Grid of the Future:
PJM RTEP Perspective

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Objectives

Outline a vision for the grid of the future and identify factors to consider when planning for that future

- Identify anticipated impacts of current trends on generation, transmission and load
- Provide a vision of what the generation and transmission system will look like
- Outline the policy, planning process and technical factors to be considered
- Develop a grid of the future road map for planning the PJM system

Grid of the Future – RTEP Perspective

Grid of the Future Report

Reviewed:

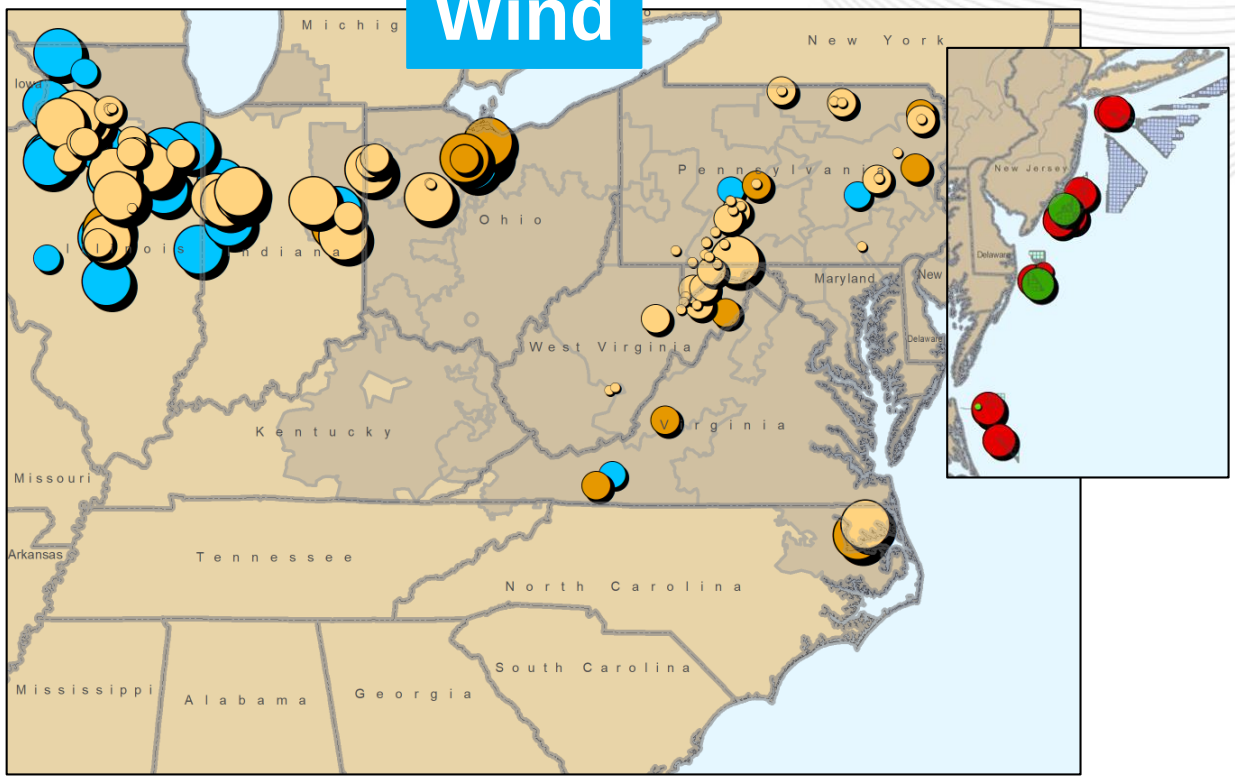
- Prior renewable integration studies and ongoing efforts
- Neighboring RTO grid of the future/future vision initiatives
- Industry reports related to renewable integration
- PJM data on generation trends and drivers
- PJM data on load electrification trends and drivers
- Relevant emerging transmission technologies

Assessed potential impacts of the trends on the PJM grid and planning process

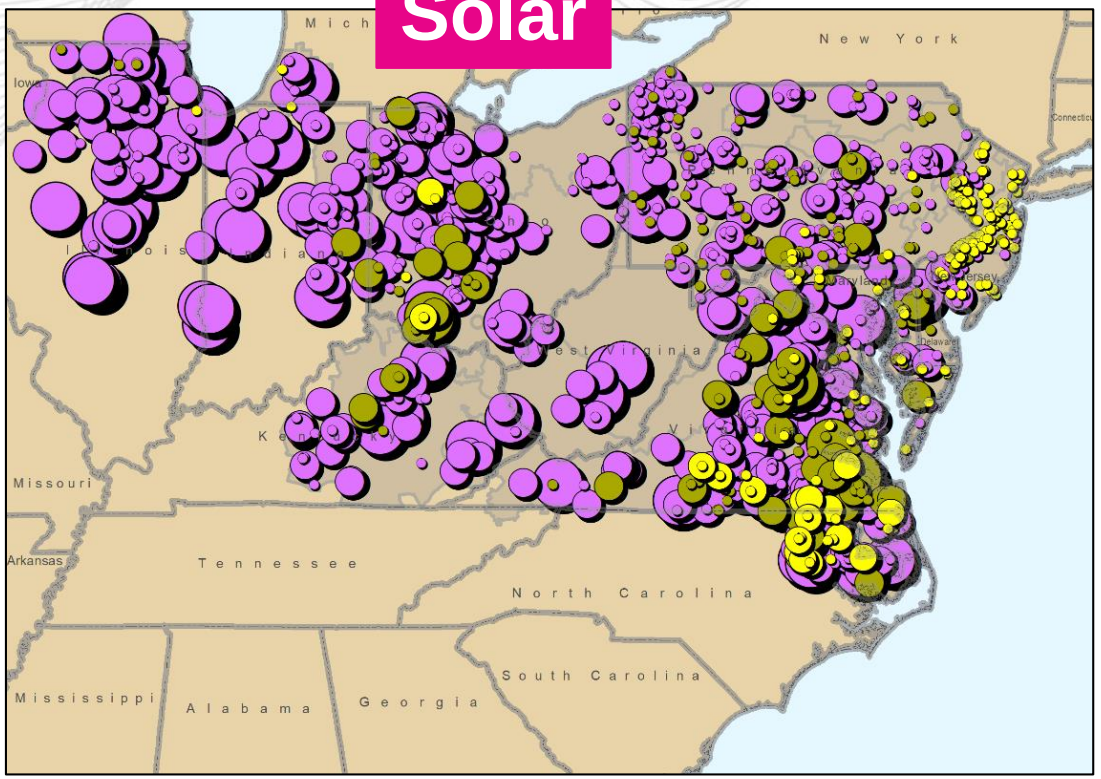
Developed a road map of future initiatives to prepare Planning for PJM's vision of the future grid

Renewable Generation

Wind



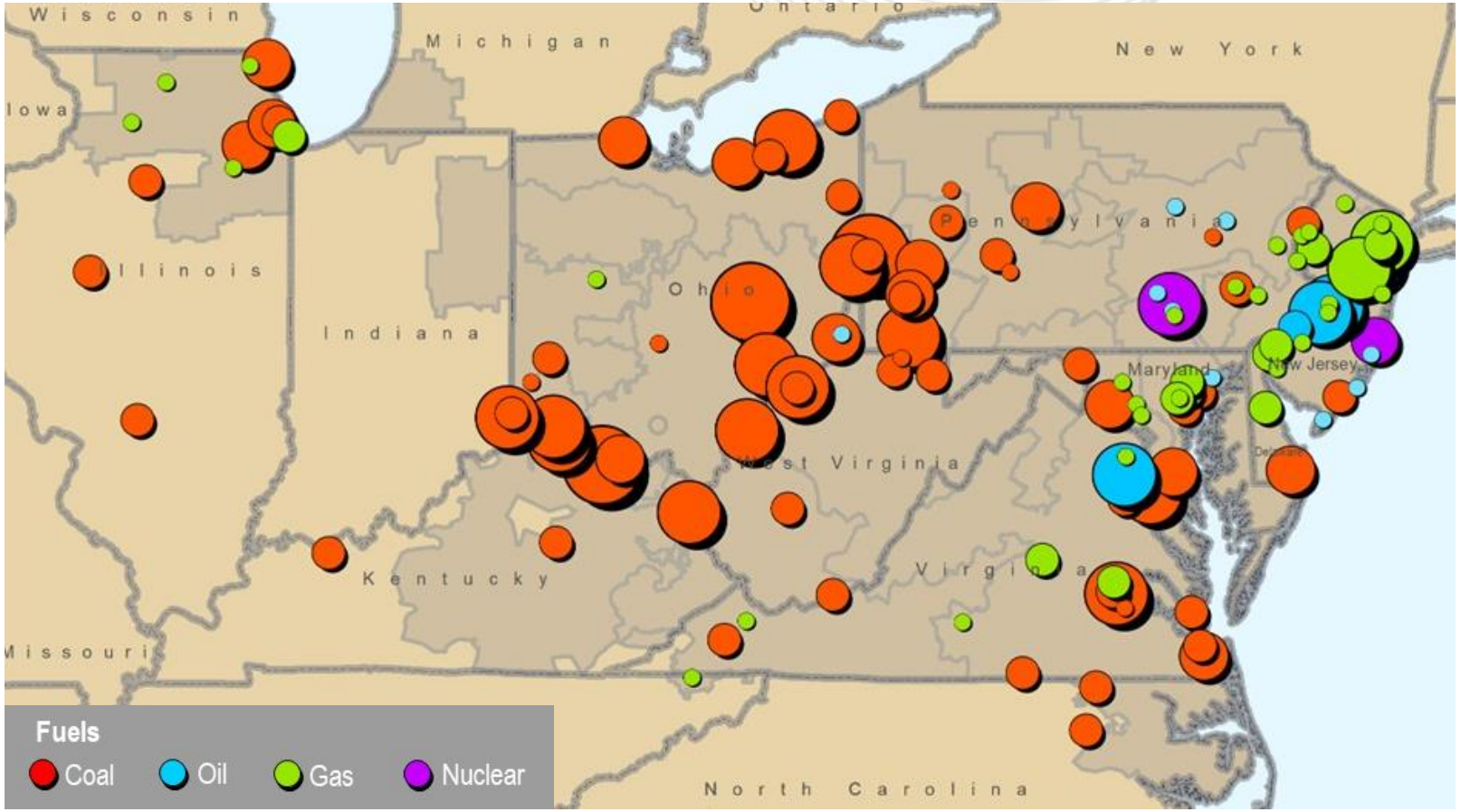
Solar



Onshore Wind	Offshore Wind
Development continues in western PJM and along Allegheny Mountains.	PJM states are collectively targeting 17 GW of wind by 2035.

Solar	Storage
Dominant resource in the PJM queue, with projects in all PJM zones	Recent growth seen in PJM, often following the solar development.

Conventional Generation – Deactivations



Conventional Generation

Coal – Over 30,000 MW retired between 2012 and 2021.

Natural Gas – Once driven by shale gas; growth slowed in wake of renewables expansion.

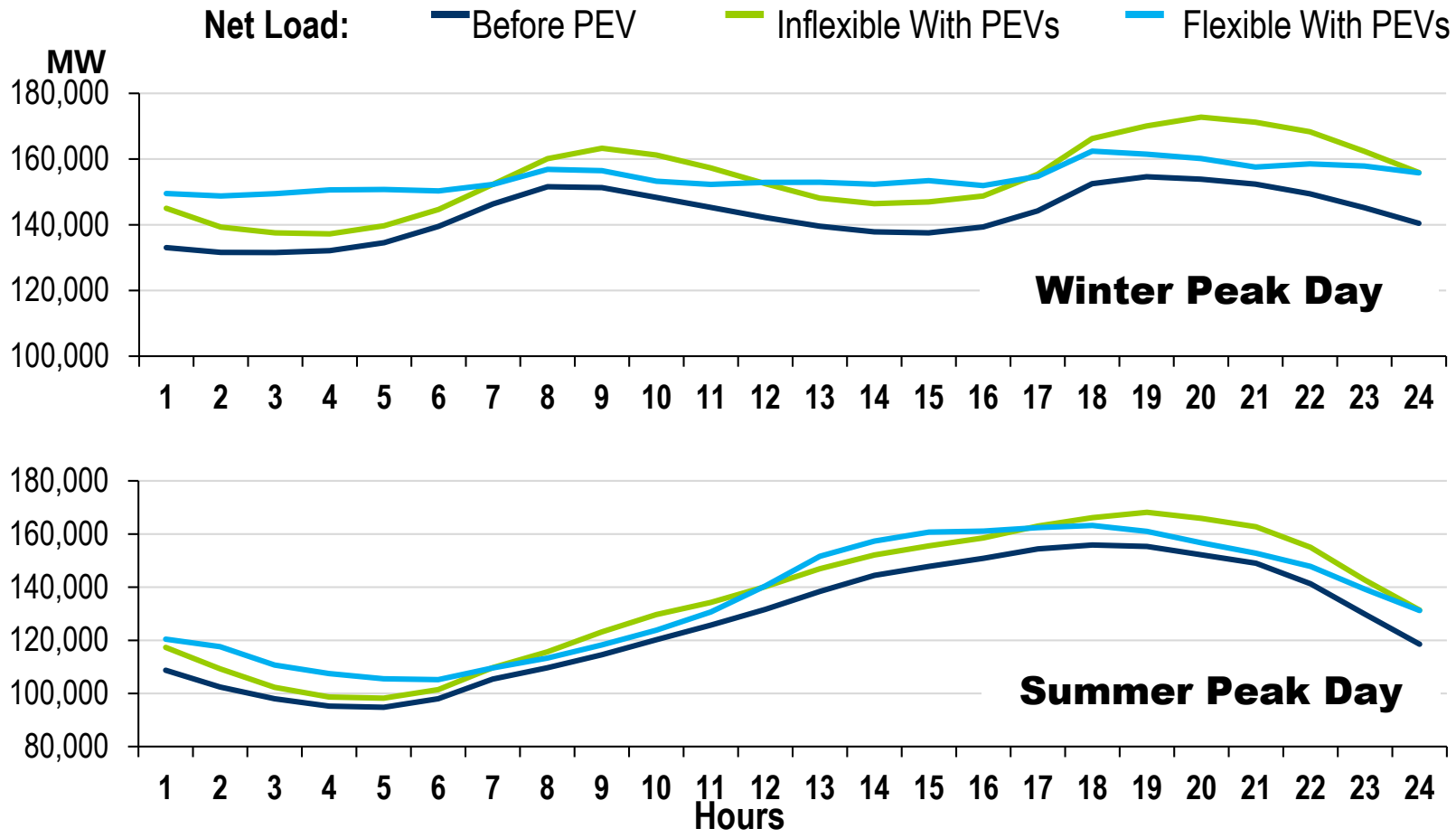
Nuclear – Future is uncertain, impacted by economics, policy, licensing.

Electrification of Transportation

- White House EV target of 50% of light-duty vehicle sales by 2030 may drive accelerated growth. PEV charging could account for ~10% of total RTO energy over next 15 years.
- Energy demand will be impacted by policies that could incentivize charging behavior that shifts charging to off-peak periods, minimizing the impact on the PJM peak load. Otherwise, the demand impact could be more significant.

Potential Future PJM Winter and Summer Peak Day Under PEV Scenario

Load	
Electrification of Transportation	**Electrification of Building Heating**
Growth of plug-in electric vehicles (PEV) will impact peak-day load shapes and drive increased energy consumption.	Growth in electric building heating is less certain due to economics compared to gas/oil heat for PJM; potential load impact could be bigger but likely further in horizon.



Impacts to Transmission Planning

DER

- FERC Order 2222 may accelerate development of DER.
- Need for greater visibility of DER will drive changes in modeling of DER; greater coordination with utilities/state commissions.

Emerging Grid Technologies

- Grid forming inverters
- Dynamic line rating
- Special conductors
- Tower configuration
- Storage as transmission
- Microgrids

Resilience

- Fuel assurance
- Extreme event planning

Planning Enhancements

- Target studies for reliability attributes – inertia, voltage control, stability, ramping and short-circuit current
- Increased probabilistic planning
- 15-year scenario planning
- Scenario planning for future generation
- Interregional planning criteria
- Resilience planning criteria

Insights From Renewable Integration and OSW Studies

To achieve the public policy goals of the PJM states, estimates are that more than 100,000 MW of renewable generation will need to be interconnected:

Wind (18–35 GW)	Solar (25–55 GW)	Storage (2–7 GW)

Initial studies performed for offshore wind, which also included all other RPS goals, indicate transmission grid enhancements will be needed to accommodate the interconnection of renewable resources.	**Near term** ~$627 million
	Long term ~$2.2–3.2 billion

Grid of the Future Road Map

Transmission Build-Out Scenario Studies – Develop scenarios to identify transmission for policy case and accelerated scenario

Targeted Reliability Studies – Additional studies that will focus on reliability attributes and build on prior scenario studies

RTEP Process Enhancements

- Modeling wind and solar in generator deliverability analysis
- DER modeling
- ELCC development
- Resilience
- Improve load forecast

Regulatory Policy Impacts

- Federal and state policies – renewables, electrification
- Long-term transmission planning (ANOPR) and Interconnection Process Reform
- State Agreement Approach (SAA)

DOE/NREL Studies – Partner with/engage with DOE, national labs and neighbors on interregional studies – National Transmission Study and Atlantic Shore OSW Transmission Study

Contact

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