

# **PJM: Charting the Path to the Grid of the Future**

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The electric grid is undergoing a revolutionary transformation—customer preference, corporate clean energy aspirations, and state and federal policy choices are dramatically changing how energy is generated, and the retirement of conventional generators threatens to outpace the construction of new resources.

Technology is offering customers new ways to interact with the system, blurring traditional distinctions between how electricity is generated and transmitted long distances and how it is delivered to homes and businesses. At the same time, the frequency of extreme weather events—and the stresses they put on the system—continues to increase.

All of these forces present challenges for operating the largest and most complex machine on earth for a product that is produced, transported and consumed in an instant.

PJM Interconnection, the grid operator for 65 million people in 13 states and the District of Columbia, along with the many stakeholders with a voice in our operations and policies, is tasked with forging solutions without sacrificing the uninterrupted power supply that allows modern society to function.

As the country's largest regional transmission organization, PJM's No. 1 job is keeping electricity flowing, and doing it cost-effectively, every moment of the day. Affordable, reliable electricity is essential for everything we do as a society—starting with powering the country's critical infrastructure we rely on, from transportation and communication to emergency services and health care.

This responsibility demands that the wholesale electricity market we oversee provides economic incentives to attract the investment needed to build and resources that maintain system reliability, as it has for over 25 years. It also requires us to plan for broader trends and events to make sure the grid is resilient enough to operate through and recover from rare, extreme and high-impact events that PJM has never experienced before.

## **Reliability Risks on the Horizon**

PJM's combined functions of operations, markets and planning have worked together successfully to keep the lights on since 1927, providing up to \$4 billion in efficiencies for our customers in the process. But there are working trends on the horizon.

In a recent report, PJM analysis showed that 40 GW of existing genera-

tion—mostly coal, gas and oil generators representing 21% of our installed capacity—is at risk of retiring by 2030. Some industry forecasts predict that renewable energy will provide nearly half the power to the country by 2032, but currently those renewable resources are not being built at the rate we need to replace those traditional generators.

As the generation fleet moves to a lower-carbon footprint, reliant on intermittent energy resources (like sun and wind), the planners and operators of the bulk electric system have to plan for a much different kind of system with different physical characteristics—and get it right. Peoples’ livelihoods and lives depend on it.

This means PJM and its stakeholders have been hard at work crafting a reliable path forward through our core functions of planning, markets and operations.

We have synthesized these efforts into our [Ensuring a Reliable Energy Transition](#) initiative, dedicated to finding answers to reliability challenges through intensive, data-driven research and analysis and collaboration across government and industry.

## **New Fuel Mix Challenges Reliability**

The story of this energy transition is told in our New Services Queue, where generation projects come to interconnect with the PJM system. More than 97 percent of the resources requesting to join the PJM system are wind, solar or batteries, or a hybrid of both.

These smaller, weather-dependent resources generate energy in a whole different way than traditional thermal generators powered by coal, oil, gas or nuclear, introducing a new set of physical dynamics and characteristics.

Underlying the new reality of grid operations is the fact that intermittent and limited-duration resources like batteries do not replace “1 for 1,” but rather require multiple megawatts to replace 1 MW of dispatchable generation due to their limited availability in certain hours of the day and seasons of the year.

As generators increasingly rely on renewable energy sources like wind and solar, PJM has identified trends that could realize a shortage of generating resources as early as 2027:

- The demand for power is growing with the electrification of transportation, industrial and building sectors, along with the development of energy-intensive data centers—driven in part by the increase in artificial intelligence and machine learning processes—at an unprecedented rate.
- At the same time, fossil fuel generators that balance the grid today are retiring at a significant rate.

- Replacement generation is made up of primarily intermittent and limited-duration resources that require multiple megawatts to replace 1 MW of dispatchable generation.
- Renewable resources that have passed through PJM’s vetting process are not being built at the pace required to replace these resources, through factors beyond PJM’s control, like supply chain issues, cost of capital and permitting.

The related analysis is detailed in our [most recent paper](#) in the Energy Transition in PJM series.

## **New Planning Process Begins**

Critical to getting generation online, PJM this summer began transitioning to a new “first-ready, first-served” interconnection process that improves project cost certainty for network upgrades and significantly improves the overall process by which new and upgraded generation resources are studied and introduced onto the electrical grid.

In the transition period to our new interconnection process, we will study enough interconnection requests to replace the entire generation fleet of nearly 200 GW and far more than make up for retiring coal, oil and gas generators.

The key question is: Will the new generation actually come online?

Right now, we have more than 40,000 MW of projects that have completed PJM’s study process and should be moving to construction.

Yet in 2022, we saw just 2,000 MW in projects built, and only 700 MW of those were renewables. So far in 2023, we have seen 620 MW of solar, 285 MW of wind, and 41 MW of storage come online, along with 3,100 MW of natural gas.

Many projects coming through the queue are not being built because of siting, financing or supply chain issues. These factors are out of PJM’s control.

PJM is not alone in having stalled projects. This same issue is happening across the country. But we are leading the pack in clearing our queue. A recent S&P Global Market Intelligence analysis of U.S. interconnection queues found that PJM has the shortest project turnaround time of all grid operators in the country.

## **Reliability-First Policies**

These reliability concerns are not unique to the PJM grid. As this year’s North American Electric Reliability Corporation’s (NERC) summer assessment showed, roughly two-thirds of the U.S. (but not the PJM region) already faced increased resource adequacy risk this past summer.

However, we believe this risk is avoidable. How? Through policies that accelerate the rate of entry of new generation (such as through permitting reform)

and slow the exit of the traditional thermal generation we use to balance the grid today. This will give time for replacement generation to be installed and operating at the required scale.

In addition, PJM advocates an approach to policymaking that expressly considers reliability impacts in the development phase of the policy—not after the fact.

We continue to work with both state and federal policymakers to ensure that reliability considerations are built into all environmental and renewable generation policies.

## **PJM Steps Up as Independent Industry Leader**

The energy transition presents a broad set of challenges and opportunities, and PJM is making headway in a number of areas, including:

- Enacted major interconnection reform, which is expected to result in the processing of over 250 GW of new generation requests in the next three years and produce a more predictable, streamlined process for new generators to connect with the system
- Filed with FERC a set of proposals to better recognize the relative contribution of all generation resources in meeting reliability needs
- Engaged stakeholders in developing a long-range transmission planning protocol that will enable us to analyze the longer-term needs of the system under multiple long-range scenarios to optimize a set of solutions based on the changing fleet and electrification
- Developed new rules to remove barriers to renewable resources participating in PJM's capacity market
- Performed groundbreaking work with the state of New Jersey to advance the buildout of its ambitious offshore wind program—a model that is being considered by other states

Our Ensuring a Reliable Energy Transition initiative proposes an initial set of actions to support reliability that PJM can take with its stakeholders, government and industry over the immediate, near-term and upcoming time frames to keep pace with these trends:

- **Immediate:** Ensuring the performance of existing generation resources
- **Near Term:** Maintaining adequate generation resources and deliverable megawatts to meet electricity demand

- **Upcoming:** Attracting and maintaining (as needed) resources that have essential reliability services

Essential reliability services are defined by NERC as the ability of a generation resource to provide services such as voltage control, frequency support, and ramping capability to balance the electrical grid and maintain the reliable delivery of electricity.

PJM has documented in its research that the more we depend on intermittent resources, the more we will need to share electricity with our neighboring systems to account for fluctuations in supply. PJM is already a leader in this area and regularly exports and imports electricity to adjoining systems; we are currently working both internally and externally to determine just how much of that interregional transfer capability we will need to build.

## **Helping States Achieve Their Goals**

Another action we're taking as part of our reliability initiative is offering states a way to incorporate their policy goals into our Regional Transmission Expansion Plan (RTEP).

The first state to do this was New Jersey. In October 2022, the New Jersey Board of Public Utilities (NJBPU) selected a package of onshore transmission solutions that, in conjunction with prior action, will enable the injection of 7,500 MW of offshore wind capacity by 2035.

The NJBPU order was informed by technical analysis performed by PJM staff under the State Agreement Approach (SAA), through which states can access PJM's expertise and existing planning process to cost-effectively develop and optimize the transmission improvements necessary to support the reliable interconnection of certain desirable resources.

The SAA enables a state or group of states to propose a project that could potentially realize public policy requirements as long as the state (or states) agrees to pay all costs of the state-selected buildout included in the RTEP.

The first engagement of the SAA was so successful, New Jersey returned to PJM in April and requested to partner on a second stage to enable an additional 3,500 MW of offshore wind energy. New Jersey's experience can serve as a template for PJM's other coastal states.

## **Together, We Will Find Solutions**

PJM has sufficient generation to meet the needs of our system today. However, as we look further out, we are concerned by the trends we see.

Despite PJM's healthy reserve margins, recent winter storms have provided a sobering reminder of the critical role that resource adequacy will play through

the energy transition. For the first time in recent history, PJM could be at risk of facing resource adequacy challenges.

Decarbonizing the grid will be a challenge, for all of us, but it will happen. We're all going to have to work together to find solutions, including state and federal policymakers.

The solutions are there; this country has proven that time and time again, it simply requires dedicated resources and brainpower. PJM will find those solutions but will need all stakeholders at the table to do so.

## **Author Capsule Bio**

Kenneth Seiler leads PJM's System Planning Division. He is responsible for all activities related to resource adequacy, generation interconnection, interregional planning and transmission planning, including the development of the Regional Transmission Expansion Plan. Previously, Seiler was the executive director of System Operations and was responsible for the reliable operation and coordination of the bulk power system, including PJM's real-time dispatch operations and near-term reliability studies. Seiler oversaw the dispatcher training and certification functions, as well as the markets coordination function, to ensure the efficient and most cost-effective dispatch of the generation fleet.

Seiler is on the board of directors of ReliabilityFirst, one of the eight Federal Energy Regulatory Commission-designated regional entities responsible for ensuring the reliability of the North American bulk power system. He is also on the board of PJM Environmental Information Services Inc. In addition, he is an instructor for the Mayfly Project, a national organization that uses fly fishing as a catalyst to mentor and support children in foster care and introduce them to their local water ecosystems, with a hope that connecting them to a rewarding hobby will provide an opportunity for foster children to have fun, build confidence and develop a meaningful connection.

Prior to joining PJM, Seiler was employed by Metropolitan Edison Company/GPU Energy for nearly 14 years. He held the positions of operations manager, transmission engineering manager, relay protection and control engineer, and substation/transmission construction and maintenance engineer. He earned a Bachelor of Science in electrical engineering from The Pennsylvania State University and a Master of Business Administration from Lebanon Valley College.