

Planning for the Grid of the Future in PJM

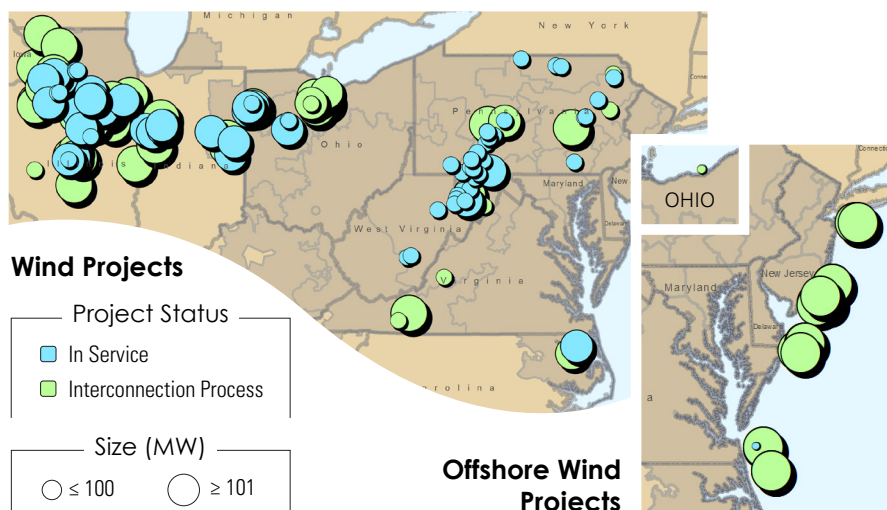
PJM's Grid of the Future Objectives

- Identify the impacts of current generation, transmission, technology and load trends
- Provide a vision of what generation and the transmission system will look like in the future
- Outline any public policy, planning process and technology drivers
- Develop a planning road map for the PJM system

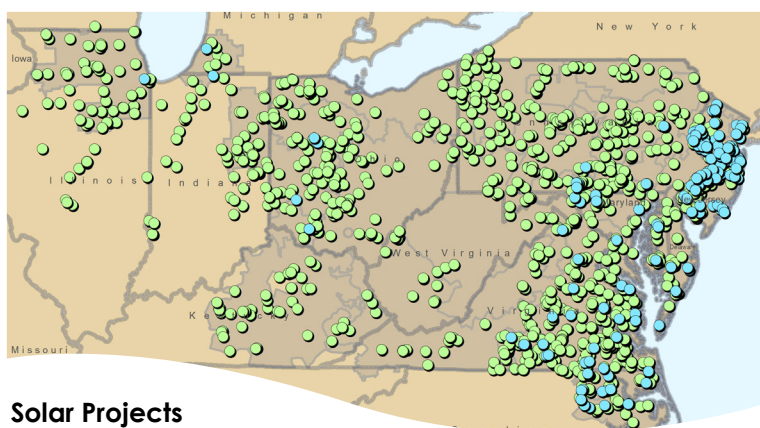
Over the past decade, an increasing focus by federal and state governments on climate change, energy independence and other public policy areas has highlighted the critical role of a reliable and resilient transmission system.

PJM is examining current industry trends and drivers and how they could impact PJM's transmission planning process in order to best prepare for the "grid of the future."

Generation Trends



- The development of onshore wind projects continues in PJM's western regions and along the Allegheny Mountains.
- PJM states have collectively targeted 17 GW of offshore wind generation coming online by 2035.
- Solar generation dominates PJM's new services queue with projects throughout the PJM footprint.
- Energy storage projects have also grown recently, often following solar development.



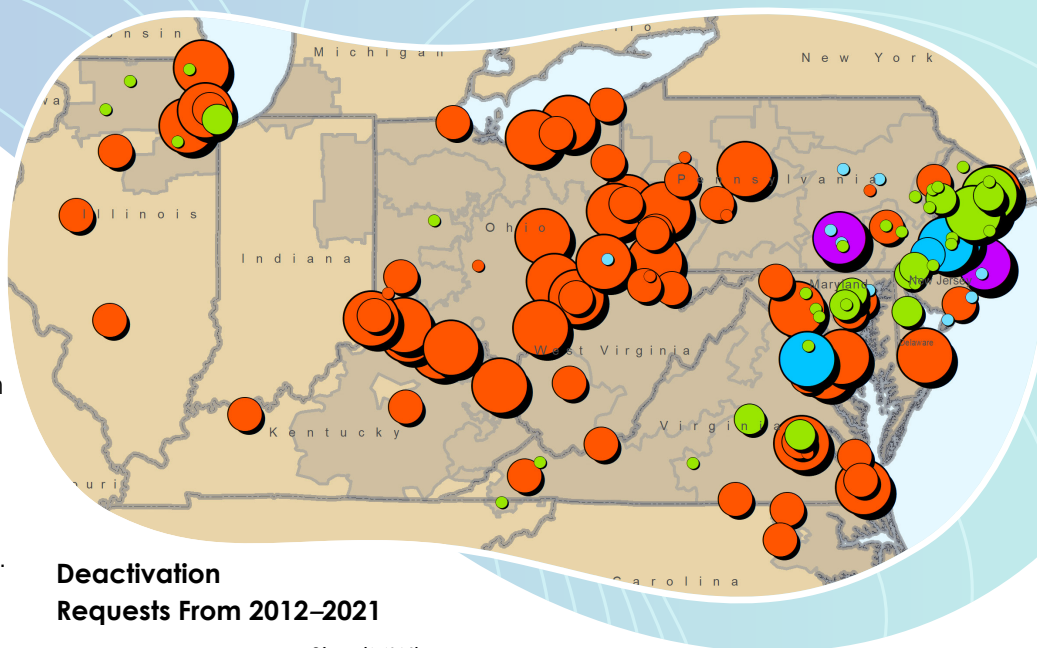
Renewable generation is expected to grow over 100,000 MW to meet state policy goals.

Projects shown are as of September 2021. For an up-to-date list, visit [PJM.com](https://www.pjm.com) > Planning > Services & Requests > [New Services Queue](https://www.pjm.com).

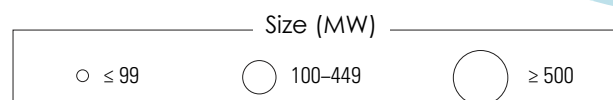


Driven by economics and public policy, conventional generation will continue to retire.

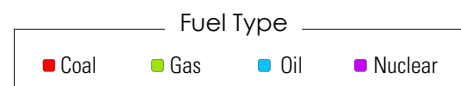
- 30,000+ MW of coal generation retired between 2012 and 2021.
- The future of nuclear remains uncertain, impacted by economics, policy and licensing.
- Once driven by shale gas, the growth of natural gas generation has slowed in the wake of the expansion of renewables.



Deactivation Requests From 2012–2021



From 2012 through 2021, 24,507 MW of generation retirements accounted for \$4.1 billion of baseline transmission investment. The remaining 16,702 MW that retired during this time did not require system enhancements to maintain grid reliability.



Grid of the Future Road Map

PJM has identified four areas of focus to continue enhancing its planning processes in preparation for the future grid:

Transmission build-out scenario studies will be conducted in 2022 that are intended to help enable a decarbonized grid over the next 20–30 years. These studies will:

- Align with PJM's renewable integration and offshore wind studies, including accelerated penetration scenarios
- Provide an in-depth assessment of greater building and transportation electrification impacts



Electricity Use Trends

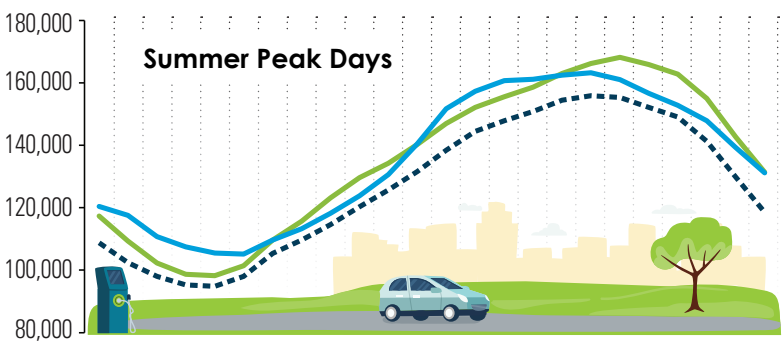
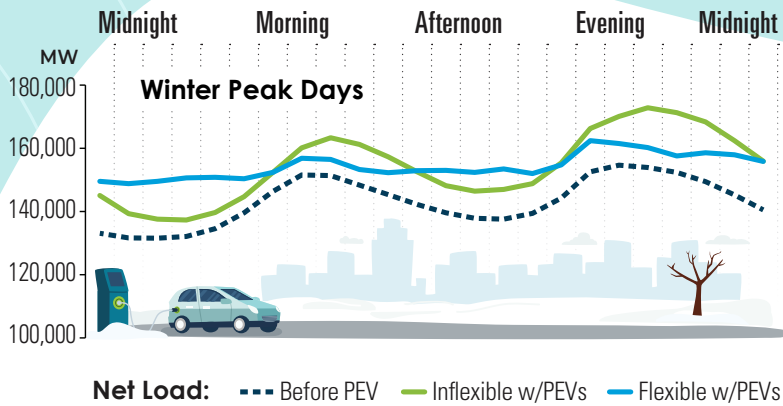
Electricity load trends will be largely driven by transportation and building electrification.

Electrification of Transportation

The growth of plug-in electric vehicles (PEVs) will impact how and when electricity is used on peak load days and ultimately drive increased energy consumption.

Electrification of Building Heating

The growth of electric building heating is less certain due to its economics compared to gas and oil heat in the PJM footprint. While the potential load impacts of more electric heating could be significant, its impacts are more likely further in the future.



Targeted reliability studies will take place that will:

- Evaluate generation and transmission reliability attributes, e.g., reactive control, stability, system inertia and frequency control, and short-circuit impacts
- Build on the results of PJM's offshore wind transmission scenario study results

RTEP process enhancements will continue:

- Modeling wind and solar impacts on generator deliverability analysis per Effective Load-Carrying Capability (ELCC) development driven by renewables penetration
- Planning for resilience: fuel assurance, extreme events, etc.
- Interconnection process reforms to improve efficiency

Technology Trends

The future of distributed energy resources includes both retail and wholesale market participation.

FERC Order 2222 enables distributed energy resources (DER), including non-wholesale DER, to participate in wholesale markets. PJM will need to implement changes in its planning process modeling and dispatch methods to consider future DER growth anticipated with the implementation of Order 2222 and similar orders.

The continued penetration of DER will require close and effective coordination between PJM, utilities and state commissions in order to ensure reliable and efficient operations.

Emerging technologies will provide innovative transmission planning solutions.

PJM anticipates that innovative solutions that maximize the use of existing facilities and existing transmission corridors will play a role in meeting future grid needs.

Technologies such as dynamic line ratings, specialized conductor designs, compact tower configurations and energy storage as a transmission asset could:

- Manage grid congestion
- Reduce the need for new transmission lines
- Mitigate potential reliability issues from increased renewable penetration



Regulatory policy impacts will continue to inform grid planning processes:

- New reliability criteria for extreme events
- State electrification policies
- Interconnection policy reform
- DER expansion
- FERC action on regional transmission planning per its recent ANOPR
- PJM's State Agreement Approach (SAA) for transmission planning

For the full report, visit [PJM.com](https://www.pjm.com) > Library > Reports & Notices > Grid of the Future: PJM RTEP Process Perspective

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