

Introduction

2023 in Review

Reliability is a core goal of PJM. Maintaining and improving competitive markets should also be a core goal of PJM. The goal of competition in PJM is to provide customers reliable wholesale power at the lowest possible price, but no lower. The PJM markets have done that. The PJM markets work, even if not perfectly. The results of PJM markets were reliable in 2023. The results of the energy market were competitive in 2023. The PJM markets bring customers the benefits of competition when the market rules allow competition to work and prevent the exercise of market power.

The markets face a challenge from potentially high levels of expected thermal generator retirements, with no clear source of replacement capacity or the fuel required for that capacity. PJM and its market participants will need to continue to resist the temptation to turn to regulatory solutions based on cost of service rather than markets. PJM and its market participants will need to resist the temptation to try to become all knowing system planners, identifying in advance the exact asset value of every resource and deciding exactly where risks lie. PJM and its market participants will need to resist the temptation to try to define the correct market prices rather than creating a competitive design that permits market fundamentals to determine prices. PJM and its market participants will need to resist the temptation to permit market power to increase prices, rather than defining markets that permit competitive clearing prices.

FERC made an explicit decision to rely on competitive markets rather than traditional regulation to provide just and reasonable rates in PJM. Failing to effectively address market power means that competition cannot effectively replace traditional regulation and cannot result in just and reasonable rates. Competitive markets are not a luxury. Effective market power mitigation is a core part of competitive markets. The goal of competitive markets is reliable power at the lowest possible price. PJM has made proposals in both the capacity market and the energy market that would undermine market power mitigation.

Markets provide incentives for innovation and efficiency. Organized, competitive wholesale power markets are the best way to facilitate the least cost path

to decarbonization. Renewables can compete, without guaranteed long term contracts. New entrant solar and wind resources are now competitive with existing coal resources in PJM. The Inflation Reduction Act incentives further reduced the costs of these resources. Innovation will occur in renewable technologies in unpredictable and beneficial ways. But the PJM markets are not perfect. Significant changes to the market design continue, including some that improve markets and some that do not. Significant issues with the market design remain. It is not guaranteed that the market design will successfully adapt to the changing realities, including the role of renewable and intermittent resources, the role of distributed resources, the role of regulated EDCs in competitive wholesale power markets, and the role of states and the federal government in subsidizing resources and in environmental regulation.

While competitive markets are critical, markets alone cannot solve all the issues faced in the PJM wholesale power market. The wholesale power market exists in a broader environment including climate challenges, fuel supply issues and the wider economy that affects the demand for power.

One of the key challenges facing the PJM markets is the potentially high level of expected thermal resource retirements between now and 2030 with no clear source of replacement capacity. Although the exact numbers may vary, an estimated total of between 24,000 MW and 58,000 MW of thermal resources are at risk of retirement, including 4,285 MW of announced retirements, 19,635 MW of retirements as a result of state and federal environmental regulations, and 33,744 MW of retirements for economic reasons, based on expected forward prices.

All of the units at risk may not retire. The actual level of MW that will retire for regulatory and economic reasons is uncertain. The probability of retirement is highest for the units that explicitly plan to retire, very high for units expected to retire for regulatory reasons, and significantly lower for units identified as uneconomic. There is some uncertainty in each category and all of the decisions can be affected by the actions of environmental and economic regulators. If all or most of the retirements related to explicit plans, and related to environmental regulatory reasons, do retire, that will, holding other things constant, tend to increase both

energy and capacity prices. Higher market prices would reduce the MW identified as uneconomic. For example, a doubling of market revenues would reduce the units identified as uneconomic by 14,817 MW or 44 percent.

The level of potential retirements is not unprecedented. Retirements during the 13 year period from 2011 to 2023 were 54,219 MW, comparable to the level of potential retirements over the next seven years. However, the current challenge associated with replacing retiring capacity resources is different than the issues related to retirements in PJM over the past 13 years. Given current technology and the short time period, the retiring capacity can only be replaced by gas fired or dual fuel generation. Renewables can replace a significant amount of the energy output but cannot replace the capacity. Capacity means that the resource is expected to be available when needed, regardless of the time of day or ambient conditions. While all resource types have forced outages, solar resources will not be available when the sun is not shining and wind resources will not be available when the wind is not blowing, regardless of derating values.

The retiring capacity consists primarily of coal steam plants and CTs. If all of the coal units identified as at risk (30,417 MW) are replaced by new gas fired CCs, those new units would require a significant amount of firm gas pipeline capacity if the new units are single fuel. The new CC plants would require 4.8 BCF/day of firm pipeline capacity, based on the maximum output level of the CCs, to replace that coal capacity. If only the coal units identified as at risk based both on explicit plans to retire and on regulatory reasons are replaced, the installed capacity of those coal resources would require 2.0 BCF/day of firm pipeline capacity based on the maximum output level of the CCs to replace that coal capacity. The level of firm pipeline capacity required to replace the capacity and reliability value of the retiring coal units could be reduced if the new CCs invested in dual fuel capability.

The current PJM interconnection queue does not include adequate thermal capacity to replace the potentially retiring thermal capacity. Of the 7,174.8 MW of combined cycle projects in the queue, 3,812.7 MW (53.1 percent) are expected to go in service based on historical completion rates as of December 31, 2023, providing both energy and capacity at that level. Of

the 202,990.3 MW of renewable projects in the queue, only 30,067.8 MW (14.8 percent) are expected to go in service based on historical completion rates and be available to supply energy. Of those 30,067.8 MW, only 11,162.9 MW (5.5 percent of the total) are expected to be capacity resources, based on historical completion rates and ELCC derate factors for storage, wind and solar.

The basic challenge is to first identify and then match supply and demand, of both energy and capacity, so that reliability is maintained. PJM and federal and state regulators cannot hope to balance supply and demand without first having a clear and reasonably accurate measure of both existing and expected supply and demand. Providing clear information to regulators and market participants about the actual and expected supply-demand balance is essential so that decisions about market design, about the timing of environmental regulations, about pipeline siting, and about transmission siting can all recognize the likely impact on the balance between supply and demand and therefore reliability.

Supply is not a fixed number but is a function of other factors including state and federal environmental rules, market design, fuel supply and queue design. Demand is a function of forces in the broader economy. Supply includes existing resources included in the expected retirement category and new supply. The expected retirement category can be affected by environmental regulatory decisions. The new supply category is also affected by environmental regulatory decisions but also by market design and the queue rules governing new entry and fuel supply.

Markets exist in a broader regulatory environment that creates significant constraints for markets. The simple fact is that the sources of new capacity that could fully replace the retiring capacity have not been clearly identified. That task is a complex one and includes significant factors outside the market design, including state and federal environmental policies and siting decisions. While market signals are essential, market signals alone cannot resolve some of the nonmarket constraints.

As part of clarifying the supply demand balance challenges and helping to resolve part of the supply challenge, issues that should be addressed immediately include: identify the availability of firm gas supply; ensure transparent information from pipelines; identify

the need for dual fuel capacity; modify the RMR process; add expedited queue options for retiring resources; and improve the capacity market design.

Given current constraints on the gas pipeline system, the potential sources of the firm gas supply required to replace potential retirements are not clear. It is essential that FERC, the states, PJM, PJM stakeholders and all segments of the gas industry (transportation, storage and commodity) address the issues of firm gas availability and the dual fuel options. PJM should immediately start a process to identify the available and potential sources of gas supply to the PJM market area in order to permit an evaluation of the risks to reliability and the related need for dual fuel capacity. PJM will rely on existing and new gas fired generation in the foreseeable future and it is essential that such resources have the gas supply arrangements that will permit them to provide reliability and flexibility and competitive offers and have accurate real-time information from the gas pipelines about the terms under which gas transportation is available.

The potential level of retirements makes a solution to the RMR (reliability must run) question essential. One of the potential results of an increase in unit retirements is an increased number of RMR contracts that provide for out of market payments to units that PJM defines to be required for reliability, until the PJM transmission grid can be expanded to support reliability. The need for RMR contracts is evidence of a failure in market design. It should never be the case that a resource does not clear in the capacity market auction and then, when it wants to retire as a result, is deemed critical to reliability and not allowed to retire. That does happen in PJM. In addition, the substantial overpayments that result from PJM's interpretation of the current rules create an incentive to request RMR contracts because the RMR payments generally exceed market revenues.

The definitions of reliability for the capacity market and transmission planners should be the same. That will require a change to the capacity market rules that do not now define reliability as stringently as the transmission planning criteria. In addition, RMR units are included in the supply of capacity for auctions after the unit has declared the intent to retire. Such inclusion overstates market supply and suppresses the capacity market price signal needed to incent the new entry needed to replace the retiring unit. Retiring units should be required

to provide notice at least 18 months in advance of retirement, in order to allow the markets to respond. If an RMR is still needed, the rules governing compensation should be clarified to provide for fair compensation, including an incentive, for all the costs that the owners of such units incur in order to provide this service, but no more than that.

Competition starts with open access to the transmission grid. The fundamental purpose of the queue process is to provide open access to the grid and to ensure that the energy from capacity resources is deliverable so that capacity resources can meet their must offer obligations in the energy market and provide reliable energy supply during all conditions. All new generation must go through the queue process. PJM's queue reforms will improve the management of that access which faces the challenge of integrating a large number of relatively small renewable projects in addition to a smaller number of traditional thermal resources.

Current proposals that generation owners should be permitted to avoid the queue process and directly transfer the generation capacity interconnection rights (CIRs) from retiring units to an affiliate or directly sell the CIRs to an unaffiliated entity should be rejected. In effect, this approach, if adopted by the large number of retiring units, would create a chaotic, bilateral private queue process that would replace and disrupt the recently redesigned PJM queue process.

Rules should be developed to permit PJM to advance projects in the queue if they would resolve immediate reliability issues that result from unit retirements. The rules should be consistent with the flexibility included in the new queue process and add the option for PJM to expedite the interconnection and commercial operation of projects in the queue that would address identified reliability issues, consistent with the standing of the projects in the queue. CIRs from retiring units should be made available to the next resource in the queue that can use them, on the retirement date of the retiring resource.

Given the nonmarket regulatory constraints, a goal of market design should be to be consistent and predictable and transparent. A consistent, predictable and transparent design would provide a stable investment environment for generators and a stable price environment for customers who both consume and invest. New supply

requires competitive incentives and a stable investment environment. The objective of the market design should be markets that work, markets that work for generators and markets that work for customers. The objective of the market design should also be markets that are transparent and understandable to market participants and to regulators. The capacity market design should be as simple as possible to meet its objectives.

The only purpose of the capacity market is to make the energy market work. That means two specific things. The capacity market needs to define the total MWh of energy that are needed to reliably serve load in all hours. The capacity market needs to provide the missing money; the capacity market needs to allow all cleared capacity resources the opportunity to cover their net avoidable costs on an annual basis to ensure the economic sustainability of the reliable energy market. The capacity market is an administrative construct designed to achieve these two purposes.

PJM's proposed ELCC approach to capacity market design has not been adequately tested, introduces volatility into asset values and capacity market outcomes and relies on PJM's untested ex ante ELCC model to define the asset values of capacity resources rather than relying on the resource owners to demonstrate asset value based on investment in improved reliability. Risk based on the level of uncertainty created by PJM's new capacity market design could have a negative impact on the economic viability of units considering retirement.

One of the benefits of competitive power markets is that changes in input prices and changes in the balance of supply and demand are reflected immediately in energy prices for both price decreases and price increases. Energy prices decreased in 2023 from 2022. The real-time load-weighted average LMP in 2023 decreased \$49.06 per MWh, or 61.2 percent from 2022, from \$80.14 per MWh to \$31.08 per MWh. This is the largest annual dollar and percent decrease in PJM real-time load-weighted average LMP since competitive markets were introduced in 1999. Of the \$49.06 per MWh decrease, 64.7 percent was a direct result of the decreased costs of fuel, emissions allowances, and consumables. Natural gas prices, coal prices, and oil prices decreased in 2023 compared to 2022. The real-time hourly average load in 2023 decreased by 3.0 percent from 2022, from 88,884 MWh to 86,193 MWh.

The total price of wholesale power decreased from \$105.30 per MWh in 2022 to \$53.42 per MWh in 2023, a decrease of 49.3 percent. Energy (58.2 percent), capacity (7.5 percent) and transmission charges (31.0 percent) are the three largest components of the total price of wholesale power, comprising 96.7 percent of the total price per MWh in 2023. Starting in the third quarter of 2019, the cost of transmission per MWh of wholesale power has been higher than the cost of capacity.

In 2023, generation from coal units decreased 27.9 percent, generation from natural gas units increased 8.4 percent, generation from oil decreased 0.8 percent, generation from wind decreased 8.1 percent, and generation from solar increased 20.1 percent compared to 2022.

Net revenue is a key measure of overall market performance as well as a measure of the incentive to invest in generation to serve PJM markets. Energy market net revenues are significantly affected by energy prices and fuel prices. Energy prices and fuel prices were significantly lower in 2023 than in 2022. Theoretical net revenues from the energy market decreased for all unit types in 2023 compared to 2022. Theoretical energy market net revenues decreased by 44 percent for a new combustion turbine (CT), 46 percent for a new combined cycle (CC), 67 percent for a new coal plant (CP), 57 percent for a new nuclear plant, 61 percent for a new onshore wind plant, 62 percent for a new offshore wind plant and 65 percent for a new solar plant.

Changes in forward energy market prices significantly affect the expected profitability of nuclear plants in PJM. Based on forward prices as of December 29, 2023, for energy, and known forward prices for capacity, all the nuclear plants in PJM are expected to cover their avoidable costs from energy and capacity market revenues in 2024, 2025, and 2026, without subsidies, with the exception of Davis Besse and Perry, both single unit nuclear plants, in 2024.

The evolution of wholesale power markets is far from complete. The PJM markets need rules in order to provide reliable energy through competition. The foundational principle of using markets, with rules to prevent the exercise of market power and provide competitive results, is essential. Private investors, regardless of technology or subsidies, will put capital at risk and earn compensatory returns in markets that

are not skewed in favor of any specific technology and in markets that are stable and that do not add risk and volatility. The core elements of the PJM market design remain robust. The use of locational marginal prices (LMP) in the energy market and locational prices in the capacity market continue to be essential to getting the price signals right. Technological and policy changes do not require that the core elements change. But the market design can be improved and made more reliable and more efficient and more competitive. The markets will also need support from regulators whose decisions create and/or limit the options available to investors in PJM resources. PJM and its market participants will need to continue to resist the temptation to turn to regulatory solutions based on cost of service rather than markets. PJM and its market participants will need to resist the temptation to try to become all knowing system planners, identifying in advance the exact asset value of every resource and deciding exactly where risks lie. PJM and its market participants will need to resist the temptation to try to define the correct market prices rather than creating a competitive design that permits market fundamentals to determine prices. PJM and its market participants will need to resist the temptation to permit market power to increase prices, rather than defining markets that permit competitive clearing prices. In the interests of all market participants, PJM and its market participants will need to continue to work constructively to refine the competitive market design and to ensure the continued effectiveness of PJM markets in providing customers wholesale power at the lowest possible price, but no lower.

PJM Market Summary Statistics

Table 1-1 shows selected summary statistics describing PJM markets.

Table 1-1 PJM market summary statistics: 2022 and 2023¹

	2022	2023	Percent Change
Average Hourly Load Plus Exports (MWh)	94,301	92,455	(2.0%)
Average Hourly Generation Plus Imports (MWh)	96,147	94,165	(2.1%)
Peak Load Plus Export (MWh)	149,531	152,797	2.2%
Installed Capacity at December 31 (MW)	183,385	178,253	(2.8%)
Load Weighted Average Real Time LMP (\$/MWh)	\$80.14	\$31.08	(61.2%)
Total Congestion Costs (\$ Million)	\$2,501.3	\$1,068.6	(57.3%)
Total Uplift Credits (\$ Million)	\$284.5	\$158.7	(44.2%)
Total PJM Billing (\$ Billion)	\$86.24	\$48.61	(43.6%)

¹ In Table 1-1, the MMU uses Total PJM Billing values provided by PJM. For 2019 and after, the MMU has modified the Total PJM Billing calculation to better reflect historical PJM total billing through the PJM settlement process.