Michael Wara posted previously about Rick Perry's proposal to subsidize coal and nuclear. In its current incarnation, the proposal is aimed purely at ISOs and RTOs that operate capacity markets, which largely means a single entity, PJM. Why the focus on PJM? Oh, I guess I had better explain.

OK, to start with, what did that sentence about ISOs mean? Here's a glossary:

ISO means independent system operators, which run areas of the national grid, including operating markets for interstate electricity sales.

RTO means regional transmission organization, which is essentially the same thing as an ISO. PJM is an RTO.

Capacity markets are markets that essentially sell options to buy electricity in the future, so in case of need the buyer has an assured source of supply.

PJM was named for Pennsylvania, New Jersey, and Maryland, but now covers a territory that goes more or less from Pennsylvania down to Maryland and west to Chicago, with some gaps along the way. One reason for the focus on PJM is just that it manages 60% of the nation's electricity supply. So what happens in PJM is really crucial.

In 2005, PJM got 90% of its power from coal and nuclear. A decade later, their share was down to 60%. As of 2015, PJM got the bulk of its power from coal (40%), nuclear (19%), and natural gas (29%). Most of the rest is oil, diesel, or hydro. Wind has been a tiny factor, and solar was only 2%. The energy mix is continuing to change: 38% of the planned new capacity in 2015 was natural gas, 39% was nuclear, and 6% was coal, just slightly above solar.

Not only has natural gas expanded rapidly, but use of coal is contracting. According to the newsletter Utility Dive,

"[B]etween 2010 and 2016, coal generation accounted for 79% of retired capacity while gas-fired generation and renewables accounted for 87% of new capacity that came online. In 2016, PJM's installed capacity consisted of 33% coal, 33% gas, 18% nuclear, and 6% renewables (including hydropower)."

PJM concluded in March 2017 that these changes did not threaten reliability and that it could absorb up to 20% renewable energy without problems. That leaves a lot of room for expansion, considering the current PJM figure for wind and solar is

more like 3%.

This brings us to the polar vortex. Unusual weather conditions (possibly linked to climate change) resulted in an unexpected surge in demand for power for heating during the winter of 2014. PJM had record winter power demand, leading it to ask generators to be prepared to operate at full capacity, appeal to consumers to reduce electricity use, and implement some emergency procedures. In the meantime, 20% of PJM's generators were down for a range of reasons: high gas prices due to demand for natural gas for heating, frozen gas pipelines, frozen coal stacks, and diesels that couldn't operate at low temperatures. Nevertheless, the grid did manage to cope with the situation.

The polar vortex problem surfaced some problems with PJM policies. PJM made major changes in its capacity markets because the existing scheme didn't provide strong enough incentives for generators to comply with their obligations (and thus not enough incentives for them to plan for reliability).

And now, back to Rick Perry. The rationale for his coal-subsidy proposal was that coal plants are needed to deal with unexpected events like the polar vortex. PJM opposed the Perry plan as unworkable and an unwarranted interference with electricity markets. PJM has proposed a plan of its own to deal with periods of energy shortage. Reading the plan was enough to convince me of the limits of my understanding of grid operation. For instance, I have only the vaguest idea of what the proposal means when it says:

"The extended LMP method with integer relaxation is a natural approximation to the minimum-uplift method based on convex hull relaxation."

However, I do think I can explain what's going on at a more general level. (Warning: even this general explanation gets very wonky.) The pricing model now used by PJM doesn't include bids for inflexible units like base-load plants (coal and nuclear) since they're on all the time anyway. But their costs may be above those of renewable sources whose bids set the price. Ideally, the base-load plants should partially reduce their output to make way for the renewable plants, but they can't – essentially, they can only be shut down or operate at full capacity. This means that the base-load plants aren't compensated for their expenses and have to get compensation (called uplift fees) outside the bidding system. Besides being an awkward solution, the uplift fees also apparently provide an opportunity to game the system.

PJM wants to use a pricing model that takes the all-or-nothing feature of these plants into account more directly by including their bids and letting them set the price under some circumstance. Of course, this also increases revenues for large, potentially inefficient generators and helps them keep running longer.

All of this sounds plausible enough, to the extent I understand it. But there are some questions that aren't fully addressed in the proposal. First, it isn't clear how serious this problem is. Inflexible generators like coal get fully compensated for their costs when renewables are temporarily off-line and they get over-compensated for their costs during peak periods when prices are set by flexible gas units rather than renewables. We're not told how often the system is in the intermediate state where solar or wind but not higher-cost flexible resources (like some natural gas plants) are used. Second, it appears that other grid operators haven't adopted this approach. PJM says it is different from the other SROs/ISOs because more of its power comes from inflexible sources. This again sounds plausible in the abstract, but the proposal doesn't provide the numbers or explain why the magnitude of the differences is sufficient to justify a different approach. Third, the proposal addresses a static problem but doesn't address dynamic issues. The root of the short-run problem is that these units are often higher cost than renewable alternatives but the renewables aren't extensively available enough to displace them fully. In the long run, we would want to see lower-cost renewables displace some of the base-load units. The report on the proposal doesn't make it clear whether it provides the right incentives for that to happen.

What little discussion I've seen of this proposal suggests that, like Perry's program, it's designed to keep coal plants operating. I'm not sure that's fair since it does seem to be suggesting an actual defect in PJM's current system. But it's not really clear how serious the defect is, whether PJM's approach is the low-cost way of addressing it, or whether it has the long-term effect of propping up generators that ought to be shuttered. But if I had to choose between them, it seems clear that PJM's proposal is based on far more expertise than Perry's.