom (Figure 4).

While regulating the amount of coal plants allowed to come online has slowed commissioning, it also means there are a large amount of coal plants in advanced construction cueing up to come online as soon as the central government allows it. A future uptick in commissioning is already planned, as the China Electricity Council is projecting the country’s coal fleet will increase by 30 GW in 2019, net of 8.7 GW of planned retirements.

Figure 4: Added (blue) and retired (red) coal-fired power capacity in China by year, and the net change (black line).



Source: GEM, Global Coal Plant Tracker, July 2019.

SLOWDOWN IN NEWLY PROPOSED CAPACITY

While about half of the restricted capacity have been revived, there has been a notable slowdown in new proposals, permits, and construction following the 2014 to 2016 provincial permitting spree. Concurrently, there has also been a large increase in cancelled capacity.

Since the height of the permitting spree, newly proposed capacity has dropped from 42.7 GW in 2015–16 to 8.5 GW in 2018–19, an 80% decline. Additionally, Development and Reform Commission (DRC) permits for new construction have collapsed, from 126.4 GW in 2015–16 to just 2.6 GW in 2018–19.

New construction has also fallen steeply since the permitting boom, declining 72% from 67.9 GW in 2015–16 to 18.7 GW in 2018–19. Meanwhile, cancelled capacity⁴ has increased nearly 300%, from 36.9 GW in 2015–16 to 145 GW in 2018–19 (Table 4).

Part of the decline in new proposals and permits may be due to the central government's "traffic light" system, first implemented in March 2016. The policy assigned each province a color to signify the severity of restrictions placed on its coal pipeline. Provinces with a red light were advised to halt all new coal plant

permits, although the policy did include loopholes, most commonly for plants that provide steam heat to residential areas. The NEA initially issued a red light to all but four provinces, although that number increased to six in 2017 and ten in 2018.

The central government has also been removing economic incentives for coal plant development, including [reducing](#) guaranteed operating hours and rates of return for new coal plants, and [mandating](#) that grid companies purchase a minimum number of hours for renewable power. The measures will further reduce average operating hours for coal plants, with the typical plant already [sitting idle](#) more often than it is being used. Facing reduced hours and income, [nearly half](#) of China's thermal power companies saw net financial loss in 2018.

However, it remains to be seen if the slowdown in new proposals will continue into the 14th FYP. Recently, Jiangxi—a "green light" province under the traffic light system—[released](#) plans for building up to 22.6 GW of new coal power, more than its current operating coal power capacity (19.3 GW), and more than the total coal power capacity of Turkey (19.4 GW).

Table 4: Changes in newly proposed, permitted, new construction, and cancelled coal power capacity, from mid-2015 to mid-2019.

	2015–16 Capacity (GW)	2016–17 Capacity (GW)	2017–18 Capacity (GW)	2018–19 Capacity (GW)	Change 2015–16 to 2018–19
Newly proposed	42.7	33.0	22.0	8.5	–80%
DRC permits	126.4	27.4	10.2	2.6	–98%
New construction	67.9	29.1	18.5	18.7	–72%
Cancelled	36.9	7.4	131.0	145.0	293%

Source: GEM, Global Coal Plant Tracker, July 2019.

4. The cancellations are primarily from a lack of activity on the project for four years or more.

CHINA'S COAL CAP AND PARIS CLIMATE GOALS

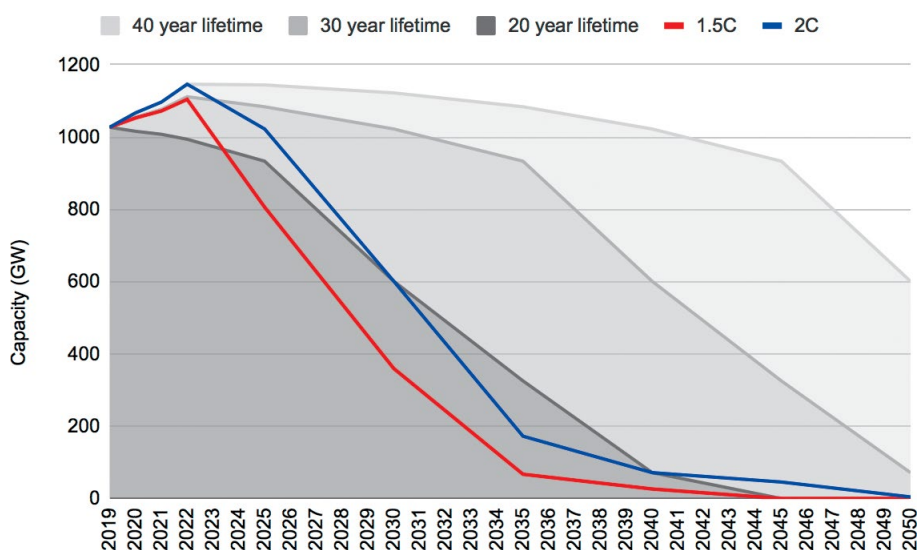
China's proposal to continue increasing its coal power capacity through 2035 is not compatible with the steep and rapid reductions needed in coal power generation to limit the rise in global average temperature to well below 2°C. It also puts at risk the prospect of an ambitious upgrade in China's pledged [emission reductions](#) under the Paris agreement—currently pegged at peaking carbon dioxide emissions by 2030—and undermines the country's potential role as a clean energy leader.

According to a recent [analysis](#) by the UN's Intergovernmental Panel on Climate Change (IPCC SR1.5), having a 50 to 67% chance of holding warming to 1.5°C requires a 70% reduction in coal power generation by 2030 below current levels and a near phase-out by 2050. Having a better than average chance (66%)

of holding warming below 2°C requires a near 60% reduction in power generation by 2030, and virtual phaseout by 2050.⁵ (It should be noted the aim of the [Paris agreement](#) is to keep the rise in global average temperature to “well below” 2°C and aiming for 1.5°C, meaning 1.5°C is the more appropriate target.)

Figure 5 below models a 1.5°C (red line) and lower 2°C (blue line) coal phase-out schedule for China based on the IPCC's global coal power scenario outlined above (see Appendix 2 for details). Under this schedule, every country retires their coal plants at the same age limit, which necessarily requires that “developed” nations with older coal fleets phase out their fleets more rapidly than countries with younger coal fleets.⁶ The figure assumes plants under construction in China are

Figure 5: China's coal plants need to retire around 20 years or less (dark gray) to meet the reductions in coal use outlined by the IPCC to hold warming below 2°C (red and blue lines).



Source: GEM estimate of China's allotted coal power capacity to be compatible with IPCC's 1.5°C and lower 2°C model pathways, assuming each country retires its capacity at the same age limit (see Appendix 2).

5. Median of the 1.5°C pathways with no or low overshoot and lower 2°C pathways in the IPCC [1.5 Special Report database](#), with no carbon capture and storage for coal plants (see Table 2.1 of [SR1.5](#) for more details).

6. Model developed and used by GEM and Greenpeace's [A Coal Phase-Out Pathway for 1.5C](#) (Nace 2018).

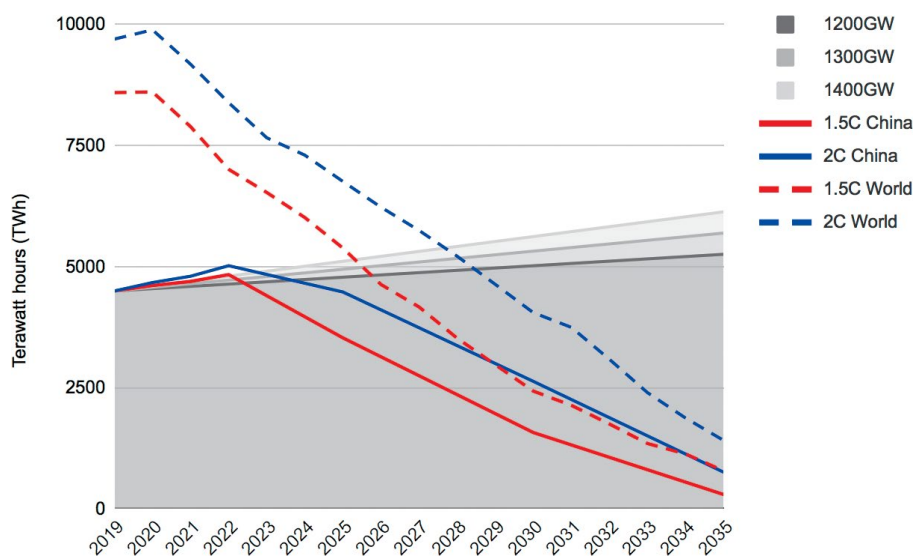
commissioned over the next five years, and all coal plants operate at the current average in China (50% capacity factor). Lifetimes for China's coal plants of 20 years (dark gray) to 40 years (light gray) are shown.

To meet the reductions in coal power used outlined by the IPCC, by 2030 China needs to reduce its coal fleet from the current 1,027 GW to 600 GW to keep warming well below 2°C, and 360 GW to keep warming to 1.5°C, according to GEM's analysis. Age-wise, coal plants need to be retired at 21 years of age or sooner to keep warming well below 2°C, and 17 years to keep warming to 1.5°C. The 30- and 40-year lifetimes far exceed the reductions needed for the temperature targets (medium and light gray), meaning coal plants will have to retire well below the current global average of 38 years. The more coal power capacity is added beyond what is under construction, the sooner the plants need to retire to meet the prescribed reductions in coal power.

Figure 6 shows the coal phase-out schedule for the 1.5°C (solid red line) and lower 2°C (solid blue line) pathways for China in terms of coal power generation rather than capacity, and the 1.5°C and lower 2°C coal power phase-out schedule for the world (red and blue dotted lines, respectively), according to the IPCC's 1.5°C report (see Appendix 3 for details).

If China increases its coal power capacity to between 1,200 and 1,400 GW by 2035 (dark to light gray), the country's coal power generation will be above the limits set for China to keep warming well below 2°C (solid red and blue lines), as well as the limits set for the entire world (dashed red and blue lines). In other words, even if the rest of the world phased out all coal power use by 2035, China's coal power generation alone would greatly exceed the global limits determined by the IPCC for coal power use.

Figure 6: China's proposed coal power caps for 2035 (gray areas) will result in coal power generation that far exceeds the limits for China to keep warming well below 2°C (solid red and blue lines), as well as the limits set for the entire world (dashed red and blue lines), based on IPCC-compatible pathways for keeping warming well below 2°C.



Source: Median of global coal power in IPCC's 1.5°C pathways with no to low overshoot (dashed red) and lower 2°C pathways (dashed blue), and GEM's estimate of China's share of the global coal power (solid lines), assuming each country retires its coal power capacity at the same age (see Appendix 3).

CONCLUSION

While the rest of the world's combined coal power capacity has decreased since the beginning of 2018, China's has increased, causing the global coal fleet to continue growing. The central government through its National Energy Commission has signalled that coal plant building will likely continue into the country's 14th FYP, through 2025. Industry groups are proposing to increase capacity up to 1,400 GW by 2035. Due to the central government's reluctance to rein in a province-level permitting boom, a large number of plants in advanced stages of construction are ready to be commissioned.

Yet the central government has also introduced measures that have significantly slowed the rate of new coal proposals and permits since 2016, and greatly increased coal plant cancellations. Thus China's continued expansion of its coal fleet is not inevitable: the central government could strengthen its existing policies discouraging coal plant building, continue incentivizing low-carbon power over coal, and begin a transition toward clean energy. The path that China's central government chooses could make or break Paris climate goals.

APPENDIX 1

Proposed coal-fired capacity in China by status and province (Megawatts)

Province	Announced	Pre-permit	Permitted	Announced + Pre-permit + Permitted	Construction	Shelved	Operating	Cancelled 2010–2019
Anhui	4,100	3,640	1,320	9,060	1,500	20,280	50,190	14,040
Beijing	0	0	0	0	0	0	0	0
Chongqing	0	0	130	130	1,820	1,815	13,140	4,840
Fujian	0	0	100	100	2,140	7,360	26,806	9,320
Gansu	0	0	0	0	2,350	13,460	18,653	22,050
Guangdong	0	1,420	0	1,420	6,830	13,620	60,096	24,400
Guangxi	2,000	700	2,000	4,700	0	2,180	19,235	8,510
Guizhou	0	1,320	700	2,020	2,600	17,520	31,370	33,440
Hainan	1,320	0	0	1,320	0	0	3,060	700
Hebei	800	820	700	2,320	4,460	1,400	44,476	8,720
Heilongjiang	0	0	295	295	1,630	1,830	18,660	7,935
Henan	0	0	0	0	7,880	700	63,305	24,140
Hubei	120	0	420	540	3,640	2,720	26,025	15,860
Hunan	0	2,060	4,000	6,060	2,100	600	19,065	10,270
Inner Mongolia	0	872	2,550	3,422	23,780	15,550	81,850	112,260
Jiangsu	0	365	0	365	80	4,640	78,579	24,940
Jiangxi	2,000	3,320	1,320	6,640	3,320	6,000	19,334	5,360
Jilin	1,210	30	200	1,440	0	0	16,746	9,390
Liaoning	60	1,700	2,100	3,860	2,430	450	30,525	12,550
Ningxia	0	0	180	180	5,020	4,740	25,870	9,820
Qinghai	0	0	0	0	0	4,700	3,160	3,745
Shaanxi	5,300	12,120	2,660	20,080	8,680	8,040	40,140	29,020
Shandong	0	1,480	3,190	4,670	11,670	18,990	90,619	25,430
Shanghai	0	0	0	0	0	0	14,310	0
Shanxi	2,000	2,000	700	4,700	11,870	27,500	58,842	24,700
Sichuan	0	0	0	0	2,000	4,000	11,425	5,200
Tianjin	0	800	0	800	860	0	11,634	3,450
Xinjiang	0	50	0	50	13,360	23,490	55,420	40,730
Yunnan	0	0	0	0	0	300	12,585	5,400
Zhejiang	0	57	0	57	1,320	2,000	42,244	10,420
Total	18,910	32,754	22,565	74,229	121,340	203,885	987,364	506,640

GEM, Global Coal Plant Tracker, July 2019.

APPENDIX 2

Coal power capacity (MW) for China to keep warming to 1.5°C and well below 2°C, as determined by GEM based on IPCC SR1.5 pathways (median of 1.5°C no and low overshoot and lower 2°C, with no carbon capture and storage). At an average capacity factor of

50%, the IPCC pathways for coal power can be met by retiring coal plants at an average of 17 years for 1.5°C and 21 years for well below 2°C, resulting in the capacity phase-out schedule below specific to China.

	CHINA	
	1.5°C	2°C
2019	1,027,000	1,027,000
2020	1,052,702	1,066,708
2021	1,071,979	1,096,490
2022	1,104,107	1,146,125
2023	1,004,708	1,104,821
2024	905,308	1,063,516
2025	805,909	1,022,212
2026	716,636	937,956
2027	627,364	853,700
2028	538,091	769,443
2029	448,819	685,187
2030	359,546	600,931
2031	301,073	515,229
2032	242,600	429,527
2033	184,126	343,825
2034	125,653	258,123
2035	67,180	172,421
2036	59,028	152,272
2037	50,876	132,124
2038	42,724	111,975
2039	34,572	91,827
2040	26,420	71,678
2041	21,136	66,483
2042	15,852	61,288
2043	10,568	56,093
2044	5,284	50,898
2045	0	45,703
2046	0	37,462
2047	0	29,221
2048	0	20,980
2049	0	12,739
2050	0	4,498

APPENDIX 3

Coal power generation (TWh) for China and the world to keep warming to 1.5°C and well below 2°C. The pathway for the world is from the IPCC SR1.5 pathways (median of the 1.5°C no and low overshoot and lower 2°C, with no carbon capture and storage).

The pathway for China was determined by GEM and assumes a 50% capacity factor and that every country retires its coal plants at the same age to meet the global IPCC coal power pathways, resulting in the coal power generation schedule below specific to China.

	CHINA		GLOBAL	
	1.5°C	2°C	1.5°C	2°C
2019	4,498	4,498	8595	9701
2020	4,611	4,672	8609	9891
2021	4,695	4,803	7892	9181
2022	4,836	5,020	7010	8387
2023	4,401	4,839	6533	7663
2024	3,965	4,658	6015	7304
2025	3,530	4,477	5385	6760
2026	3,139	4,108	4632	6229
2027	2,748	3,739	4168	5749
2028	2,357	3,370	3524	5217
2029	1,966	3,001	2977	4636
2030	1,575	2,632	2431	4051
2031	1,319	2,257	2136	3747
2032	1,063	1,881	1750	3087
2033	806	1,506	1348	2399
2034	550	1,131	1132	1874
2035	294	755	783	1412
2036	259	667	688	1222
2037	223	579	587	1075
2038	187	490	485	960
2039	151	402	312	796
2040	116	314	199	670
2041	93	291	173	618
2042	69	268	147	566
2043	46	246	120	503
2044	23	223	84	434
2045	0	200	53	377
2046	0	164	52	317
2047	0	128	52	243
2048	0	92	47	171
2049	0	56	36	110
2050	0	20	14	38