

REGIONAL TRANSMISSION EXPANSION PLANNING: Meeting the Grid's Future Needs



How does PJM optimize infrastructure investment in the states it serves? p. 1



How are transmission and interconnection planning enabling state public policy? p. 4



How does regional planning benefit consumers? p. 8

One Process, One Plan

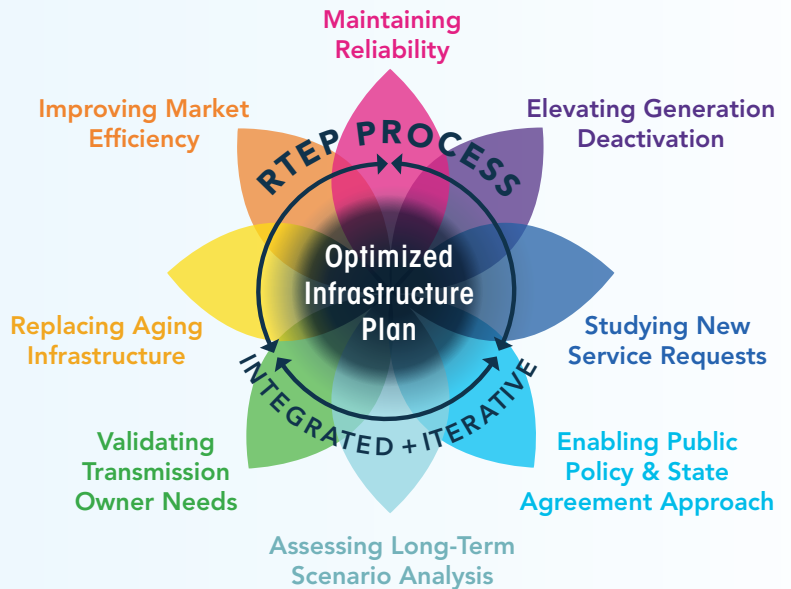
PJM's integrated planning process is designed to preserve future grid reliability and provide economic savings to load and generation customers in all of the states that PJM serves.

One Optimized Grid Solution Set

Beginning 15 years in advance, PJM identifies the transmission needed to serve customers by ensuring compliance with national, regional and local reliability criteria to prevent overloaded grid facilities.

Baseline market efficiency infrastructure provides consumers access to lower-cost power by solving transmission congestion limitations.

PJM's planning process integrates baseline reliability and market efficiency projects, interconnection-related grid upgrades and local transmission owner-led projects into a single, optimized transmission solution set.



Baseline Projects:

- + Enable essential transmission reliability to deliver generation to all electricity customers throughout PJM, allow for generation retirements and mitigate congestion to enhance market efficiency
- + Are paid for under established, FERC-approved, regional cost-sharing mechanisms

Interconnection Customer-Funded Projects:

- + Are network upgrades and local upgrades for generation, merchant transmission and long-term firm service requests
- + Are paid by the entity seeking to connect to the grid

Transmission Owner-Led Local Reliability Projects:

- + Are also known as supplemental projects
- + Are developed by transmission owners to meet their customer service, asset management (e.g., aging infrastructure) and operational flexibility and efficiency needs
- + Are paid for by the load within the transmission owner zone

Optimizing Regional Transmission Grid Solutions

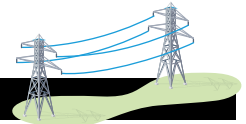
PJM leverages opportunities to develop cost-effective transmission solutions that address overlapping transmission needs by:

- + Accelerating, modifying or more robustly designing reliability-driven projects to provide economic market efficiencies by reducing congestion
- + Evaluating how supplemental projects interact with identified baseline and customer-funded projects in order to yield integrated, cost-effective solutions



Recent RTEP Optimization Examples

2022 Solution To Address Baseline and Supplemental Needs on an Interstate 138 kV Line



4

proposals received during 2022 RTEP Window No. 1 solved baseline overloads on an interstate 138 kV transmission line.



PJM identified its own solution

based on converting six elements of an existing transmission owner supplemental project into a new PJM RTEP baseline project.



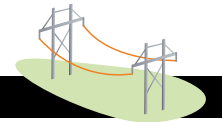
This project:

Solved identified baseline reliability criteria violations



Solved aging infrastructure, operational performance and local power delivery needs, which are normally developed by transmission owners

2021 Solution To Address Baseline and Supplemental Needs for Three Local 69 kV Lines



3

proposals received during 2021 RTEP Window No. 1 solved 30 identified baseline thermal overloads on three local 69 kV transmission lines.



PJM identified one of the proposals,

which entailed rebuilding the three lines, as the most cost-effective solution.



This project:

Solved all 30 thermal violations



Eliminated the need to pursue and solve aging infrastructure issues (deteriorating wood-pole structures on two transmission lines from 1939)

Aging Infrastructure Needs Impact Planning Solutions

In addition to developing solutions to deliver new generation to growing load, current transmission infrastructure investment also focuses on replacing aging infrastructure, some of it over 90 years old. PJM is able to incorporate investment in replacing aging infrastructure while also meeting baseline, network and supplemental needs.



Determining Baseline and Network Transmission Needs



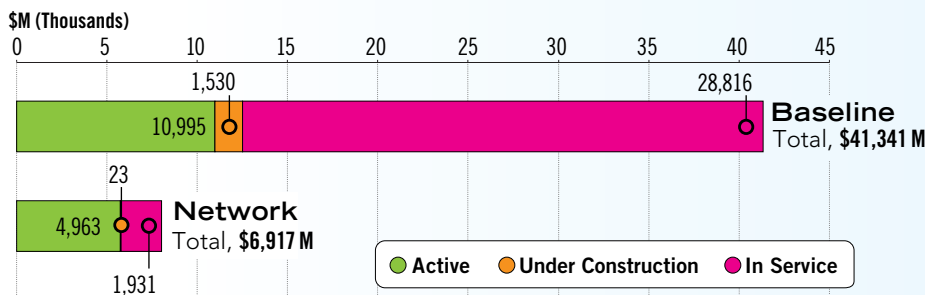
Power flow studies identify thermal overloads, voltage violations, excessive short-circuit current, generator stability and congestion on the grid.

Results of these studies drive the need for baseline and network transmission investment.



Power flow models incorporate the latest load growth data (including demand response, energy efficiency, electrification and data centers) as well as generation data (including new renewables and retiring resources).

Board-Approved RTEP Projects as of Dec. 31, 2023



PJM reviews all supplemental projects to evaluate their impact on the regional transmission system and provides the opportunity to identify any overlaps with existing baseline and network plans.

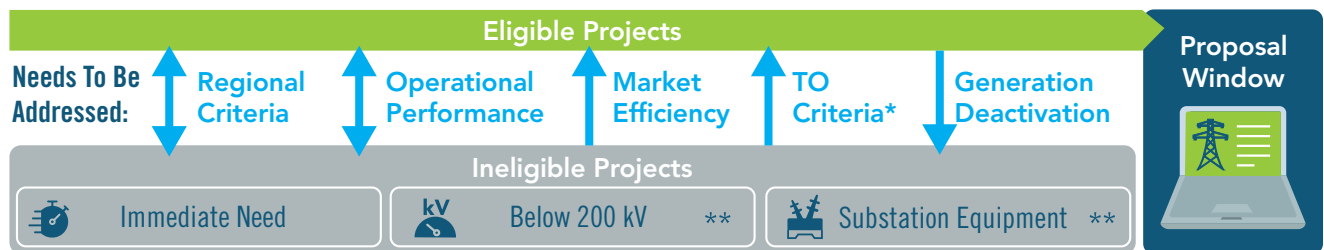
Competitive RTEP Proposal Windows Drive Efficiency and Cost-Effectiveness of Baseline Upgrades

After identifying a baseline transmission need, PJM may open a competitive proposal window based on required in-service date, voltage level and likely solution scope.

Developers submit project proposals to solve identified infrastructure needs. After a window closes, PJM evaluates all proposals to develop and recommend a solution that meets all reliability and constructability requirements.

PJM recommends proposals to the PJM Board of Managers based on window outcomes and opportunities for optimizing them with overlapping network and supplemental project needs.

PJM RTEP Proposal Window Process



*TO criteria-driven violations are eligible for proposal windows as of Jan. 1, 2020.

**Projects below 200 kV and substation equipment projects could become eligible for competition if multiple needs share common geography/contingency or if the project has multi-zonal cost allocation.

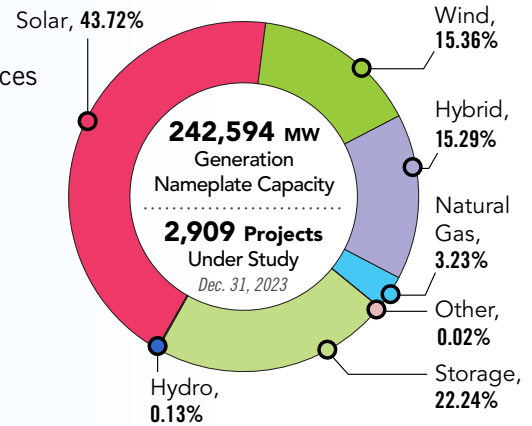
Meeting States' Grid of the Future Power Needs

PJM's Changing Capacity Mix

State and federal public policy, industry economics and consumer choices are shifting the grid away from dispatchable generation resources toward intermittent generation with little-to-no carbon emissions. PJM anticipates 40,000 MW of projected generation retirements by 2030, made up of the following, representing 21% of PJM's current installed capacity:

Retirements:		
Formally announced:	Potential policy driven:	Potential economically driven:
12 GW	25 GW	3 GW

Capacity Mix of PJM Interconnection Requests



Enabling States' Renewable Generation Public Policies

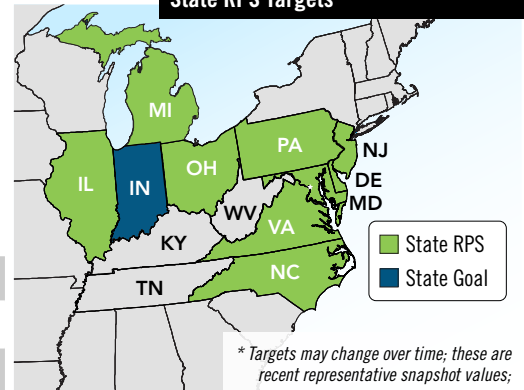
State Agreement Approach

States that wish to fund transmission grid build-out to achieve state public policy initiatives (such as offshore wind) can invoke PJM's State Agreement Approach to efficiently develop and implement needed grid expansion, as New Jersey has initially pursued for offshore wind.

NJ: 50% by 2030**	PA: 18% by 2021***	NC: 12.5% by 2021 (IOUs)
MD: 50% by 2030**	IL: 50% by 2040	OH: 8.5% by 2026
DE: 40% by 2035	VA: 100% by 2045/2050 (IOUs)	MI: 60% by 2035
DC: 100% by 2032		IN: 10% by 2025***

* Minimum solar requirement. ** Includes an additional 2.5% of Class II resources each year. *** Includes non-renewable "alternative" energy resources.

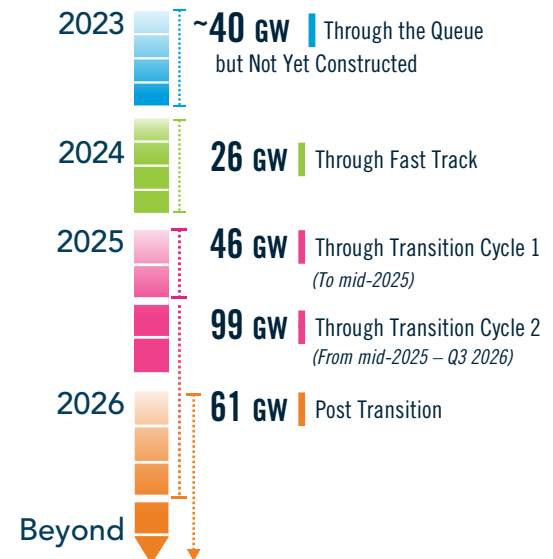
State RPS Targets*



Interconnection process reforms are reducing generation delays and improving cost certainty.

- + PJM's new interconnection process has moved from a "first-come, first-served" serial queue approach to a "first-ready, first-served" cycle approach.
- + Developers must provide financial readiness deposits and meet specified physical site control requirements at various decision points in order to move forward. Projects ready to proceed can do so, while those that aren't are incentivized to exit the process.
- + The new clustered cycle process will move projects through the cycle in a timely manner and includes a fast track for eligible projects.
- + The new process also consolidates interconnection-related service agreements and forms to increase process efficiency.

"First-Ready, First-Served" Approach

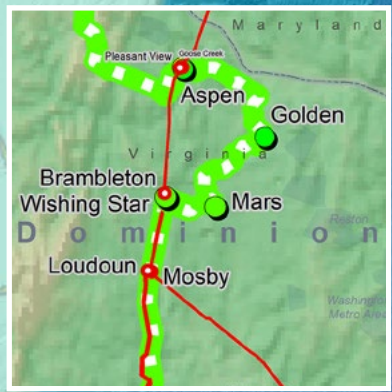




Substations and Transmission Lines:



-  345 kV
-  500 kV
-  765 kV
-  ≤ 345 kV
-  HVDC
-  New Board-Approved Baseline 500 kV Lines Since Jan. 1, 2019

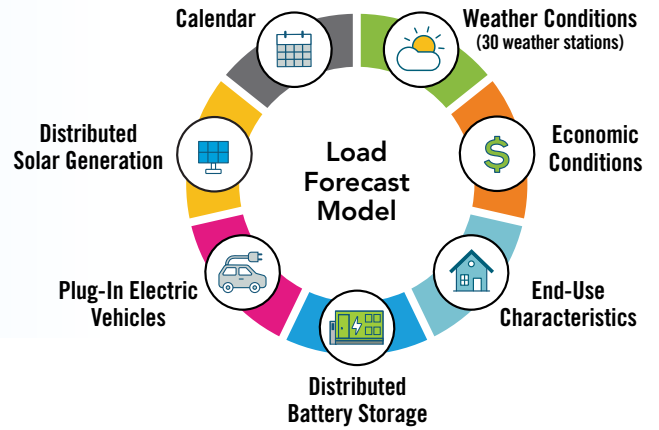


Understanding Grid of the Future Load Growth Trends

Complex Load Forecasting Parameters

- + Large load additions such as data centers
- + Distributed solar and battery storage penetration
- + Electric vehicles
- + State electrification programs
- + Efficiency and evolving home and business use

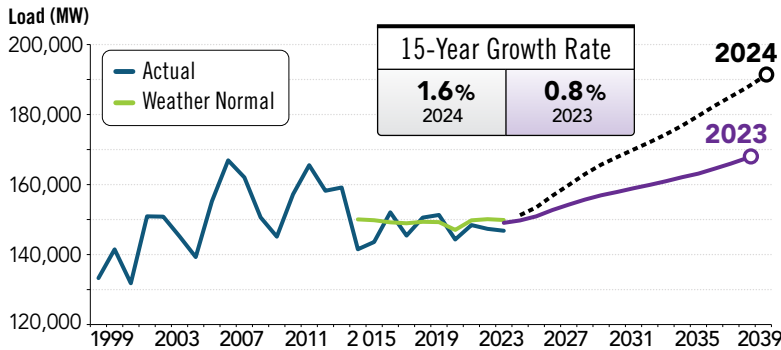
Load Forecast Model



Shifting Load Patterns

Level and timing of coincident peak and non-coincident peak demands across PJM have begun to shift.

PJM 2024 Load Forecast – Summer Peak Demand



Load forecasts are a fundamental part of PJM's power flow studies.

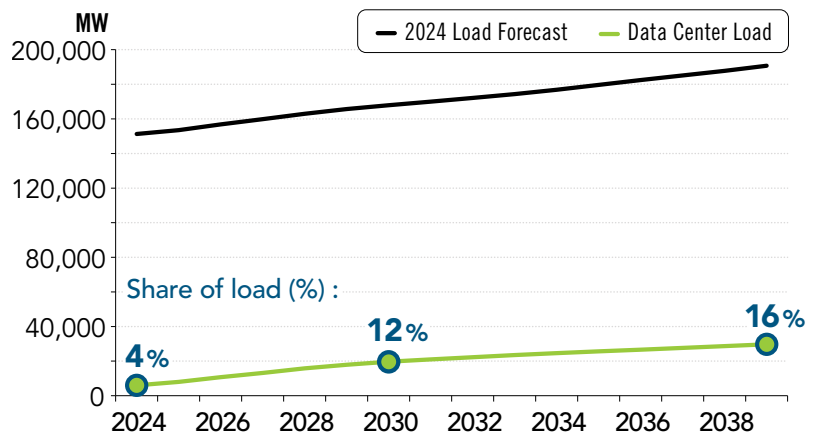
Modeling load accurately is essential for transmission expansion studies to yield plans that continue to ensure reliable and economic system operations.

The proliferation of new data centers is creating major pockets of new load in PJM.

Current data center load forecasts extend as far out as 2039 for individual transmission zones.

New transmission infrastructure approved in 2023 will enable 7,500 MW of data center load growth in the Dominion Energy and Allegheny Power (FirstEnergy) transmission zones.

Impact of Data Centers on Load Forecasts

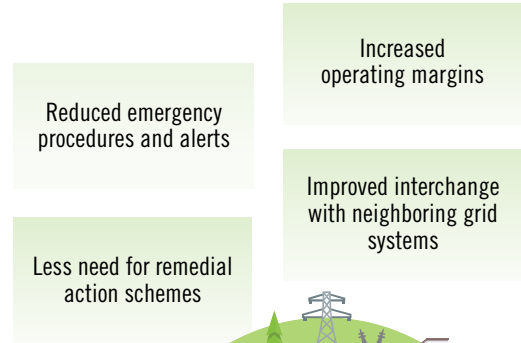


Benefits of PJM's Regional Planning Process

Regional Generation and Load Diversity Enable Energy and Capacity Savings

Hundreds of transmission interconnections between states within PJM and with neighboring systems provide consumers the reliability and economic benefits gained from regional power markets and diversity in generation and load.

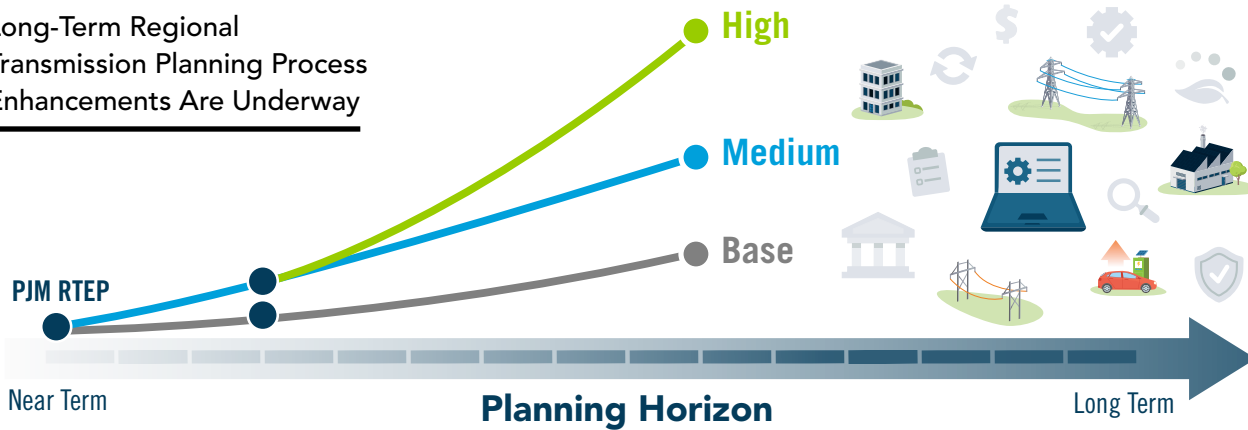
Reliability: Keeping the Lights On



Improving Grid Resilience Under Operational Challenges

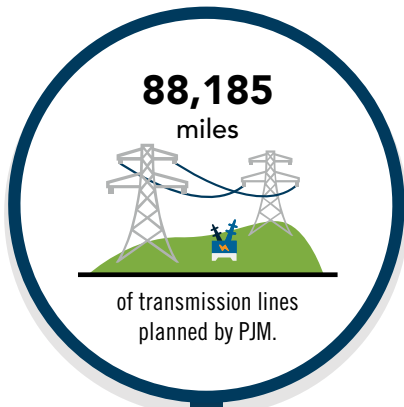
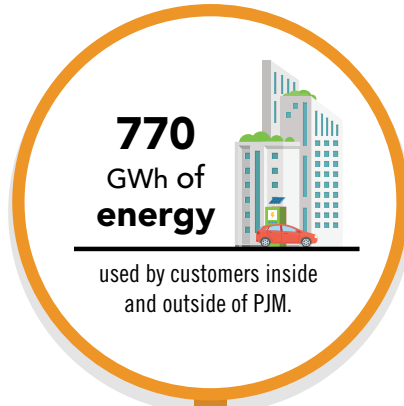
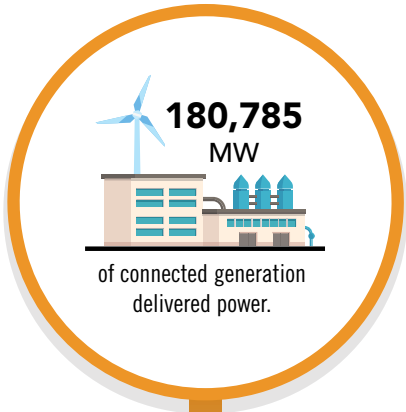


Long-Term Regional Transmission Planning Process Enhancements Are Underway



FERC Order 1920 Goals

- + Perform a sufficiently long-term assessment of transmission needs.
- + Adequately account on a forward-looking basis for known determinants.
- + Consider broader set of benefits in meeting longer-term needs.



Where Can I Find More Information?

Written Resources

Manual 14

Contains the specific business rules that govern study methodologies and solution development for baseline and new services queue-driven RTEP projects: <https://www.pjm.com/~media/documents/manuals/m14b.ashx>

Service Requests

Service requests for generation interconnection, merchant transmission, long-term firm transmission and Auction Revenue Rights: <https://www.pjm.com/planning/service-requests>

Project Status

The status of baseline, network and supplemental projects: <https://www.pjm.com/planning/rtep-upgrades-status.aspx>

Energy Transition in PJM: Resource Retirements, Replacements & Risks

<https://www.pjm.com/~media/library/reports-notices/special-reports/2023/energy-transition-in-pjm-resource-retirements-replacements-and-risks.ashx>

Annual RTEP Reports

Additional detail on key projects: <https://www.pjm.com/library/reports-notices/rtep-documents.aspx>

Maps

Order or download printable maps of PJM's transmission infrastructure from 69–765 kV facilities: <https://www.pjm.com/library/maps/map-ordering.aspx>

Interactive Forums

Planning Community

A forum for stakeholders and PJM staff to collaborate. Includes self-service resources, knowledge articles and discussion boards. Request access at: <https://pjm.force.com/planning/s/>

Planning Committee

Standing committee in the PJM stakeholder process that has the responsibility to review and recommend system planning strategies and policies as well as planning and engineering designs: <https://www.pjm.com/committees-and-groups/committees/pc.aspx>

The Transmission Expansion Advisory Committee

Forum for stakeholders and PJM staff to exchange ideas, discuss study input assumptions and review results: <https://www.pjm.com/committees-and-groups/committees/teac.aspx>

Interconnection Process Subcommittee (IPS)

<https://www.pjm.com/committees-and-groups/subcommittees/ips>

Subregional RTEP Committees

Provide a forum for stakeholders to discuss local planning concerns:

- + Mid-Atlantic Subregional RTEP Committee: <https://www.pjm.com/committees-and-groups/committees/srtepm-a.aspx>
- + Western Subregional RTEP Committee: <https://www.pjm.com/committees-and-groups/committees/srtepm-w.aspx>
- + Southern Subregional RTEP Committee: <https://www.pjm.com/committees-and-groups/committees/srtepm-s.aspx>



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