Electricity Markets 101

September 9, 2021

NATIONAL GOVERNORS ASSOCIATION

Electricity Markets Plan

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Speakers

- Mark Lebel, Associate, Regulatory Assistance Project
- Evelyn Robinson, Managing Partner, State Government Affairs, PJM Interconnection

September 9th, 2021

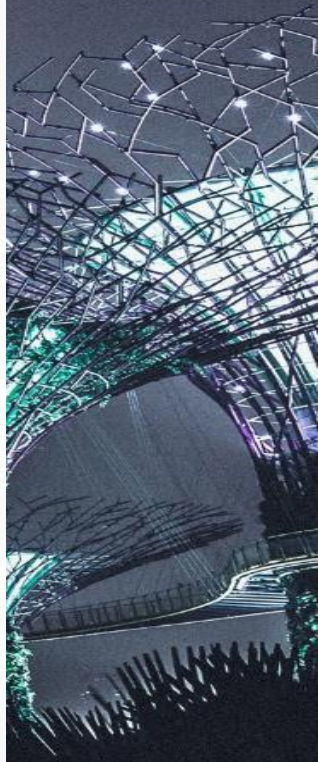
History and Theory of Wholesale Electricity Markets

National Governors Association – Webinar on Electricity Markets 101

Mark LeBel
Associate
Regulatory Assistance Project (RAP)®

50 State Street, Suite 3
Montpelier, Vermont 05602
USA

802-498-0732
mlebel@raponline.org
raponline.org



Early Regulatory Developments

- Early competition to provide electricity service started in cities in late 19th century
- State regulation begins in early 20th century and includes state-backed monopoly service territories
  - Natural monopoly and “wasteful competition”
- Federal legislation and regulation fills an important role starting in the 1930s
  - “Interstate commerce” gap
  - Break-up of major interstate utility conglomerates
  - Expansion of rural service

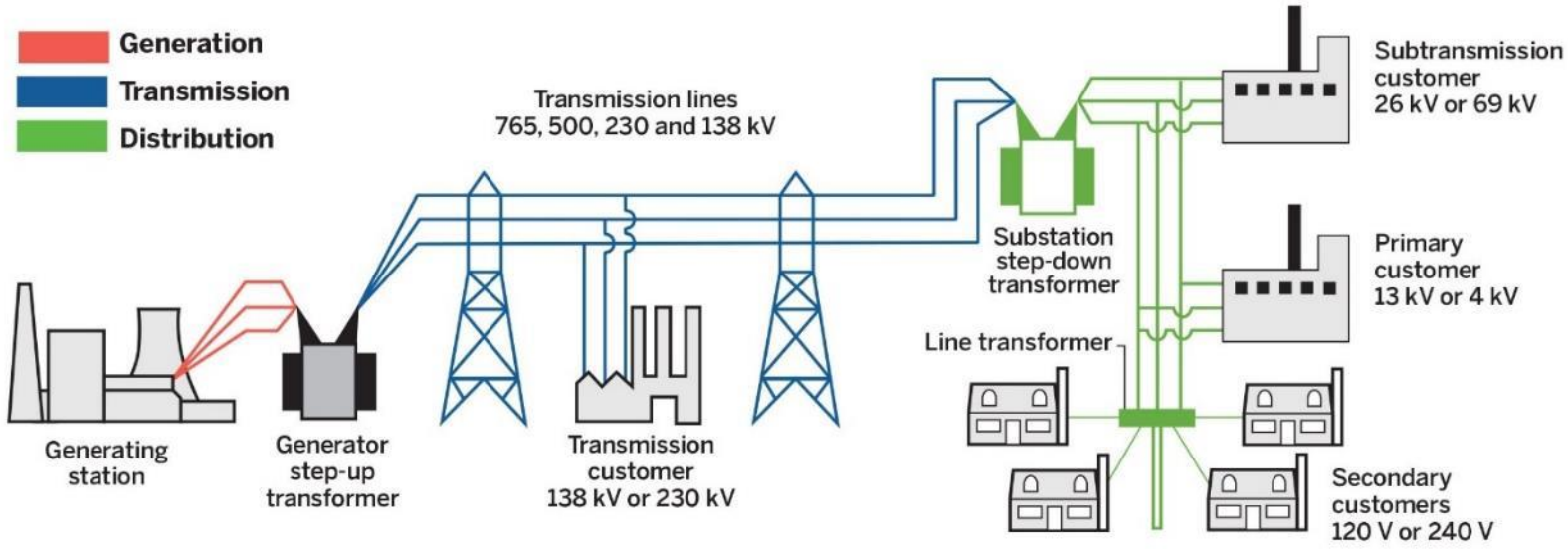
Pearl Street Station, first commercial power plant in the United States

Source: Wikipedia. *Pearl Street Station*

Vertically Integrated Utilities Rule the Earth in the mid-20th century

- Majority of electric service provided by utilities that own generation, transmission, and distribution assets
  - Most generation is either steam turbines or hydroelectric
- Cost-of-service ratemaking is predominant model
  - FERC Uniform System of Accounts
- Wholesale sales in interstate commerce regulated by FERC
  - Sales to smaller utilities (e.g., munis and coops)
  - Purchased power agreements
  - Informal sales and trading

Traditional Electric Utility



Source: Adapted from U.S.-Canada Power System Outage Task Force. (2004). *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*

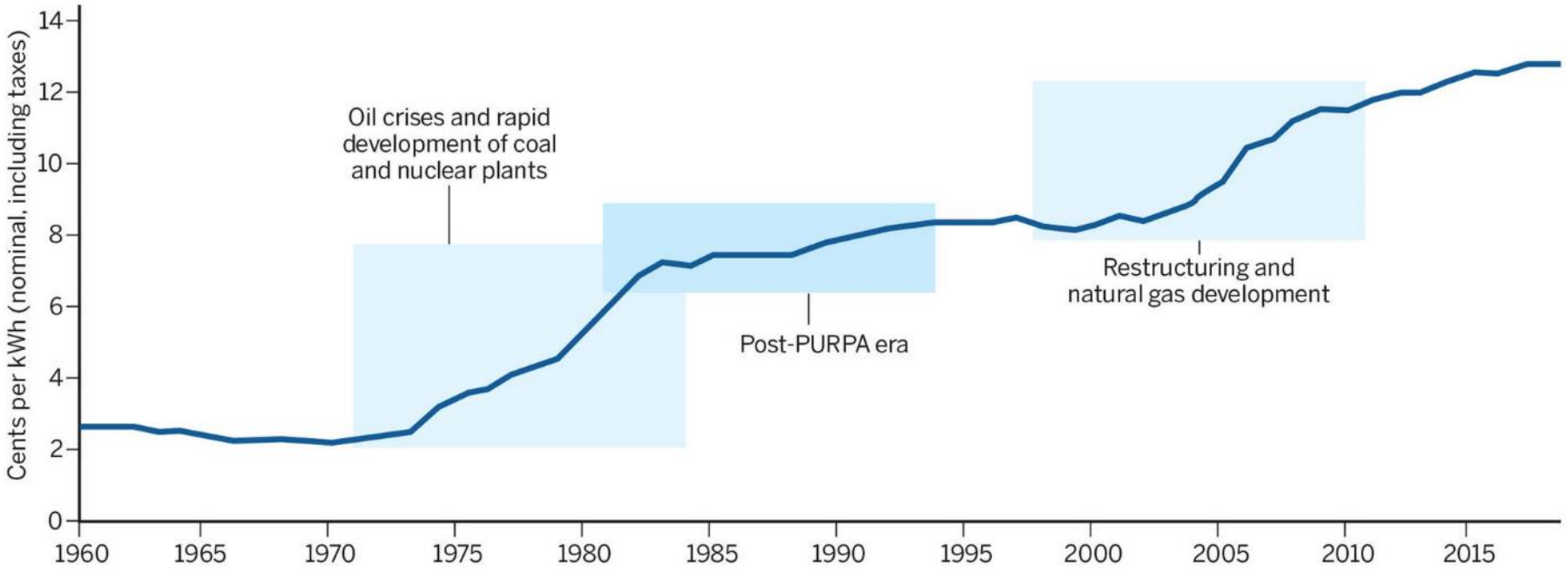
The Foundations Shake

- Nuclear power and combustion turbines are established as viable technologies in 1950s and 1960s
  - Combined cycle generation becomes viable in 1980s and 1990s
- Major northeast blackout in 1965
- International oil crises in 1970s have major economic impacts across many different fuel and electricity markets
- “Deregulatory” movement gains steam in 1960s and 1970s across all industries
  - Key academic work specific to electricity in the 1980s

Issues with Traditional Utility Structure and Regulation

- Cost-plus revenue structure provides little incentive for cost control
- Incentive to make large capital investments but little incentive to operate reliably and efficiently
- Little incentive to coordinate with neighboring utilities and jurisdictions
- Customer choice of supply presents thorny regulatory issues

U.S. Average Electricity Prices Over Time



Data source: U.S. Energy Information Administration. (2019, March). *Monthly Energy Review*

Controversies Under the Traditional Regulatory Model

- New generation technologies eroded typical economies of scale for utilities starting in the 1970s
  - No longer a natural monopoly for generation
- Partly in reaction to higher fuel prices, utilities made major capital investments in nuclear and coal plants
  - Nuclear cost overruns led to cost disallowances and litigation
- Integrated resource planning starting in the 1980s was another set of reforms that lives on in many places
  - Incorporates both supply and demand-side options
- Industrial customers demanded lowest rates possible as cost of new supply undercut historic embedded costs

Goals of Wholesale Electricity Generation Markets

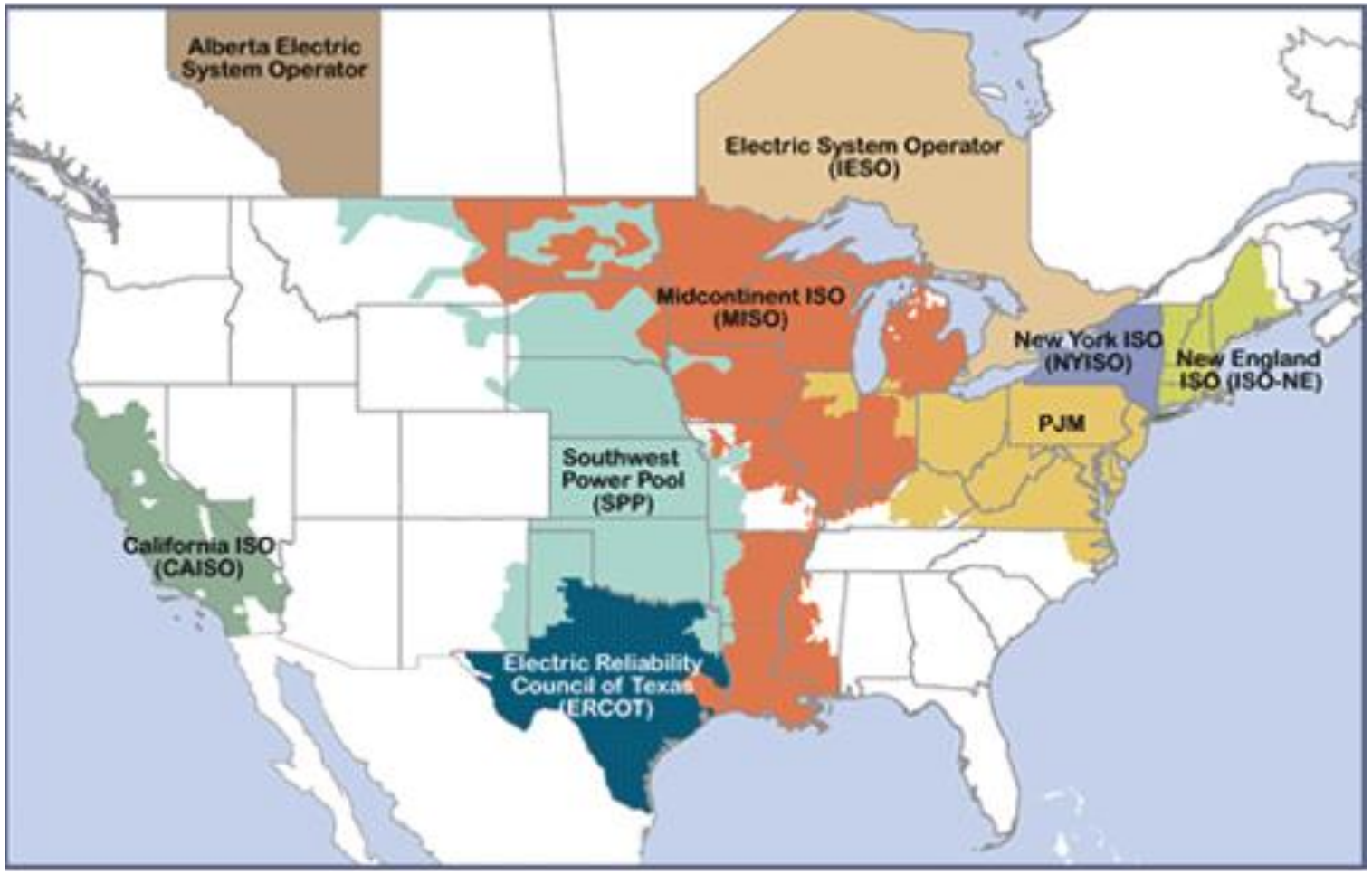
- Efficient and coordinated regional dispatch of electric generation units
  - “Bid-based, security-constrained, economic dispatch with locational prices”
- Efficient entry of new plants and exit of uneconomic plants
- Customer choice
- Efficient achievement of public policy goals

Key Federal Policies

- Key Federal laws
  - Public Utility Regulatory Policies Act of 1978
    - Long-term contracts for small independent generation and renewables
  - Energy Policy Act of 1992
    - Key policies to enable wholesale electricity markets
    - Amendment of Public Utility Holding Company Act of 1935
  - Energy Policy Act of 2005
    - Additional wholesale electricity market policies
    - Repeal of Public Utility Holding Company Act of 1935
- Key FERC Orders
  - Orders 888 and 889 in 1996 – Open access transmission, information sharing, and regional planning
  - Order 2000 in 1999 – encouraged formation of Regional Transmission Organizations (RTOs)

State Restructuring Policies

- Restructuring of asset ownership varied by state
  - Divestment of generation assets owned by utilities
  - Separation of asset ownership within utilities
  - Rules for transactions with other utility affiliates
- Many states who joined ISOs/RTOs did not require divestment or kept generation resource adequacy responsibility
- Structure of supply procurement for retail customers
- Origin of renewable portfolio standards and energy efficiency policies in several states


Alberta Electric System Operator
Electric System Operator (IESO)
Midcontinent ISO (MISO)
New York ISO (NYISO)
New England ISO (ISO-NE)
PJM
Southwest Power Pool (SPP)
California ISO (CAISO)
Electric Reliability Council of Texas (ERCOT)

Key Implementation Issues

- Prevention of market power and manipulation
- Stranded costs for legacy generation assets
- Planning and rules for reliability
- Market products and definitions
- Transmission planning and competition
- Integration of demand-side and distribution level resources
- Debate over state energy and environmental policies

About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org

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Electricity Markets

Evelyn Robinson, Managing Partner

PJM Interconnection

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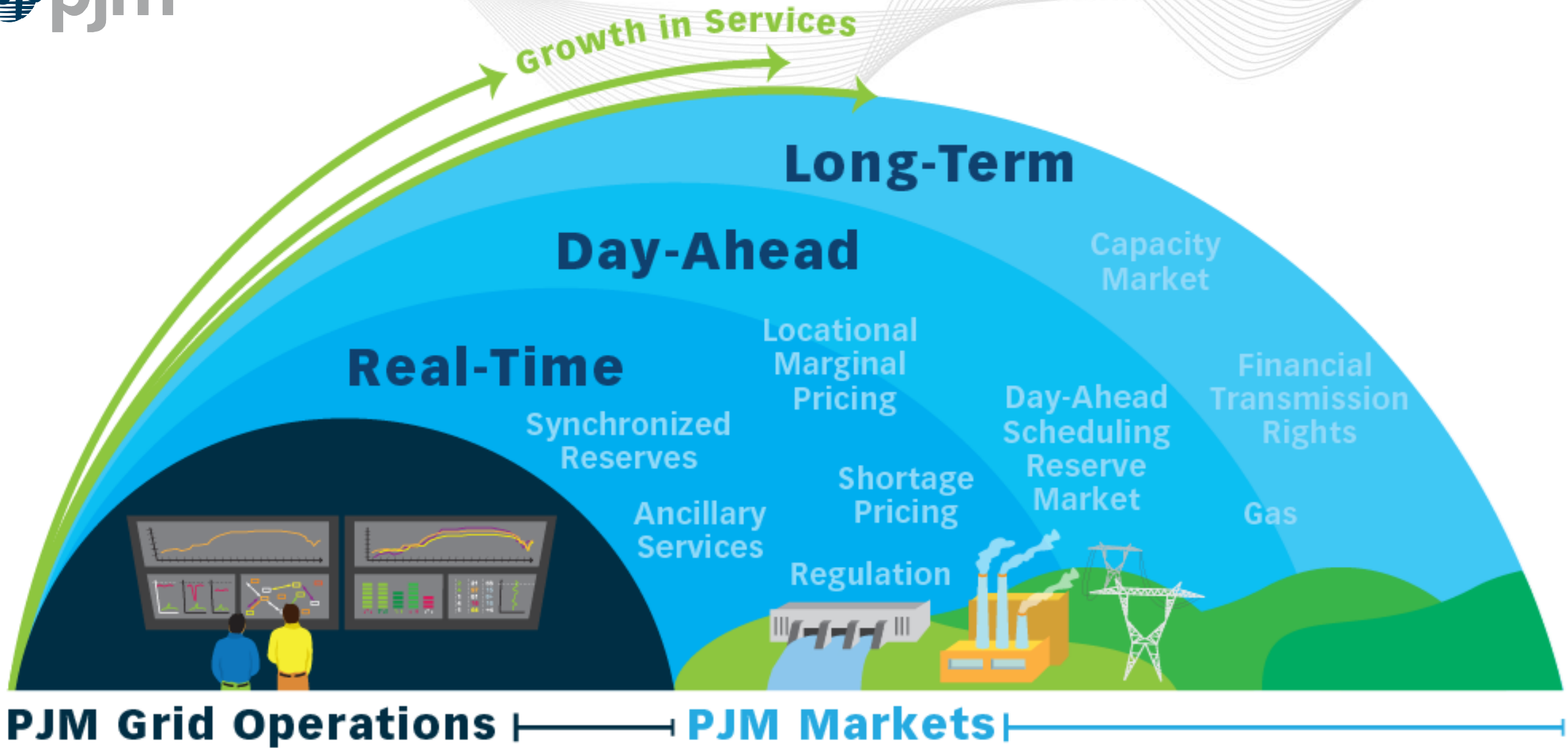
PJM Markets



Two Market Settlement

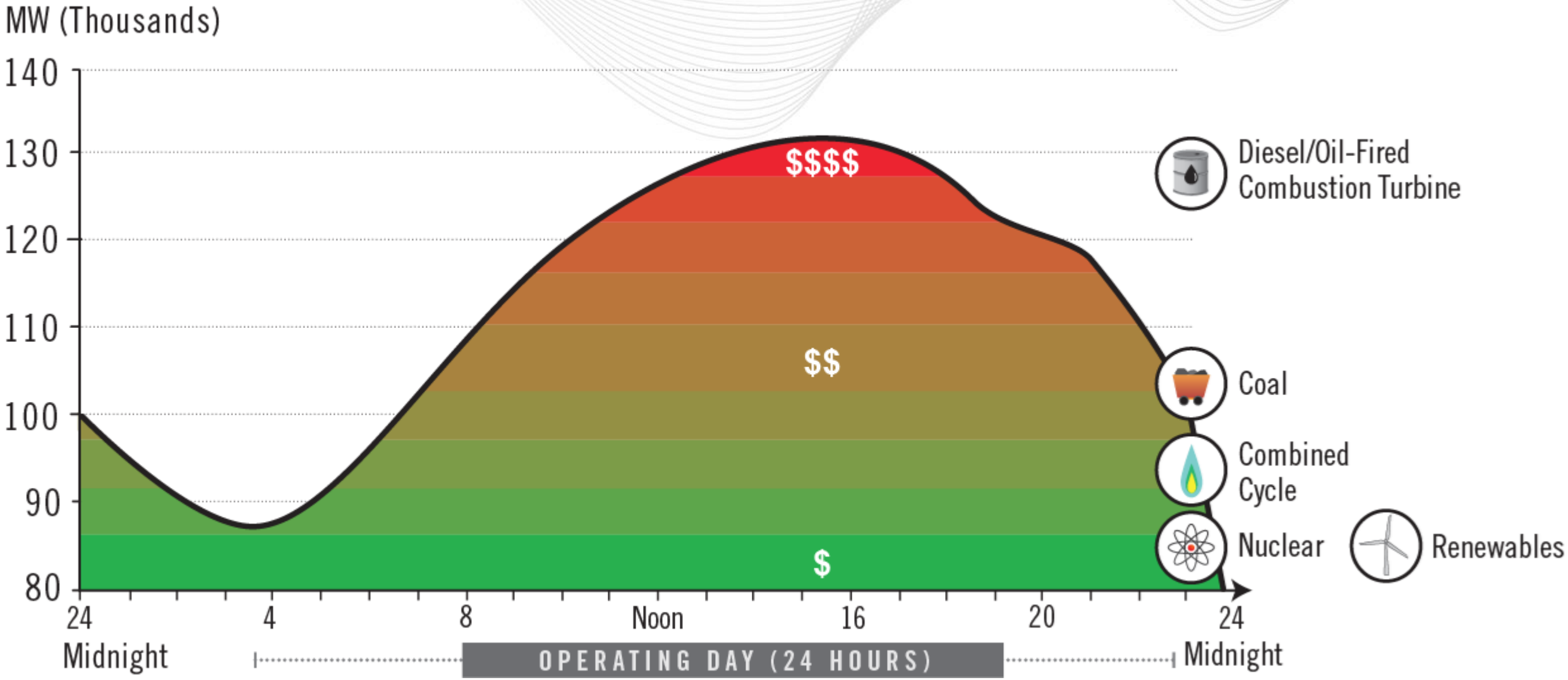
Day-Ahead Market

- Financial market using ***Bid-In Load***
- Prices calculated hourly/hourly settlements
- Includes virtual bids and price-sensitive demand

Real-Time Market

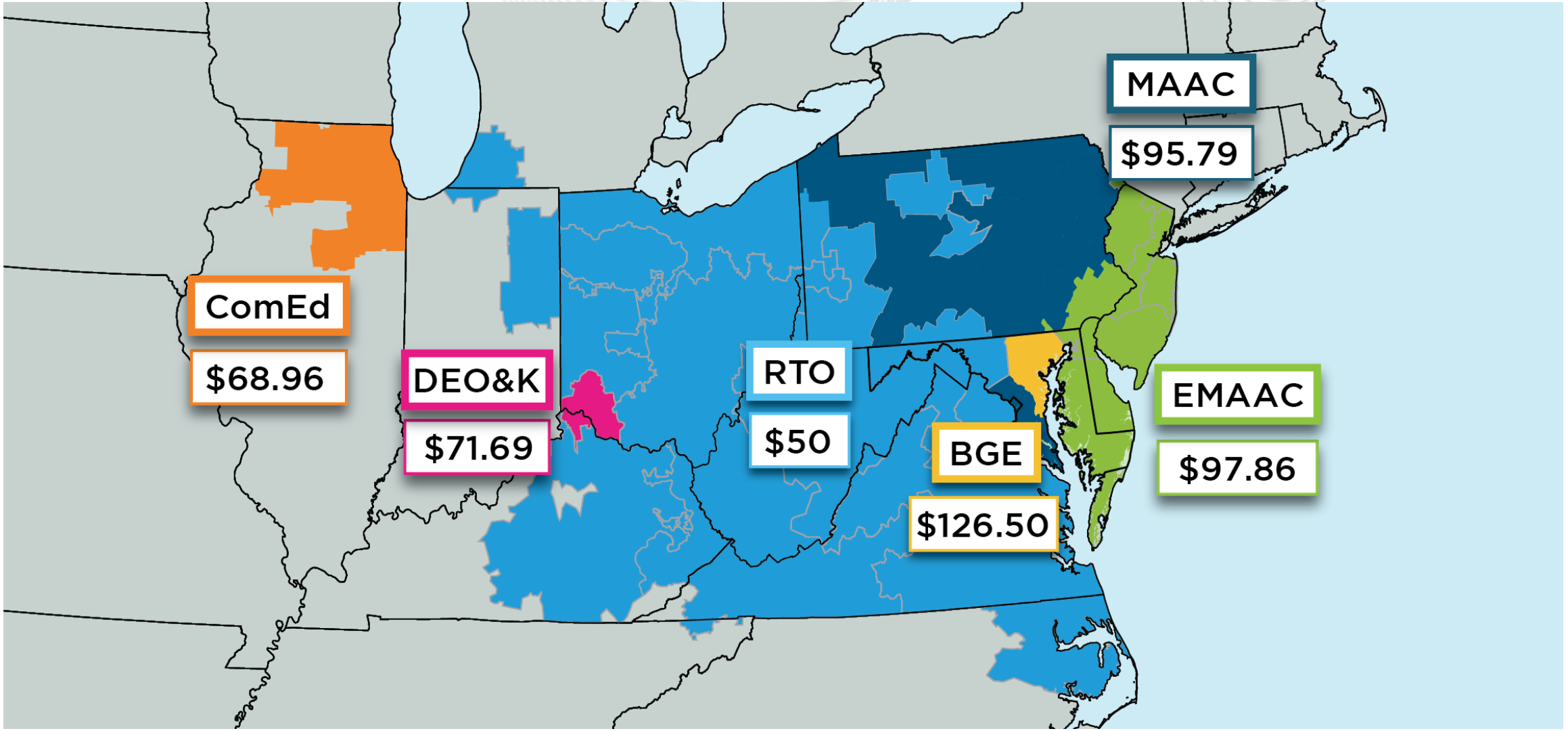
- Physical market based on actual system conditions
- Prices calculated every five minutes
- Hourly settlements based on deviations from day-ahead position

Energy Market – Economic Dispatch



PJM Capacity Market

2022/2023 Base Residual Auction Clearing Prices ($/MW-Day)



Regulation:

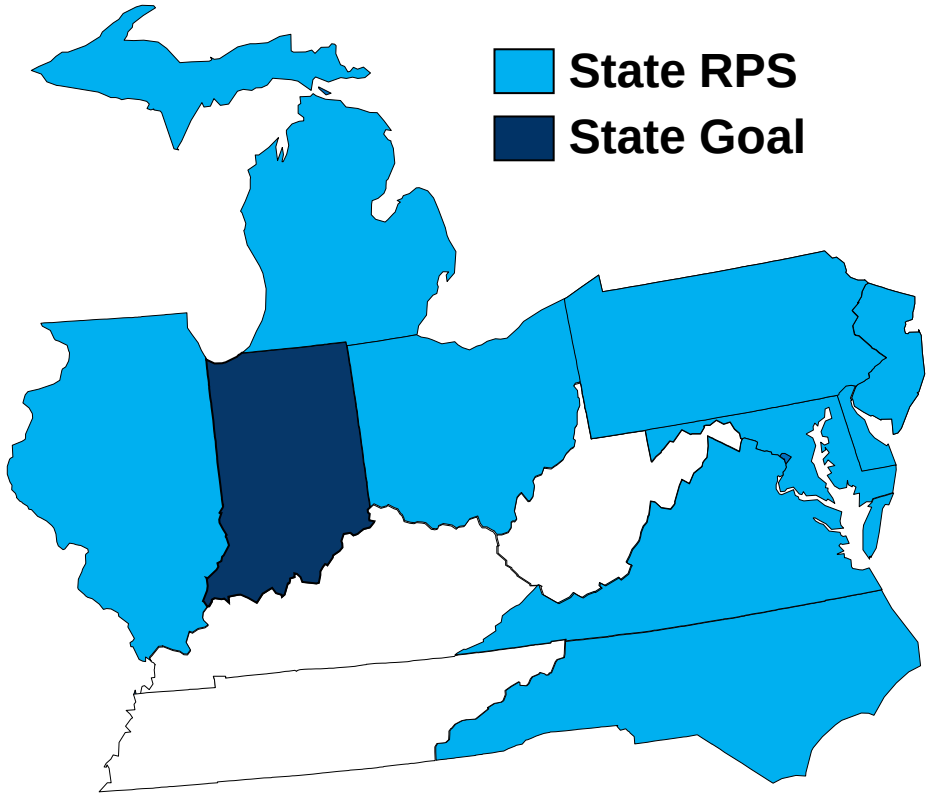
Used to control small mismatches between generation and demand load for effective system frequency control

Synchronized and Non-Synchronized Reserves:

Supply electricity if the grid has an unexpected need for more power on short notice

PJM States With RPS

State Renewable Portfolio Standards (RPS) require suppliers to utilize renewable resources to serve an increasing percentage of total demand.



Feb. 2021

State RPS Targets*

- ☼ **NJ:** 50% by 2030**
- ☼ **MD:** 50% by 2030
- ☼ **DE:** 40% by 2035
- ☼ **DC:** 100% by 2032
- ☼ **PA:** 18% by 2021***
- ☼ **IL:** 25% by 2025-26
- ☼ **VA:** 100% by 2045/2050 (IOUs)
- ☼ **NC:** 12.5% by 2021 (IOUs)
- **OH:** 8.5% by 2026
- **MI:** 15% by 2021
- **IN:** 10% by 2025***

☼ Minimum solar requirement

* Targets may change over time; these are recent representative snapshot values.
** Includes an additional 2.5% of Class II resources each year.
*** Includes non-renewable "alternative" energy resources.

State Agreement Approach

Allows a state (or states) to include their public policy requirements in PJM's planning parameters, thereby enabling PJM to open a competitive window and solicit potential transmission solutions to advance the public policy.

Cost Allocation:

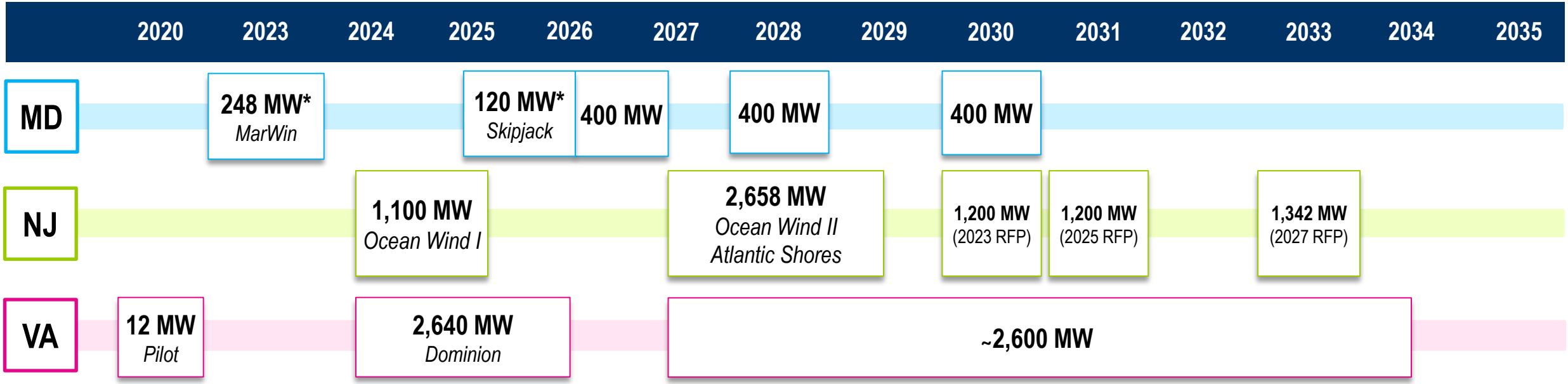
"All costs related to a state public policy project or Supplemental Project included in the Regional Transmission Expansion Plan to address state Public Policy Requirements pursuant to this Section shall be recovered from customers in a state(s) in the PJM Region that agrees to be responsible for the projects. ***No such costs shall be recovered from customers in a state that did not agree to be responsible for such cost allocation."***

PJM Operating Agreement, Schedule 6, section 1.5.9(a)

In November 2020, the New Jersey Board of Public Utilities initiated the State Agreement Approach to solicit transmission proposals that would accommodate the integration of up to 7,500 MW of offshore wind by 2035.

Offshore Wind Targets in PJM States

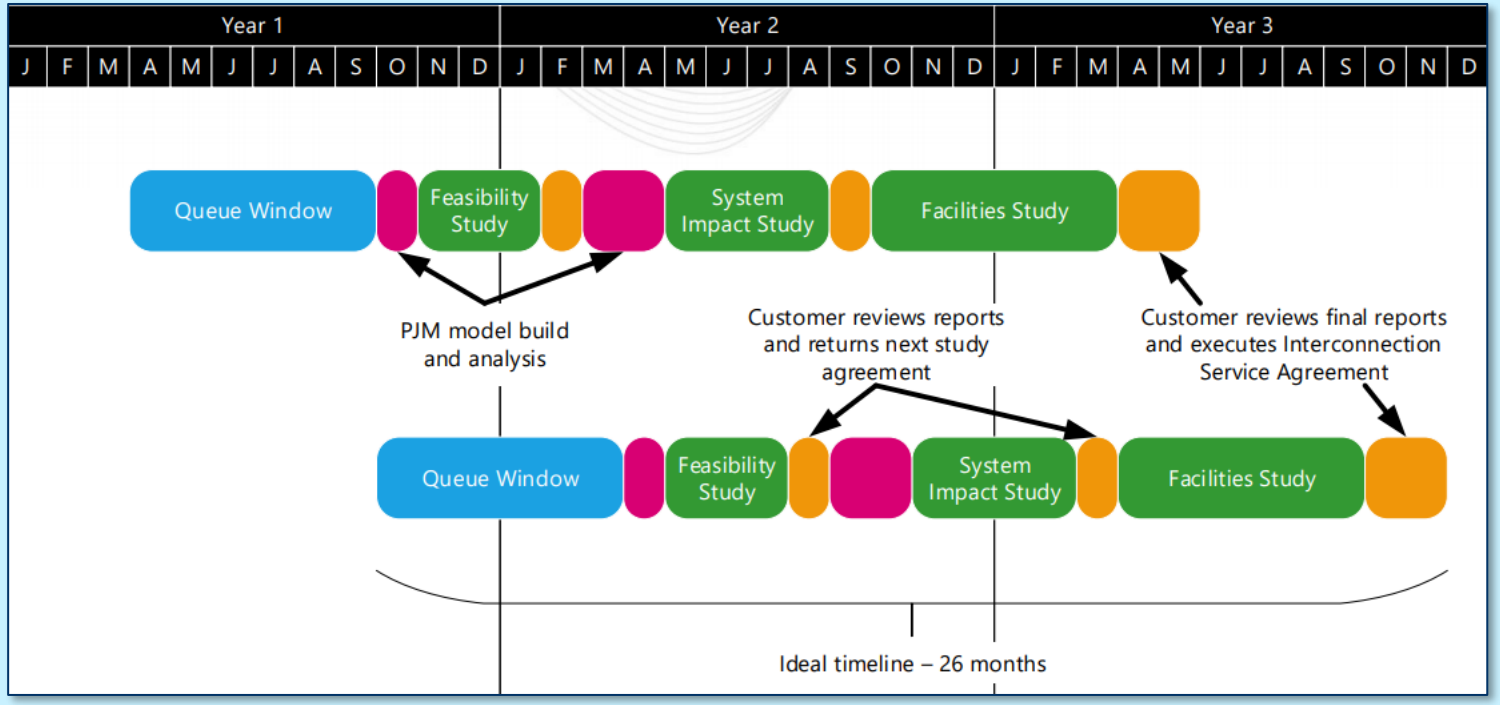
	Maryland	New Jersey	Virginia
	Target: **1,568 MW by 2030**	Target: **7,500 MW by 2035**	Target: **5,200 MW by 2034**
POLICIES	• Maryland PSC Order No. 88192 (2017) • Clean Energy Jobs Act of 2019	• Clean Energy Act of 2018 • Executive Order No. 92 (2019)	• Virginia SCC Order (2018) • Virginia Clean Economy Act of 2020



*Subject to delay; **NC announced offshore wind target of 8,000 MW by 2040 per Executive Order No. 218 (2021).

Transmission Planning Reform

Current Interconnection Phases and Ideal Timeline



- PJM is evaluating ways to reform its interconnection process.
- Influx of projects are causing delays in study phases.
- Goal is to get process back on schedule and accommodate changing resource mix entering interconnection queue.

PJM and stakeholders are also engaging on broader transmission planning issues relating to regional planning, cost allocation and accommodating more intermittent resources, among other relevant topics.

Thank You!