Challenges for Getting the Prices Right in PJM's Wholesale Electricity Markets

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Electricity markets could benefit from a "more effective invisible hand," according to Hung-po Chao, Senior Director and Chief Economist for the PJM Interconnection, speaking in Monday's energy policy seminar. (Link to Chao's presentation.) In his talk, Chao presented an overview of the PJM system operator's proposal for enhancing price formation in the world's largest electricity market, proposed changes to its approach to pricing electricity to better reflect the costs of all resources needed to serve load. The intention, Chao said, is to "improve market efficiency and resilience to advance social and policy objectives," making changes that may be especially valuable in a market in which zero-marginal-cost renewables are increasingly available for dispatch.

Chao explained that, among market-traded commodities, electricity is unique in its need to maintain a constant balance between supply and demand. For this reason, system operators such as PJM are needed to govern the dispatch of electric generation plants, balancing available generation with demand at all times. Nonetheless, a market approach to pricing "has worked successfully for twenty years," Chao said.

Chao presented a thumbnail example of current dispatch and pricing methods and of the problems that can occur when they are applied to lumpy, inflexible resources. In an ideal world, the system operator would dispatch generation smoothly, starting with the cheapest resource and including more expensive resources until demand would be fully met (after considering constraints imposed by the transmission system and generator constraints such as minimum run times), with all generation paid at the price of the most expensive resource dispatched. The system needs are served at the lowest possible cost, and no generation has an incentive to bid manipulatively—each unit receives the greatest possible profit by bidding in a way that honestly reflects its costs and running constraints, while consumers benefit from market-driven innovation and operational efficiency that keep the lights on for all times at the lowest possible prices.

In reality, this ideal market situation does not always exist, Chao explained, and this can lead to some inefficient results. If the next-cheapest unit available to the system operator is lumpy and inflexible, and dispatching it would result in over-production of electricity, Chao said, the system operator may have to skip up to a more expensive flexible resource in order to perfectly match demand. The result is a higher price overall, and (more problematically) lumpy skipped-over resources that have an incentive to manipulate the bidding system (for example, by claiming a longer minimum run time) to ensure they are deployed and receive that tempting price. Although the manipulative bids may be rational for each individual actor, collectively, they can result in collapsing prices that must be corrected through out of market payments (or uplift)—leaving the system trapped in a kind of "prisoner's dilemma" that benefits neither consumers nor generators.

The potential for these kinds of problems to exist has been known since the beginning of markets, Chao reported, but they were long thought to be a "minor, theoretical deviation," not a real threat to market performance. This may be changing, however, as the lumpy resources are pushed up the dispatch order by zero-marginal-cost

renewable energy and other changes, putting them at the margin more frequently. PJM does not know for certain how much market distortion has resulted, Chao said, but indications of the influence of these kinds of imperfections can be seen in certain counter-intuitive market developments—for example, prices falling as demand increases, or large numbers of generating units "self-scheduling," indicating they plan to run at any price, rather than submitting a price-based bid.

PJM's proposal, Chao explained, one that builds on the Extended Locational Pricing (ELMP) approach, leaves existing dispatch processes in place, but would add a separate "pricing run" intended to optimize prices and their incentive effects by using a mathematical technique called "integer relaxation" to simulate a smoother, less lumpy dispatch, in a way that will "allow prices to reflect the costs of all resources needed to serve load." If this works properly, Chao said, it should improve market transparency, reduce cost shifts to capacity markets, improve scarcity pricing, and improve incentives for investment, demand participation, and system reliability.

Chao 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 and by the Belfer Center for Science and International Affairs.