Interactions between market reform and a carbon price in China's power sector

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Executive summary

China is intent on limiting and reducing greenhouse gas emissions, and the electricity sector is the largest contributor to China's energy related emission. Whether or not China can decarbonize its power sector will matter greatly for the national emissions trajectory. The power industry has been included in China's regional pilot emissions trading schemes and is also slated for inclusion in the planned national emissions trading scheme. Different from other jurisdictions that have ETS or carbon taxes that cover the power sector, China's electricity sector however is not liberalized and retail price is still largely under regulation. Thus, the effectiveness of China's ETS will in part depend on the nature and extent of electricity sector reform, as well as the interaction between electricity reform and the design of the ETS.

This paper analyzes aspects of the interaction of the two elements of energy and climate policy in China, through qualitative assessment of the interaction and the functioning of China's electricity system, and through a preliminary quantitative assessment of selected aspects of electricity market reform and carbon pricing. We lay out three possible channels for effects and interactions of carbon pricing and electricity market reform: incentives for lower-emissions investment in power supply, changes in the merit order (the ordering in which power plants are dispatched for production) of electricity dispatch, and reduction in electricity demand in response to higher electricity prices. Moving from a regulated electricity system to a market-based system will usually affect the electricity supply mix as well as the amount of electricity used, and with it emissions.

Whether power market liberalization in itself increases or decreases emissions depends on the particular circumstances. China's electricity sector is still largely under a regulated price and operating with an "equal generation hour" dispatch rule which prescribes similar annual generation hours of similar kinds of generation units in each province.

To understand the interaction between the carbon pricing and electricity market reform in China, we use a logit model to represent the choices among various generation technologies to produce electricity. We consider four scenarios for the impact of market reform and introduction of a carbon price in China's electricity sector. A base case scenario where there is no carbon price in the electricity sector and the "equal generation hours" dispatch rules remain; a market reform scenario which assumes the power market will be liberalized in the year 2020 and that energy saving generation dispatch will be introduced, where the merit order is renewables, nuclear, cogeneration, natural gas, coal and oil generators; a carbon price scenario assuming a low to moderate carbon price of 25 RMB/tCO2 (around USD3.6/tCO2) in the year 2020, and increasing

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by 8% per year from 2020 to 2040; and a combination of market reform and ETS, where the power sector will be liberalized in year 2020, together with a carbon price.

Our analysis indicates that if China can successfully liberalize its power market by shifting dispatch rules from "equal generation hours" to energy saving dispatch, then the share of non-fossil fuel generation can be increased to 34% in 2020. A carbon price starting at 25 tCO2 and without market reform would achieve a 30% share, only marginally higher than in the reference case. The reason is that the introduction of a carbon price does not change the merit order for generators. Both options are consistent with the national target of 15% non-fossil fuel in primary energy at 2020. For 2030 however, a low to moderate carbon price or market reform individually would not be enough to achieve the 2030 target for the share of non-fossil fuel generation; a combination of the carbon price and market reform however would achieve the goal. We also estimate that without market liberalization, in 2030 a carbon price needs to be twice as high than if a carbon price is applied with market reform, in order to achieve the same level of non-fossil fuel generation. We estimate that without further policy interventions, the future decarbonization rate in China's electricity supply would reduce to around 1% per year. By combining market reform and a carbon price, we estimate that the decarbonization rate in electricity supply can be raised to 3.5% per year in 2030.

To achieve significant change towards lower-carbon electricity generation using market instruments, it is necessary to incentivize more investment in low carbon generation technologies and to reduce the utilization hours of fossil fuel generating units. A combination of market reform and a moderate carbon price is likely to be the most effective and arguably most feasibly policy package to cut emissions in China's power sector. The design of an ETS can address the transitional impact on generators' profitability caused by the change of dispatch rules and introduction of carbon price.

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