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New moves in China's power market reform chess game

This paper provides an update on China's progress towards achieving carbon peaking and neutrality given developments in the past year, particularly in terms of major growth in both coal and renewable capacity, as well as the newly published power market reform documents.

- High-level emphasis on energy security over climate and air quality priorities is contributing to a burst of coal power construction across China. Coal additions are taking place in regions with ample coal capacity to meet peak and balance variable renewables. This appears to be driven primarily by the desire of provincial officials to lock in more infrastructure investments now, while coal plants are encouraged.
- China's present coal boom is likely to lead to overcapacity in many provinces. Currently, China relies on administrative policies to encourage grid companies and provincial planners to absorb variable renewable energy.
- As the coal overcapacity problem worsens, financial losses at coal plants are driving the push to adopt a specific capacity payment for coal plants. The capacity payment policy announced in November 2023 could provide further incentive to build more coal capacity, which might eventually lead officials to weaken requirements for fully utilizing wind and solar energy, and even to discourage construction of new wind and solar capacity.
- China's other recent market reform documents, such as the recently released principles for a national power market design, leave most aspects of market design up to provincial officials, and may provide insufficient impetus to increase volumes of inter-provincial trading or spot market trading that could reduce the motivation to build more coal plants.
- The coal overbuild, while aimed at improving reliability, will also lead to higher costs, especially compared to alternatives such as increasing power trading among provinces and regions, or increasing demand response by allowing greater price volatility in short-term power markets. Higher costs ultimately lead to higher electricity prices, whether these are borne by the state (such as through financial losses at state-owned coal plants) or by electricity customers through higher prices.
- Similarly, coal overcapacity could restrict the interest in investment in new gas capacity and, in the absence of high-volume spot electricity markets, could reduce the dispatch of existing gas-fired power assets.
- China remains committed to carbon neutrality and its renewable capacity is also expanding at an accelerating rate, including distributed solar photovoltaics (PV) and energy storage to balance the intermittency of renewables. Wind and solar not only will exceed China's 2030 targets years ahead of schedule, but also could surpass what various forecasts suggested

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China would need to achieve carbon neutrality by mid-century.[1] However, this assumes that renewables continue to be added and fully utilized.

- While renewables are growing at an unprecedented pace and curtailment is presently under control, tying up financial resources in excess coal capacity could pressure planners and other market players to slow the energy transition. This could include allowing greater wind and solar curtailment (which allows coal plants to operate at higher levels to recover costs), discouraging new renewable additions, or imposing new costs on renewable generators (such as capacity payments, storage requirements, or requirements to subsidize local industry) that would slow investment in the field.
- Lastly, an energy transition with a higher peak of coal electricity production implies increased tension at global climate talks, given the visibility of China's coal build-out and the government's sensitivity to criticism on this point. Now that China has largely ended financing for coal projects abroad, ironically this tends to focus even more global attention on China as the last country still building coal power at scale.[2]

Introduction: Are power reforms slow, or merely less ambitious than many assumed?

Electric power market reform is a long process. In April, China's National Energy Administration (NEA) compared the country's changing power system and related reforms to a 'game of chess covering the whole country'. Power market reforms have now been under way for eight years—that is, since 2015, when China's State Council issued Document #9 on deepening reform of the power sector.[3] A flurry of documents released over the past several months leave many important issues unresolved, and contradictions appear to be increasing between various high-level policy pronouncements on climate, energy security, and the role of markets. These include a new set of national power market design principles issued in September, a new policy expanding the coverage of green certificates, and a new capacity mechanism that would offer coal plants payments to help the sector avoid financial losses.

Step-by-step progress on reform policies, combined with the accelerating build-out of renewable energy, can contribute to meeting China's climate objectives of carbon peaking and carbon neutrality. However, overcapacity in coal power and new incentives for coal generators could ultimately slow the build-out and uptake of clean energy, and could incentivize local officials to de-prioritize climate policy, undermining China's announced climate objectives.

In early 2022, the National Development and Reform Commission (NDRC) set out a timeline for power markets, calling for a national design by 2025, and for this design to be basically implemented by 2030.[4] This timeline suggests that power market reforms are only just past the halfway mark. The document listed various types of power markets that the national market would include:

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[1] For example, the *China Energy Transition Outlook 2023* estimated that China would have around 7 TW of wind and solar capacity by 2060 to achieve carbon neutrality. At 200 GW per year of new wind and solar additions, this would be achieved by around 2053. 'China Energy Transformation Outlook 2023: Special Report for COP27,' China Energy Transition Program, 12 November 2022, at https://www.cet.energy/2022/11/12/china-energy-transformation-outlook-2023-special-report-for-cop27/.

[2] India has gradually reduced coal power plans, and its pipeline of projects is far smaller than China's. Sarita Chaganti Singh and Sudarshan Varadhan, 'India amends power policy draft to halt new coal-fired capacity,' Reuters, 4 May 2023, at https://www.reuters.com/business/energy/india-amends-power-policy-draft-halt-new-coal-fired-capacity-sources-2023-05-04/.

[3] '关于进一步深化电力体制改革的若干意见（中发 9 号）[Opinions on Further Deepening the Reform of Power System (Document No. 9)],' China State Council, 9 April 2015, at https://www.ndrc.gov.cn/fggz/tzgg/ggkx/201504/t20150409_1077736.html or http://fjb.nea.gov.cn/pufa_view.aspx?id=31434.

[4] '我国将加快建设全国统一电力市场体系 [China will accelerate development of a unified national power market system],' National Development and Reform Commission, 3 February 2022, at https://www.gov.cn/xinwen/2022-02/03/content_5671824.htm.

- A unified national market, with trading centres in Beijing and Guangzhou, and eventually a single national trading centre;
- Regional and provincial markets within the national unified power market system;
- Cross-provincial and cross-regional markets;
- Medium- and long-term electric power markets—typically with contracts of a month or year, though terms can be longer or shorter;
- Electricity spot markets;
- Ancillary services markets, which provide flexible, ramping resources.

In addition, the NDRC document called for exploring the role of green power trading and establishing a capacity payment mechanism. This year's energy work plan included spot market design, energy bases, distributed PV, and green certificates.[5] All are now clearly under way.

Aside from policy, major events and speeches are sending out different signals. Though energy security has been underlined as a top national priority since 2019, the energy shortages in 2021 and 2022 underlined the urgency of prioritizing energy security over other long-term goals. This year's Government Work Report, released at the Two Sessions of the National People's Congress, states that China will 'give full play to the role of coal as the *main energy source*', a new but only slightly different phrasing for coal, which had earlier been called a 'ballast stone' (stabilizing factor) or 'foundation' of the energy system. In early 2023, NEA's annual work plan listed energy supply security first, above other important tasks. Leading into the summer, China's poor hydro conditions and a sustained heatwave in northern China passed without major electricity disruptions. Not only has coal power helped fill the hydro gap, but China's provinces have been on a coal building spree. Yet construction of new wind and solar has also accelerated, and the market share of clean energy is rising even as coal output grows.

This raises two important questions: First, will coal's comeback prove temporary, and are China's climate objectives of carbon peaking and carbon neutrality still on track? Second, is power market reform, especially recent policies, likely to accelerate China's energy transition, or is the slow pace of reform holding it back?

Clean energy transition in the power sector is still on track, but risks loom large

China's additions of wind and solar PV are experiencing growth unlike any seen previously anywhere in the world. In the first three quarters of 2023, China added 129 GW of new PV capacity,[6] up 145 per cent from the same period the prior year, and far higher than the total added for the full year of 2022 (87 GW) (Figure 1). Indeed, China added more PV in the first three quarters than the total installed PV capacity of the USA at the end of 2022 (119 GW). Wind capacity additions were also up strongly: in the first three quarters of 2023, China added 33 GW of wind, compared to 19 GW added in the same period of 2022 (Figure 2).[7] Given that most wind and PV additions typically complete at the end of the year, it is possible that China could add over 200 GW of wind and solar in 2023. This is substantially higher

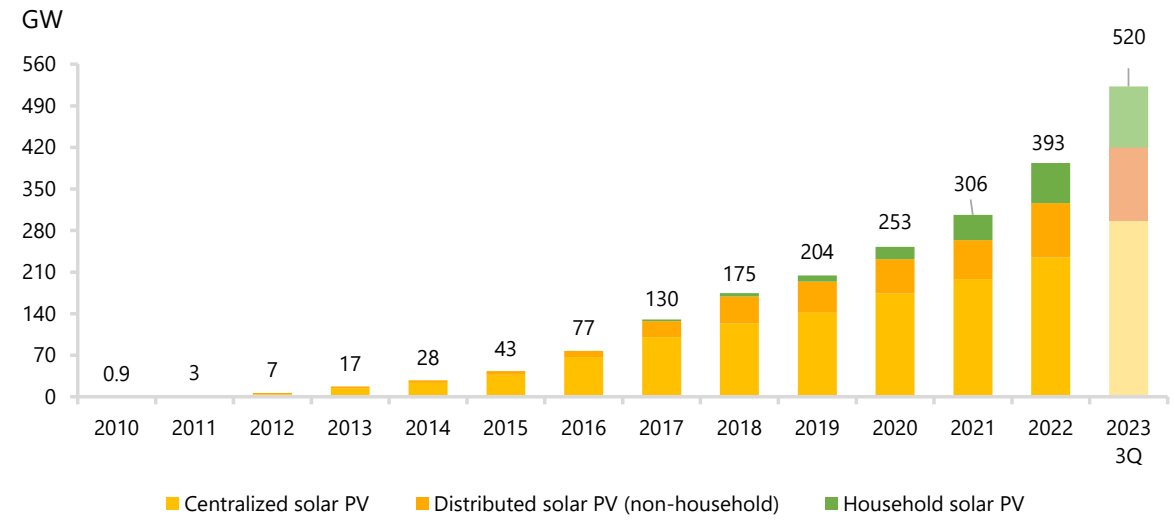
[5] '2023 年能源工作指导意见 [2023 Energy Work Guidance],' National Energy Administration, 6 April 2023, at http://zfxxgk.nea.gov.cn/2023-04/06/c_1310710616.htm.

[6] '国家能源局 2023 年四季度新闻发布会文字实录 [Record of NEA 4Q 2023 news conference],' National Energy Administration, 31 October 2023, at https://www.nea.gov.cn/2023-10/31/c_1310748132.htm.

[7] '国家能源局 2023 年四季度新闻发布会文字实录 [Record of NEA 4Q 2023 news conference],' National Energy Administration, 31 October 2023, at https://www.nea.gov.cn/2023-10/31/c_1310748132.htm; '国家能源局 2022 年四季度网上新闻发布会文字实录 [Record of NEA 4Q 2022 news conference],' National Energy Administration, 14 November 2022, at https://www.nea.gov.cn/2022-11/14/c_1310676392.htm.

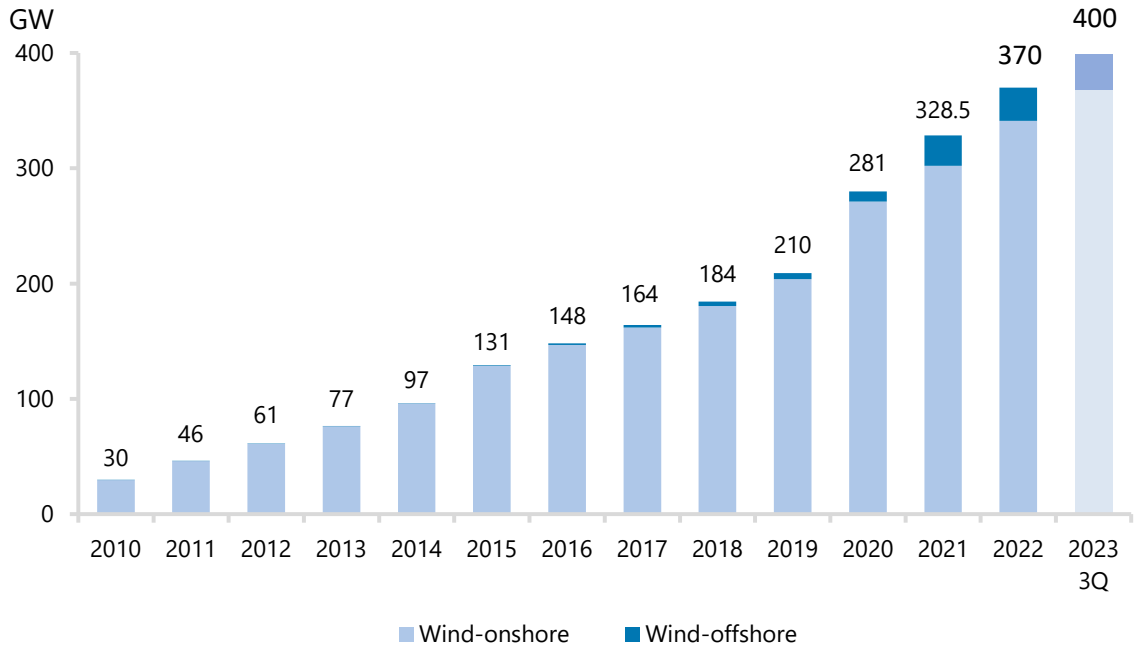
than forecasts for 160 GW of additions at the beginning of the year, as well as the target set in the 2023 energy work plan.[8]

Figure 1: China's historical solar PV capacity through 3Q 2023



Source: author

Figure 2: China's historical wind power capacity through 3Q 2023



Source: author

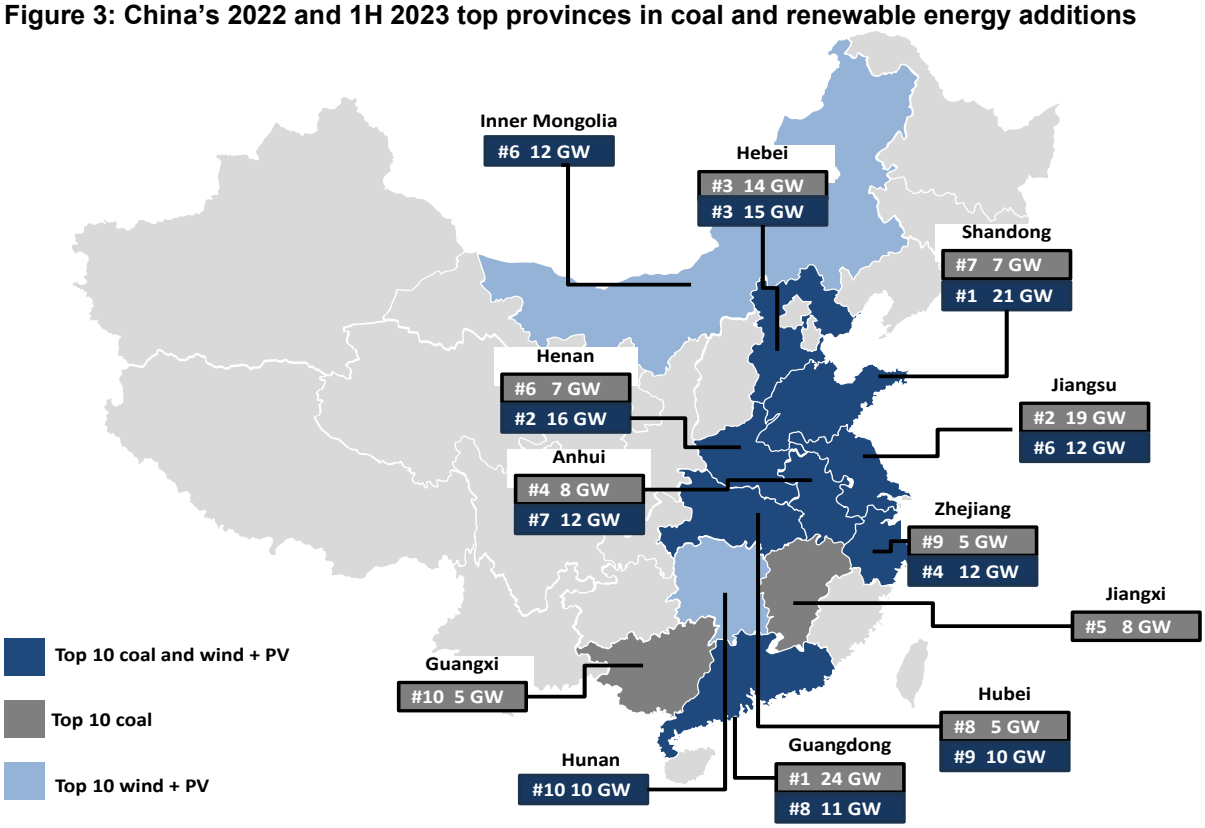
[8] '国家能源局：2023 年新增风光装机 160GW 增幅超 33% [NEA: In 2023 wind and solar PV should add 160 GW, growth of over 33 per cent],' Beijixing, January 2023, at https://mguangfu.bjx.com.cn/mnews/20230103/1280289.shtml; '2023 年能源工作指导意见 [2023 Energy Work Plan Guiding Opinions,' National Energy Administration, April 2023, at http://zfxxgk.nea.gov.cn/2023-04/06/c_1310710616.htm.

In terms of geography, most solar PV is being added in East China, especially in Shandong, Hebei, Jiangsu, Henan, Zhejiang, Guangdong, and Anhui. These seven provinces accounted for over half of PV additions in 2022 and the first half of 2023. Many of the PV additions in these regions are on residential rooftops, reflecting the Whole County PV Programme, which has a year-end 2023 completion target. For wind, NEA reported that 70 per cent of new additions in 2023 were in the northern half of China.[9] Leading provinces for new wind additions in 2022 and the first half of 2023 were Inner Mongolia, Jilin, Heilongjiang, Shandong, and Gansu, together accounting for over 60 per cent of new wind additions during this period.

Meanwhile coal capacity is rising, often in regions with ample existing capacity

As for coal, China approved at least 50 GW of coal capacity in the first half of 2023, far more than added in recent years, with the exception of 2022 when China added 70 GW of new coal capacity for the full year. As shown in Figure 3, provinces adding most coal capacity in 2022 and the first half of 2023 were Guangdong, Jiangsu, Hebei, Anhui, Jiangxi, Henan, Zhejiang, Guangxi, Shandong, and Hubei. Greenpeace analysed individual plant documents and found that planning documents cited various justifications for adding new coal: providing more energy, winter heating, or even economic stimulus—in short, not necessarily specifically tailored for peak regulation or renewable integration.[10]

Figure 3: China's 2022 and 1H 2023 top provinces in coal and renewable energy additions



Source: author

[9] '国家能源局 2023 年三季度网上新闻发布会文字实录 [Record of NEA 3Q 2023 news conference],' National Energy Administration, 31 July 2023, at http://www.nea.gov.cn/2023-07/31/c_1310734825.htm.

[10] 'China's 2023 coal approvals grow to 50.4 GW, as coal constricts space for energy storage, climate solutions,' Greenpeace East Asia, 3 August 2023, at https://www.greenpeace.org/eastasia/press/8139/chinas-2023-coal-approvals-grow-to-50-4-gw-as-coal-constricts-space-for-energy-storage-climate-solutions/; 'China has already approved more new coal in 2023 than it did in all of 2021 — Greenpeace,' Greenpeace East Asia, 24 April 2023, at https://www.greenpeace.org/eastasia/press/7939/china-has-already-approved-more-new-coal-in-2023-than-it-did-in-all-of-2021-greenpeace/.

There is strong overlap between provinces adding renewables and those adding coal, but there is no apparent link between new coal capacity and the need to balance the intermittency of renewables. New capacity is pouring into regions that have ample surplus capacity already, whereas provinces that have experienced increased vulnerability to power outages due to poor hydro conditions appear less active. A recent study by the Centre for Research on Energy and Clean Air (CREA) found that almost all coal plants were constructed in regions where thermal capacity far exceeded peak loads (especially the North China, Central China, and Northwest China regions), and in provinces where thermal capacity already has more than triple the local capacity of variable renewables.[11]

Coal power has also been producing more electricity, largely to replace hydro, which has undergone a second consecutive year of shortages. In June, hydro electricity output fell 34 per cent year-on-year, while coal output rose 14 per cent.[12] Hydro output increased substantially in August, potentially helping to alleviate near-term (2023 and 2024) power shortage concerns, and leading to a slight monthly decline in coal power.

China's coal power building boom has been under way for several years, even as coal additions dwindled in the rest of the developing world, raising concerns worldwide about locking in emissions. Indeed, the building boom roughly coincides with President Xi's announcement of the Dual Carbon goals. The coal expansion followed a period from roughly 2016 to 2019, in which central regulators struggled to clamp down on coal overcapacity, and sought to address the issue by adopting a set of traffic light policies (from 2020 onward) designating which provinces could seek approval for new plants.[13] Perceptions of a looming electricity shortage—reinforced by the actual occurrence of major outages in 2021 and 2022—combined with renewed focus on energy security beginning roughly in 2019, shifted the focus of both central and local planners away from overcapacity and towards reinforcing coal as the 'ballast stone' of the power system.

While some new dispatchable capacity is undoubtedly necessary under China's present circumstances of increasing peak loads and surging wind and solar capacity, new coal additions do not appear to result from a national plan or official policy. Indeed, the turn back to coal represents a reversal of policy trends that had been evident just a few years ago. In January 2021 the Central Environmental Inspection Team (CEIT) criticized NEA for failing to strictly control coal additions and 'approving what should not be approved',[14] and in April 2021 President Xi pledged to 'strictly control' new coal capacity through 2025,[15] after which coal should start to decline.

Currently, there is little evidence that control or supervision of coal capacity by NEA or other planners has been increased or made stricter. Regions and provinces with thermal power capacity substantially higher than peak load—without accounting for renewables—continue to see strong growth in coal

[11] Flora Champenois et al., 'China's new coal power spree continues as more provinces jump on the bandwagon,' Centre for Research on Energy and Clean Air, 29 August 2023, at https://energyandcleanair.org/wp/wp-content/uploads/2023/08/CREA_GEM_China-coal-power-briefing-2023H1_08.2023.pdf.

[12] Lauri Myllyvirta, 'China energy and emissions trends: July 2023 snapshot,' Centre for Research on Energy and Clean Air, 17 July 2023, at https://energyandcleanair.org/china-energy-and-emissions-trends-july-snapshot/.

[13] For some discussion of central government coal overcapacity policies and the incentives of local officials, see Qianqian Zhang et al., 'Reducing coal overcapacity in China: a new perspective of optimizing local officials' promotion system,' Environmental Science and Pollution Research volume 29, 22 July 2022, at https://link.springer.com/article/10.1007/s11356-022-22010-2 and Jiahai Yuan et al., 'China overinvested in coal power: Here's why,' Centre for Economic Policy Research, 16 March 2019, at https://cepr.org/voxeu/columns/china-overinvested-coal-power-heres-why; '国家能源局关于发布 2023 年煤电规划建设风险预警的通知 [NEA Notice on 2023 Coal Planning and Construction Risk Warning],' National Energy Administration, 26 February 2020, at http://www.nea.gov.cn/2020-02/26/c_138820419.htm.

[14] '中央第六生态环境保护督察组向国家能源局反馈督察情况,' Ministry of Ecology and Environment, 29 January 2021, at https://www.mee.gov.cn/xxgk2018/xxgk/xxgk15/202101/t20210129_819526.html. The phrase in Chinese is '该建的没建、不该建的建了', or 'what should be built wasn't built, and what shouldn't be built was built'.

[15] David Stanway and Cate Cadell, "President Xi says China will start cutting coal consumption from 2026," Reuters, 22 April 2021, at https://www.reuters.com/world/china/chinas-xi-says-china-will-phase-down-coal-consumption-over-2026-2030-2021-04-22/.

power additions.[16] While most or all new coal plants are now described as serving the dual purposes of peak load regulation and renewable integration backup, analysts have observed that many coal plants appear destined mainly for bulk power production.[17] The primary purpose of adding new capacity appears to relate to provincial governments seeking to lock in investments for large state-owned energy projects, combined with the longstanding desire to build out provincial thermal capacity to avoid importing power from neighbouring provinces.

Storage resources are adding more flexibility to help absorb renewables

In terms of handling the challenge of integrating variable renewable energy, China is also adding battery capacity at a furious rate. According to figures published by the Zhongguancun Energy Storage Industry Technology Alliance (China Energy Storage Allliance, CNESA), China's largest energy storage group, China added a record 12 GW of battery energy storage in 2022, almost tripling its total capacity.[18] Even more significantly, China's currently planned battery energy storage pipeline has surpassed 100 GW, much of which CNESA expects to be completed within two years. (CNESA's official forecasts are more conservative, suggesting China would reach 100 GW by around 2026 or 2027.[19]) In any case, China should far surpass its official target (set by NEA in 2021) for 30 GW of new energy storage by 2025.[20] While the largest projects are in remote areas such as Xinjiang, Qinghai, and Gansu—with Qinghai adding the world's first GW-scale battery—major installations are also taking place in eastern China, such as in Hebei and Shandong. Shandong, Shanxi, and Gansu have allowed storage to participate in spot market transactions. Typical energy storage projects have two hours of energy storage capacity. Hence, battery and pumped hydro storage (59 GW in 2022) is far smaller than the country's wind and solar capacity (over 900 GW as of 3Q 2023). However, every unit of storage capacity does provide flexibility that offsets the need for some new coal additions, and could ultimately directly compete with the new coal capacity being added currently.

The wind and solar share of electricity production continues to rise

As renewable capacity continues to grow, its share of generation has increased, gradually chipping away at coal's share even as coal output rises as well. In the past two years, China's wind and solar share has grown at over two percentage points annually, and this year's incremental increase could easily match that, rising from 14 per cent in 2022 to above 16 per cent, even as the hydro shortage dips into the clean energy share. In terms of both capacity and electricity generated, wind and solar remain on track or even ahead of what is needed to meet China's carbon neutrality target by 2060. China's official targets call for clean energy to provide the majority of incremental electricity production, a goal that still seems conservative in light of their current growth rates.

[16] Flora Champenois et al., 'China's new coal power spree continues as more provinces jump on the bandwagon,' Centre for Research on Energy and Clean Air, 29 August 2023, at https://energyandcleanair.org/wp/wp-content/uploads/2023/08/CREA_GEM_China-coal-power-briefing-2023H1_08.2023.pdf.

[17] Lauri Myllyvirta, 'More renewables, more coal: Where are China's emissions really headed?,' China Dialogue, 3 April 2023, at https://chinadialogue.net/en/energy/where-are-chinas-emissions-really-headed/.

[18] Liu Wei, '2022 储能产业盘点：截止 2022 年底电力储能项目累计装机 59.4GW 同比增长 37% [2022 storage industry conclusion: by the end of 2022, electricity energy storage reached 59.4 GW and grew 37%],' Beijixing, 16 January 2023, at https://news.bjx.com.cn/html/20230116/1283429.shtml.

[19] '储能产业研究白皮书 2023 发布 [Energy storage industry 2023 white paper published],' China Power, 11 April 2023, at http://mm.chinapower.com.cn/chuneng/dongtai1/20230411/195709.html.

[20] '关于对国家发展改革委 国家能源局关于加快推动新型储能发展的指导意见（征求意见稿）公开征求意见的公告,' National Energy Administration, 21 April 2021, at http://www.nea.gov.cn/2021-04/21/c_139896047.htm.

Future renewable capacity and generation share will depend on central and provincial policy makers

What do the capacity additions mean for the future of renewables versus coal, and for the low-carbon transition? High-level signals continue to indicate coal has political backing, with longtime top climate negotiator Xie Zhenhua saying recently that it is unrealistic for China to phase out coal, and repeating Xi Jinping's phrase about the need to first build the new before tearing down the old.[21] This high-level support for coal doesn't offer many clues about what will happen after years in which China continues to build the 'old' and 'new' simultaneously, with thermal capacity far exceeding regional peak loads.

In the long run, the future of renewable energy becoming the 'main' energy source by mid-century, as indicated in the 14th Five-Year Plan, depends on both continuing to add new capacity and continuing to use its output fully. Prior to 2019, wind and solar suffered from serious issues with curtailment, with wind curtailment topping 20 per cent in many provinces, including in regions with ample transmission. One leading factor driving curtailment was a provincial and grid company preference for upholding monthly and annual dispatch contracts with coal plants rather than accepting variable renewable energy.[22] Administrative measures were adopted to encourage grid operators and provincial officials to reduce curtailment—financial penalties for grid companies and annual renewable energy quotas for provincial officials—and these measures have kept curtailment low even as wind and solar capacity and output quadrupled.[23] Such administrative measures from the central government have been made necessary given provincial preferences for coal power as a stimulus measure, employment source, and driver of local tax revenues.

Administrative controls have political limits, and there is a possibility that provincial officials and grid companies will eventually push back on renewables, allowing curtailment to drift up in favour of coal again in the future. On curtailment, provinces could resist accepting renewable energy from neighbouring provinces, especially if the province has already met its renewable obligation for the year.[24]

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[21] David Stanway, 'China climate envoy says phasing out fossil fuels 'unrealistic',' Reuters, 23 September 2023, at https://www.reuters.com/sustainability/climate-energy/china-climate-envoy-says-phasing-out-fossil-fuels-unrealistic-2023-09-22/.

[22] Hao Zhang, 'Prioritizing Access of Renewable Energy to the Grid in China: Regulatory Mechanisms and Challenges for Implementation', *Chinese Journal of Environmental Law*, 3 December 2019, at https://brill.com/view/journals/cjel/3/2/article-p167_3.xml?language=en#FN000130.

[23] In 2016, when wind and solar curtailment peaked at 16 per cent for wind and 11 per cent for solar, China's wind capacity was 148 GW and solar capacity was 77 GW. Since that time, wind capacity has risen by 170 per cent to 400 GW and solar PV capacity has risen by 570 per cent to 520 GW. Total wind and solar capacity rose by 308 per cent. Curtailment is below 3 per cent. The main policies leading to reduced curtailment included mandates that provinces reduce curtailment below defined levels by 2019, as well as penalties for grid companies that failed to fully integrate renewable energy. See '清洁能源消纳行动计划（2018-2020 年），发改能源规〔2018〕1575 号 [Clean energy consumption action plan [2018-2020], NDRC Energy Planning (2018) No. 1575],' National Development and Reform Commission and National Energy Administration, 30 October 2018, https://www.ndrc.gov.cn/xxgk/zcfb/ghxwj/201812/t20181204_960958.html;'可再生能源发电全额保障性收购管理办法, 发改能源 [2016]625 号 [Renewable Electricity Full Purchase Guarantee Management Act, NDRC (2016) No. 625],' National Development and Reform Commission Number 625, 24 March 2016, http://www.nea.gov.cn/2016-03/28/c_135230445.htm; '电网企业全额保障性收购可再生能源电量监管办法(修订) (征求意见稿) [Grid Company Full Purchase of Renewable Electricity Supervision Act Amendment (Revised) (Draft for Comment)],' National Development and Reform Commission, 22 November 2019, at https://www.ndrc.gov.cn/xwdt/tzgg/201911/t20191122_1204501.html.

[24] The provincial renewable obligation requires provinces and provincial grid companies to obtain a certain percentage of electricity consumption from renewable energy, with separate targets for all renewables (hydro, wind, solar, biomass) and for the non-hydro subset. The targets are set on an annual basis, often mid-year, and typically when investment plans and transmission capacity for the year are already established. In this respect, they differ from renewable portfolio standards in that they are not intended to guide investment, only to mandate consumption of capacity already present or under construction. They are an administrative mechanism for ensuring implementation of existing policies. For the original policy, see '关于印发各省级行政区域 2020 年可再生能源电力消纳责任权重的通知 [Renewable Energy Electricity Consumption Obligation in 2020 for

On capacity, provinces may eventually clamp down on renewable additions, claiming inadequate ability to absorb the power locally—especially if inter-provincial trading fails to expand as necessary. In the past, provinces have used annual plans for 'renewable energy consumption capacity'—set by local officials and grid companies through a closed-door process—to essentially forbid new wind or solar investments locally even while approving new local coal plants to meet rising power demand. For example, in May 2020, Hunan officials announced a halt to all new ground-mounted solar PV projects in the province, citing inadequate 'consumption capacity'. At that point the provincial PV project pipeline was just 1 GW. However, a week later the province approved a new 2 GW coal plant.[25]

More recently, individual counties have been accused of forbidding any new solar installations due to oversupply, and have ignored multiple instructions from the central government not to issue such bans. In a colourful phrase, one expert likened local interpretations of these policies prohibiting such solar bans to 'a monk with a twisted lip reading the wrong sutra'.[26] Provinces have also imposed additional costs on renewable generators, such as requiring project owners to promise to invest in local industrial projects in exchange for approval. The practice, known as 'trading industry for projects', is sometimes explicit and quantitative. A county in Zhejiang province requires investment in local industry of RMB 300 million in exchange for approving a 100 MW solar project. Shandong has required a large solar project to take on RMB 3 billion in local debt in exchange for project approval.[27] These practices violate earlier instructions from NEA that barred provinces from imposing extra fees on renewable generators that do not relate to direct costs in the energy system.

Despite this situation, the outlook for renewables remains positive for two reasons. First, it is unlikely that China would abandon its Dual Carbon goals or the concept of an Ecological Civilization, given both their prominence domestically and internationally, and their direct link to President Xi. Second, China's clean energy industry has become an economic driver in its own right, as well as a political priority aligned with the concept of 'high quality economic development'. If the domestic market for wind, solar, and batteries fell dramatically—beyond the more perennial problem of overcapacity in clean energy manufacturing—this would bring unacceptable political and economic consequences for both provincial and national officials.

This summer's power market reform documents could bolster coal at the expense of other energy sources

Market reforms could play an important role in bolstering clean energy, given its improving economics and low marginal cost. As noted in a paper published in February this year,[28] it appears likely that market reforms will proceed slowly, and in the near term officials will focus on incremental changes that expand the role of markets only around the edges. However, in some respects, recent reform documents—especially on 'capacity payments' to coal plants—could give a major boost to the

Each Provincial Administrative Region China National Energy Administration],' National Energy Administration, 1 June 2020, http://www.nea.gov.cn/2020-06/01/c_139105253.htm.

[25] '湖南省暂停新增普通地面光伏项目备案 [Hunan province plans temporarily halt to all conventional ground-mounted PV projects]', Beijixing, 26 May 2020, at https://guangfu.bjx.com.cn/news/20200526/1075883.shtml; '疯狂的新煤电！2×1000MW 超超临界煤电机组将扩建 [New Coal Power Craze! Two 1,000 MW Supercritical Coal Power Units To Be Built]', In-en, 5 June 2020, at https://power.in-en.com/html/power-2367935.shtml.

[26] '光伏"整县推进"扭曲变形，大量民营企业主被逼到死亡边缘 [Whole County PV policy distortions are pushing many private companies to the brink of death],' Huaxia Energy News, 15 August 2022, at https://mp.weixin.qq.com/s/eKxd1zIZ1BV-eHmQBETrzA.

[27] Tian Si, '各地超 15GW 光伏项目被废止：宝贵的新能源指标为何大批"空转"？ [Regions cancel over 15 GW of solar PV; why have precious new energy targets been left idle?,' Huaxia Energy, 8 November 2023, at https://mp.weixin.qq.com/s/CO-6uEK6aWVhMuawfng5FQ.

[28] Anders Hove, 'Assessing China's power sector low-carbon transition: a framing paper,' Oxford Institute for Energy Studies, February 2023, at https://www.oxfordenergy.org/publications/assessing-chinas-power-sector-low-carbon-transition-a-framing-paper/.

economics of coal power, with the unintended consequence of potentially undermining future investments in lower-cost renewables, storage, or demand flexibility.

In terms of language, China's enthusiasm for 'giving full play' to the market remains much in evidence in policy documents. Phrasing around allowing markets to play a 'decisive role in the allocation of energy resources' continues to appear in most documents related to energy market policies.[29] However, this year's Government Work Report, released at the annual Two Sessions in 2023, appeared to qualify this by adding a new sentence on the importance of planning:

> Focus on key areas and key links to deepen reforms, and stimulate market vitality and social creativity. Adhere to the direction of socialist market economic reform, properly handle the relationship between the government and the market, and enable the market to play a decisive role in resource allocation. Give full play to the role of the government and promote a better combination of an effective market and an effective government.[30]

New market reforms continue to be issued on a regular basis, covering all aspects of electricity trading—mid-to-long-term (MLT) bilateral power trading, spot markets, ancillary services (which, in the absence of a liquid spot market, play a larger role in balancing than elsewhere), and green power trading. At the same time, the role of markets remains strictly contained. Power prices trade in a narrow range, especially on the MLT market, with price caps set at 20 per cent above an administratively set coal power tariff level, and often trade at that level. Not only does the MLT market dominate power trading, but the role of spot markets remains sharply constrained by the central government, and NDRC guidance on energy security states that industry should lock in 90 per cent of annual power demand via the MLT market.[31] This practice limits the spot market, and it also creates a two-track system where variable renewables trade more in spot markets and suffer from periods of oversupply, while coal locks in revenue on MLT contracts and is relatively insulated from spot prices. (However, MLT contracts can include time-of-use factors and power curves, allowing some consideration of shorter-term fluctuations in output, consumption, and pricing.) As for regulation of energy prices, although wholesale power price caps hurt coal generators, regulated upstream coal prices help.

This year's work plan includes new regulations for national power trading, and in September the NEA finalized a new trial set of Basic Rules for spot market trading.[32] Though the document omitted some

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[29] The language around markets playing a 'decisive role' in the energy sector was introduced in 2013: '中共中央关于全面深化改革若干重大问题的决定 [Decision of the Central Committee of the Communist Party of China on Several Major Issues Concerning Comprehensively Deepening Reform],' Central People's Government of PRC, 15 November 2013, at http://www.gov.cn/jrzg/2013-11/15/content_2528179.htm. The 14th Five-Year Plan Outline and 2035 work plan includes the phrase 'market leading' as one of its principles. '中华人民共和国国民经济和社会发展第十四个五年规划和 2035 年远景目标纲要,' China State Council, 13 March 2021, at http://www.gov.cn/xinwen/2021-03/13/content_5592681.htm; The 14th Five-Year Plan for a Modern Energy System also includes the phrase. "国务院关于印发十四五市场监管现代化规划的通知 [The State Council issued the "14th Five-Year Plan" Notice of Market Supervision Modernization Plan]," State Council of China, 14 December 2021, at http://www.gov.cn/zhengce/content/2022-01/27/content_5670717.htm.

[29] '政府工作报告 [Government Work Report],' China State Council, March 2023, at https://www.gov.cn/zhuanti/2023lhzfgzbg/index.htm.

[30] '国家发展改革委 国家能源局关于做好 2023 年电力中长期合同签订履约工作的通知 [NDRC and NEA notice on 2023 mid-to-long-term contract coverage],' National Development and Reform Commission, 2 December 2022, at https://www.ndrc.gov.cn/xxgk/zcfb/tz/202212/t20221222_1343756.html.

[30]'电力现货市场基本规则 (试行) [Electricity Spot Power Market Basic Rules (trial)],' National Development and Reform Commission, 7 September 2023, at https://www.ndrc.gov.cn/xxgk/zcfb/ghxwj/202309/t20230915_1360625.html.

[31] '国家发展改革委 国家能源局关于做好 2023 年电力中长期合同签订履约工作的通知 [NDRC and NEA notice on 2023 mid-to-long-term contract coverage],' National Development and Reform Commission, 2 December 2022, at https://www.ndrc.gov.cn/xxgk/zcfb/tz/202212/t20221222_1343756.html.

[32] '电力现货市场基本规则 (试行) [Electricity Spot Power Market Basic Rules (trial)],' National Development and Reform Commission, 7 September 2023, at https://www.ndrc.gov.cn/xxgk/zcfb/ghxwj/202309/t20230915_1360625.html.

technical aspects from its earlier draft version,[33] many of the key elements and language remained. The Basic Rules document provides a general outline of principles for market functioning, defines roles and responsibilities of different stakeholders, and assigns most responsibility for design of spot market to the provinces.

The new document provides more specific language around the eventual convergence of ancillary services markets (which now handle the need for flexible operation of power plants, known as 'peak shaving') and spot markets. The final version of the document limits its applicability to provinces with zonal pricing, meaning it covers provinces with fewer transmission constraints such as those in eastern China. The document also retains language allowing provincial officials to suspend markets for a long list of (undefined) reasons, such as high prices, volatility, or when 'intervention is deemed necessary':

> If one of the following situations occurs during the operation of the spot market, the relevant competent departments such as the National Energy Administration's agencies and provincial price authorities will make market intervention decisions in accordance with their duties, including temporarily suspending market operations and suspending the implementation of some or all rules, price control and other measures, and entrust market operation agencies to implement market intervention: (1) When the power supply is seriously insufficient. (2) When the electricity market is not operated and managed in accordance with the rules. (3) When the power market operating rules do not meet the needs of power market transactions and must be significantly modified. (4) When there is malicious collusion to manipulate electricity market transactions that seriously affects the transaction results. (5) When the market price reaches the price limit and control conditions are triggered. (6) Other situations where market intervention is deemed necessary.

Within China, there has been criticism of the new document, in particular for its vagueness. One commentator noted that China's national spot market rules document has only around a dozen pages, far shorter than markets designs elsewhere. This appears to relate to the practice of incremental reform, based on the principle of 'first pilot, then summarize, then promote', and the present documents, including the forthcoming national design, represent only a *summary of present practice*, rather than a major reform.[34]

The advantage of incremental reform, sometimes called muddling through, is the avoidance of risk and preservation of current stakeholder interests, which facilitates consensus building and reduces the political cost of adopting reforms. The disadvantage is that China's present power sector political economy incentives—in which price signals play a limited role in either short-term dispatch or power sector planning—result in systematic overinvestment in infrastructure, particularly coal power. As a result, administrative planning is playing a larger role in the power sector over time, at central and local levels. And in the barely hidden tug-of-war between the central government and local government, national officials have openly complained they lack authority to control or supervise coal investments—a fact that was recorded in the 2021 report detailing the CEIT inspection of NEA.[35]

There have been other notable reform documents released or discussed in recent months. A policy reform on green certificates expands the coverage of such certificates to all renewable energy sources, and removes a major impediment to trading by changing how renewables with feed-in tariff subsidies

[33] '国家能源局综合司关于公开征求《电力现货市场基本规则（征求意见稿）》《电力现货市场监管办法（征求意见稿）》意见的通知 [National Energy Administration Comprehensive Department Issues Consultation Drafts of 'Spot Power Market Basic Principles' and 'Spot Power Market Management Measures'],' National Energy Administration, 25 November 2022, at http://www.nea.gov.cn/2022-11/25/c_1310679693.htm.

[34] Liu Lianqi, '新政解读：《现货基本规则》的定位和正确打开方式,' China Electricity Council Media, 18 September 2023, at https://mp.weixin.qq.com/s/8l9eFJcDMqx2hEu0RShuGQ.

[35] '中央第六生态环境保护督察组向国家能源局反馈督察情况,' Ministry of Ecology and Environment, 29 January 2021, at https://www.mee.gov.cn/xxgk2018/xxgk/xxgk15/202101/t20210129_819526.html.

are compensated.[36] While a step forward, the policy may ultimately fall short of what is needed to encourage private sector uptake of the certificates on a voluntary basis, especially the international companies that have been most active in voluntary green power purchases.[37] As for using green certificates or renewable energy to comply with Dual Control (quotas for energy consumption and energy intensity), the new policy indicates that this will still require more work on measurement, reporting, and verification, even though the idea was put forward nearly two years ago.

Capacity payments could distort markets and impose extra costs on renewables or consumers

Capacity markets are a hot topic worldwide, and in China as well. The concept of a capacity payment mechanism, possibly based on market mechanisms such as a capacity auction, was put forward in an NDRC work plan in 2019.[38] In September, it was reported that a draft capacity payment mechanism policy would allow provinces to begin payments to coal plants, set at a level to enable them to recover 30–50 per cent of capacity costs, with the percentage determined by 'local conditions'.[39] Coal company stocks surged immediately after the idea was floated, and sector analysts speculated that the government and industry have reached consensus for annual capacity subsidies of RMB 100 per kW of coal capacity.[40]

In November, the NDRC issued a Notice on establishing a coal power capacity price mechanism.[41] The policy contains the following main points:

- Qualifying coal plants should receive a fixed monthly payment based on a percentage of their annual fixed costs, determined by the NDRC as RMB 330/kW of capacity. The percentage ranges from 30 to 50 per cent. Seven provinces with a higher share of low-carbon energy receive a higher payment, while all others receive RMB 100/kW. The seven provinces are Henan, Hunan, Chongqing, Sichuan, Qinghai, Yunnan, and Guangxi.
- Coal plants that do not meet national standards for flexibility, efficiency, or environmental performance do not qualify for the payments.

[36] '关于做好可再生能源绿色电力证书全覆盖工作促进可再生能源电力消费的通知 [Notice regarding completing work on renewable energy green certificate full coverage to encourage renewable energy consumption],' National Development and Reform Commission, Ministry of Finance, and National Energy Administration, 25 July 2023, at https://www.ndrc.gov.cn/xxgk/zcfb/tz/202308/t20230803_1359092_ext.html.

[37] Anders Hove and Gary Sipeng Xie, 'Green certificates with Chinese characteristics: Will green certificates help China's clean energy transition?,' Oxford Institute for Energy Studies, July 2023, at https://www.oxfordenergy.org/publications/green-certificates-with-chinese-characteristics-will-green-certificates-help-chinas-clean-energy-transition/; and Anders Hove, 'After China's new green certificate policy, major questions remain,' Oxford Institute for Energy Studies LinkedIn post, 11 August 2023, at https://www.linkedin.com/feed/update/urn:li:activity:7095686834520780800/.

[38] '国家发展和改革委员会关于深化燃煤发电上网电价形成机制改革的指导意见 [Guiding Opinions of the National Development and Reform Commission on Deepening the Reform of the On-grid Price Formation Mechanism for Coal-fired Power Generation],' National Development and Reform Commission, 25 October 2019, at http://www.gov.cn/xinwen/2019-10/25/content_5444655.htm.

[39] Wu Weinan, '煤电容量电价机制征求意见，电改大踏步前进, [Coal capacity price mechanism request for comments, a step forward for power market reform],' i-Energy, 12 September 2023. The original article on WeChat was deleted shortly after it was posted.

[40] '容量电价改革今年要落地，煤电的"救命稻草"来了 [Capacity price reform will be in place this year, coal power lifeline is here],' Huaxia Energy Net (36kr), 19 September 2023, at https://36kr.com/p/2438474414600451.

[41] '关于建立煤电容量电价机制的通知 [Notice on Establishing a Coal Power Capacity Price Mechanism],' National Development and Reform Commission, 10 November 2023, at https://www.ndrc.gov.cn/xxgk/zcfb/tz/202311/t20231110_1361897_ext.html; '国家发展改革委有关负责同志就建立煤电容量电价机制答记者问 [Q&A with NDRC officials regarding the Notice on Establishing a Coal Power Capacity Price Mechanism],' National Development and Reform Commission, 10 November 2023, at https://www.ndrc.gov.cn/xxgk/jd/jd/202311/t20231110_1361904.html.

- Monthly payments will be reduced if coal plants are unable to operate at maximum capacity when dispatched. The penalty begins at 10 per cent reduction on the first instance, rises to 50 per cent on the third instance, and to 100 per cent on the fourth. If a plant was penalized to the 100 per cent level on three months in a calendar year, it will no longer qualify for payments.

The new national policy applies to all provinces except those with a capacity mechanism already in place, which currently includes only Shandong. In 2020 Shandong instituted a flat per-kWh payment to coal plants, which it describes as a capacity payment, and it subsequently extended the policy for several years.[42] The national coal plant capacity payment resembles the Shandong design in that it applies only to coal plants, and is set administratively; it differs in that it is based on capacity and not on electricity generated.

To date, the idea of a capacity mechanism in China seems restricted to designing a system specific to coal-fired power capacity, aimed at solving the perceived problem of financial losses at coal plants. The special urgency to address the issue now likely relates to the pressure to ensure that provincial policy-driven mandates to add more coal for energy security do not worsen the financial position of the major power sector players. There has been little discussion of technology-neutral capacity markets that could include energy storage, demand response, or renewables paired with storage. Similarly, there are no capacity mechanisms that include payment for performance—that is, scoring fast-response technologies such as batteries more highly than slow-responding thermal plants. The justification for excluding other technologies from capacity payments is straightforward: these alternatives are promoted or supported via other policies, such as mandates for new renewables to include storage, or ancillary service payments for peak shaving. This practice of having one policy for each problem facilitates compartmentalization, but hinders integration of different markets.

Notably, the plan for a coal-only capacity payment mechanism does differ from the language of the NDRC's document calling for a national power market blueprint by 2025, which seemed to envision a more flexible, market-oriented design for such a capacity mechanism:

> Establish a cost recovery mechanism for power generation capacity based on local conditions. Guide various regions to establish a market-oriented power generation capacity cost recovery mechanism based on actual conditions, and explore various methods such as capacity compensation mechanisms, capacity markets, and electricity scarcity prices to ensure fixed cost recovery of power sources and long-term power supply security.

The new capacity payment for coal power has major implications for market reforms. The segregation of MLT contracts, spot markets, and ancillary services markets already hinders the ability of market prices to convey investment signals. A flat capacity payment made only to coal plants could further reduce the role of markets relative to administrative planning, distorting the prices coal plants bid into the MLT and spot markets (due to increased willingness to bid below operating cost), and could exacerbate the potential for the current boom in coal plant construction to create systematic overcapacity at the regional and provincial levels.

The new capacity payment policy mentions markets only indirectly. In the NDRC's explanation of the policy, officials state that the capacity payment will be paid by industrial and commercial electricity consumers, but that electricity prices will not necessarily rise: 'Since the establishment of a coal power

[42] Shandong initially adopted its capacity payment system in 2020. See "山东省发展和改革委员会关于电力现货市场容量补偿电价有关事项的通知 [Shandong DRC Notice on Electricity Spot Market Capacity Compensation Price," Shandong DRC, 2 June 2020, at http://www.shandong.gov.cn/art/2020/6/2/art_107851_107306.html; '全国首个燃煤机组容量电价补偿机制得以验证, [China's first coal-fired unit capacity electricity price compensation mechanism has been verified],' China5e, 28 June 2020, at https://www.china5e.com/news/news-1090489-1.html. For the 2022 adjustment, see '山东：2023 年电网代购电取消峰谷电价！支持新能源与储能联合体参与电力市场！ [Shandong: In 2023 grid companies will cancel time-of-use prices! And support new energy and battery participating in power markets],' Energy Trend, 25 October 2022, at https://www.energytrend.cn/news/20221025-112297.html.

capacity price mechanism is mainly about the adjustment of the electricity price structure, the overall price level of coal power is basically stable, especially the slight decline in electricity prices, which will drive other power sources such as hydropower, nuclear power, and new energy to participate in market transactions. Some electricity prices will follow.'[43]

Although this wording stops short of guaranteeing that electricity prices will decline, the expectation is clear: industrial and commercial customers will pay for the coal power capacity costs, and this will be compensated by lower prices paid to other generation sources.

Policy changes could eventually squeeze renewables and gas

A flat subsidy to coal power will have the potential to substantially improve the long-term economics of coal with respect to renewables, raise the total revenue of coal generators, and further distort the incentives provincial officials face in approving local coal investments versus opting for increased electricity trade at the inter-provincial and inter-regional levels. Overinvestment in coal ultimately raises the cost of the power system for users, relative to other solutions for integrating a high proportion of renewable energy, and provides a rhetorical base for constraining renewables under the theory that the energy transition is 'too costly'.

Up to now, increasing coal capacity has not apparently affected other competing technologies. Curtailment of wind and solar peaked in 2016, after which administrative incentives and provincial mandates essentially resolved a problem many had earlier argued was due to physical constraints or the geographic location of renewables. While China's wind and solar share in the power mix is still low, overcapacity will increase pressure to uphold low-cost contracts with coal generators—providing them with needed revenues by dispatching them ahead of alternatives such as renewables or gas. In the past, provinces with excess coal capacity have sometimes restricted new wind and solar additions. A similar process could happen for future gas-fired power investments.

New sensitivities on climate

One consequence of the turn back to coal has been an increase in international media attention and diplomatic criticism outside China. The gradual decline of new coal power projects outside China, combined with China's own decision to wind down further investments in coal abroad, has made China more of an obvious outlier. Policy makers within China view such critiques as unfair and unjustified, and increasingly view China's domestic climate and energy policies as a sensitive topic. In August, the NEA's top administrator published a speech on national security, in which he particularly warned against the dangers posed by foreign criticism of China's energy policies:[44]

> The task of promoting carbon peak carbon neutrality is arduous. Some contradictions and problems in the development of energy transformation are often the focus of foreign hostile forces wanting to steal and attack. They are keeping a close eye on China's energy sector, stepping up the collection of various data and information in order to distort and slander China's energy strategic planning, transformation and development, and interfere with our hard-won security and stability.

[43] '国家发展改革委有关负责同志就建立煤电容量电价机制答记者问 [Q&A with NDRC officials regarding the Notice on Establishing a Coal Power Capacity Price Mechanism],' National Development and Reform Commission, 10 November 2023, at https://www.ndrc.gov.cn/xxgk/jd/jd/202311/t20231110_1361904.html.

[44] John Kemp, 'China calls for more secrecy on sensitive energy issues,' Reuters, August 2023, at https://www.reuters.com/markets/commodities/china-calls-more-secrecy-sensitive-energy-issues-2023-08-16/; original speech text has since been removed from the Internet.

Prior to the speech, China's new national security law had already had a seriously chilling effect on data sharing and discussion of various industry trends or policy topics.[45] It seems inevitable that warnings regarding any criticism of 'China's energy strategic planning' serving the interests of 'hostile foreign forces' will make it more difficult—inside and outside China—to study and evaluate China's low-carbon energy transition, as more such policy discussions move behind closed doors.

Summary and conclusions: Transition on track, but risks increasing

With the end of summer and the return of better hydropower conditions, China may be past the worst in terms of risk of outages and resulting concerns around energy security. China's wind and solar capacity is expanding at a record rate, and there is little sign that national policy makers are seeking to slow the renewables build-out.

Yet the boom in coal construction, combined with slow progress on inter-provincial power trading and spot markets, and the introduction of a capacity payment aimed solely at coal, loom as clouds along the horizon of the power sector's low-carbon transition. There is limited appetite for dramatic reforms that would shift the incentives of local officials away from coal, and this raises the risk that the coal build-out will eventually begin to affect both investment in new renewables and other cleaner energy sources, and the dispatch of the power system. Coal overcapacity, combined with policies to shift more financial resources to coal plants, ultimately risks slowing the energy transition and resulting in more carbon emissions than would have been strictly necessary or economically justified under a different approach.

While central government plans clearly presage an ultimate turn towards a greater role for markets, and an eventual increase in inter-provincial trading under a modern power system, it is not clear whether the top policy makers envision markets playing a significantly greater role than they do at present. The current circumstances appear likely to increase the role and importance of both administrative planning and short-term policy decisions, in favour of preserving the 'old' while building the 'new'.

In terms of China's overall climate objectives, renewable additions and their successful integration into the power system to date imply that China is still quantitatively on track to achieve the necessary amount of clean energy capacity necessary to achieve a 2030 carbon peak and mid-century carbon neutrality. Given recent hydro shortages and power outages in 2021 and 2022, officials appear to accept more coal as the main solution to energy security concerns. This does not necessarily mean delaying the country's climate targets. Explicitly announcing such a change would appear politically unacceptable. But current developments raise new risks of not meeting the country's climate objectives and will increase economic pressure, especially at the local level, to postpone any increase in climate policy ambition.

[45] Alex Pavevski, 'China's new anti-espionage law is sending a chill through foreign corporations and citizens alike,' The Conversation, 27 September 2023, at https://theconversation.com/chinas-new-anti-espionage-law-is-sending-a-chill-through-foreign-corporations-and-citizens-alike-212010.