

Thinking beyond diversification: Next step in China's coal power transition

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Lead author: Muyi Yang

Other authors: Yongping Sun, Xunpeng Shi

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About

This report reviews China's coal power transition, focusing on large generation state-owned enterprises (SOEs) that own the majority of the country's coal power assets. It highlights the current strategies employed by both central and local generation SOEs to diversify into renewable energy capacity and the impact this has on facilitating a relative decline in coal power. Additionally, it stresses the need for a 'beyond-diversification' strategy as China moves into a new phase of absolute coal power decline, emphasising the importance of managing potential impacts on the coal-electricity ecosystem and broader consequences.

Executive Summary

Time to consider a 'beyond-diversification' strategy

Large generation state-owned enterprises (SOEs), both central and local, play a critical role in China's coal power transition, given their ownership and operational control over the majority of the country's coal power fleet.

Recent years have witnessed a growing trend among these entities to diversify into renewable energy. By 2022, central generation SOEs accounted for roughly 40% of the country's solar capacity and 70% of the wind capacity. Major local generation SOEs, such as Guangdong Energy Group and Zhejiang Provincial Energy Group, have also emerged as key investors in renewable energy projects.

This strategy has made a significant contribution to China's inexorable march towards renewable energy, resulting in a relative decline in coal power. The share of coal generation has decreased from over 70% in the mid-2000s, to around 60% in 2023.

This decline is also accelerating. From 1991 to 2000, only 15% of the increase in electricity demand was met by clean electricity. This share increased to 22% over the period 2001-2010, and further to 47% over the period 2011-2020. If hydro had remained at 2022 levels, non-fossil fuel generation would have met more than half of the demand increase in 2023, further pushing coal power out of the generation mix.

An absolute decline in coal power is in sight. If current trends continue, recent IEA forecasts indicate that clean electricity will soon meet all incremental demand for electricity in China, marking the beginning of a new era of absolute coal power decline.

Coal power in China, like in many other coal-producing countries, is an integral aspect of the coal-electricity ecosystem. This ecosystem is characterised by extensive cross-industry and cross-ownership linkages encompassing coal production and supply, logistics, the coal chemical industry, power generation and relevant equipment manufacturing.

Consequently, an absolute decline in coal generation will inevitably impact other interconnected entities. While diversification strategies by large generation SOEs weaken

their commitment to the existing coal-dominated power system, they fall short in addressing potential tensions and conflicts arising from the absolute decline in coal power and its broader impacts.

Key issues for consideration while devising a beyond diversification strategy include:

01 A beyond-diversification approach is more than green industrialisation

The growth of clean industries like solar PV, wind, and battery storage can generate economic and employment gains to offset socio-economic losses from the transition. However, coal-dependent regions may not benefit equally, as they do not always have a clear advantage over other regions in the clean energy economy. Managing the transition in these regions will be increasingly important as coal consumption declines.

02 Ensuring a just transition extends beyond coal-electricity workers

The coal-electricity ecosystem is deeply embedded in local socio-economic systems, and its decline could impact interconnected economic activities, exacerbating existing issues such as slow improvements in living standards and the rural-urban divide. Comprehensive strategies are needed to support economic restructuring and diversification, invest in new industries, provide retraining and reskilling, and promote inclusive development to mitigate potential social tensions and disparities.

03 Effective coordination among relevant stakeholders is crucial

Central government agencies, SOEs, local authorities, and private investors all play roles in the coal-electricity ecosystem. Policy decisions require extensive bargaining and consultation both horizontally among public

agencies, SOEs, and private sectors, and vertically across different government levels.

04 Gradualism and experimentalism can be effective tools for sustaining progress while navigating complexities

Often described as ‘crossing the river by touching the stones’, these approaches allow for careful testing and adjustment of strategies and policies, facilitating the adaptation of broader policy directives into pragmatic, localised actions.

Large state-owned enterprises have actively diversified into renewable energy in China, significantly contributing to a relative decline in coal power. If current trends continue, a new era of absolute coal power decline is in sight. Chinese policymakers and relevant stakeholders need to consider a ‘beyond-diversification’ approach as the country is fast approaching this critical turning point. A key aspect of this approach is managing tensions and conflicts that may arise from an absolute decline in coal power and its impact on interconnected entities within the coal-electricity ecosystem.

Muyi Yang

Senior Electricity Policy Analyst - China,
Ember



Since the proposal of the 'dual carbon' goals in 2020, China's coal power sector has begun accelerating its transition, particularly from 2024 onward. The transition is driven by a combination of market forces and government policies, with the latter promoting new energy through various incentives. Historically, coal power has been a key part of the national economy. A deeper transition away from coal power transition will have broader impacts on interconnected industries, household consumption, tax revenue, and employment. Given these implications, it is important for the government to adjust its attention allocation to address the potential impacts of deeper transition and to develop corresponding strategies.

Yongping Sun

Vice Dean of Institute of State Governance at HUST; Director of Research Center for Global Climate Governance at HUST; Co-Director of the Collaborative Innovation Center for Emission Trading System



In transitioning away from coal power, adopting a strategy that emphasises renewable energy and ensures a just transition for all affected groups is crucial. This approach should provide comprehensive support for coal-dependent regions, including mining cities, coal workers, and power generation companies. A holistic strategy must integrate energy transition with economic restructuring, worker reskilling, and other essential socio-economic changes to ensure the benefits are equitably distributed.

Xunpeng Shi

President, International Society for
Energy Transition Studies; Professor of
Energy Economics and Sustainability,
University of Technology Sydney



Chapter 1 Current approach

Diversification into renewable energy

The urgency of tackling the climate change challenge has highlighted the need for rapid and deep decarbonisation of the electricity sector, making the transition away from coal power crucial. This transition is particularly important for China, which houses over half of the world's coal-fired installed capacity. Generation State-owned Enterprises (SOEs) play an important role in this transition process, considering their ownership and management control over the majority of the country's coal power fleet. With that in mind, this chapter delves into the strategy adopted by large SOEs to diversify their portfolios by investing in renewable energy projects.

Critical role of generation SOEs

Before 1985, China's power sector was dominated by publicly owned, vertically integrated electric utilities, under the administrative supervision of the Ministry of Electric Power Industry (MEPI), along with its local-level subordinates, the Bureau of Electric Power (BEP).

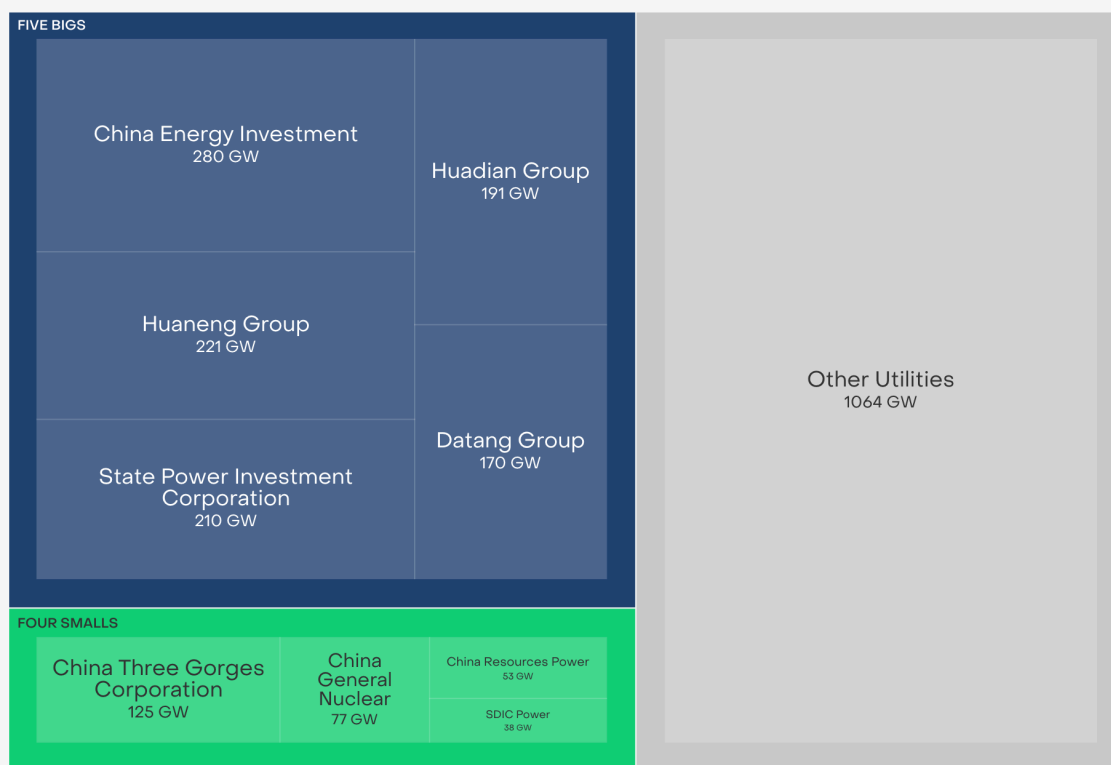
In 1997, significant steps were taken to separate government functions from the operational management of these utilities, primarily due to [financial performance concerns](#). This led to the establishment of the State Power Corporation (SPC), which took over operational management from the MEPI and acquired electricity assets from local BEPs, marking a significant milestone in this process.

Further restructuring occurred in 2002, dividing the SPC's generation assets among [five major generation SOEs](#): Huaneng, Huadian, Guodian, Datang and China Power Investment. Subsequent mergers and acquisitions have reinforced the dominance of major SOEs in China's power generation segment, often referred to as the ['Five Bigs and Four Smalls'](#), or ['Five Bigs and Six Smalls'](#) that also include China National Nuclear, and China Energy Conservation and Environmental Protection (CECEP).

By the end of 2022, the total installed capacity of the Five Bigs and Four Smalls exceeded [1,360 GW](#), accounting for over half of the country's total capacity, which stood at [approximately 2,400 GW](#). While Three Gorges Corporation, China National Nuclear and China General Nuclear Power stand out, the remaining central SOEs possess [substantial coal power assets](#).

The 'Five Bigs and Four Smalls' account for over half of China's generation capacity

Share of total installed capacity owned by major state-owned utilities, as of 2022



Source: Ember's analysis based on 2022 installed capacity data of the state-owned enterprises from International Energy Network.
 "Five Bigs and Four Smalls" refer to the five largest and four relative smaller central government-owned utilities of China in terms of asset size and policymaking leverage

Local generation SOEs also hold significant shares in their respective local markets, primarily coal-based. Indeed, several large local SOEs, such as Zhejiang Provincial Energy Group, Guangdong Energy Group and Beijing Energy Group, lead other local enterprises in the generation sector, boasting installed capacity [comparable to](#) central SOEs.

The Guangdong Energy Group, the largest local generation SOE in Guangdong, had an installed capacity exceeding [50 GW](#) in 2024. This accounted for approximately 30% of the province's total installed capacity. Despite a substantial surge in clean energy capacity, thermal capacity, particularly coal power, still comprised about half of its power generation assets by February 2024.

Likewise, the Zhejiang Provincial Energy Group, a large SOE based in Zhejiang Province, had an installed capacity of [39.4 GW](#) by the end of 2022, representing about 40% of the province's total installed capacity. About 16% (6.3 GW) of this capacity was based on renewable energy, while the rest dominated by thermal power, especially coal.

The limited presence of private investors in coal power generation further underscores the SOEs' dominance in the coal power sector, as private entities often face challenges in securing fuel supplies. In 2002, foreign investors held [approximately 7%](#) of the market share. However, this presence has drastically diminished, with foreign investors having almost completely withdrawn their investments from the market. Concurrently, domestic private capital's share in the coal-fired power market has also decreased, currently accounting for only 5% of the entire market.

Large SOEs diversifying to renewable energy

In recent years, large generation SOEs in China have shown a trend towards diversifying into renewable energy. This shift has been facilitated by the establishment of dedicated subsidiaries, with [substantial capital expenditure \(capex\)](#) allocated to renewable energy projects through these entities.

Since 2011, the wind and solar capacity of central generation SOEs has increased nearly five-folds, surpassing [200 GW](#) by the end of 2020, roughly equivalent to the total installed capacity of Germany. By 2022, the central generation SOEs accounted for roughly [40%](#) of the country's solar capacity and 70% of the wind capacity.

In 2022, the State Power Investment Corporation (SPIC) became the first central SOE to [surpass 50 GW](#) of solar capacity, rising 10 GW from the previous year. Other large central SOEs, including Huaneng, Huadian, China Energy Investment, Three Gorges Corporation,

China National Nuclear Corporation and China General Nuclear Power, also [exceeded 10 GW](#) of solar capacity.

In the wind power sector, China Energy Investment (CEI) exceeded 60 GW of installed capacity in 2023, just slightly behind Germany's total wind power capacity of 69.5 GW in 2023. Other central SOEs, such as SPIC, Huaneng, Huadian, China General Nuclear Power and Datang, each [surpassed 20 GW](#), while Three Gorges Corporation and China Resources exceeded 15 GW.

In addition to central generation SOEs, major local generation SOEs, such as Guangdong Energy Group, Hebei Construction & Investment Group, and Zhejiang Provincial Energy Group, have emerged as [key investors](#) in renewable energy projects.

Policy support for the diversification strategy

The diversification by large generation SOEs in China is closely linked to strong policy support for renewable energy and the perceived opportunities it presents.

The [13th Five-Year Plan on Renewable Energy](#), issued by the National Development and Reform Commission (NDRC) in 2016, aimed to achieve 680 GW of renewable energy capacity by 2020. Various [incentives](#) were provided to support this goal, including attractive feed-in tariffs (FiTs) and access to capital from policy banks. The FiTs have been gradually [phased out](#) since 2021 and replaced by competitive auction.

Policy support for renewable energy was further strengthened in 2021 with the release of the [Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy](#). This document serves as the blueprint for China's climate strategy within the [1+N policy framework](#). It emphasises the need to strictly control the development of coal-fired power generation projects and advocates for the deployment of non-fossil energy sources, with a particular emphasis on renewable energy, to replace coal power in meeting rising electricity demand.

To translate these guiding objectives into action, the [14th Energy Five-Year Plan \(2021-2025\)](#), China's strategic planning document for energy sector development, sets a target to increase

the share of non-fossil generation to around 39% by the end of 2025. Later in June 2022, the NRDC announced the [plan for renewable energy development](#), delineating specific targets for renewable generation and capacity utilisation (refer to Table 1). This plan also emphasises the development of large utility-scale renewable energy bases in resource-rich western regions alongside deploying distributed renewable energy systems within eastern city-clusters.

Furthermore, in December 2021, the State-Owned Assets Supervision and Administration Commission (SASAC), the governing body for overseeing and managing central SOEs in China (e.g., the appointment of senior executives), released the [Guiding Opinions on Promoting High-Quality Development of Central SOEs and Advancing Carbon Peak and Carbon Neutrality](#), setting a mandate for central SOEs to incorporate over 50% of renewable energy in their generation capacity mix by 2025.

China's 14th Five-Year Plan for renewable energy development: Main targets

Category	2020 level	2025 target	Unit
Total renewable energy consumption	0.68	1	Billion tones of standard coal
Share of renewable electricity consumption	28.8	33.0	%
Share of non-hydro renewable electricity consumption	11.4	18.0	%
Renewable generation	2.21	3.30	Trillion kWh
Non-electric utilisation of renewable energy, including geothermal heating, biomass heating and fuel, and solar heating	-	≥60	Million tonnes of standard coal

Source: The 14th Five-Year Plan for Renewable Energy Development

Chapter 2 Emerging outcomes

The relative decline of coal

As large SOEs actively diversify into renewable energy, China's electricity landscape has undergone a significant transformation, with coal power falling relatively in the generation mix. If current trends continue, China is approaching a critical turning point in its transition towards a clean electricity future, where coal power will begin to decline in absolute terms.

Relatively less coal in the generation mix

Coal power in China has seen a relative decline, dropping from over 70% in the mid-2000s, to about 60% in 2023. This trend is largely driven by the rapid expansion of non-fossil generation, particularly from renewable energy sources.

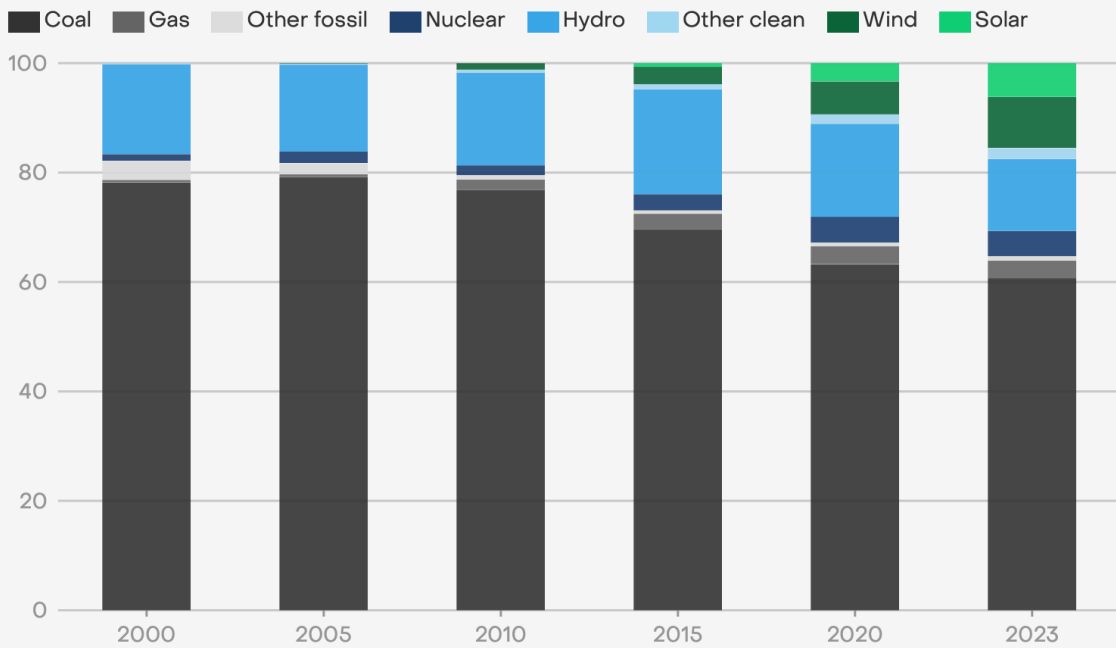
Since 2020, the total capacity of non-fossil fuel generation in China, led by wind and solar, has increased by about 60%, rising from about [980 GW](#) in 2020 to over [1,570 GW](#) in 2023. In 2023, non-fossil fuel generation capacity surpassed that of thermal capacity for the first time, constituting more than half of the country's total installed capacity. Meanwhile, the share of coal capacity has [dropped below 40%](#).

It is also worth noting that distributed solar capacity has experienced a substantial increase, growing from 3 GW in 2013 to [over 250 GW](#) in 2023. In 2023, over one-third of the total solar capacity added came from distributed systems.

China's rapid build-up of renewable energy capacity has resulted in less coal in the generation mix. In 2000, only 18% of China's electricity came from non-fossil energy sources. By 2023, the share has doubled to 35%. Most of the growth in the share of non-fossil fuel generation occurred in recent years, primarily due to a rapid addition of wind and solar. Indeed, the combined share of wind and solar generation grew from about 4% in 2015 to almost 16% in 2023. In 2023, wind and solar together produced more electricity than hydro for the first time.

Coal's share in China's generation mix is declining

Share in electricity generation (%)



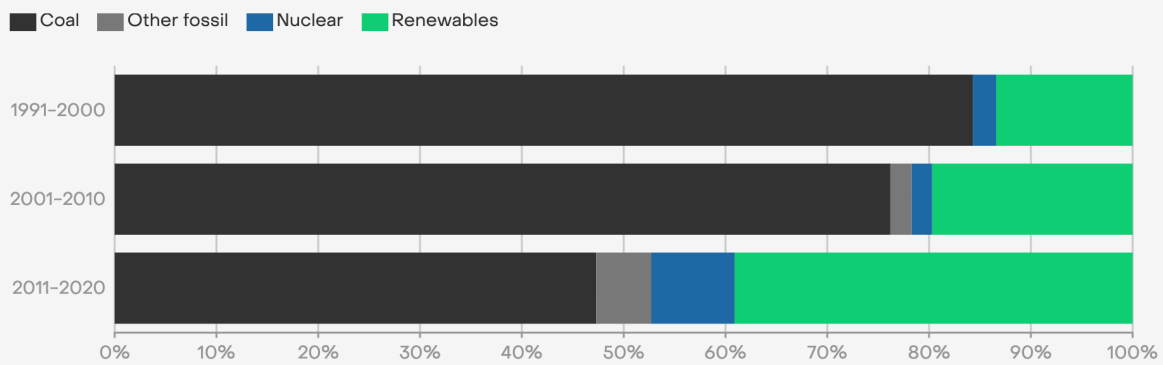
Source: Yearly electricity data, Ember

Accelerating trends

From 1991 to 2000, about 85% of the increase in electricity demand was met by coal power. This share declined to 76% over the period 2001-2010, and further to 47% over the period 2011-2020.

China's electricity demand growth is being increasingly met by renewables

Share of decadal electricity demand growth (%) met by different sources



Source: Yearly electricity data, Ember

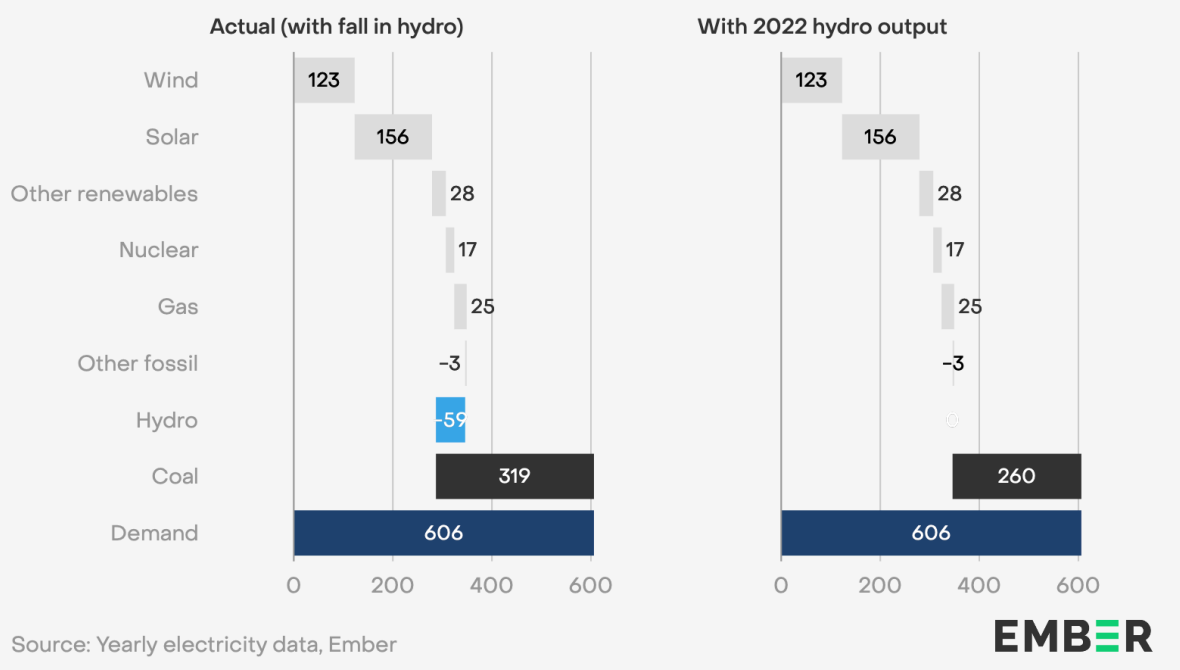


China’s demand for electricity grew strongly in 2023, increasing by [6.7%](#) compared to the previous year. This was higher than the average annual demand growth of about 6% between 2013 and 2022, and well above the low demand growth in 2022 of [3.6%](#).

Wind (123 TWh) and solar (156 TWh) met 46% of the demand increase, followed by bioenergy (28 TWh) and nuclear (17 TWh). Poor hydro conditions led to a decrease of about 59 TWh in hydro generation in 2023. If hydro had remained at 2022 levels, non-fossil fuel generation would have met more than half of the demand increase in 2023, further pushing coal power out of the generation mix.

Without a fall in hydro output, lesser coal power is needed to meet China's power demand growth

Changes in electricity generation in 2023 vs 2022 (TWh)



A critical turning point is in sight

If current trends continue, China is fast approaching a critical turning point where all incremental electricity demand will be met by non-fossil fuel generation, marking the onset of a new era with coal generation in absolute decline.

Back in 2021, President Xi Jinping [stated](#): “We will strictly limit the increase in coal consumption over the 14th five-year plan period (2021-2025) and phase it down in the 15th five-year plan period (2026-2030)”. As the largest coal consumer in the country, coal generation is very likely to begin its absolute decline around the same time.

A recent [IEA analysis](#) predicts that non-fossil fuel generation in China, including renewables and nuclear, is expected to meet almost all of the incremental electricity demand over 2024-2026, assuming normal weather conditions and a recovery in hydropower output. Similarly, the IEA [World Energy Outlook](#) report suggests that coal generation in China would peak around 2025 and decline thereafter.

The coal industry in China appears to have acknowledged that the country's coal consumption is likely to reach a [plateau period](#).

Chapter 3 Further reflections

The need to go beyond diversification

With China's inexorable march towards renewable energy, primarily driven by large generation SOEs, the country is fast approaching a critical juncture where coal power will be in absolute decline, creating an immediate need to go beyond diversification.

This need arises from the fact that coal power in China, like in many other coal-producing countries, is an integral aspect of the coal-electricity ecosystem. This ecosystem is characterised by extensive cross-industry and cross-ownership linkages encompassing coal production and supply, logistics, the coal chemical industry, power generation and the manufacturing of related equipment and facilities. Consequently, an absolute decline in coal generation will inevitably impact other interconnected and interdependent segments of this system, with far-reaching ramifications, particularly within the broader socio-economic assemblages that have evolved around it.

Diversification strategy by large generation SOEs is useful, as it weakens the incumbent utilities' commitment to the existing coal-dominated power system, making deeper transition (an absolute decline in coal power and associated ecosystem, in our instance) possible. However, its effectiveness begins to wane when considering its inability to adequately address the tensions and conflicts that may arise from the absolute decline in coal power and the wider impacts associated with it.

To build on the progress made by SOEs, it is crucial to extend diversification efforts to coal-dependent regions. These regions face unique challenges as they transition away from coal-based industries, requiring tailored strategies that address local economic dependencies and socio-economic conditions. By diversifying the economic base of these areas, a smoother transition can be facilitated, mitigating the adverse effects on local communities and workers who have long relied on the coal-electricity sectors.

A beyond-diversification approach

The question is: what a 'beyond-diversification' approach may look like? Given the complexity of the task, there are likely no simple answers or one-size-fits-all solutions for different coal-dependent regions in China. In addition to highlighting the critical need for a beyond-diversification approach, this report seeks to facilitate thinking on how to devise such an approach by emphasising issues that decision-makers may like to consider.

- **A beyond-diversification approach is much more than green industrialisation.**

The burgeoning clean industry, including solar PV, wind and battery storage, will generate economic and job gains more than sufficient to offset the economic losses incurred from the transition, allowing for all to benefit. However, this offset effect may not always be realised, or even fungible, given that coal-dependent regions may not have a clear advantage over other regions in the clean energy economy. The struggling economic restructuring of [coal-mining cities](#) may lend some credence to this viewpoint. Managing the transition in such traditionally coal-dependent regions will become more important in the coming years as coal use starts absolute decline.

- **Ensuring a just transition is important, but it requires a broader focus than just workers directly engaged in coal-electricity-related businesses.**

The coal-electricity ecosystem is deeply embedded in the local socio-economic systems. Therefore, the impact of an absolute decline in this ecosystem could ripple through to other interconnected economic activities, putting pressure on the broader socio-economic contexts in which it operates. This could exacerbate existing tensions and contradictions, such as slow improvements in living standards and a widening rural-urban divide. Addressing these issues requires comprehensive strategies that support economic restructuring and diversification, invest in new industries, provide retraining and reskilling, and promote inclusive development to mitigate potential social tensions and disparities.

- **Fostering effective coordination among relevant stakeholders is crucial.**

There is a wide and diverse range of stakeholders, including central government agencies, SOEs, local authorities and private investors, deeply involved in the coal-electricity ecosystem. In such settings, policy decisions often arise from

extensive bargaining and consultation, both horizontally between public agencies, SOEs and private sectors, as well as vertically across different levels of government. A strong central leadership is critical for building consensus, especially when the involved actors hold differing views.

- **Gradualism and experimentalism can be effective tools for sustaining progress while navigating complexities.** Often likened to ‘crossing the river by touching the stones’, these approaches are [widely recognised](#) as pivotal to China’s economic success. They allow for careful testing and adjustment of strategies and policies, facilitating the adaptation of broader policy directives into pragmatic, localised actions tailored to specific circumstances. Additionally, they help promote consensus-building among a diverse range of stakeholders by incorporating iterative improvements based on practical experience and feedback.

Supporting Materials

Acknowledgements

Contributors

[Aditya Lolla](#), [Nicolas Fulghum](#), [Shiyao Zhang](#), [Reynaldo Dizon](#), [Rini Sucahyo](#), [Ardhi Arsala Rahmani](#)

Cover image

Grab bucket cranes along a quay load ships with coal to be used for generating electricity at Lianyungang Port in Lianyungang City, east China's Jiang

Credit: [Cynthia Lee](#) / Alamy Stock Photo

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