



Creating Markets for Wind Electricity in China: An Analysis of Grid and Institutional Causes of Curtailment

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China has the world's largest installed renewable energy capacity and has adopted many policies to support renewable energy, Environment and Natural Resources Program Fellow Michael Davidson said on Monday, speaking at the HKS Energy Policy Seminar. However, Davidson, observed, curtailment rates for China's renewable resources are "astronomical," compared with many other countries, resulting in the burning of many additional tons of coal and the release of many more tons of CO₂ when coal generation is used while wind, solar and hydro energy is curtailed.

Why does this happen in China, despite policies to promote renewables, including policies giving renewable generation dispatch priority? Factors identified by other researchers, Davidson noted, include lack of adequate transmission capacity, an inflexible mix of fossil fuels and cogeneration, and preferential policies for coal generation.

Electricity systems in China are managed at the provincial level, so Davidson's research focused on better understanding the curtailment dynamic through case studies of four Chinese provinces, conducting interviews, reviewing archival materials and developing a grid operations model to test the impacts of different institutions and technical factors. In addition to the already recognized impacts of inflexible generation and limited transmission, Davidson identified some structural challenges contributing to curtailment.

One such challenge was in scheduling power through long-term contracts. Wind and solar have "priority dispatch" in China—but a great deal of dispatch is committed ahead of time to conventional plants (primarily coal and nuclear), who are guaranteed annual minimum generation and run at "minimum output" levels that are not strictly technical limits. Provincial governments play some role in influencing these arrangements, and their primary interest may be in minimizing electricity prices for local industry, not in maximizing dispatch of wind, Davidson noted. New markets, mostly replacing minimum guarantees with contractual requirements, do not reduce the impact of this commitment scheduling on renewable energy.

In addition, Davidson observed, it is difficult to trade wind electricity across provinces, as there are strict limits on the amount of energy that can be traded—the expectation is that most provinces will, in general, meet their own electricity needs, and it is difficult for exporting provinces to change cross-border flows on timescales important for wind and solar variability.

Different provinces in China are experimenting with market mechanisms intended to help manage curtailments, Davidson noted. In the Northeast, a "peaking" market is being tried that allows plants to be paid to reduce their output below the contractual "minimum" level, theoretically opening more room for wind and solar when surplus electricity is available. However, Davidson said, the overall impact of such a market on renewables may be at best mixed, as the costs of this market fall disproportionately on renewable energy—in other words, renewable energy generation must pay coal and/or nuclear to produce less.



Davidson also examined the implementation of a day-ahead electricity market in Yunnan province. There, a day-ahead market has been established; however, this market is still relatively small compared to the amount of electricity generation dispatched through long-term contracts, and due its particular design does not create an appropriate scarcity signal in the market, Davidson said.

What might be done to reduce curtailment in China? Davidson focused on three possible measures: limiting long-term physical contracts to allow more room for renewables; limiting provincial authority over energy markets; and easing rules over inter-provincial trading, suggesting that perhaps the last of these offered the best combination of feasibility and potential impact.

Davidson spoke as part of the Kennedy School's Energy Policy Seminar Series, which is sponsored by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government.