

PJM's Capacity Market: The Short Squeeze on Coal and Growing Opportunities for Battery Storage

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In February 2023, PJM finalized the results for its Base Residual Auction (BRA) for the 2024/2025 delivery year. Capacity prices in this auction fell to just under \$29/MW-day, the lowest since 2014, continuing a trend of declining prices exhibited in the past several BRAs. The auction's low prices indicate a healthy reserve margin across the Regional Transmission Organization (RTO), but they also obscure a looming challenge on the horizon for PJM: the need to potentially replace upwards of 40 GW of aging thermal capacity (mostly coal) over the next decade, especially as low capacity revenues drive inefficient units to retire.

As demand grows and new capacity resources are needed, the combination of an increasingly climate-oriented state policy landscape, standalone storage investment tax credit, growing renewable penetration, and expected cost declines will make storage resources the primary unit for new entry and the new price setter in the PJM capacity market.

What happened in the last capacity auction?

Lower prices in the recent auction are partly due to higher gas and power prices, which left generators with less revenue to make up in the capacity auction. The removal of the minimum offer price rule (MOPR) also put downward pressure on prices in the RTO by allowing resources that receive state subsidies to successfully clear into the market, increasing overall supply. In the first capacity auction after the MOPR change, the amount of nuclear capacity that cleared the auction increased by over 5 GW, which contributed to the decrease in capacity prices.

Despite lower overall capacity prices in PJM, **Figure 1** shows that some areas have significantly higher capacity value with regional constraints causing five Locational Deliverability Areas to clear at significantly higher prices

than the rest of the RTO. The Eastern MAAC region has been experiencing transmission constraints that have driven premiums in previous auctions. In the Delmarva Power South (DPL-South) region, fewer resources bid into the auction than PJM expected. The unexpected capacity shortfall and the subsequent unnecessarily high reliability requirement resulted in a sudden price jump, reaching \$90.64/MW-day. PJM appealed to the Federal Energy Regulatory Commission (FERC) to change its rules to allow it to lower an area's reliability requirement during an auction if generators do not bid into the auction as expected. FERC approved the change and PJM was able to revise the auction results, this time preventing prices in DPL-South from rising even higher to 'unjust and unreasonable' levels.

Lower auction prices increase the economic pressure on thermal generators and will drive thermal retirement. As low-cost renewables increasingly displace thermal generation and cause thermal capacity factors to decline, coal is particularly affected due to its high fixed costs.

While capacity prices can rise to meet these fixed costs, they will only increase to a level that supports more affordable resources such as gas plants and storage, which have better economics than coal under low capacity factors and volatile prices. **Figure 2** shows that the average cost of energy increases much more rapidly for coal than for other assets as capacity factors decline, illustrating the challenges of operating coal at low capacity factors. About 40 plants, or a quarter of PJM's current coal fleet, operate at capacity factors of 20% or below, accounting for about 26 GW of capacity. The average capacity factor for operating coal plants in PJM is around 46% but is forecasted to drop to just over 20% by 2030 as cheaper renewable energy enters the market. Falling capacity factors will further exacerbate economic pressure on coal.

Figure 1: February 2023 PJM capacity auction results (\$/MW-day) ¹

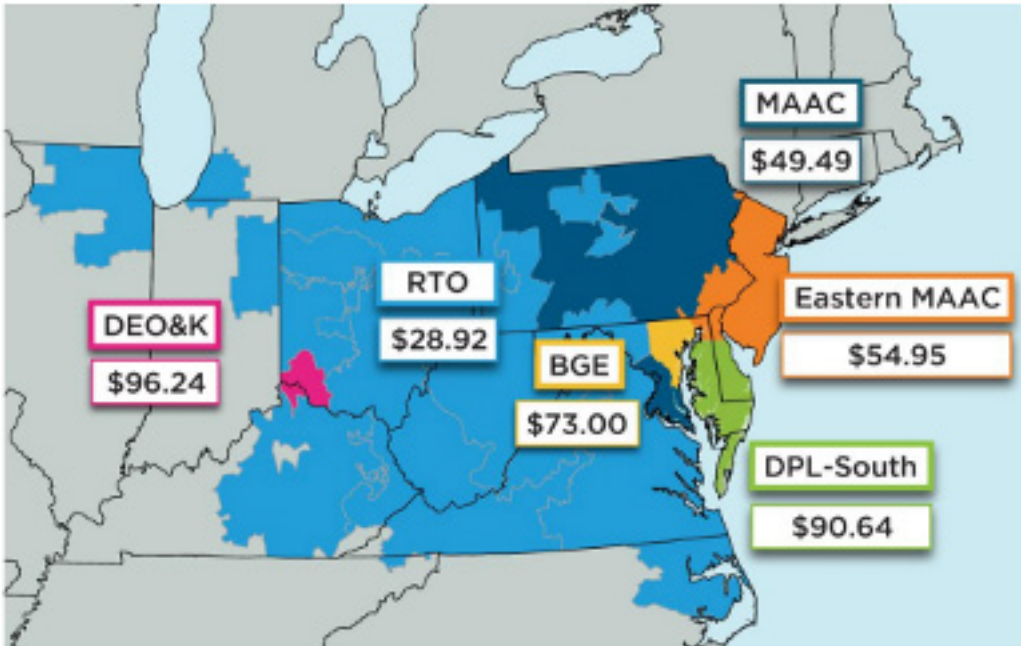
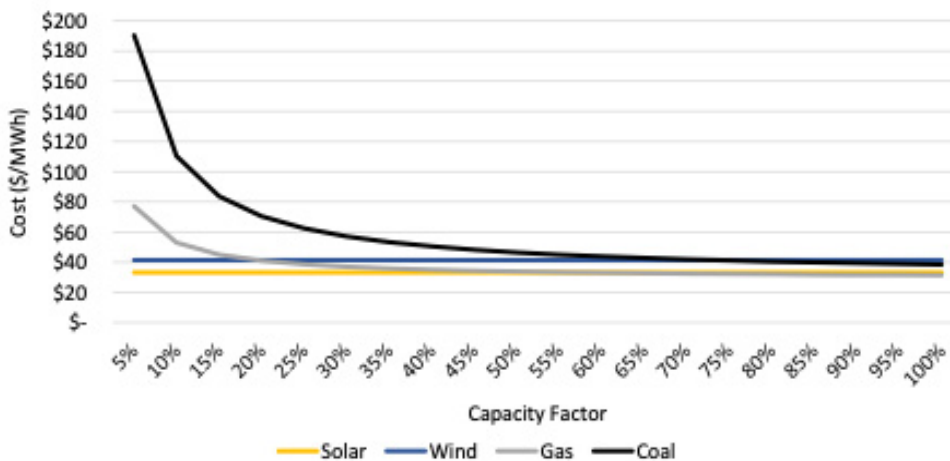


Figure 2: Average cost of energy as a function of capacity factor for different technologies. Solar and wind are held constant for comparison against thermal generation at different capacity factors



Non-performance penalties and risks are also weighing heavily on thermal finances, especially in light of low capacity prices. Winter Storm Elliott in December 2022 led to high demand and alongside 47 GW of expected generation experiencing forced outages - about a quarter of the system's generation capacity. Gas generators accounted for over 70% of the outages on that day, primarily due to equipment failure in the sudden cold.

Coal generators accounted for another 15% of outages. PJM's Capacity Performance rules charge non-performance penalties to generators that do not fulfill their commitments, and PJM currently estimates these charges at \$1.8 billion for the winter storm. These noncompliance penalties push net capacity revenues even lower, putting additional pressure on thermal generation with elevated outage risks during extreme weather events.

¹ [PJM Capacity Auction News Release](#)

² [Energy Transition in PJM: Resource Retirements, Replacements, Risks](#)

What will replace retiring thermal capacity in PJM?

Nearly 95% of incoming capacity in the interconnection queue consists of renewables and storage, while 40 GW of thermal assets – mostly coal – face the prospect of retirement over the next decade, with installed coal capacity having already decreased by about 20 GW since the BRA for the 2019/2020 deliverability year. Retirements at this scale, along with an increasingly weather-dependent power system, raise reliability concerns over the next decade. PJM also forecasts significant load growth over the next decade due to incoming data centers, government efforts to speed the electrification of buildings and transportation, and new incentives for domestic manufacturing. Interconnection queue delays compound these concerns, as the rate of new entry may not be sufficient to compensate for thermal retirements and expected load growth by 2030, as project completion rates continue to decline with surging queue volumes. As supply conditions tighten, capacity prices will have to rise to either keep current generation online or to incentivize new resource entry. PJM's interconnection queue is infamously backlogged, but the RTO recently received FERC approval for a plan to reform its queue process in a way that incentivizes preparedness and expedites new entry. As capacity prices and renewable penetration rise, conditions for new capacity will favor flexible resources like gas and storage.

The continued push for more ambitious climate and energy policy will necessitate a shift away from thermal capacity in several PJM states. While the current reference resource that determines the capacity price cap is a combustion turbine, the changing regulatory landscape and emerging economic conditions may soon necessitate a switch to storage as the reference resource. Growing renewable penetration will drive increasing price volatility

and provide batteries larger revenues from arbitrage opportunities in the real-time market. In addition, declining technology costs and the investment tax credit (ITC) for standalone storage in the Inflation Reduction Act will reduce the net CONE (Cost of New Entry) for storage. Under these conditions, it is likely that storage will become more competitive with gas and eventually supplant it as the marginal unit in the capacity market. In the meantime, thermal generation will effectively be playing a game of 'chicken' with each other, with capacity staying online in hopes of higher future capacity prices, but those prices are only likely to rise once thermal generation retires.

What remains clear is the prospect that 25% of PJM's system capacity may retire over the next decade, and expected renewables and storage additions will face challenges maintaining reliability during these retirements and load growth. While the pace of change presents concerns, if the system becomes tight, capacity prices will necessarily have to rise to cover the costs of constructing new resources or preventing existing resources from going offline. With this dynamic of tightening reserve margins advancing, storage resources stand to benefit and supplant gas as the new marginal capacity resource, benefitting from a combination of Federal and state policy support, increased price volatility from increased renewables, and nascent corporate demand for 24x7 carbon free energy.

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