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China Coal Cap

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STUDY ON COAL CONSUMPTION CONTROL POLICY OF POWER SECTOR IN THE 14TH FIVE-YEAR PLAN PERIOD EXECUTIVE SUMMARY

华北电力大学
NORTH CHINA ELECTRIC POWER UNIVERSITY

NRDC
自然资源保护协会
NATURAL RESOURCES DEFENSE COUNCIL

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Executive Summary

During China's 13th Five-Year Plan period (2016-2020), load management and supply-side reforms in the power sector effectively helped to control the rapid growth of new coal-power capacity. In 2020, China's total power generation capacity was 2,200 GW, of which coal accounted for 1,080 GW. This marked the first time that the coal's share of power capacity (49.1%) has fallen below 50%. In total, coal generated 4,630 TWh of electricity, which represents a decrease from 67.9% of power generated in 2015 to 60.8% in 2020.

However, due to the sheer size of the coal power industry, China still led the world in the construction of new coal plants (approximately 88.13 GW) and has plans for an additional 159 GW of new projects. Furthermore, industry-wide overcapacity, low utilization rates, declining profits, and increasingly stringent environmental and climate requirements continue to pose major challenges to the development of coal power. With China's new climate pledges and efforts to strictly control coal consumption, how to steadily advance controls on the coal industry remains a difficult question that demands urgent discussion.

The 14th Five-Year Plan period (2021-2025) is a critical window for China's power sector transition. This report considers the impact of the global pandemic on China's economic development and electricity demand, together with analysis of the fundamental macro-economic elements and key factors influencing electricity demand in the next five years, to forecast the nation's electricity demand in 2025. It discusses different scenarios for China's power sector development and the reasonable size of coal power fleet, accounting for the constraints imposed by climate targets, the development potential of electricity resources, etc. Finally, le、ssons learned from low-carbon development under the 13th Five-Year Plan inform a discussion of key issues and pathways for controlling coal consumption in the power sector.

Key Takeaways

1. Substitution by renewable energy resources was the most effective methods for controlling coal consumption during the 13th Five-Year Plan period

During the 13th FYP period, through advances in supply side reforms and demand side power reduction measures, **the coal power industry saved 385 million tons of coal equivalent (tce).** This reduction was driven by the substitution of coal power with renewables (265 million tce), coal power efficiency improvement, i.e., giving dispatch priority to resources with the lowest cost of generation (42 million tce), line loss reduction (52 million tce), and strengthened supplied side management (26 million tce). See Figure 1 for details.

In 2020 alone, the power sector consumed 1.33 billion tce of coal, a slight increase from 2019. However, compared to a scenario without policies and regulations, the Chinese power sector succeeded in saving 109 million tce of coal. Of this, substitution by renewable resources accounted for 82 million tce, representing 75% of savings.

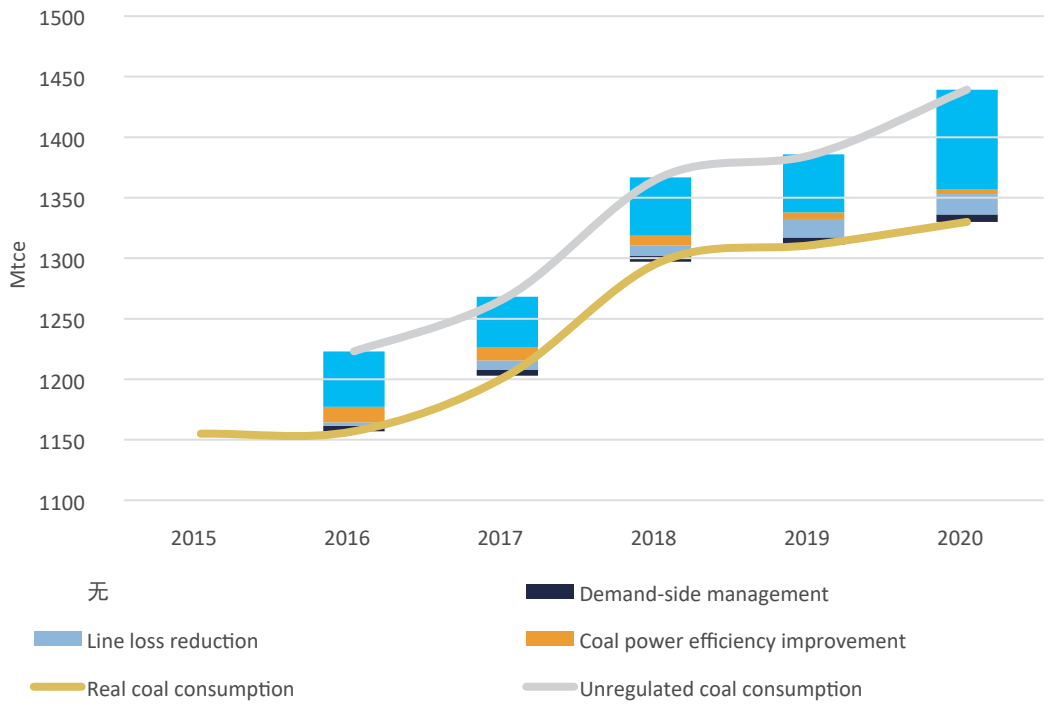

Figure 1: 13th FYP power sector coal consumption and savings through different approaches

2. Key projects in China's new infrastructure initiative and electrification will increase electricity demand during the 14th Five-Year Plan period

The 14th Five-Year Plan period is a critical window for transforming China's existing energy and industrial systems. Conventional energy and energy-intensive industries will gradually decline, and new economic drivers (i.e., advanced technology and equipment manufacturing) will emerge. The new infrastructure initiative will become a national policy, with a focus on leading in ascendent industries, such as information technology, software, and information services, that will bring economic growth. The vigorous promotion of new infrastructure and electrification will drive significant increases in China's electricity consumption.

According to our forecast into the 14th Five-Year Plan period, electricity demand will increase by approximately 4-5% annually. By 2025, electricity consumption could reach between 9.2 million GWh (in the business-as-usual scenario) and 9.6 million GWh (in the high-electrification scenario). The share of electricity consumed by tertiary industries and residents will rise to 37-39%, while the share of electricity consumed by secondary industries will fall to approximately 60-61%.

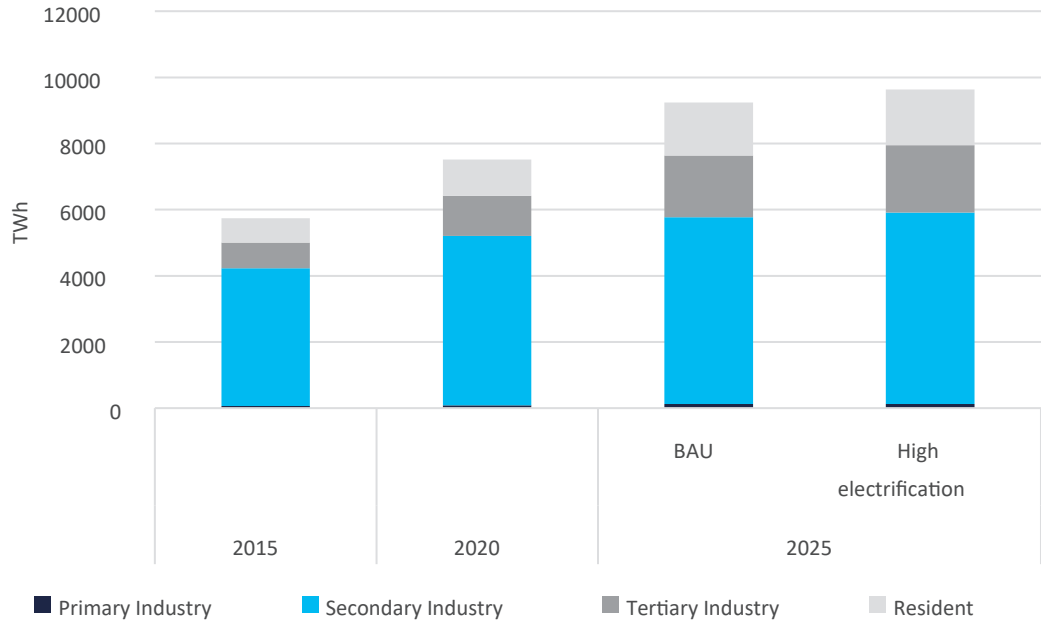

Figure 2: Forecasted scenarios of electricity demand in 2025

3. Restricting installed coal power capacity to 1,100 GWs by 2025 will help the power sector achieve peak carbon sooner and will lay the foundation for carbon neutrality

In April of 2021, at the Leaders Summit on Climate, President Xi announced that "China will strictly control coal power projects, as well as will strictly control the growth of coal consumption during the 14th Five-Year Plan period and gradually reducing coal consumption during the 15th Five-Year Plan" Over next few years, the power sector will face dual pressures to not only meet China's climate targets, but also guarantee electricity supply for the entire nation.

Based on findings from IPCC AR5, we identified and calculated base-line scenarios for the Chinese power sector's total carbon budget between 2019 and 2050. According to historical data and forecasts of future emissions trends, China must limit annual carbon emissions of its power sector to 3.85 billion tons by 2025 (see Figure 3).

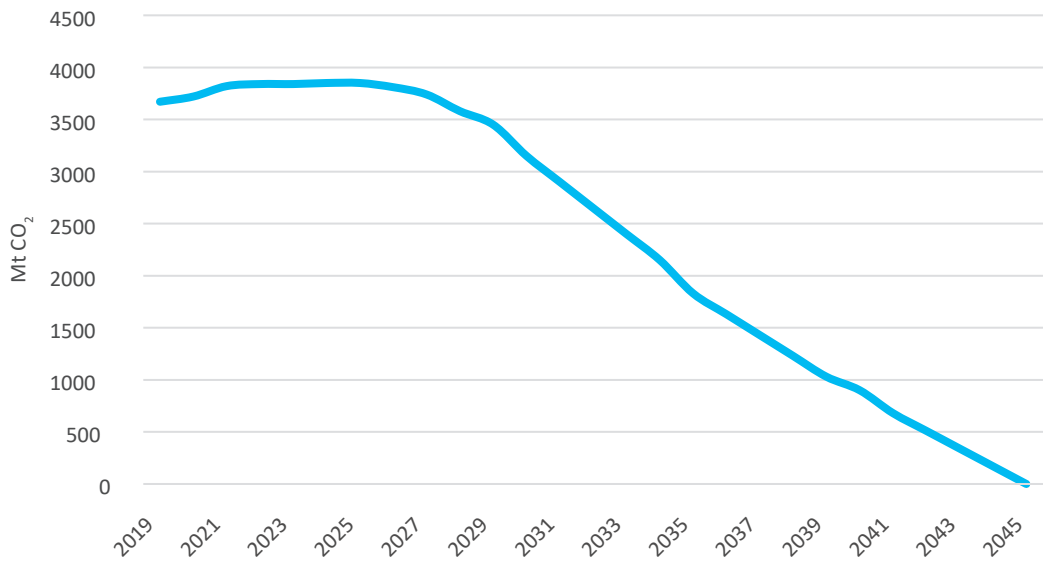

Figure 3: Yearly carbon emission budget of coal industry under the 2°C target scenario from 2019 to 2050

According to correlation analysis of the carbon emissions and installed coal power capacity, as well as the carbon budget for China's coal power sector under the 2°C target scenario, we estimate that the coal power capacity must not be allowed to exceed 1,150 GWs by 2025 (see Table 1).

Table 1: Scale of coal power under the carbon emissions budget

	2025	2030	2035	2040	2045
Base-line annual coal emissions budget (million tons)	3,850	3150	1830	895	0
Coal power capacity allowed (GW)	1,150	980	720	340	0

To meet China's electricity demand through 2025, two different development pathways were simulated for the power sector. First, under a coal-driven pathway, non-fossil fuel electricity is expected to account for 41.1-42.9% of electricity output by 2025. 1,200 GW of coal power capacity with 4,400 hours of utilization would be sufficient to meet electricity demand in the high-electrification scenario. In a business-as-usual scenario, 50 out of 1,200 GW of coal power units can be sidelined as backup resourcesunder both scenarios for the coal-driven pathway, the installed capacity of coal power will exceed the acceptable threshold established by the carbon emissions budget and is inconsistent with China's climate pledges.

Second, under a renewable energy-driven pathway, non-fossil fuel electricity accounts for 46.8-48.8% of electricity

output by 2025, nearly achieving China's 50% non-fossil fuel electricity by 2030 target. Coal capacity reaches 1,100 GW with average utilization falling to 4,000-4,200 hours per year, and ancillary service capabilities are bolstered to cope with large-scale new-energy consumption. In the low-electricity demand scenario, 50 GW of coal plants can be selectively sidelined, which will both improve the supply capabilities of the power system and alleviate the problem of coal overcapacity.

When it comes to balancing the growth in electricity demand with the constraints imposed by emissions reduction targets, the new energy-driven pathway is a more realistic choice. By 2025, 1,100 GW of coal capacity with lower utilizations (fewer than 4,200 hours) will be sufficient to meet demand, and boosts to new infrastructure and electrification will help achieve non-fossil fuel targets sooner. Accelerating the decarbonization of the electricity sector will enable China to achieve peak emissions by 2030 or earlier, thereby laying a solid foundation for achieving its carbon neutrality goal. **This report recommends that China adopts the renewable energy-driven pathway as its electricity development policy and limits coal power capacity to roughly 1,100 GW by 2025 (see Figure 4).**

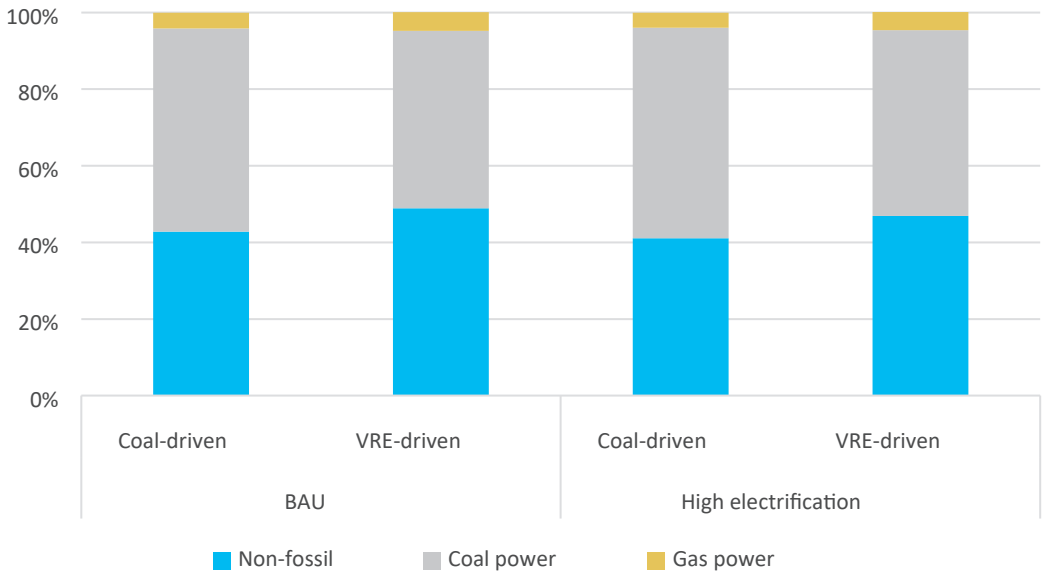

Figure 4: Forecasts of 2025 power generation structures under different pathways

4. Solutions for the power sector to limit coal consumption in the 14th Five-Year Period

During the 14th Five-Year Plan period, efforts to regulate and limit coal will face several key issues: increased electricity demand spurred by advances in electrification, underutilization of intra-regional transmission lines, barriers to the inter-regional consumption of renewable energy resources, short-term electricity shortages during peaks, and the urgent need for a framework guiding the power sector's green transition.

This report offers five areas of solutions (see Figure 5).

1) Strictly limit the amount of new coal capacity and avoid repeating the overcapacity situation experienced under the 13th Five-Year Plan period. China should prudently manage coal power development policy, strictly limit new coal capacity, and increase the utilization of existing "coal power + ultra-high voltage (UHV)" resources instead of building more coal power plants. In addition to laying a foundation for a cleaner and more efficient power supply, adjusting the role of coal power from baseload to peaker plants will also help electricity utilities better prepare for a grid dominated by renewables.

2) Align high-quality coal development with regional policies and power sector characteristics. In Eastern China, energy development plans should be adjusted to align with regional development requirements. This includes strict limits on new coal projects, and early retirement of units larger than 300 MW with operating lifetime of 25-30 years. In central China, cities and provinces should bolster efforts to optimize local electricity supply structures and clarify the roles of different electricity resources (supply-side, demand-side, and storage). Only when there the base load is consistently insufficient should a new coal power plant be constructed.

3) Leverage electricity market reforms to promote adjustments in the role of coal power. China's energy planner should establish a mechanism for evaluating the role of coal power, including power generation, ancillary services, capacity supply, and other services. Use market mechanisms to ensure that efficient units receive economical operating schedules, and that peaker units are compensated in accordance with their market value.

4) Synergize power generation between coal and renewable energy. In the transition from peak carbon to carbon neutrality in the power sector, coal and renewable energy will coexist until a cleaner and more efficient power system is created, which means both will play an important role in providing reliable energy in the next couple of decades.

5) Promote electrification driven by renewable energy resources. The 14th Five-Year Plan should continue to promote the electrification of the industrial, transportation, construction, and the residential sectors. In order to reduce coal, oil, and natural gas consumption on the end-use side, as well as promote renewable energy driven electrification, coal power should be gradually replaced by renewable resources.

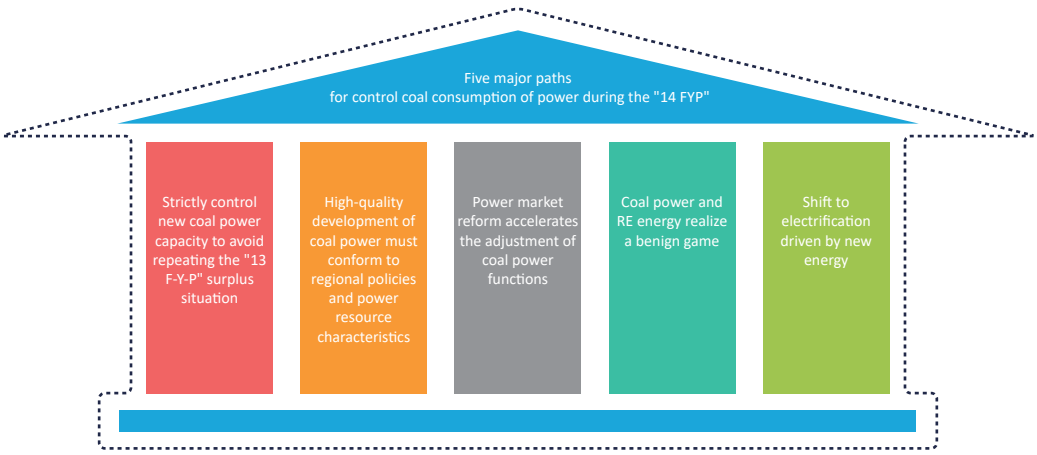

Figure 5: Five pillars of coal consumption control in the 14th Five-Year Plan

Policy Recommendations

1. Given that the 14th Five-Year Plan is a strategic window for transitioning to low-carbon electricity, carbon emissions targets should be included as strong constraints on the development of coal power.

For the power sector, achieving peak greenhouse gas emissions by 2025 will greatly improve China's chances to peak emissions before 2030. China's coal fleet already leads the world in efficiency, but the room for further emissions reduction is limited. In order to avoid locking the power sector into a path of high-emissions, the 14th Five-Year Plan must establish a vision for peak coal use, use China's climate targets as strict limits on the development of coal power, strictly prevent the continued expansion of coal power to meet short-term demand, and impose additional barriers to promote mid/long-term energy transition.

2. Coal power development must consider uncertainty in the macro-environment and carefully advance supply-side policy reforms

The current coal fleet still has large amounts of underutilized capacity that could be used to cope with increases in overall and baseload demand. Even new large-scale, high-efficiency coal projects that reduce or replace existing coal power should only be used as baseload resources and have a limited ability to improve power system flexibility. Power supply challenges caused by short-term peak shortages should be addressed though more realistic and economic means, such as demand response, etc. Therefore, policies should be introduced to prevent further expansion of coal power.

3. Utilize market mechanisms in the period to promote adjustment in the role of coal power

After five years of pilot projects, electricity market reform has entered a more substantial phase and will become the primary means for promoting structural optimization of the power system during the 14th Five-Year Plan period. Spot market bidding rules should be made fairer and more reasonable by establishing a price grading system for coal units and recognizing efficient base-load units. The pricing mechanism in ancillary service markets should account for all services a unit provides, determine pricing standards for each area based on the degree of contribution, accurately reflect the true value of ancillary services, encourage coal units to take part in flexibility services, and guarantee high shares of renewable energy consumption. Capacity mechanisms should send mid to long-term price signals to attract investments in capacity, especially in the deployment of peak resources, to guarantee reliable electricity supply at a relatively low social cost. Overall, by leveraging competition, electricity market reforms can help set the roles of different technologies, thereby improving the operating efficiency of the power system.

4. Grasp the essence of "new infrastructure"

Increased investment in "new infrastructure" is an important means for China to boost its economy and meet future energy demand. In terms of the power sector, "new infrastructure" includes renewable energy, smart grids, microgrids and distributed energy resources, new forms of energy storage, new energy vehicle charging infrastructure, and other infrastructure network projects — all of which will provide a foundation for intelligent, clean, and diversified power sector development. Building "new infrastructure" itself will be a long-term, trail-blazing, and wholistic endeavor. Doing

so will stimulate capital flows, research and development, structural transformation, employment, and other facets of the economy. Although investing in coal could spur short-term economic growth and employment, it has limited potential for long-term development and will increase energy supply costs, depress industrial and economic efficiency, and hinder the transition to low carbon.

5. Promote cleaner and more efficient regional energy flows

Given the underutilization of existing UHV lines, as well as the large quantity of lines currently approved/under construction, constructing new coal plants near consumption centers presents a barrier to inter-province energy exchange. Redundancy between electricity transmission and coal transmission lines depresses utilization rates, which leads to low efficiency infrastructure investment. Furthermore, since the share of renewable resources in central and eastern China lags behind that of the western provinces, the 14th Five-Year Period should promote increased access to and utilization of interregional UHV lines. Power sector infrastructure should not be merely a means of stimulating investment; instead, the nation should leverage its development to provide cleaner and more secure electricity going forward.