RAP®

June 2019

Strategies for China to Reduce the Risk of New Coal Power Plant Investments

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In May 2019, China's National Energy Administration (NEA) loosened restrictions on new coal power plant construction, giving eight provinces the green light to build new coal-fired generation capacity.[1] The NEA created these restrictions in 2016 to limit investments in new coal power generation in view of overcapacity, poor economics and air quality concerns. Since 2016, there had been an almost outright ban on new construction.[2]

Because of the increasingly uncertain value proposition of new coal power generation, even investments that pass the NEA's three-pronged warning system may not be in China's long-term national interest. New investments in coal generation capacity create several risks:

- *Asset risk* — the risk that new investments in baseload coal generation capacity will be underutilized and uneconomic as demand growth slows, as China moves to competitive wholesale markets, and as the costs of solar and wind generation and energy storage continue to fall.
- *Institutional risk* — the risk the new coal investments will create further entrenched interests and delay the transition to the clean, efficient and competitive electricity sector envisioned in "Document 9" (2015), the State Council's vision for the current round of electricity reforms.
- *Environmental risk* — the risk that building new coal generation capacity will slow or even reverse progress toward regional air quality improvements.

[1] More specifically, the NEA gave eight regions a "green" rating on all three of the metrics listed in footnote 2. These regions include Western Inner Mongolia, Northern Hebei (non-critical air quality areas), Shaanxi (non-critical air quality areas), Hubei, Hunan, Chongqing, Guangdong and Hainan. Three provinces (Liaoning, Henan and Fujian) were given a mixture of green and orange ratings. See NEA. (2019). *Coal Planning and Construction Risk Warning System for 2022*《2022年煤电规划建设风险预警》. Retrieved from http://zfxxgk.nea.gov.cn/auto84/201904/t20190419_3655.htm.

[2] These restrictions are determined by an annual warning system known as the Coal Planning and Construction Risk Warning System (煤电规划建设风险预警). The warning system is based on three metrics: "economic warning" (经济性预警), based on rate on equity return; generation adequacy (装机充裕度), based on reserve margins; and resource constraints (资源约束), based on air quality and other metrics. For each year, the metrics used in the warning system apply to coal generation investments that come online three years into the future (e.g., the year 2019 report evaluates metrics in 2022), assuming a three-year construction phase for new coal units.

These risks can be reduced by strengthening existing measures and continued implementation of existing policy directions in three areas: (1) electricity planning and investment, (2) electricity markets and (3) environmental regulations.

Electricity Planning and Investment

Moving toward comprehensive generation planning. Even as it loosened restrictions on new coal generation investment, the NEA encouraged provinces to prioritize non-coal resources in meeting demand growth.[3] In many provinces, it may be possible to cost-effectively meet growth in demand with new renewable generation and energy storage, given recent cost declines and performance improvements for these resources. However, China's existing investment planning and decision-making processes are still oriented around coal generation and are not set up to facilitate least-cost investments in non-coal resources. China has the planning tools and expertise to plan for an electricity system that is increasingly less reliant on coal generation, but it does not appear that they are actually being used in investment planning and decision-making. In 2016, the NEA released electricity planning guidelines that underscored the critical role of comprehensive planning.[4] Implementing these guidelines and encouraging and supporting provinces to meet international standards for electricity planning would set a more equal investment playing field and significantly reduce the risks of new coal investment.

Incorporating risk management into generation planning. Both the NEA's warning system and electricity planning analysis in China more broadly rely on point estimates. In a world of uncertain electricity demand growth and rapidly changing costs, this approach unnecessarily shifts risks from producers to consumers and raises long-term electricity costs and, ultimately, prices. There are multiple tools that planners in China can draw on — from scenario analysis to option value analysis — to better incorporate risk management into generation planning. Doing so would reduce the risks of overinvestment in coal generation due to demand forecast error or poor economics.

Supporting investments in energy efficiency and demand response. For provinces where electricity demand is outpacing available supply — primarily in China's north, central and eastern grid regions[5] — investments in energy efficiency and demand response are likely to be a lower cost, lower risk option than investments in new supply. Energy efficiency investment in China has historically focused on industry and transportation but is now in transition, as electricity demand growth shifts from heavy industry to information technology, services and residential users. More effort is needed on demand-side management for these "smaller size" end users. Several provinces have made investments in demand response infrastructure, but lack business models for a creating a self-sustaining industry. For both energy efficiency and demand response, some degree of policy support is likely needed to help create new business models for equipment manufacturers, energy service companies and load serving entities.

Clarifying the link between investment planning and wholesale markets. With a recent policy push to move the majority of industrial consumers and coal generators to bilateral contracts and the push to

[3] NEA (2019).

[4] NEA. (2016). *Methods for Managing Electricity Planning*《电力规划管理办法》. For more discussion, see Dupuy, M. and Xuan, W. (2016). *Excess Coal Generation Capacity and Renewables Curtailment in China: Getting With the Plan*. Retrieved from https://www.raponline.org/blog/excess-coal-generation-capacity-and-renewables-curtailment-in-china-getting-with-the-plan/

[5] Several provinces in these regions received "green" scores under the generation adequacy indicator in the NEA's warning system.

develop spot markets, responsibilities for planning and investment decision-making need to evolve. Clarifying responsibilities in the context of new markets would help to ensure that planning and investment decision-making is constrained by reliability and environmental obligations and allocates investment risk to where it can be most effectively managed. In thinking through how planning and markets should intersect, experience from the U.S. — such as California's statewide integrated resource plan — may be a useful reference.[6]

Electricity Markets

Moving ahead with implementation of practical and effective market designs. Electricity markets can be an important part of the package of strategies to reduce the risks associated with coal power investment. However, designing and implementing these markets is a complex undertaking and there are many junctures at which entrenched interests can obfuscate or undermine the process. The best course will be to avoid distractions regarding the finer details of market models from other parts of the world and, instead, put practical and workable market models into place that fit China's institutions and conditions. It will then be possible to develop more complex and refined market designs over time. The analogous independent system operator and regional transmission organization markets in the United States first began to operate decades ago, but various market design details are still subject to intense debate. Any initial market design in China should focus on supporting economic dispatch and sending better price signals for investment (and retirement) choices. In addition, it would be worthwhile considering a "plan B" to support these outcomes of better dispatch and investment, should the spot market effort bog down in all or parts of the country. This plan B could include more limited administrative efforts to reform generator dispatch and compensation.[7]

Requiring all coal units to be "in the market." Historically, coal generators in China received guaranteed operating hours through an annual planning process, with all generators receiving roughly the same number of hours. This approach led to higher operating costs, as inefficient units operated the same number of hours as more efficient ones. It also socialized some of the investment risk for coal generators, by providing units that would otherwise operate in a smaller number of hours with a minimum number of operating hours. The shift to bilateral contracts was intended to "unwind" this operating hour planning process and remove guarantees for coal generators. Following through on the goal of moving all coal generation to bilateral contracts would help to better internalize investment risks for generating companies. Requiring coal generators to participate in spot markets would also help to better internalize fuel and operating cost risks.

Allowing non-thermal resources to participate on a level playing field in wholesale markets. Initially, most provincial medium- and long-term markets and spot markets have limited market participation to thermal resources, at least initially, while nodding to the notion that renewable energy will be subject to "priority dispatch." Implementing more explicit market rules that require equal treatment among all resources – including renewable energy, storage and demand response – will help to support lower-cost and reliable alternatives to coal. In the case of renewable energy, priority dispatch has been a legal and policy requirement for many years but has never been comprehensively

[6] For more on California's statewide IRP, see https://www.cpuc.ca.gov/irp/. Also see RAP, NRDC. (2017). *Power Sector Planning: US Experience and Recommendations for China*. Retrieved from: https://www.raponline.org/knowledge-center/power-sector-planning-us-experience-and-recommendations-for-china/

[7] See Dupuy, M. (2019). *Comments on National Energy Administration's "Advancing Electricity Spot Market Implementation*. Retrieved from https://www.raponline.org/knowledge-center/comments-on-national-energy-administrations-advancing-electricity-spot-market-implementation/ Also see: RAP, NRDC. (2017). *Electricity Wholesale Markets: US Experience and Recommendations for China*. Retrieved from https://www.raponline.org/knowledge-center/electricity-wholesale-markets-us-experience-and-recommendations-for-china/

implemented or enforced. Allowing renewable energy to participate fully in the spot and medium- and long-term wholesale markets should have the effect of bolstering the implementation of priority dispatch. That is, wind, solar and run-of-river hydro all have near-zero operating cost and should thus tend to be dispatched in a priority manner in any reasonably well-designed market. In addition, it will be very important to create integrated markets with wide multiprovincial footprints to facilitate the displacement of coal by low-cost renewable energy from other provinces. All of this would help to strengthen the business model for renewable energy and energy storage as an alternative to new coal investments.

Environmental Regulations

Enforcing existing emissions standards for coal units. In 2015, China's Ministry of Ecology and Environment issued a standard that required all "retrofittable" coal units to meet "super low" emission standards for sulfur dioxide (SO_2), nitrogen oxides (NO_X) and particulate matter (PM) by 2020.[8] Meeting these standards, which are comparable to those for natural gas units, requires pollution removal efficiencies that are much higher than what has been commercially available in, for instance, the United States. National policy support in China has led to significant investments in pollution control equipment for coal power plants, with dramatic reported reductions in emissions of all three pollutants.[9] However, empirical evidence suggests that there is a discrepancy between reported and observed emissions.[10] Better enforcement of emissions standards for coal generators would reduce inaccurate reporting by coal generators and help to meet air quality standards, which are based on measured concentrations rather than reported emissions. It would also reduce the risk that new coal plants that are non-compliant suddenly become uneconomic when they are forced to comply with emissions standards.

Moving forward with CO_2 pricing. China plans to implement a national cap-and-trade system for CO_2 beginning with the electricity sector in 2020. CO_2 prices that are meaningfully high can provide a powerful signal for both the operation of the electricity system and investment in new generation. As a guide for investment, CO_2 prices may not need to be that high to meaningfully tilt investment away from coal, given recent declines in costs for solar and wind generation and battery storage. For instance, a 50 yuan/tCO_2 cost (US$7/$tCO_2$) will add around 40 yuan/MWh to the operating cost of a new coal generator.[11] Having at least some cost signal will help to reduce the risk of having too much new coal generation capacity come online, relative to China's longer term energy and climate policy goals.

[8] More specifically, retrofittable (具备改造条件) units should meet emissions standards of 10, 35, and 50 mg/m^3 for PM, SO_2, and NO_X. See MEE, *Workplan for Implementing Super Low Emission Standards for Coal-Fired Power Plants* 《全面实施燃煤电厂超低排放和节能改造工作方案》. Retrieved from http://www.mee.gov.cn/gkml/hbb/bwj/201512/t20151215_319170.htm

[9] See, for instance, Ding Yiting. (2018. "Coal Can be Low Emissions" (煤炭也能烧出低排放). *People's Daily*. Retrieved from http://env.people.com.cn/n1/2018/0409/c1010-29913123.html.

[10] Karplus, V., Zhang, S., and Almond, D. (2018). Quantifying coal power plant responses to tighter SO2 emissions standards in China. *Proceedings of the National Academy of Sciences*. 115: 7004-7009. Retrieved from https://www.pnas.org/content/pnas/115/27/7004.full.pdf

[11] Assuming an emissions intensity (rate) of 0.8 tCO_2/MWh, which using a coal emissions factor of 2.7 tCO_2/tce, is equivalent to a net heat rate of around 300 kgce/MWh.