



Capacity Market Design: The PJM Experience

International Workshop on Electricity Sector Modernization

September 4-5

Brasilia, Brazil

Craig Glazer

Vice President Federal
Government Policy

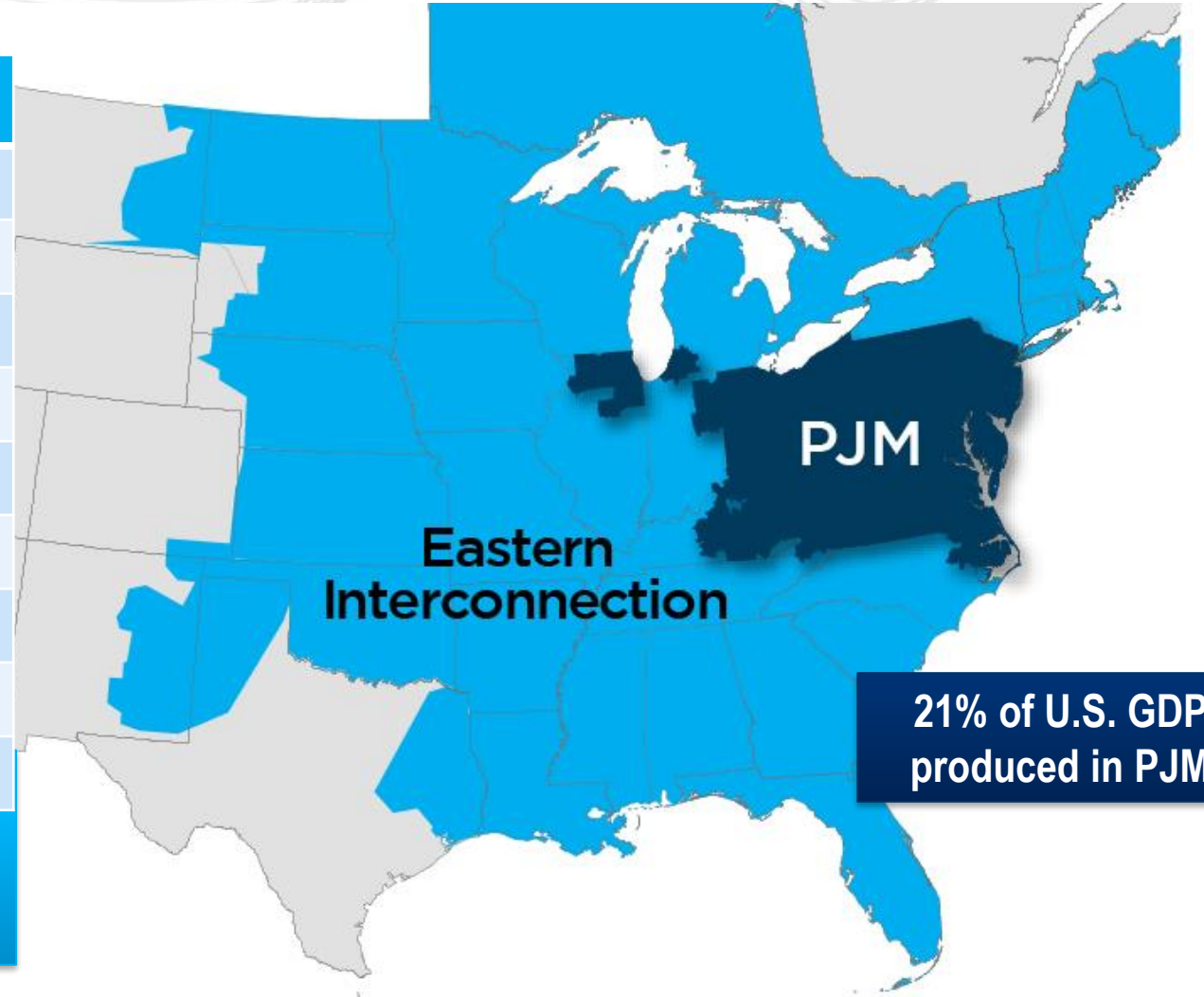
PJM Interconnection

September, 2019

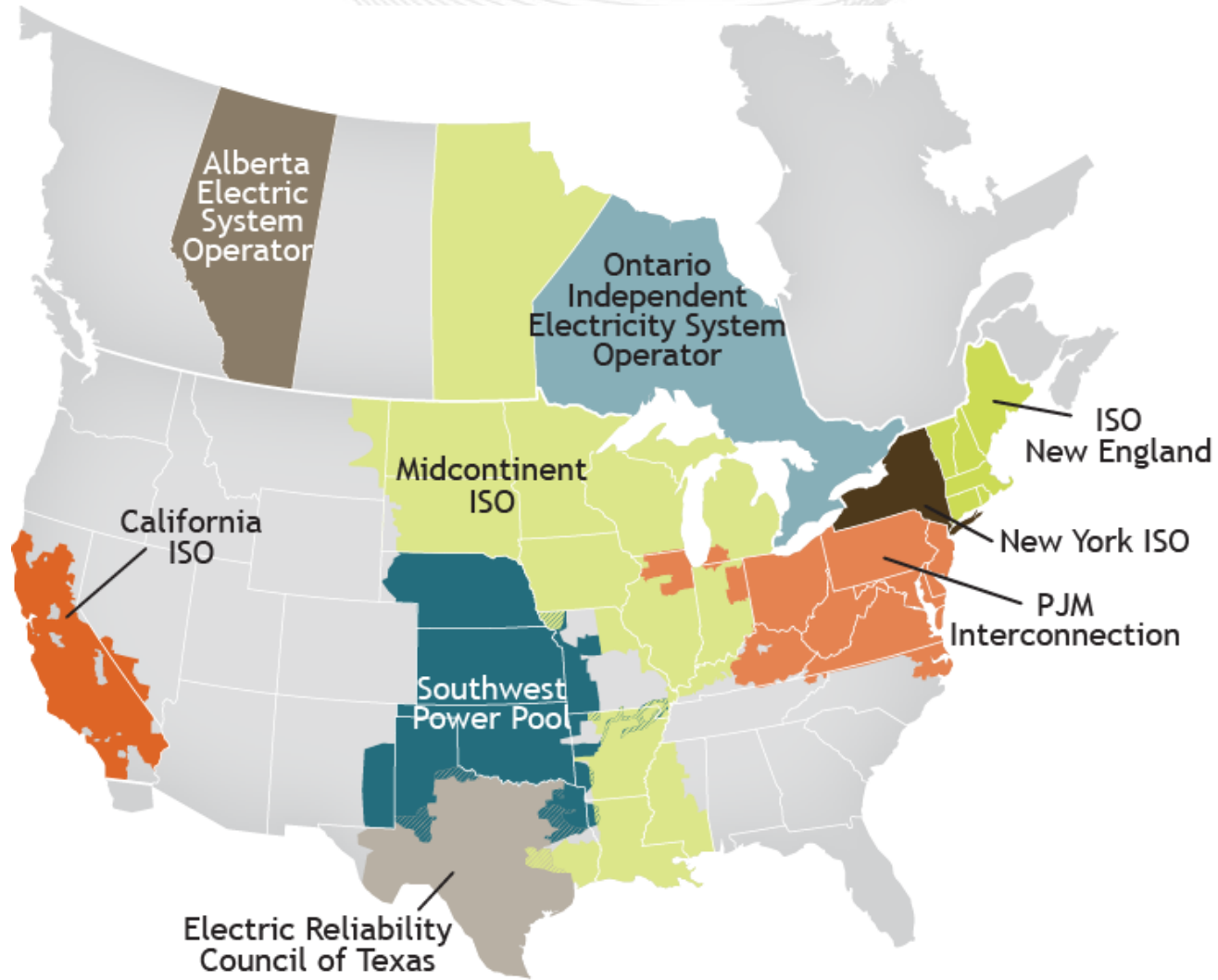
Key Statistics

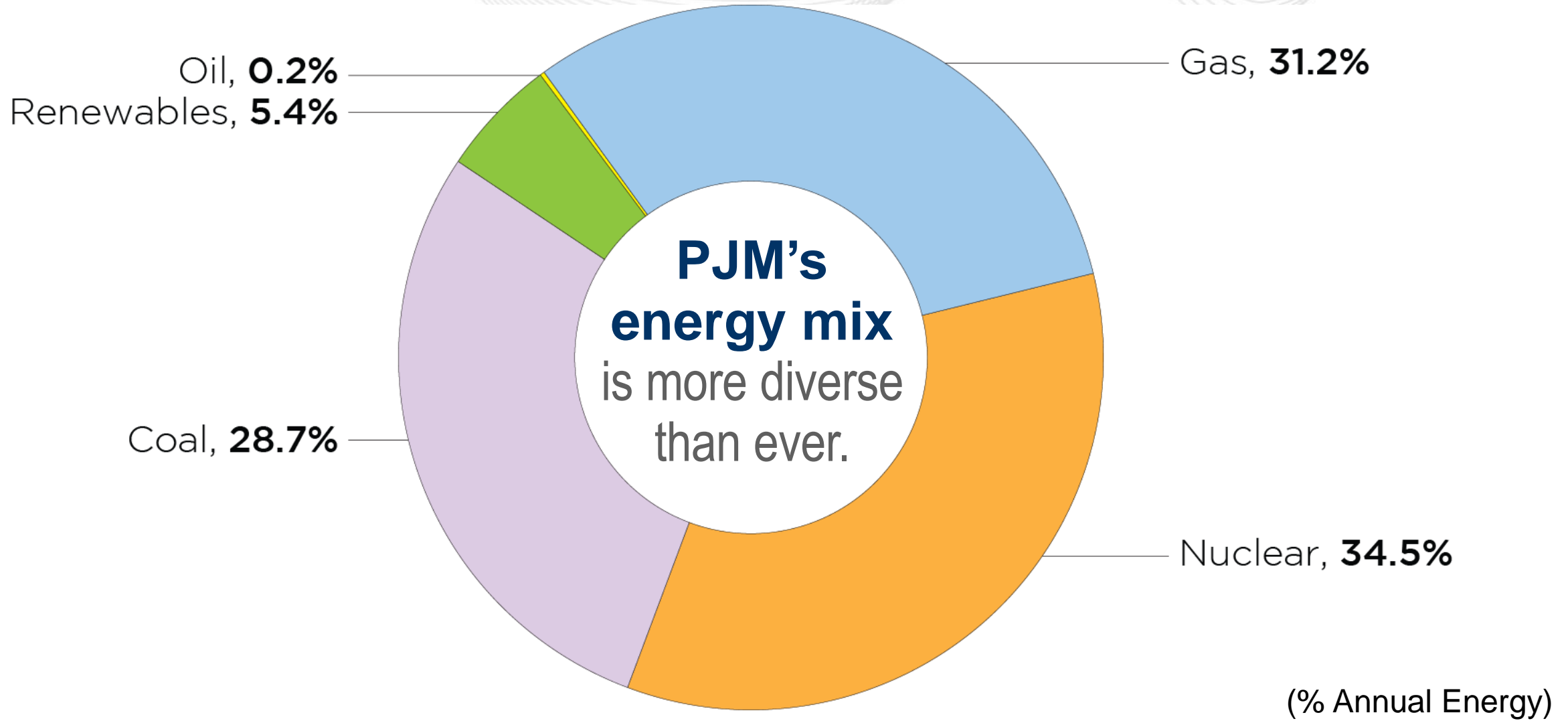
Member companies	1,010+
Millions of people served	65
Peak load in megawatts	165,492
MW of generating capacity	180,086
Miles of transmission lines	84,236
2018 GWh of annual energy	806,546
Generation sources	1,379
Square miles of territory	369,089
States served	13 + DC

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



As of 1/2019



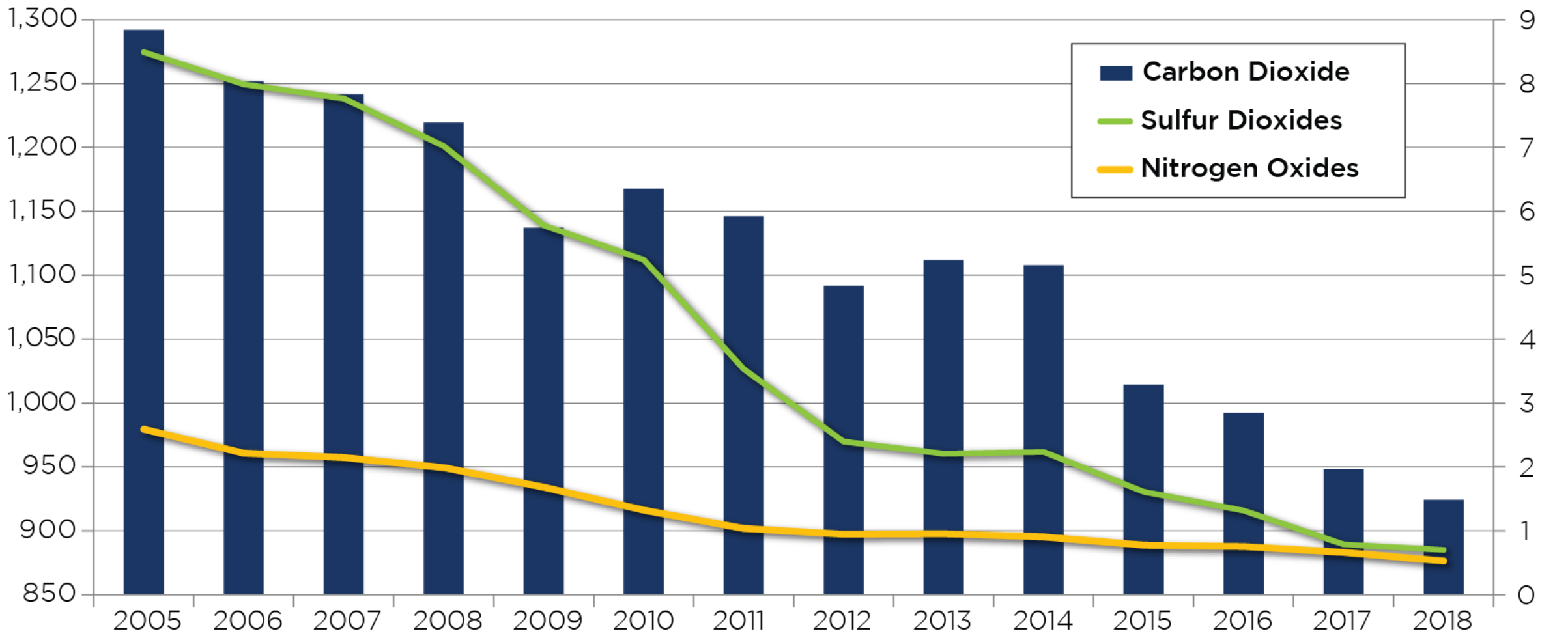


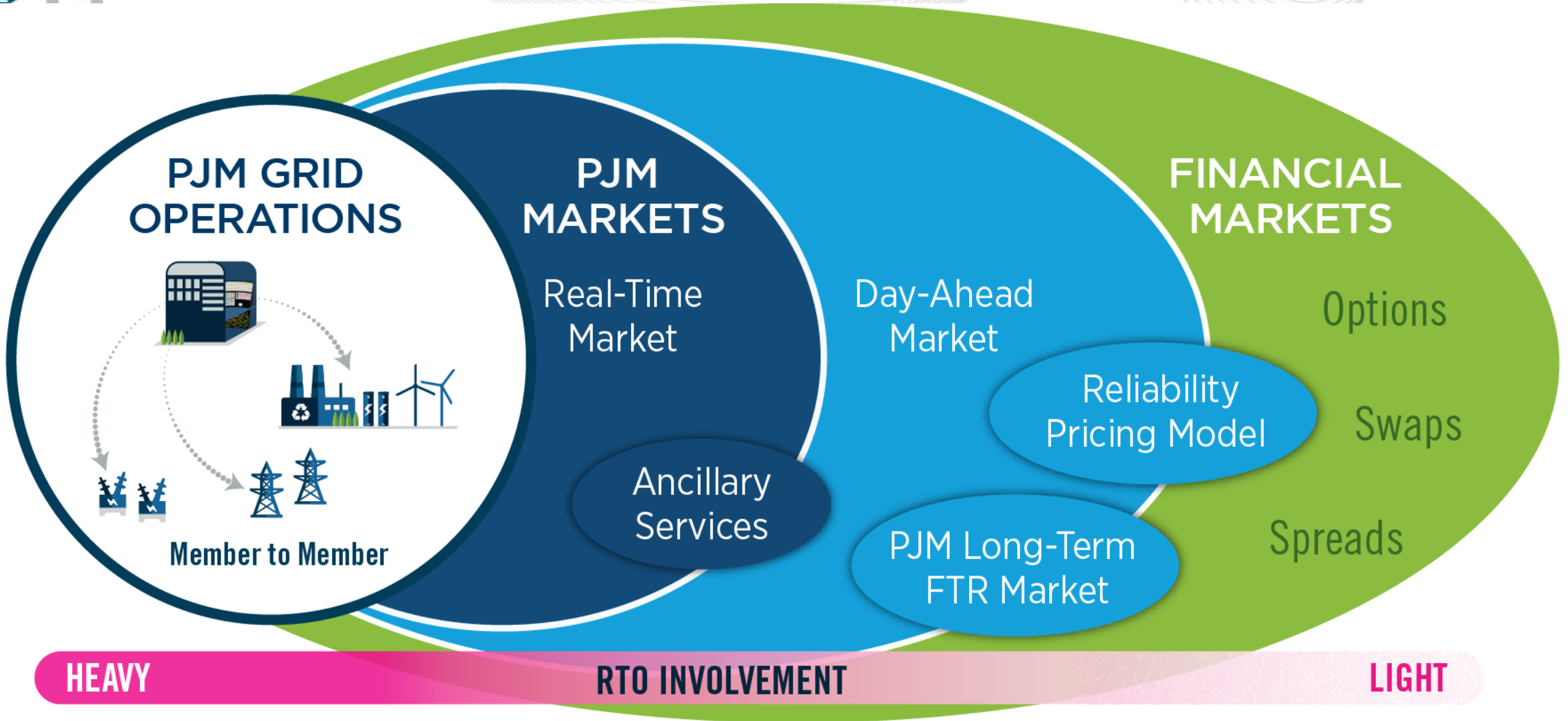


2005-2018 PJM Average Emissions

CO₂
lbs/MWh

SO₂ and NO_x
lbs/MWh

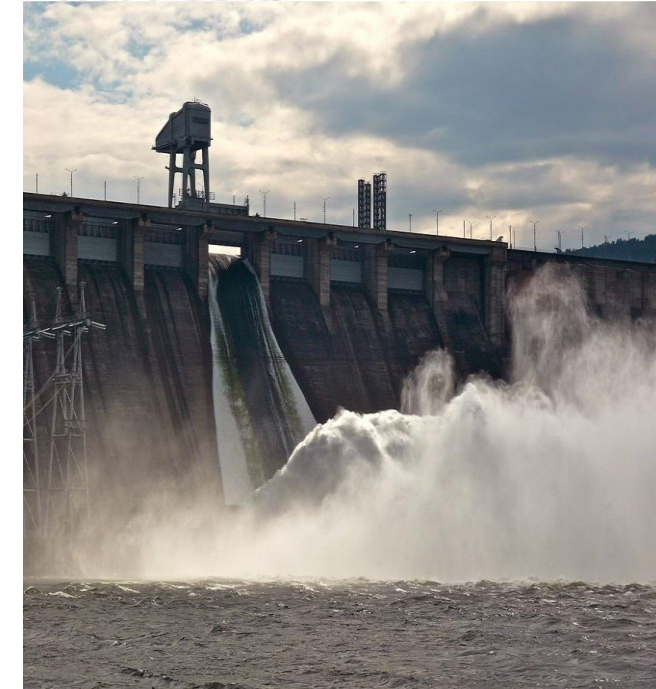




Some Context... PJM vs. ONS

Similarities

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



Some Context...PJM vs. ONS

Key Differences

- Predominately hydro (ONS) vs. thermal (PJM) system
- 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





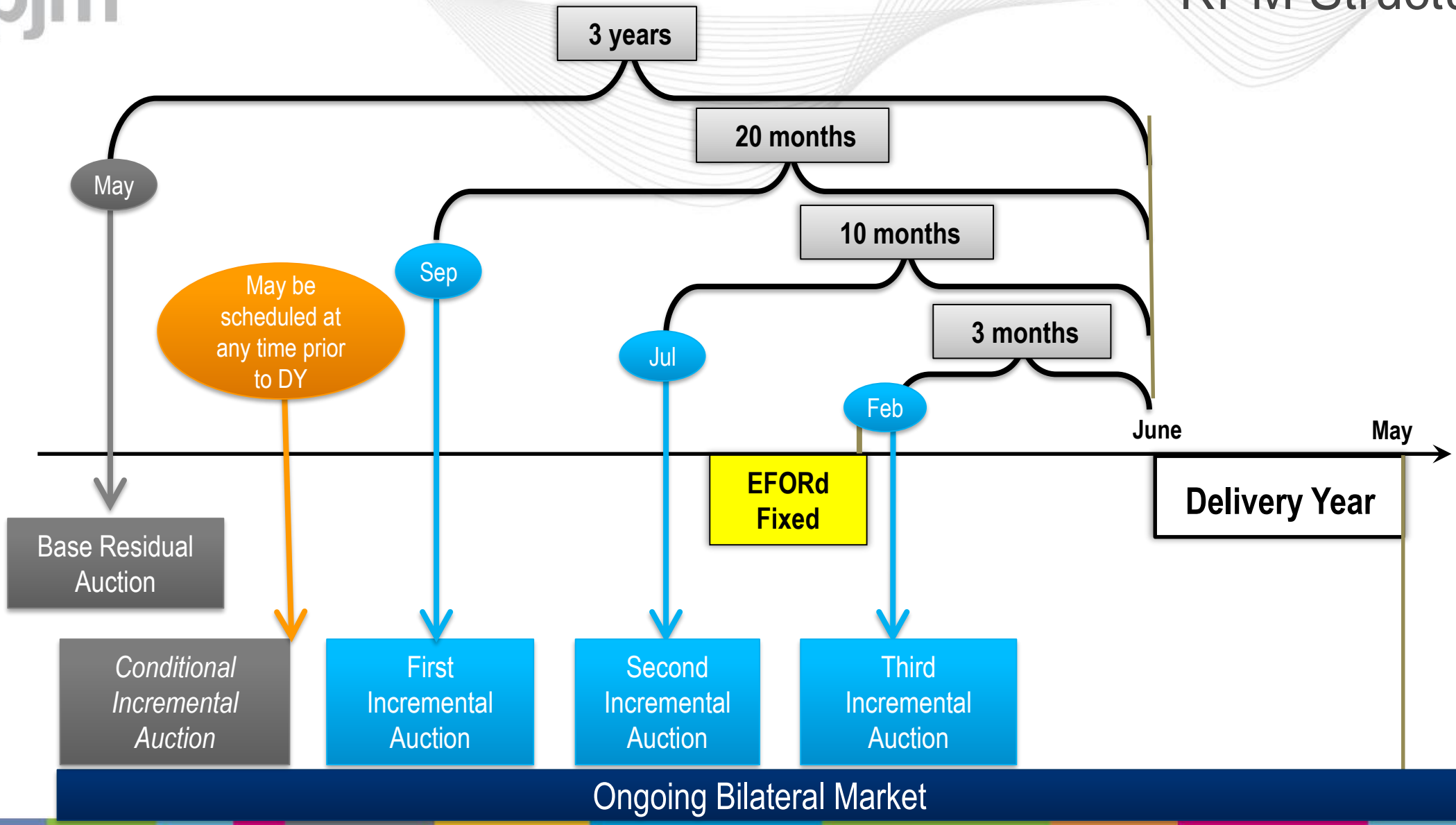
Long Term PPAs vs. the Capacity Market

- 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

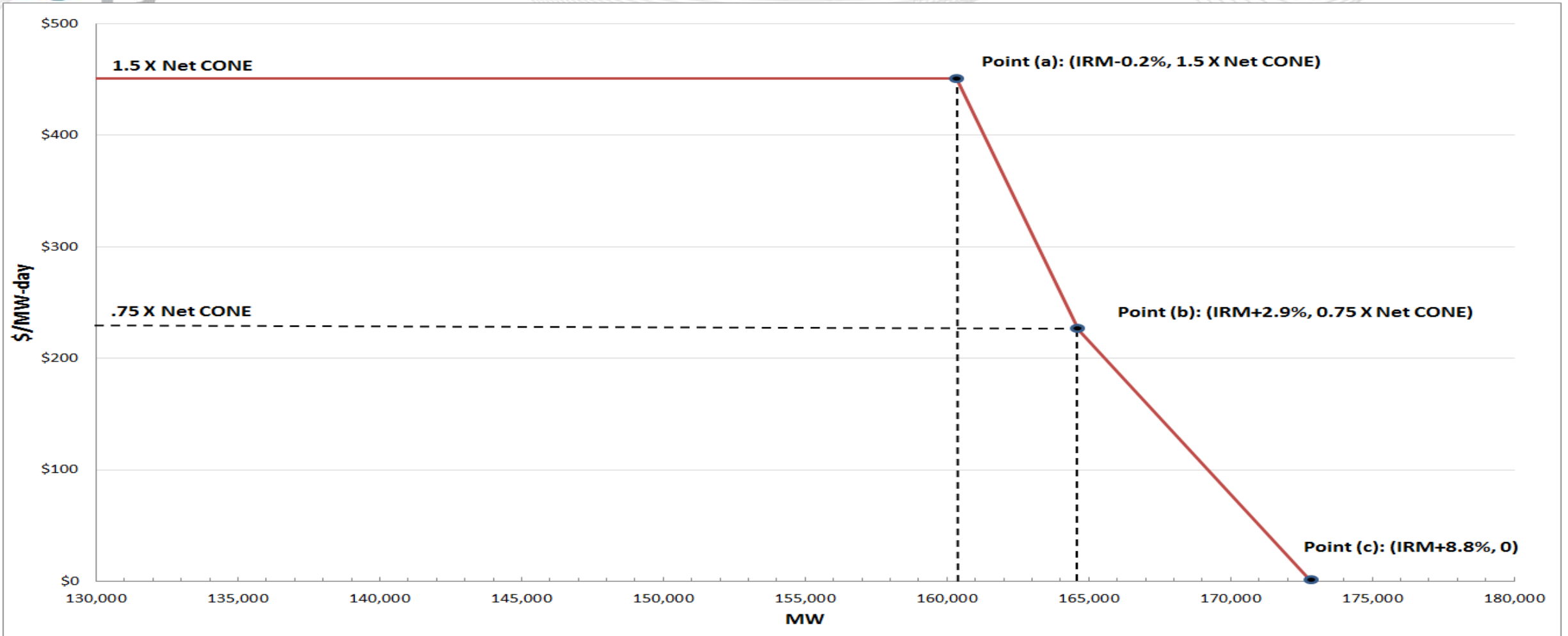


The Variable Resource Requirement (VRR) Curve is a downward sloping demand curve that relates the maximum price for a given level of capacity resource commitment relative to reliability requirements

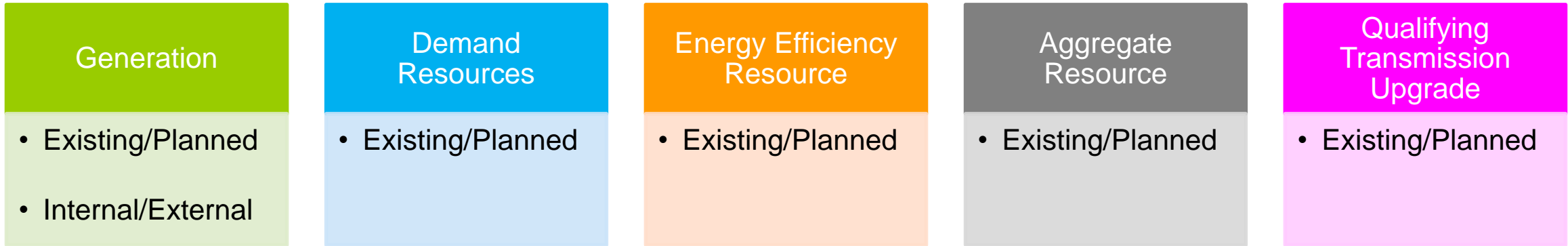
- The price is higher when the resources are less than the reliability requirement and lower when the resources are in excess
- VRR Curves are defined for the PJM RTO and for each constrained Locational Deliverability Area (LDA) modeled within the PJM region



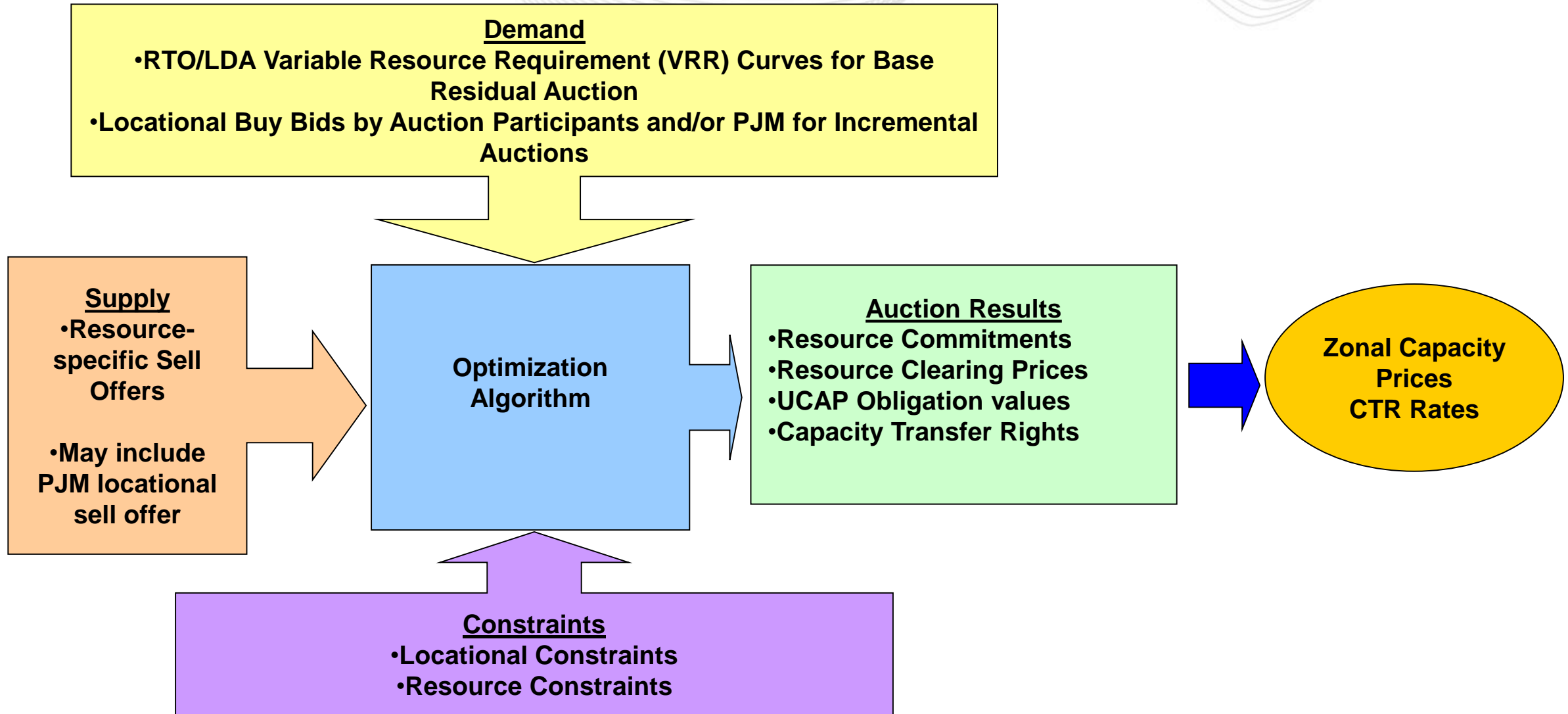
Variable Resource Requirement (VRR) Curve



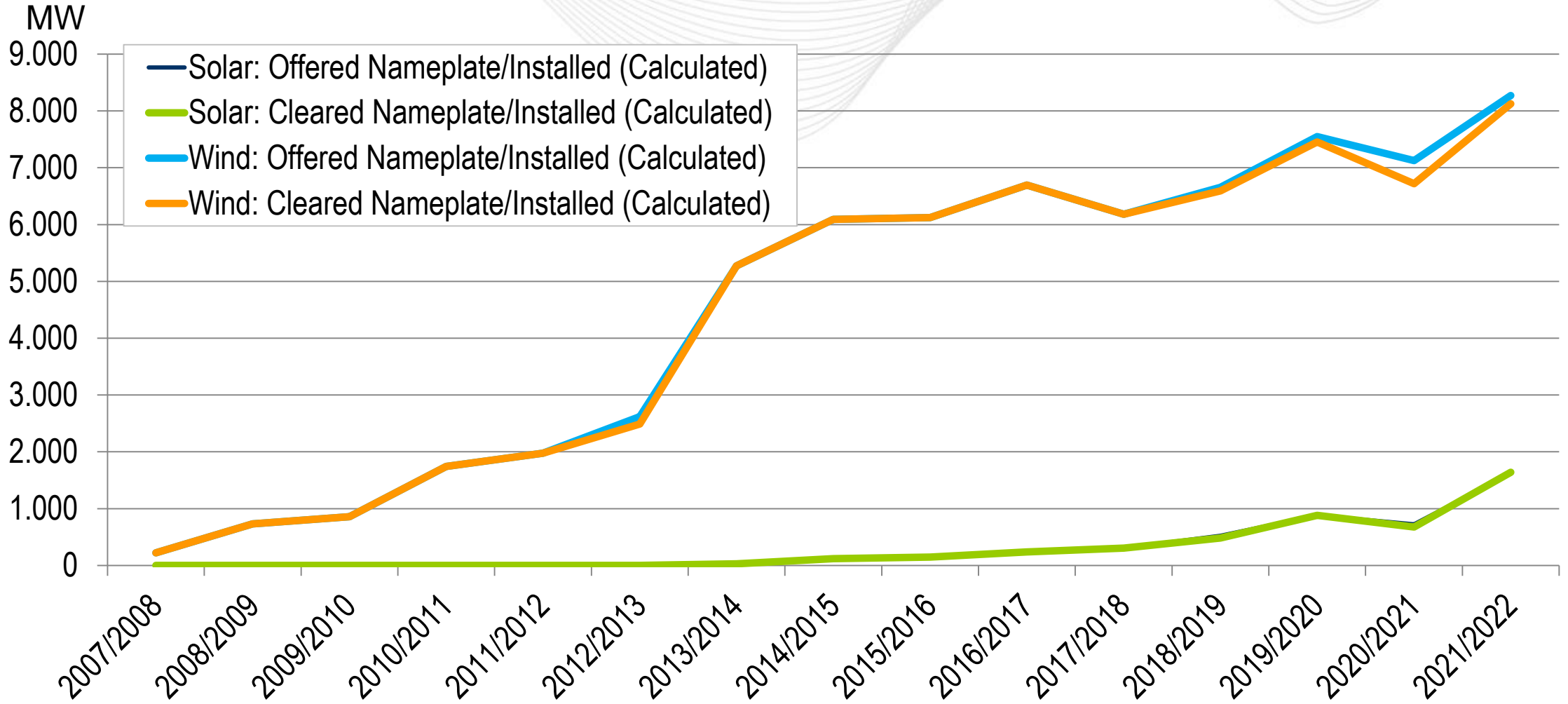
A VRR Curve is defined for the PJM Region & each LDA



- Existing generation capacity resources must offer into each RPM Auction (prevent physical withholding)
- Application of Market Seller Offer Caps to existing generation capacity resource sell offers (prevent economic withholding)
- Application of Minimum Offer Price Rule (MOPR) to planned generation capacity resource sell offers (prevent buyer-side market power)



Wind & Solar Offered and Cleared (nameplate)



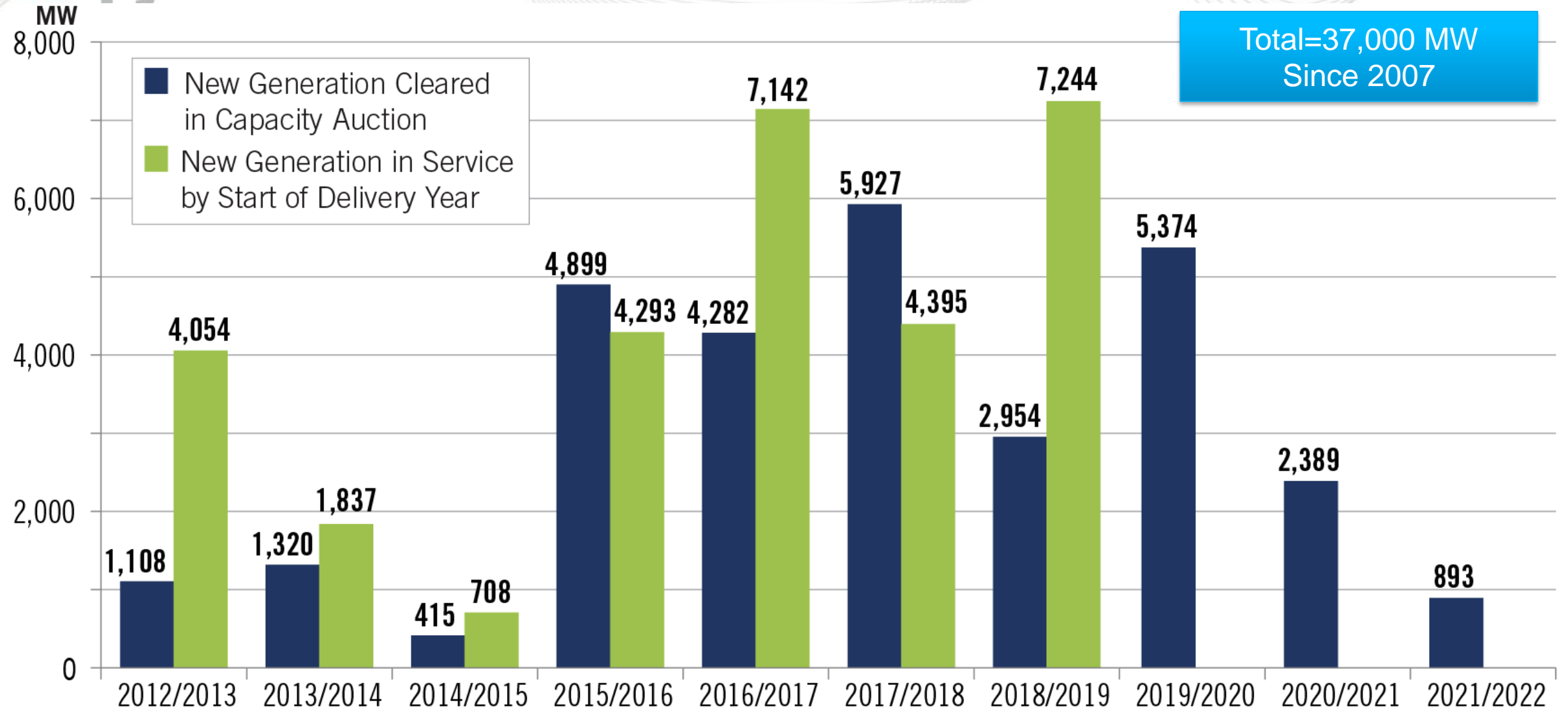
Capacity Market Results

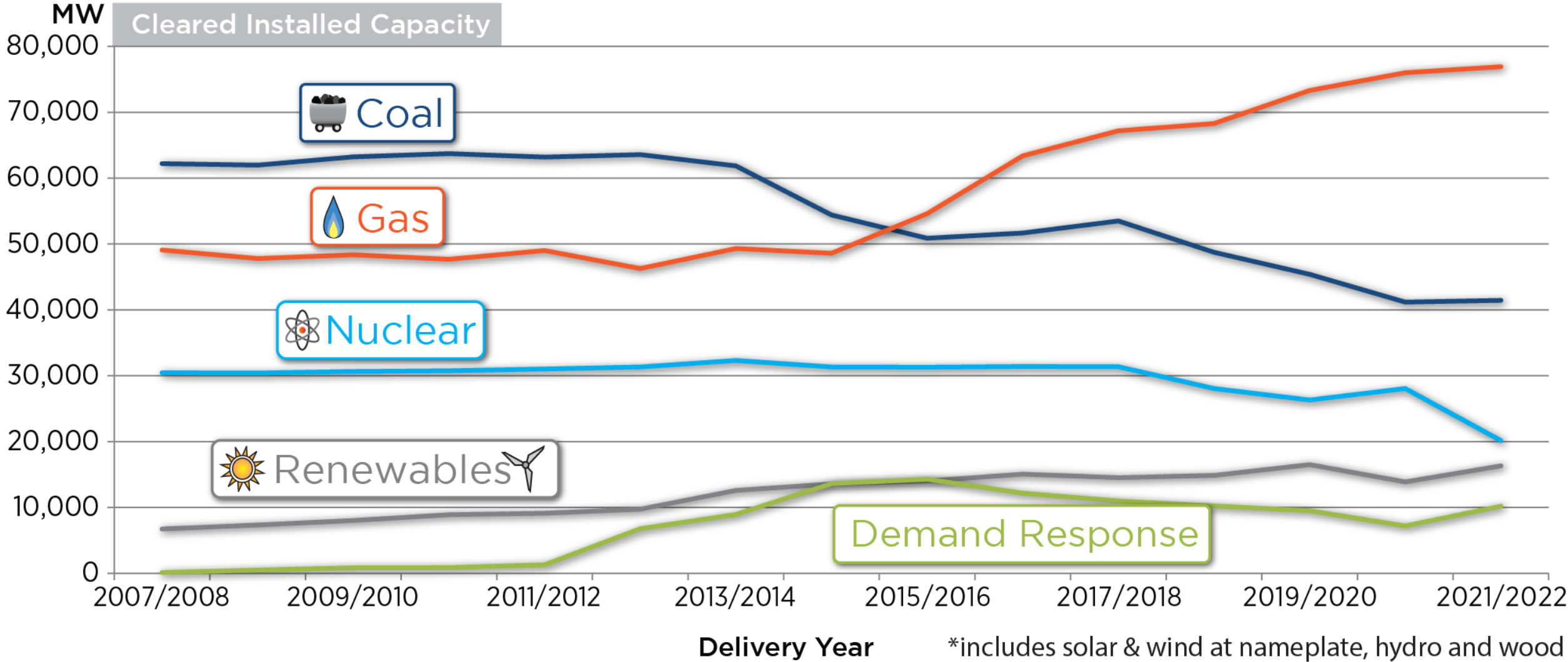




Competitive Generation Investment

Total=37,000 MW Since 2007



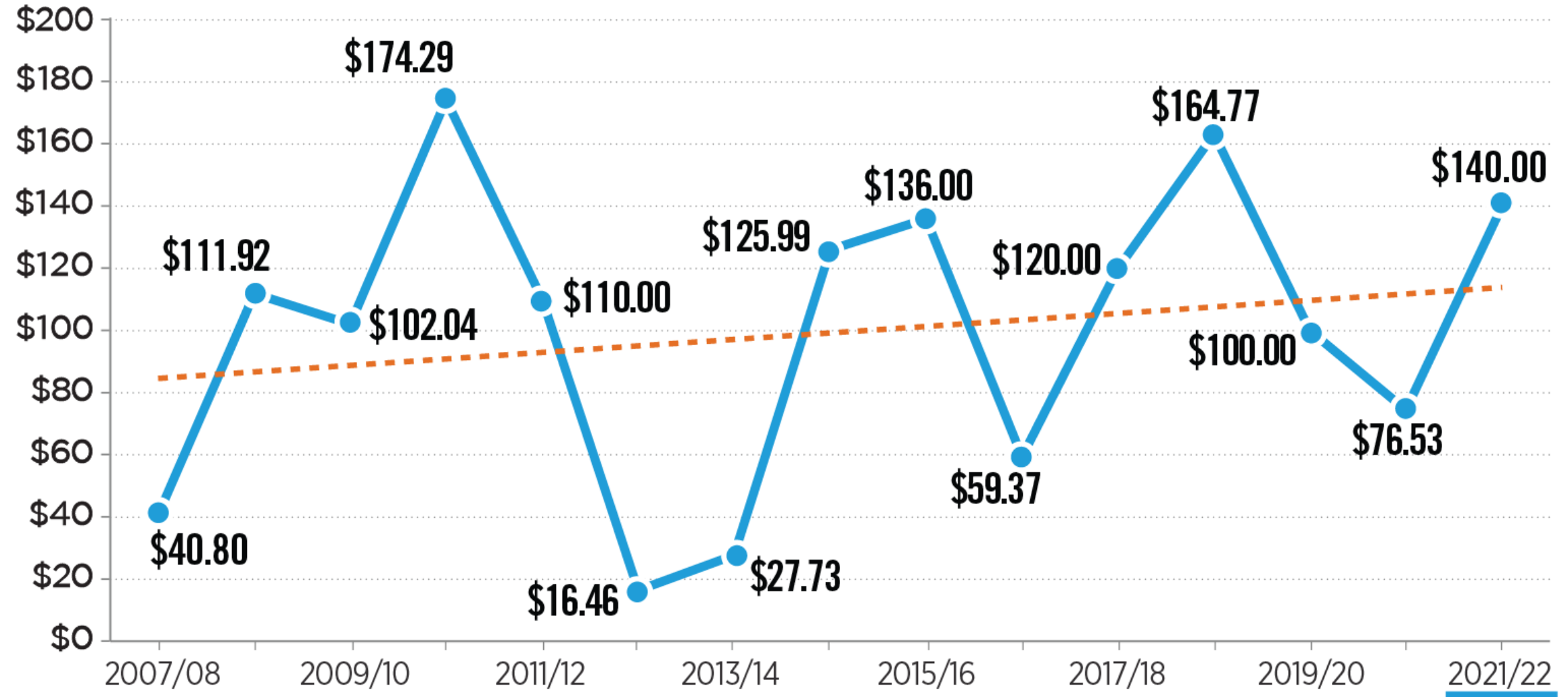


*includes solar & wind at nameplate, hydro and wood



2021/2022 RPM Base Residual Auction RTO Clearing Prices

\$/MW-Day





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

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



Policy Headaches Looking Forward:

- Policy initiatives working against competitive market fundamentals
- Losing Our Way: Re-regulation by piece part



State Legislative Actions:

- Lack of federal carbon policy or regional agreements on carbon pricing
- State parochial actions have dominated:
 - Out of market state financial subsidies for specific nuclear or coal units
 - Lack of political will for full re-regulation including taking on resource adequacy
 - Renewable Portfolio Standards—Little consideration of cost or feasibility



Re-regulation plant by plant.

- The “half slave/half free” problem
- Skewed investment signals
- Re-juggling the risk allocation formula once again
- Ignoring the lessons of the past—(stranded costs, technology risk etc.)



Looking Further.

- Monetizing the value of Distributed Resources thru a single market
- Fuel security vs. fuel diversity
- More transparent natural gas markets
- Being mindful of our past: Keep the 'risk/reward' decision on the investor side



An Added Complication:

Who Decides?



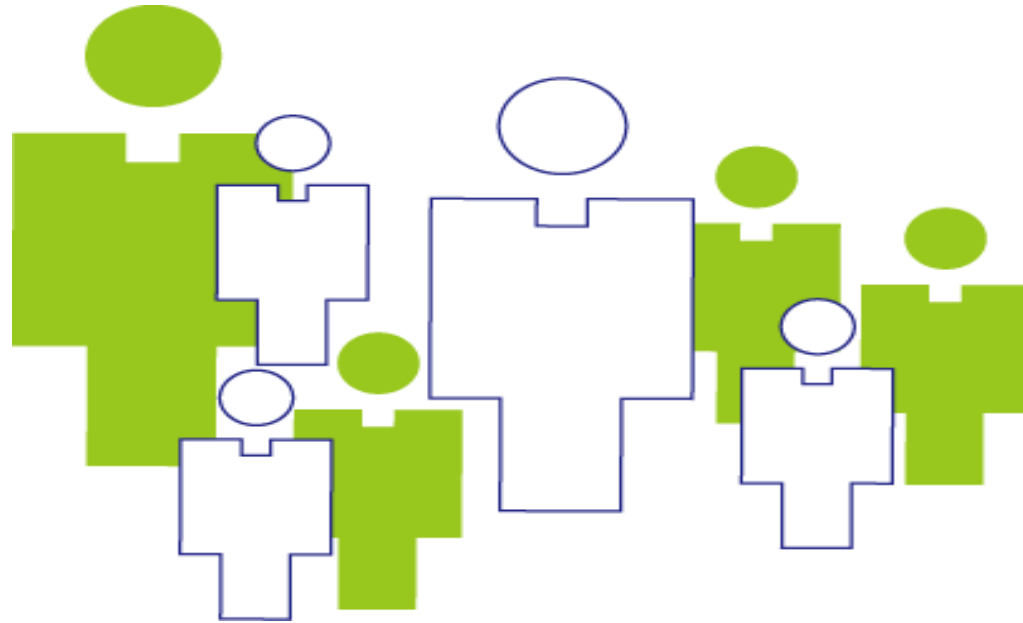
- States:
 - State Energy Policies:
Governors/legislators
 - State PUCs
- FERC
- Environmental Agencies
- Department of Energy
- Congress
- US Supreme Court



“Hanging in mid-air”: a dangerous place



- A restructured industry or “Golden memories of yesteryear...”
 - The choice is ours



LET'S TALK...



Craig Glazer
Vice President-Federal Government Policy
PJM Interconnection
Washington, D.C. , USA
1-202-423-4743
craig.glazer@pjm.com