Capacity Market Design: The PJM Experience

USEA EMI Webinar:

"*Capacity Markets for Power Generation: Key Features and Potential Application to Southeast Europe*

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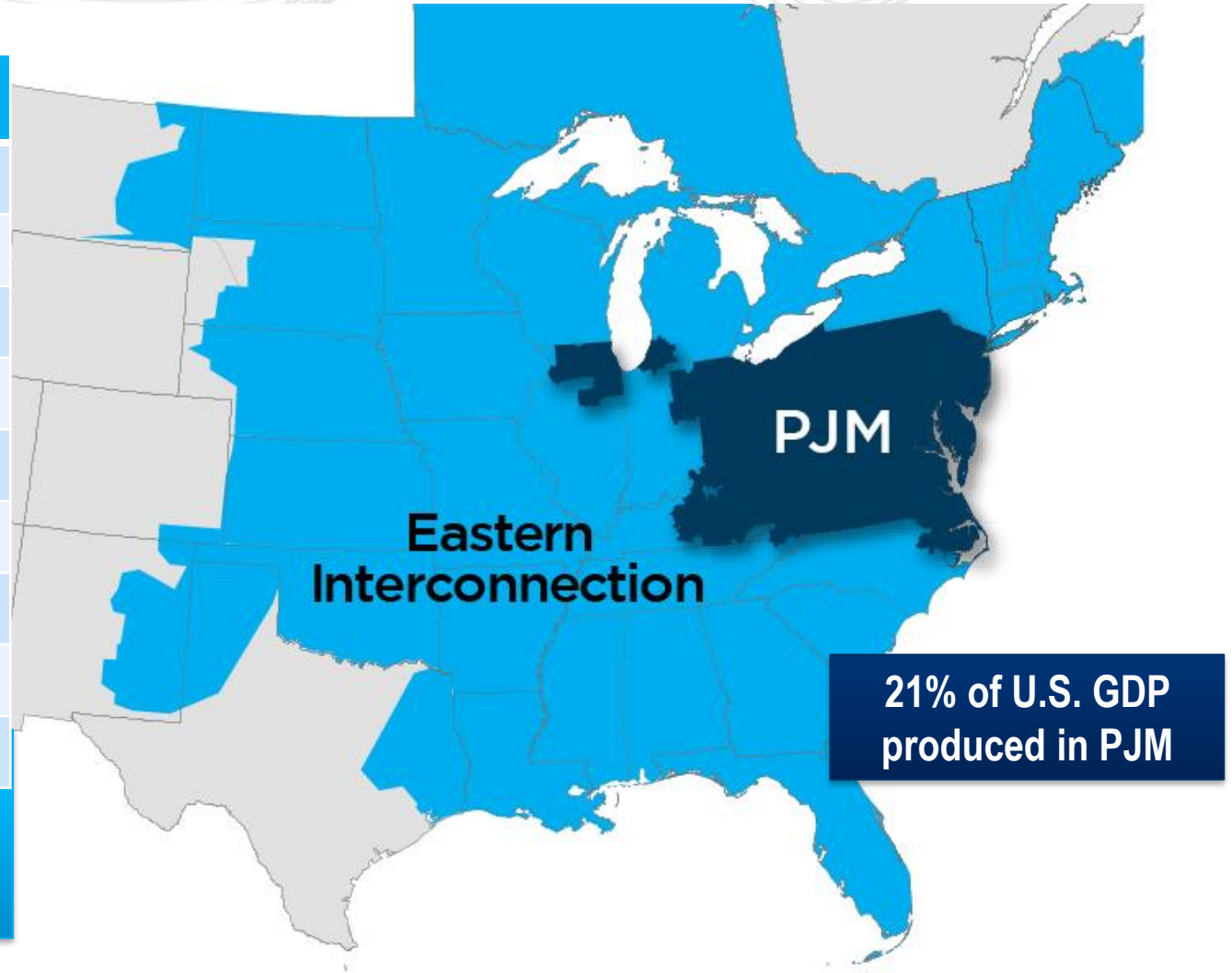
PJM Interconnection

PJM – Primary Focus

PJM as Part of the Eastern Interconnection

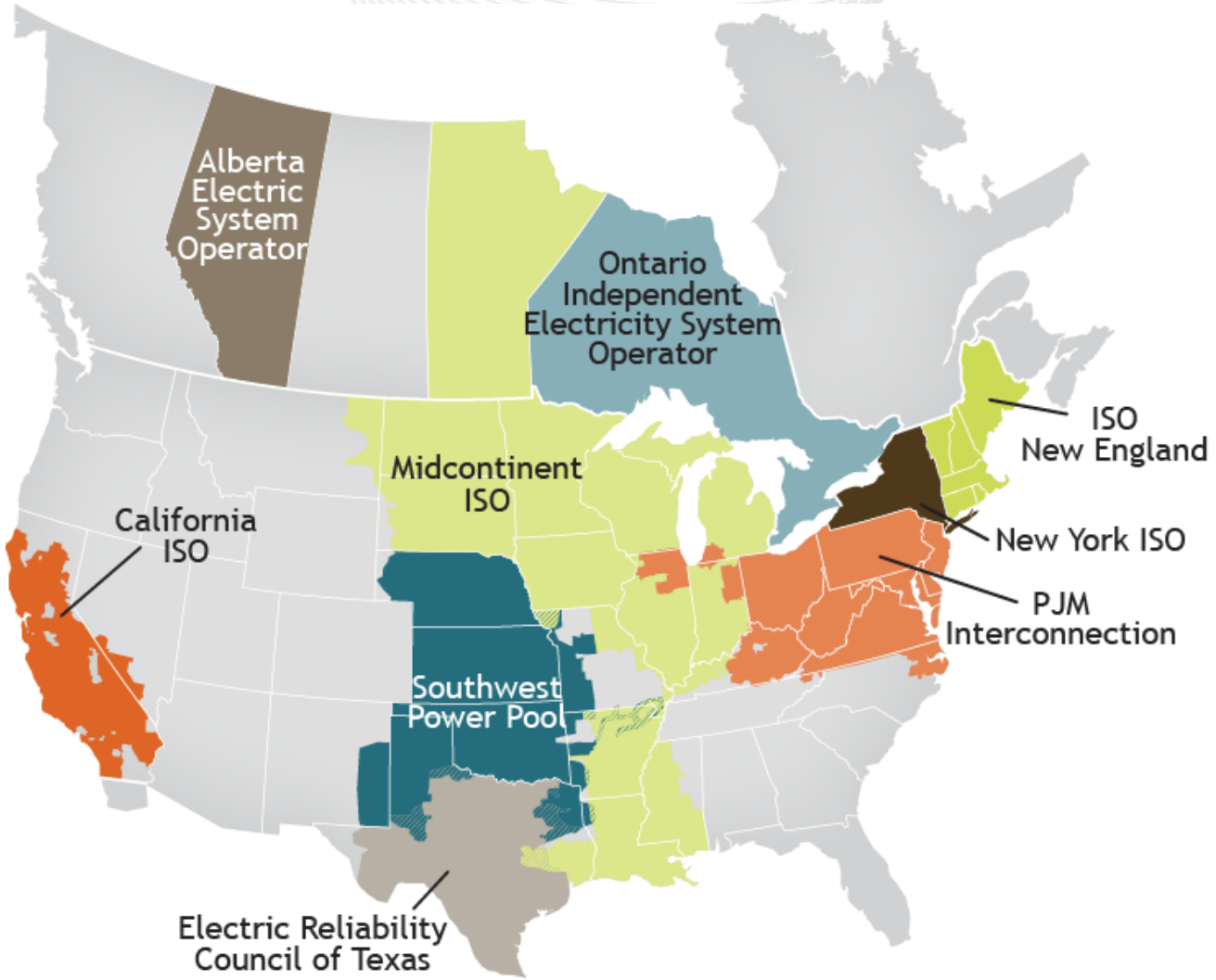
Key Statistics	
Member companies	1,010+
Millions of people served	65
Peak load in megawatts	165,492
MW of generating capacity	180,086
Miles of transmission lines	84,236
2018 GWh of annual energy	806,546
Generation sources	1,379
Square miles of territory	369,089
States served	13 + DC

- 26% of load in Eastern Interconnection
- 20% of transmission assets in Eastern Interconnection

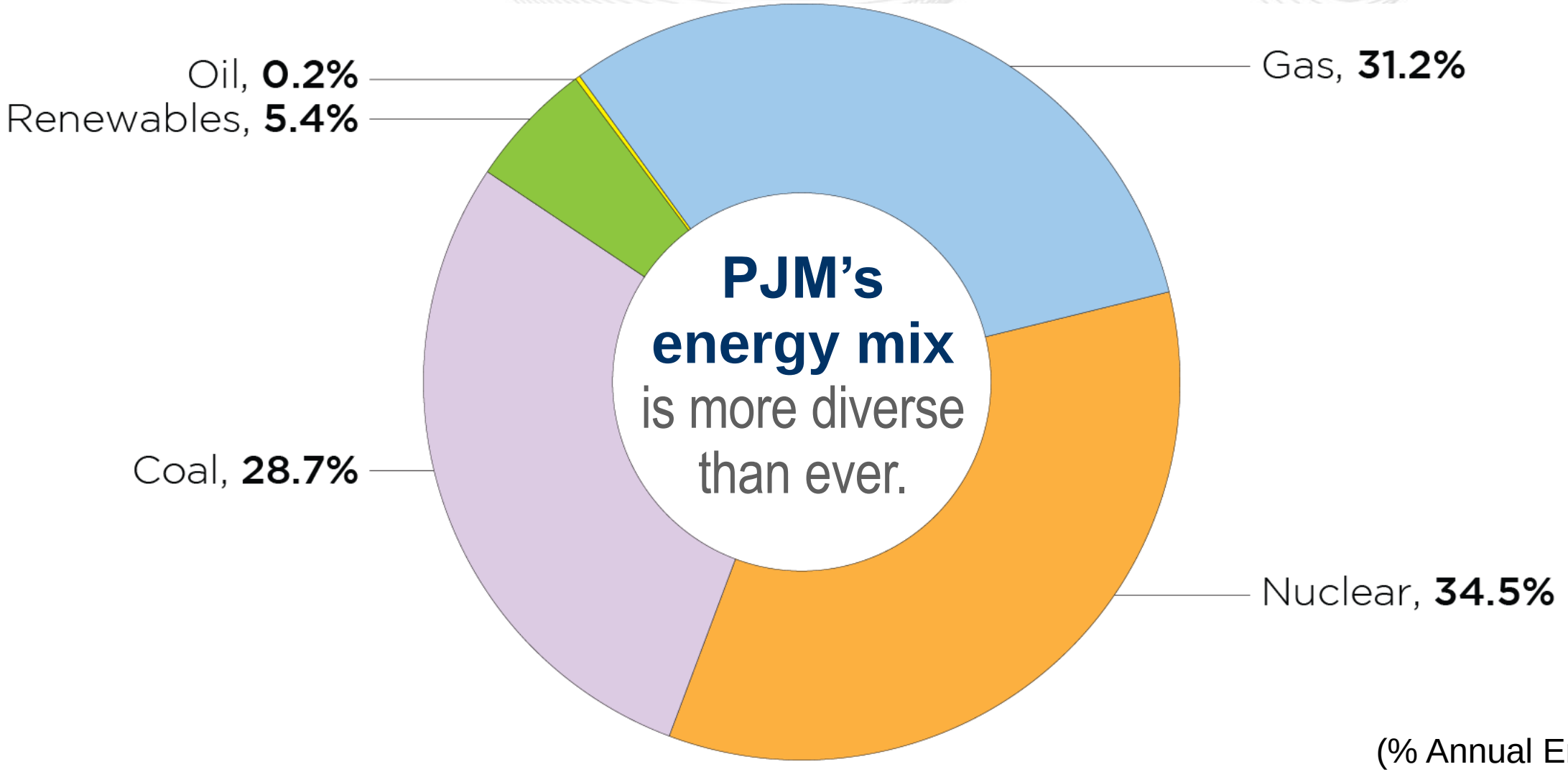


As of 1/2019

ISO/RTOs

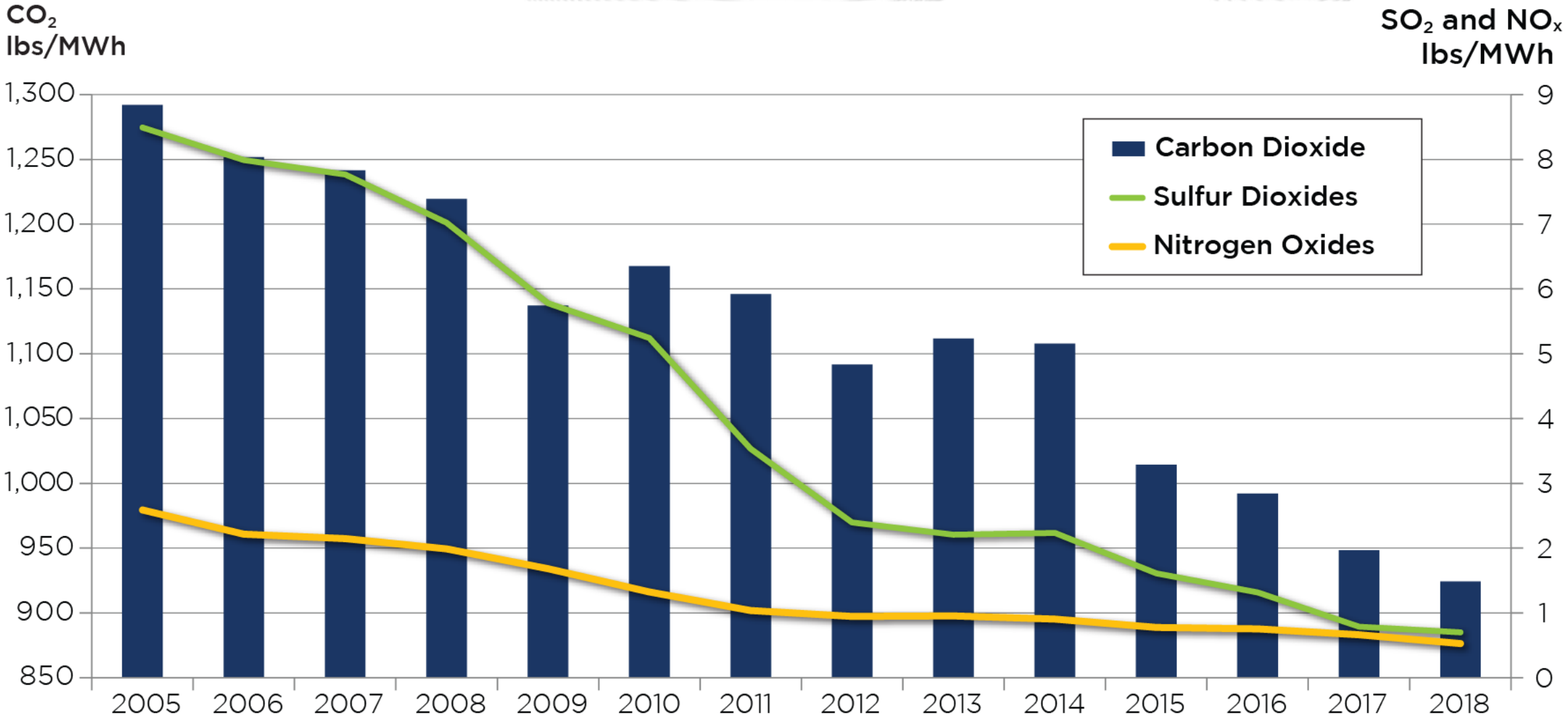


PJM System Mix

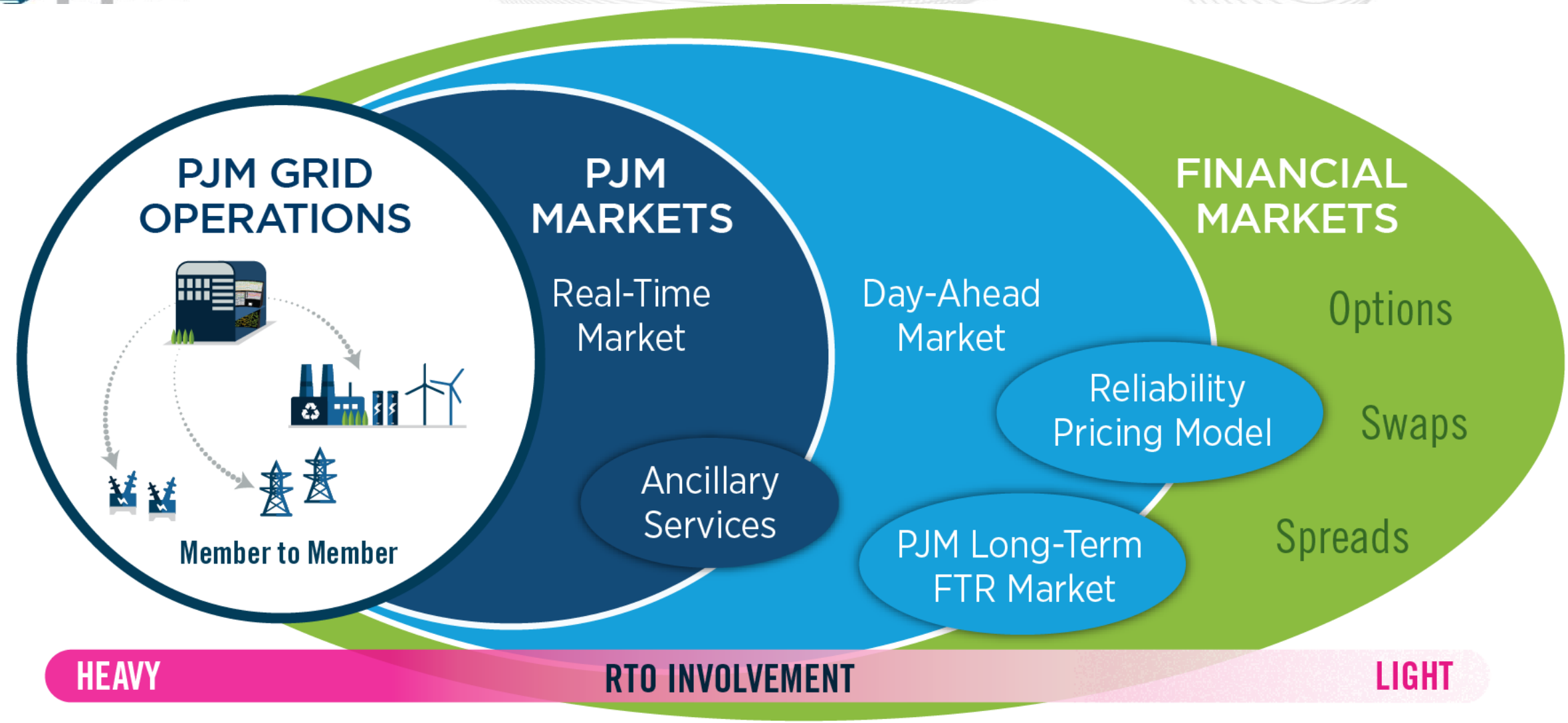


(% Annual Energy)

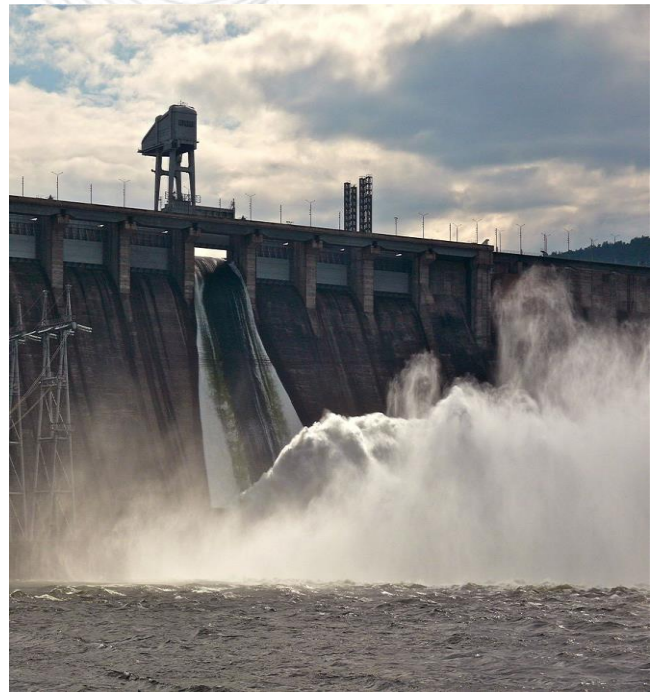
2005-2018 PJM Average Emissions



Evolution of Markets



A Review of Context



Some Context… PJM vs. Southeast Europe

Similarities

- Generation resources distant from load
- Mix of IPPs vs. legacy publicly-owned generation
- Long Term Purchase Power Agreements Available and Respected in the Dispatch

Some Context…PJM vs. Southeast Europe

Key Differences

- No one resource type (gas, nuclear, hydro coal) or owner dominant (PJM)
- Policies driven by both state and federal regulators (PJM)
- Most generation dependent on market revenues for recovery of costs
- Locational marginal price energy market

Capacity Market Options and their applications in the US:

- *Capacity Auctions*—PJM Model
- *Decentralized Obligation to Contract Capacity*—
  - MISO Model/Original PJM Model Before Retail Choice
- *Bundled purchase of capacity and energy*
- *Fixed long term contracts to agents to procure capacity*
  - Municipal Purchasing Authorities/ Fixed Resource Requirements
- *Strategic procurement of reserves in real time*

PJM Forward Capacity Auction Goals:

- Send long term locational investment signal
- Send forward closure signal for inefficient units
- Provide competition in procurement of capacity
- Provide revenue stability to lower risk premiums in energy markets
- Address the ‘hurdle rate’ for introduction of new technologies and demand side resources
- Ensure non-discrimination as between supply and demand side resources

Capacity Market Key Elements:

- 3 Year Forward Auction
- Call right on energy during emergencies
- Locational Pricing Based on Transmission Constraints
- All Resource Participation—Pricing to set future investment signal
- Incremental Auctions for Adjustments to Load
- Year round obligation with penalties for non-performance during emergencies
- Market Power mitigation

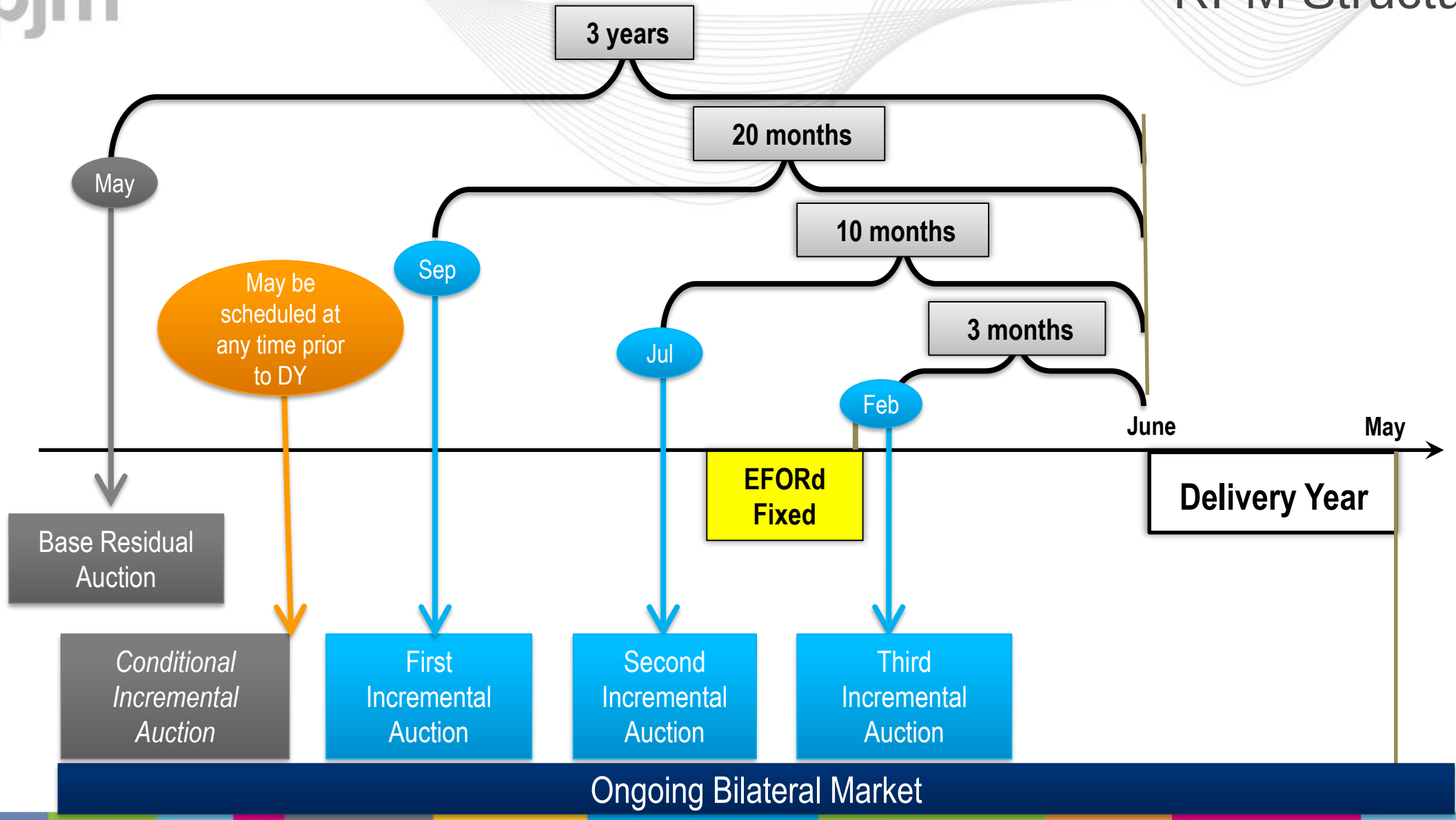
Long Term PPAs vs. the Capacity Market

- Capacity Market provides a price signal to inform and value long term arrangements
- ‘Contract for Differences’ the principle tool to incorporate capacity market prices
- Three year forward requirement provides reasonable forward commitment while avoiding advent of uneconomic contracts driven by market design

Capacity Market Evolution in PJM:

- Traditional Regulation—Capacity obligation in retail rate base
- Retail Choice—Obligation on new LSEs, development of daily capacity market
- RPM—Three Year Forward Market
- Demand Response and Energy Efficiency Rules
- Capacity Performance—Clarifying the Obligation
- Addressing State Subsidies—Price Suppression vs. a Natural Smaller Market

RPM Structure

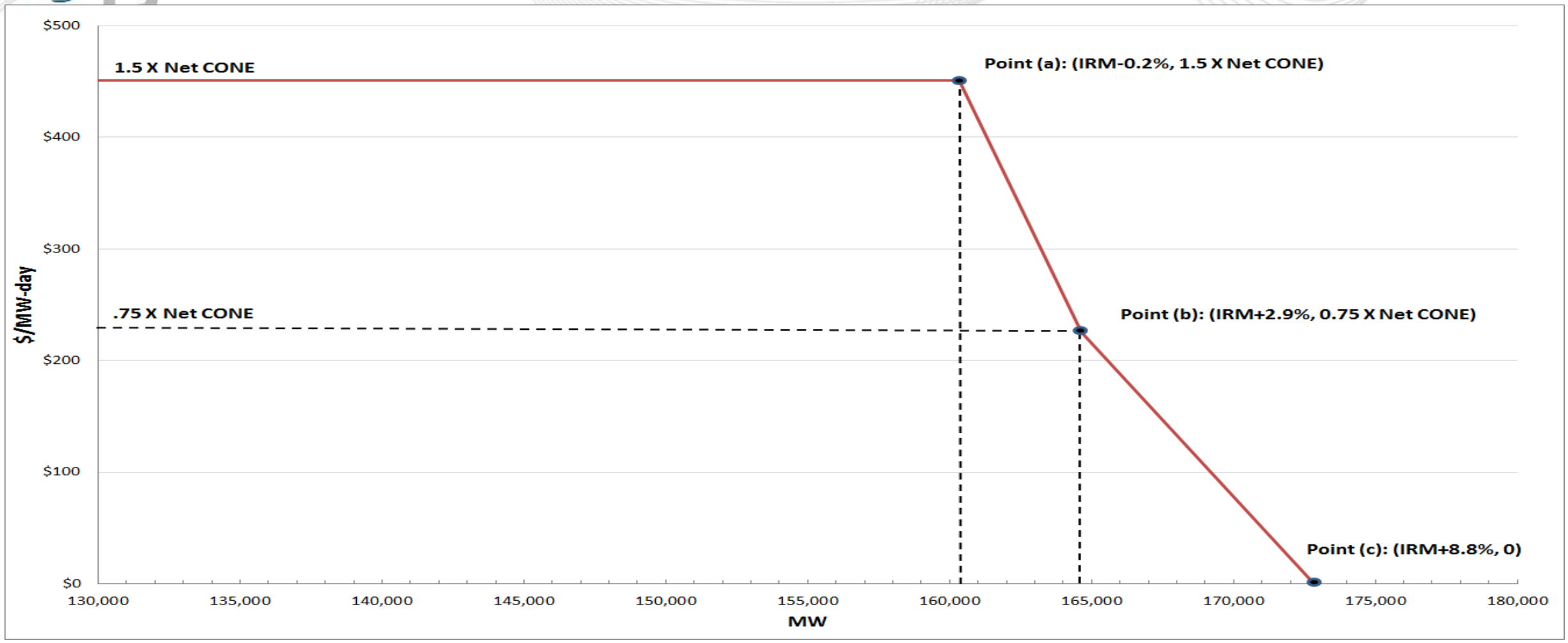


What is the VRR?

The Variable Resource Requirement (VRR) Curve is a downward sloping demand curve that relates the maximum price for a given level of capacity resource commitment relative to reliability requirements

- The price is higher when the resources are less than the reliability requirement and lower when the resources are in excess
- VRR Curves are defined for the PJM RTO and for each constrained Locational Deliverability Area (LDA) modeled within the PJM region

Variable Resource Requirement (VRR) Curve



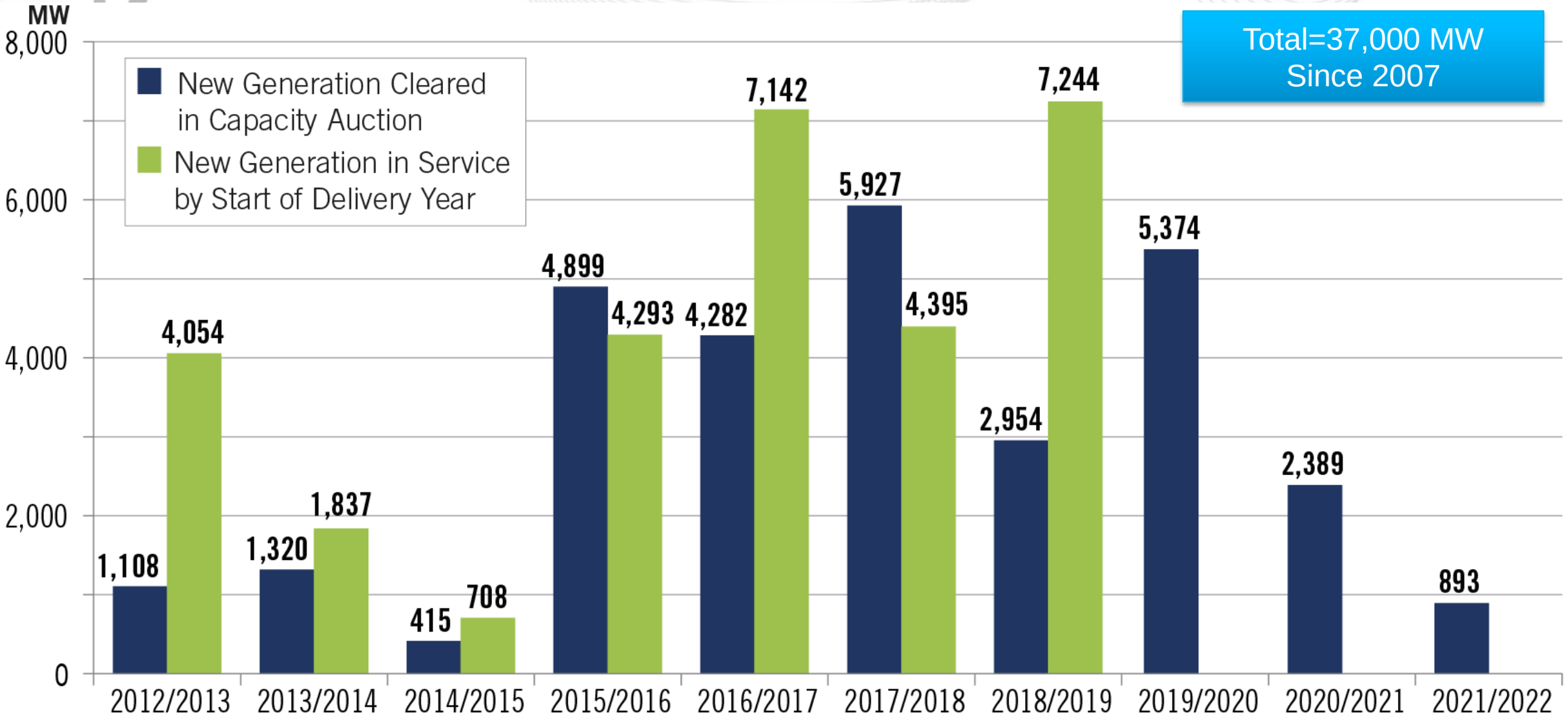
A VRR Curve is defined for the PJM Region & each LDA

Supply Resources in RPM

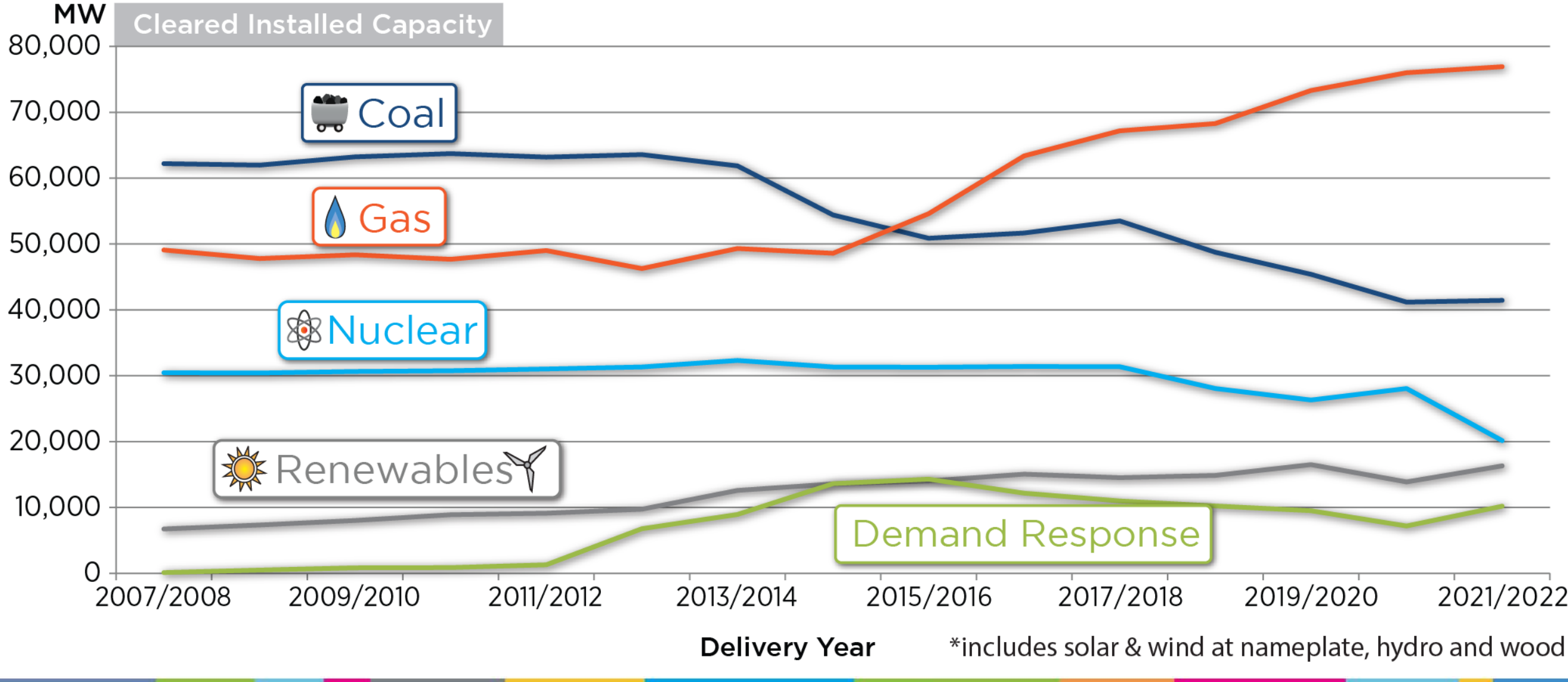
Generation	Demand Resources	Energy Efficiency Resource	Aggregate Resource	Qualifying Transmission Upgrade
• Existing/Planned • Internal/External	• Existing/Planned	• Existing/Planned	• Existing/Planned	• Existing/Planned

Capacity Market Results

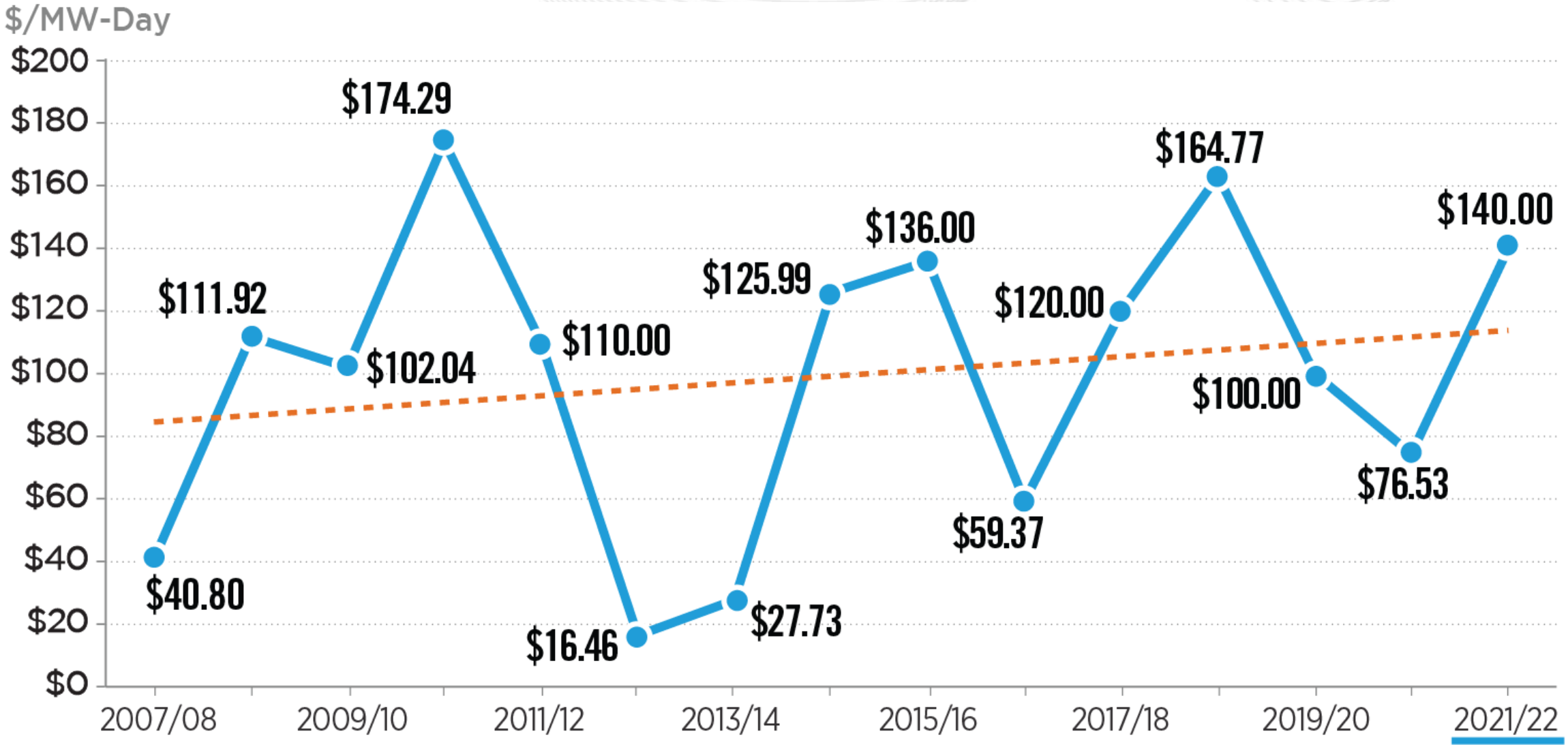
Competitive Generation Investment



Cleared Installed Capacity



2021/2022 RPM Base Residual Auction RTO Clearing Prices



Capacity Market Lessons Learned

The Good

- Market has attracted new investment and allowed for rapid turnover and de-carbonization of the fleet
- Market has encouraged development of new demand side technologies as alternatives to thermal generation
- Market has provided a home for renewables and hydro subject to deration to reflect variability

Capacity Market Lessons Learned

The Challenges

- Pricing very sensitive to changes in grid topology
- Potential dampening of impact of shortage pricing
- “All MWs the Same” does not account for other policy goals
- Prices have been well below authorized market mitigation caps
- Seasonal vs. annual procurements
- Subsidized resources competing with non-subsidized resources
- Impact on long term contracting

LET'S TALK…

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