

# Energy Transition in PJM: Frameworks for Analysis

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December 15, 2021



Facilitate Decarbonization



Grid of the Future



Innovation

## THE ENABLING FOUNDATION



Maintain Reliability



Stakeholder Engagement and Governance



Risk Management



Workforce Development



Efficiencies of Scale



CULTURE

Monitor Developments



## Industry Research/Outreach

- Leverage PJM's work: GE (2012), MOPR, Offshore Wind Study, Carbon Pricing.
- Review industry experience: CAISO, MISO, NERC, ESIG, NREL, SPP, ERCOT.



## Analytics Markets/Operations

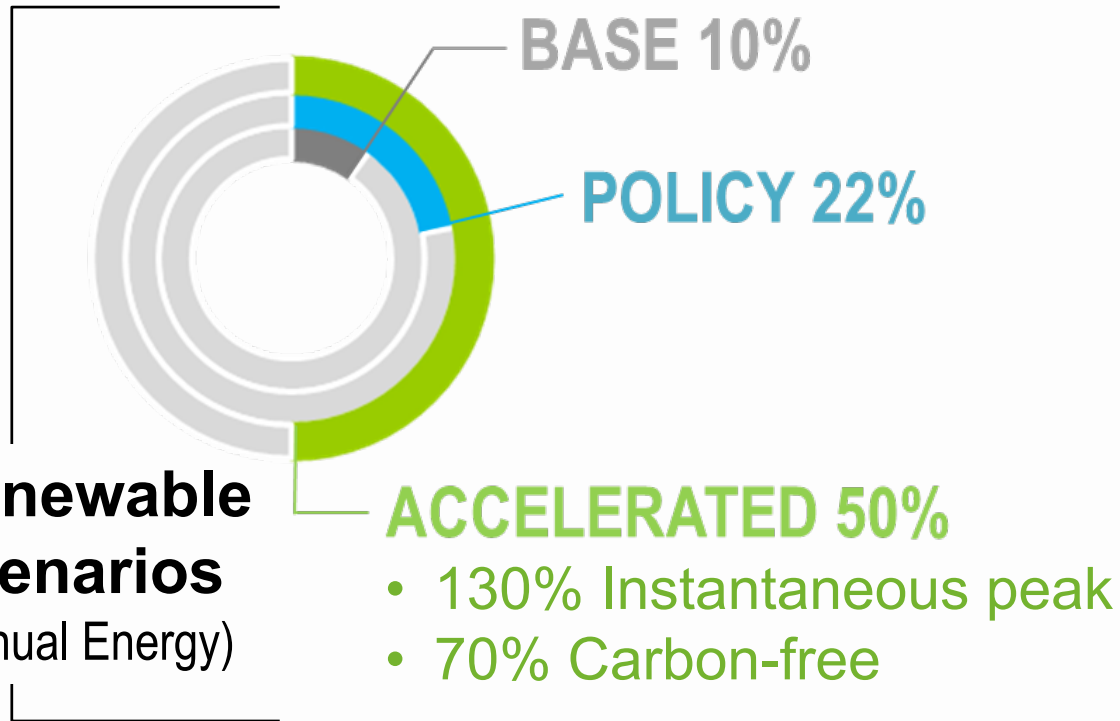
- Understand the impact of renewables in the context of PJM.
- Identify tipping points.



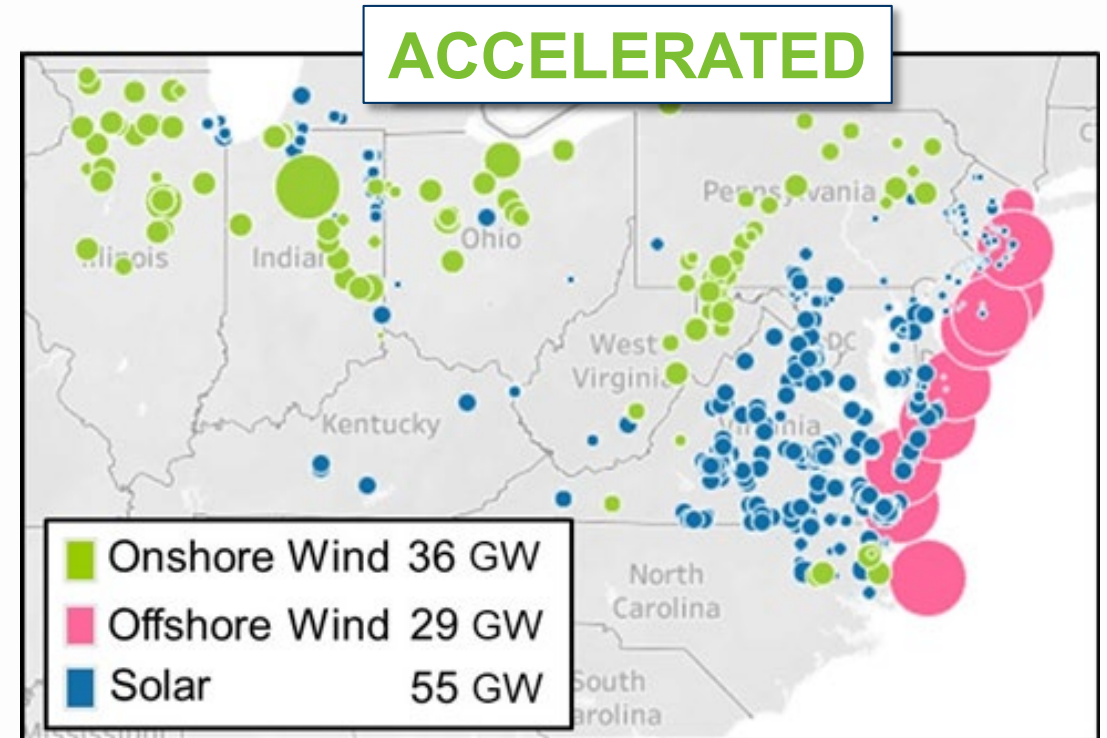
## Takeaways

- We do not propose solutions (it is not a position piece).
- The intent is to inform and initiate discussion on changes that may be required given industry trends.

“**Living study**” to identify gaps and opportunities. The initial findings should not be regarded as expected outcomes, but as bookends to be refined as the study progresses.



Note: Policies and Market rules “as-is” April 2020.





**Correctly Calculating Capacity Contribution of Generators is Essential**



**Flexibility Becomes Increasingly Important with Growing Uncertainty**



**Thermal Generators Provide Essential Reliability Services and an Adequate Supply Will Be Needed Until a Substitute is Deployed at Scale**



**Regional Markets Facilitate a Reliable and Cost-Effective Energy Transition**



**Reliability Standards Must Evolve**

## Focus Area No. 1



## Correctly Calculating Capacity Contribution of Generators is Essential

### KEY INDICATORS

- 70% nameplate capacity on top of the forecast peak load to satisfy 1-in-10-year LOLE
- 130% instantaneous penetration of renewables

### OPPORTUNITY

Continuously improve and incorporate sophisticated methods to accurately account for the capacity value contribution of all generation resources



## Focus Area No. 2



## Flexibility Becomes Increasingly Important With Growing Uncertainty

### KEY INDICATORS

- 50% steeper net-load ramps
- Frequent dispatch of generators to EcoMin
- Lower capacity factors for thermal resources
- Average LMP decreases by as much as 26%

### OPPORTUNITY

Procuring flexibility through market-based methods ensures that the true need for ancillary services is transparently priced and competitively procured in a cost-effective manner.

## Focus Area No. 3



## Thermal Generators Provide Essential Reliability Services; An Adequate Supply will be Needed Until a Substitute is Deployed at Scale

### KEY INDICATORS

- As renewable penetration increases, there is an overall decline of essential reliability services.
- Robust interconnection lessens wide-area impacts.

### OPPORTUNITY

Today, thermal resources supply essential reliability services. Until a different technology can provide a reliable substitute at scale, an adequate supply of thermal resources will be needed to maintain grid stability. PJM and stakeholders must ensure that the market structure provides the right incentives to maintain these services.



## Focus Area No. 4



## Regional Markets Facilitate a Reliable and Cost-Effective Energy Transition

### KEY INDICATORS

- Exports increased by 140%.
- 20 GW peak interchange with MISO.
- Changes in congestion patterns.
- 10% renewable curtailment.
- Geographically-diverse renewable generation cut in half the ramping requirements.

### OPPORTUNITY

The economies of scale, geographical diversity and robust transmission system of PJM Interconnection facilitate an efficient and reliable integration of renewable resources. Study results suggest an opportunity for strategic regional transmission expansion, grid-enhancing technologies, and an increased need for storage.

## Focus Area No. 5



## Reliability Standards Must Evolve

### KEY INDICATORS

- Increasingly critical infrastructure interdependences (transportation, heating, etc.).
- Impacts of extreme weather events (Texas winter event).

### OPPORTUNITY

Reliability cannot be achieved in a vacuum. In order to facilitate a reliable energy transition, the evolution of PJM's markets, operations and transmission planning must be accompanied by the advancement of comparable reliability requirements across interdependent infrastructure.



## Additional Sensitivities

- Electrification
- Generation retirement
- Energy storage and hybrid resources
- Interchange



## Essential Reliability Services

Quantitative analysis of ERS



## Transmission Expansion

Transmission upgrades for system reliability and efficiency



## Market Design

- Downward sloping ORDC
- Updated ELCC rules

# APPENDIX

## Generation



- ✓ ELCC: wind/solar
- ✓ Retirements: declared, policy and “at-risk”
- ✓ Renewable hourly profiles based on geographical location (NREL)
- ✓ Storage **not** modeled
- ✓ Off-shore wind explicitly modeled

## Transmission



- ✓ Interchange respects available transfer capability
- ✓ Methodology for transmission expansion
- ✓ Neighboring RTOs maintain status-quo

## Load



- ✓ DR: ~7 GW.
- ✓ Load Forecast 2035: implicitly models energy efficiency, DER and electrification

## Markets



- ✓ As-Is 2020: **not** modeling ORDC, fast start, renewables do not participate in reserves, etc.
- ✓ Projected fuel & commodity prices (IHS).
- ✓ RGGI Carbon Pricing in VA, PA, MD, DE, NJ