PJM's Final Long-term and Short-term Market Analysis of the Clean Power Plan and Reference Model

PJM Interconnection

September 15, 2016

Evaluate potential impacts of states complying with the Clean Power Plan on:

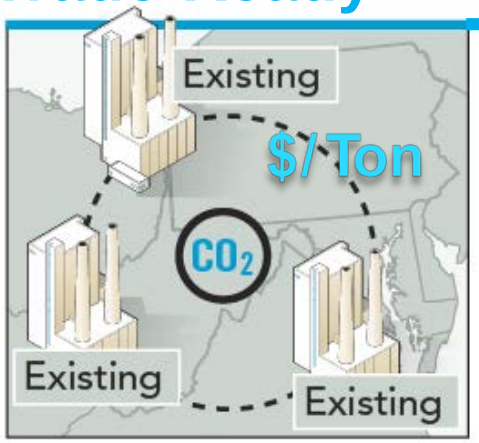
- Resource adequacy
- Operational impacts on the transmission system
- PJM energy and capacity market prices
- Compliance costs associated with achieving the U.S. EPA's CO_2 emission targets

PJM CPP Study Key Takeaways

- Resources and states in the PJM region achieve compliance with the Clean Power Plan under all studied scenarios and compliance pathways.
- Resource adequacy is maintained under all studied scenarios and compliance pathways
- Clean Power Plan compliance reduces and shifts transmission congestion
- Regional, mass-based compliance applied to existing sources leads to the lowest compliance cost over the 20 years studied

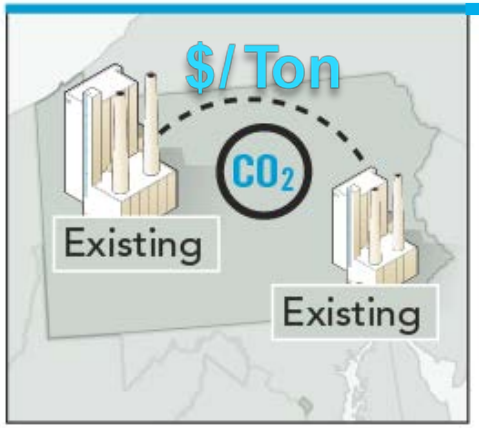
Mass-Based Compliance Pathway Scenarios

Trade-Ready



Single CO_2 limit applied to the PJM region for 111(d) existing resources

State Mass



Each state applies a CO_2 limit covering all 111(d) existing resources

New Source Complement

Single CO_2 limit applied to the PJM region for 111(d) existing and 111(b) new sources

State Mass New Source Complement

Each state applies a CO_2 limit covering all 111(d) existing resources and 111(b) new sources

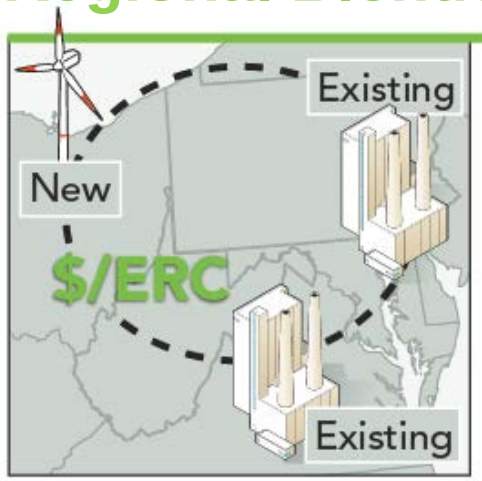
[1] Proposed Federal Plan for the Clean Power Plan (PDF) - http://www.gpo.gov/fdsys/pkg/FR-2015-10-23/pdf/2015-22848.pdf

Rate-Based Compliance Pathway Scenarios

Trade-Ready Rate

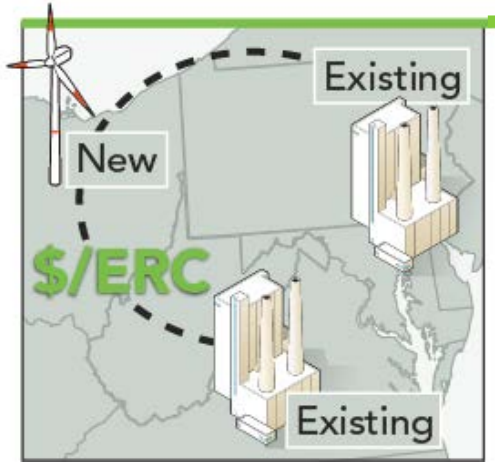
Emissions performance measured against the sub-category CO_2 emission rate targets for combined cycle and steam turbine resources

Regional Blended Rate



Emissions performance measured against a weighted average of PJM states' CO_2 emissions rate targets

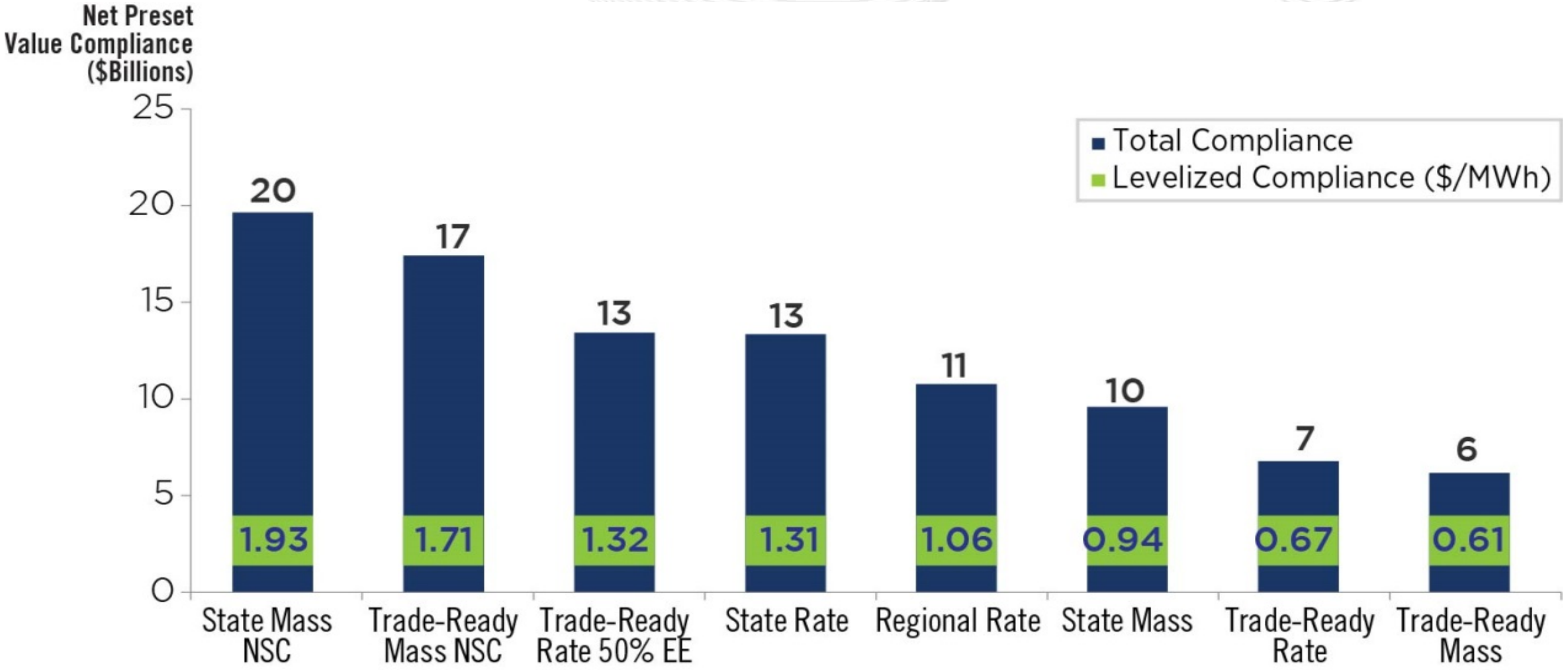
State Blended Rate



Emissions performance measured against the state CO_2 emissions rate target

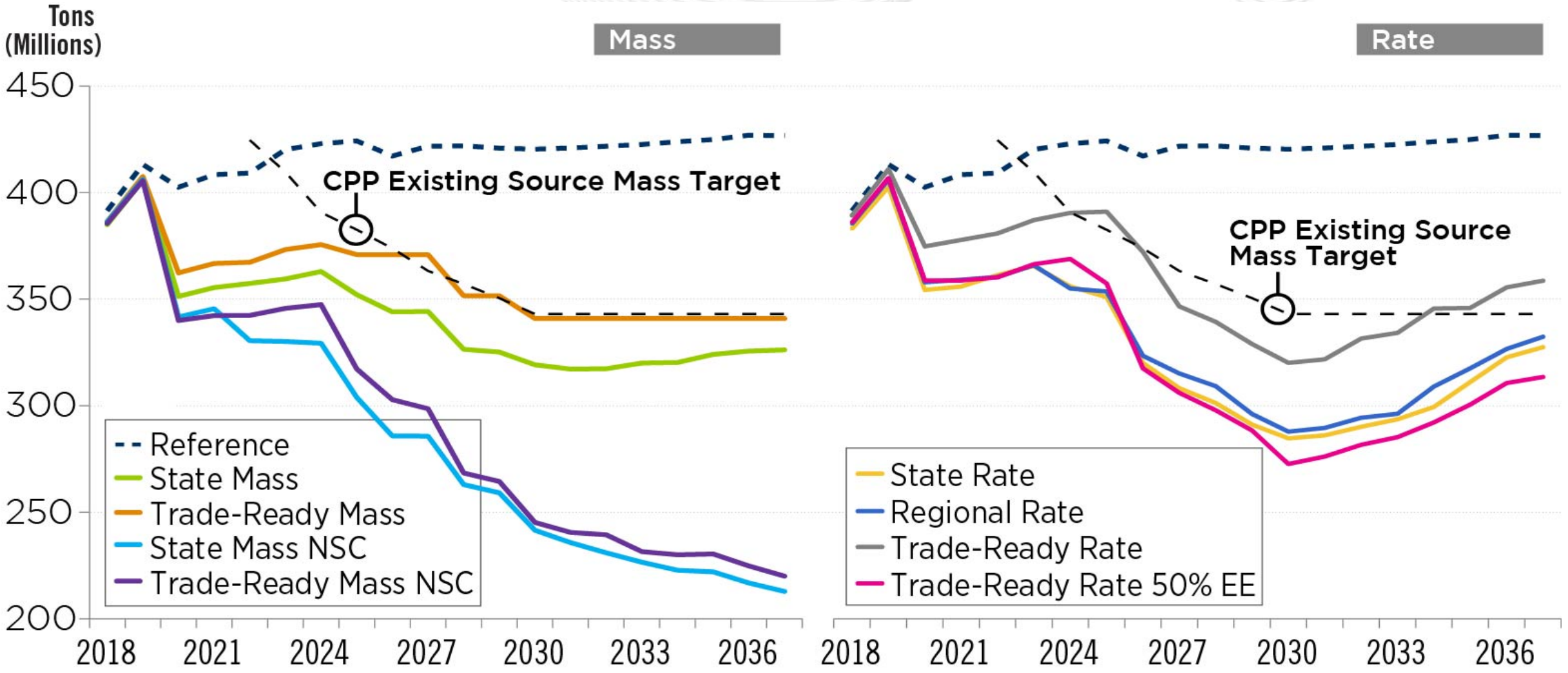
[1] Proposed Federal Plan for the Clean Power Plan (PDF) - http://www.gpo.gov/fdsys/pkg/FR-2015-10-23/pdf/2015-22848.pdf

Going-Forward, Production and Investment Cost Increase
CPP Compliance Cost (2018-2037)

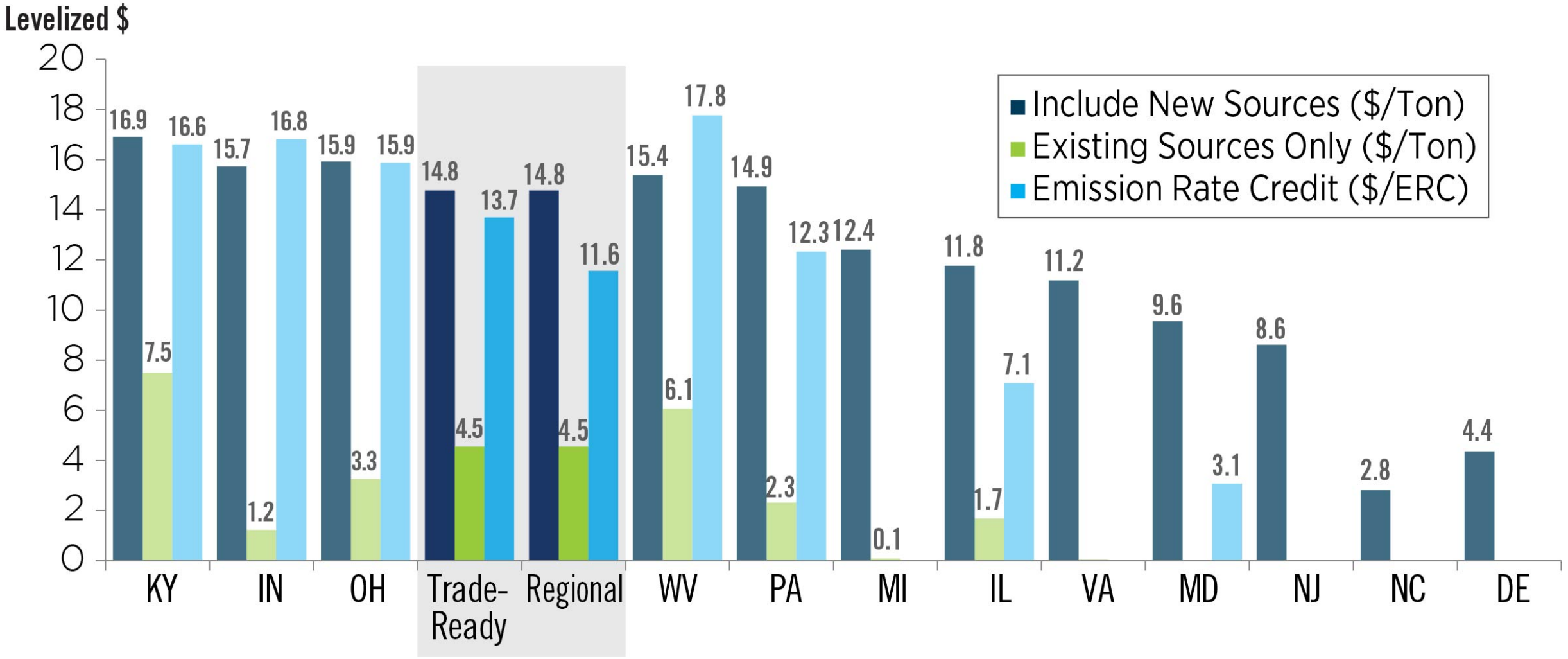


Clean Power Plan Compliance: Emissions and Energy Prices

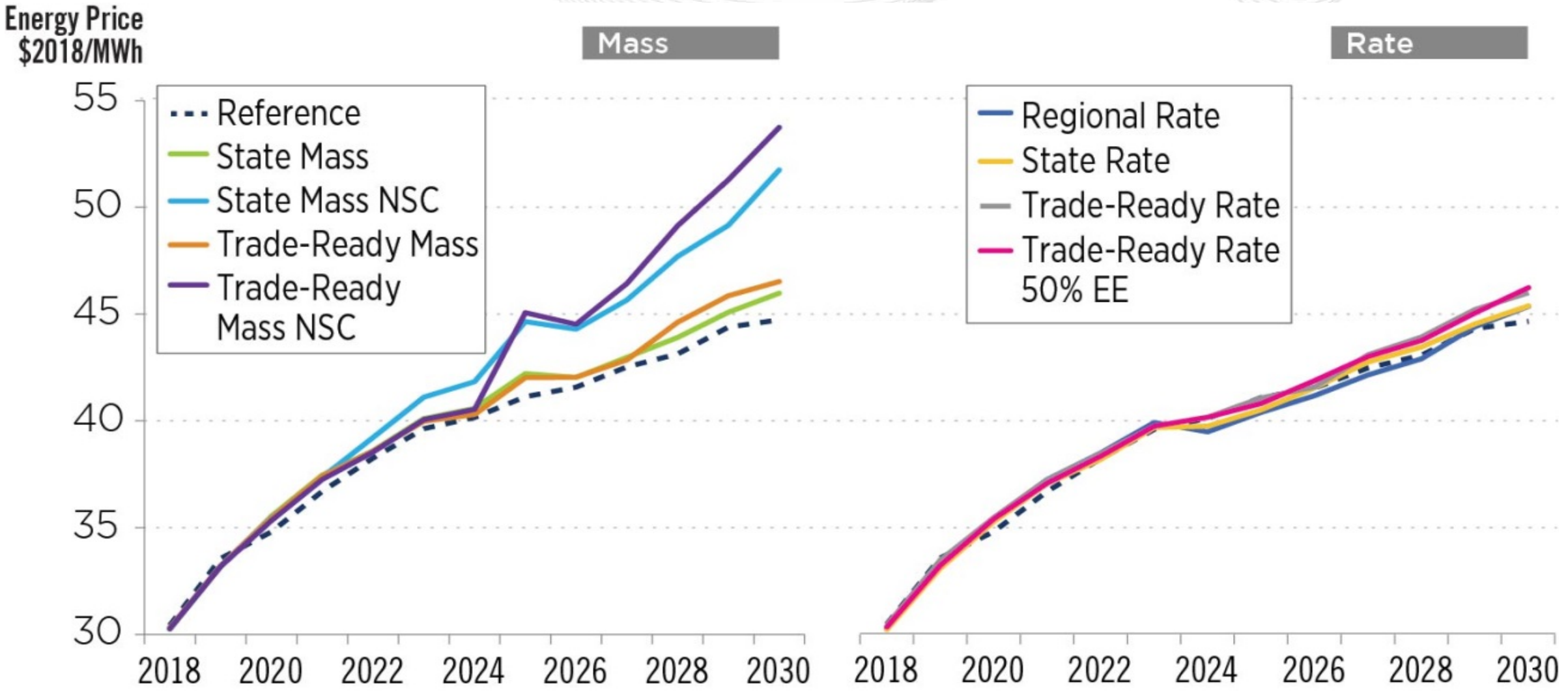
PJM States Achieve CO_2 Emissions Targets in all Scenarios



CO2 Prices (2022-2037) in Mass-based and Rate-based Markets

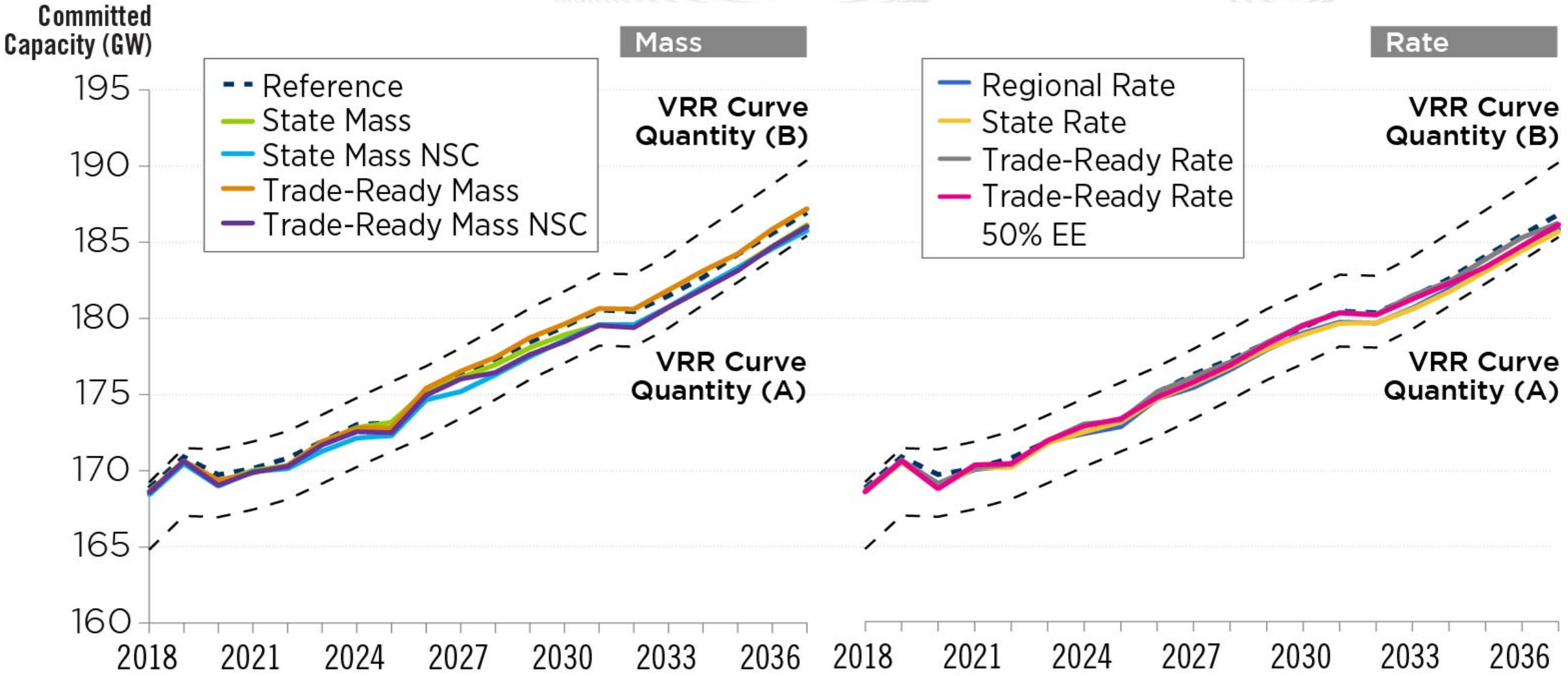


Energy Market Prices for the PJM Region under Mass- and Rate-based Compliance Pathways

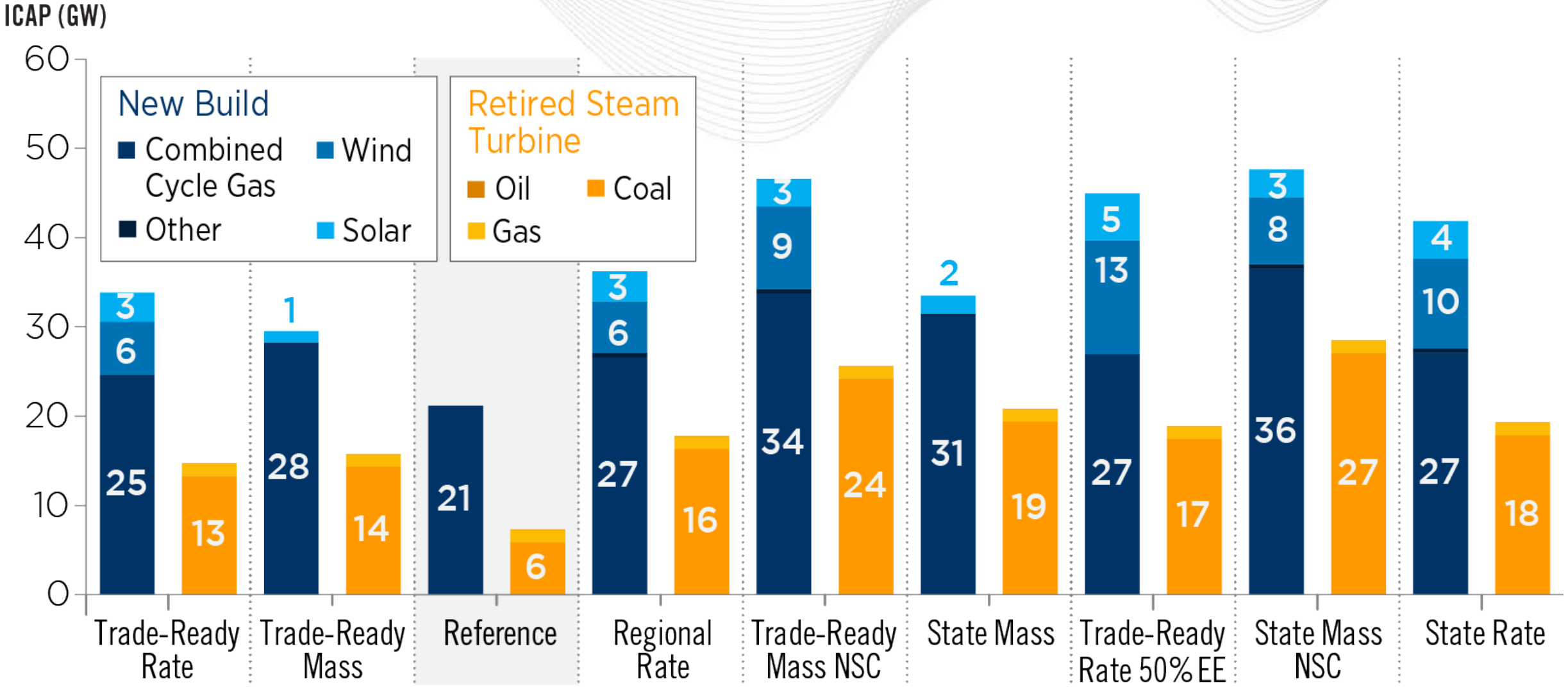


Clean Power Plan Compliance: Resource Adequacy, Generation Mix and Capacity Prices

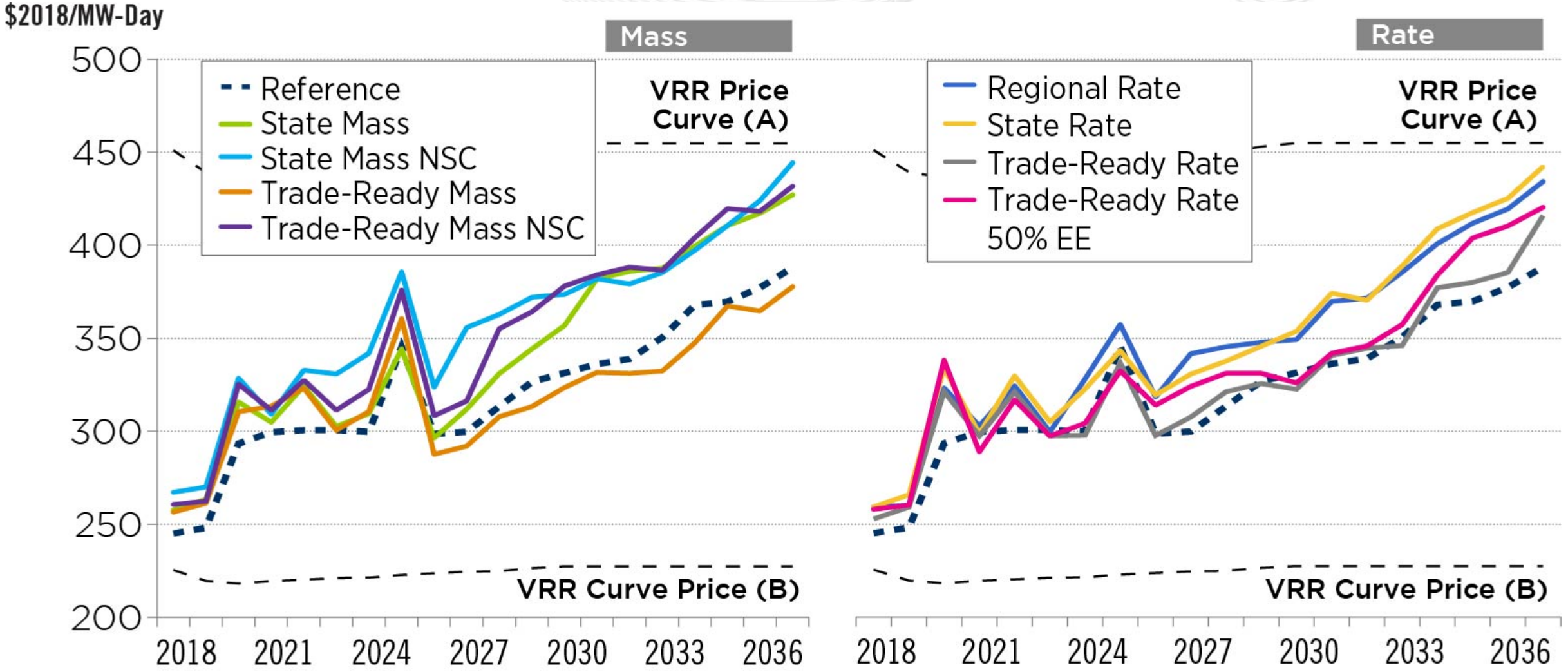
Resource Adequacy is Maintained Under all Compliance Pathways



Turnover in Generating Resource Nameplate Capacity due to the Clean Power Plan (2018 -2037)

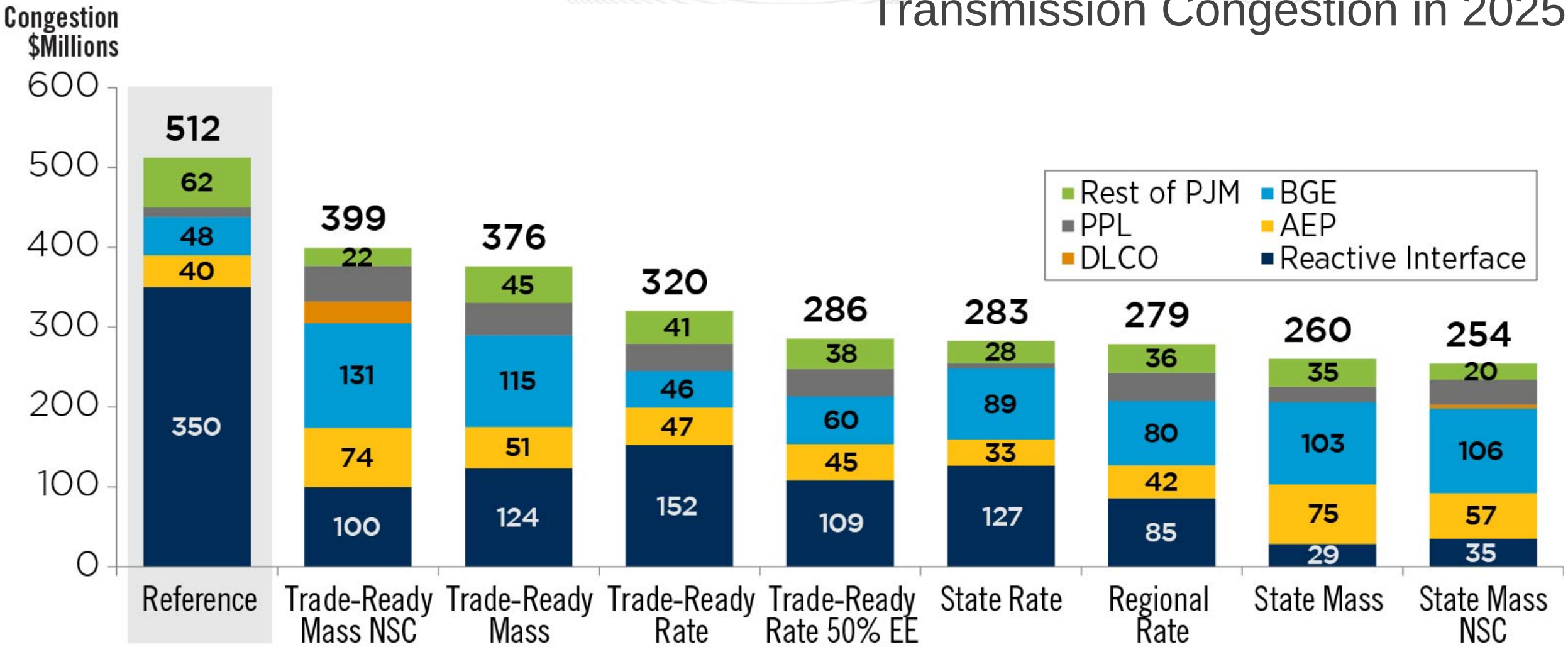


Capacity Market Prices for the PJM Region Under Mass- and Rate-Based Compliance Pathways



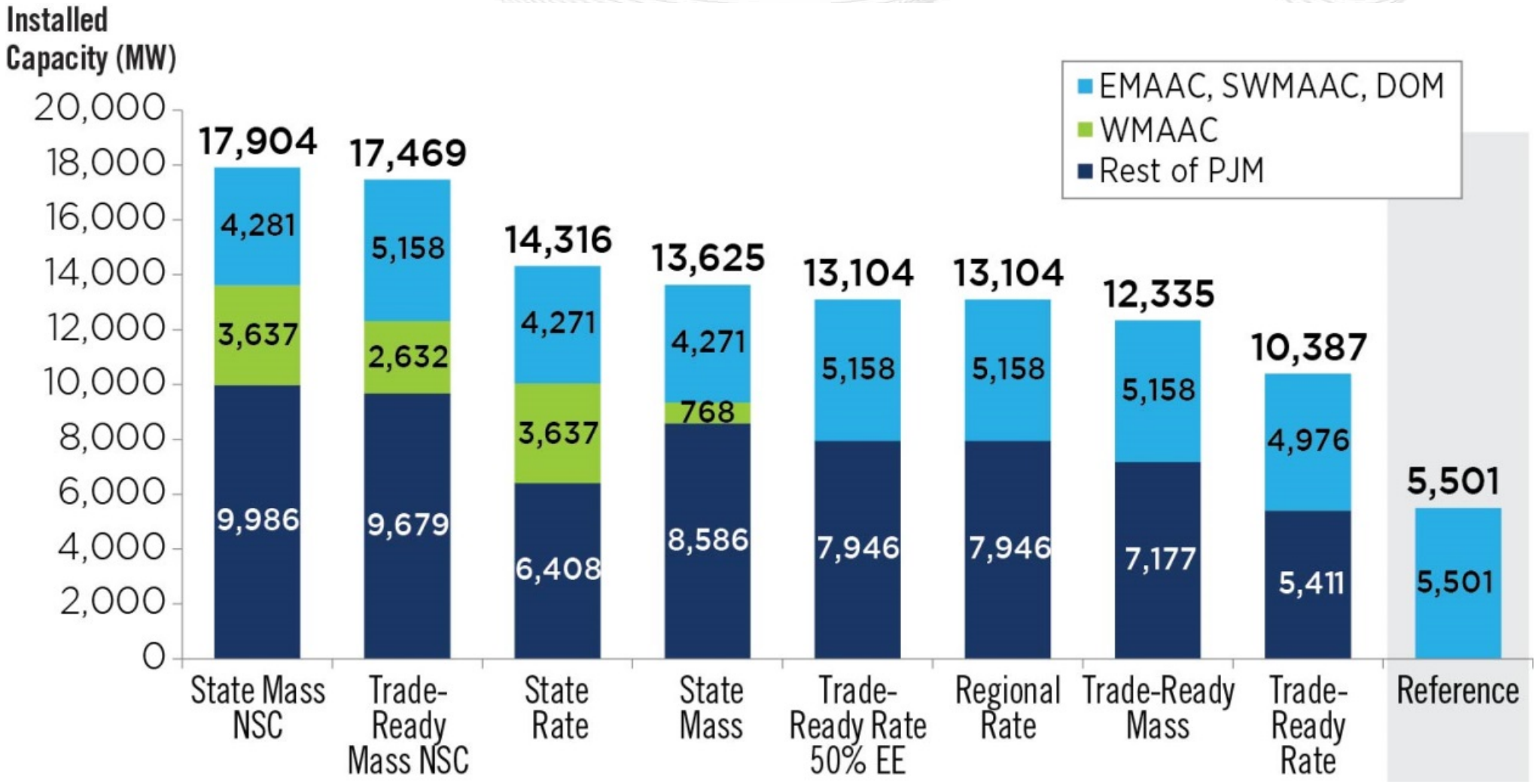
Clean Power Plan Compliance: Transmission System Effects

High Voltage Transmission System is Utilized Less Security Constrained Economic Dispatch Analysis Transmission Congestion in 2025

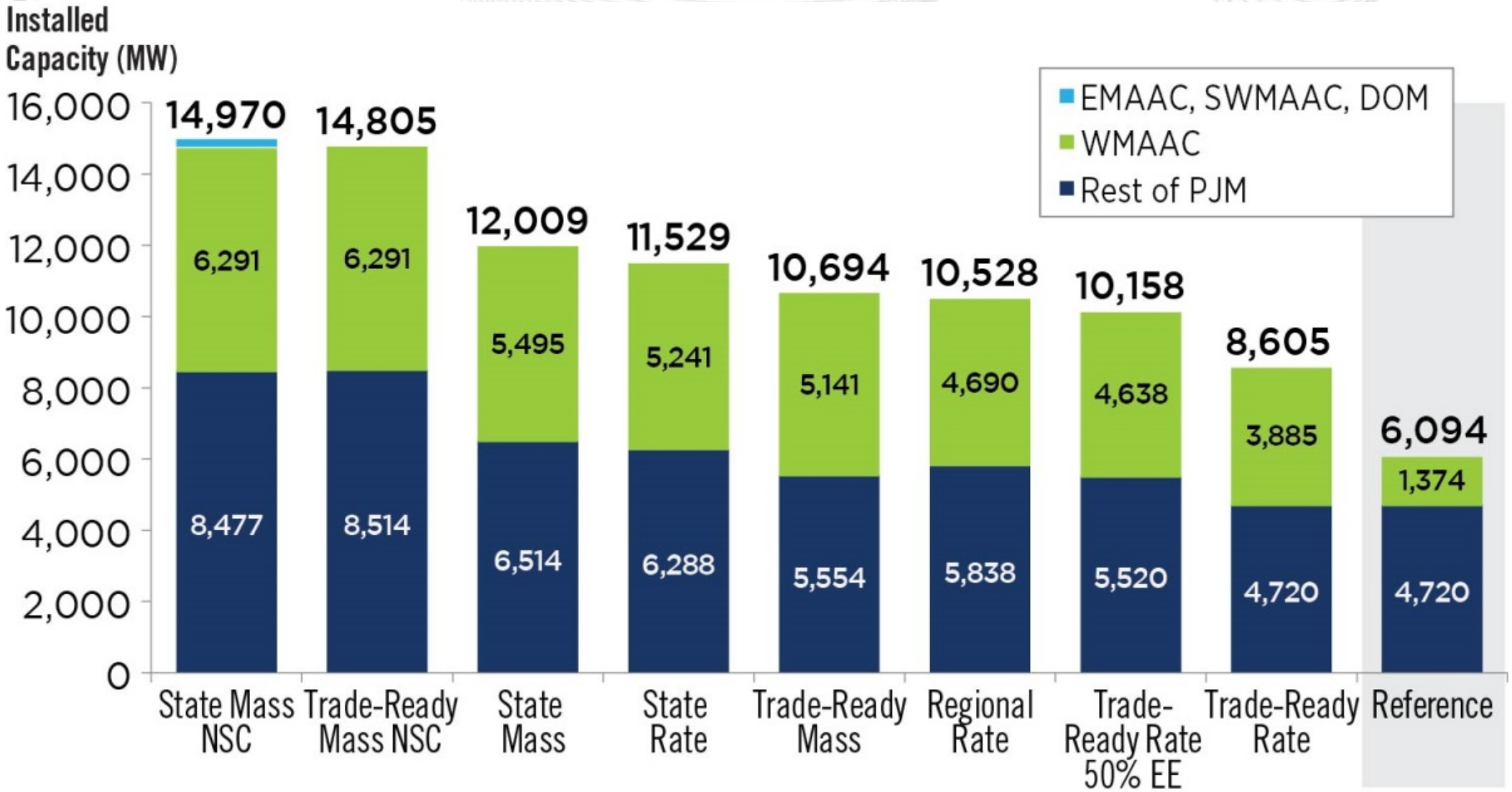


*Analysis focused on transmission limitations at the 230 kV system and up. Limited set of 138 kV or below constraints evaluated.

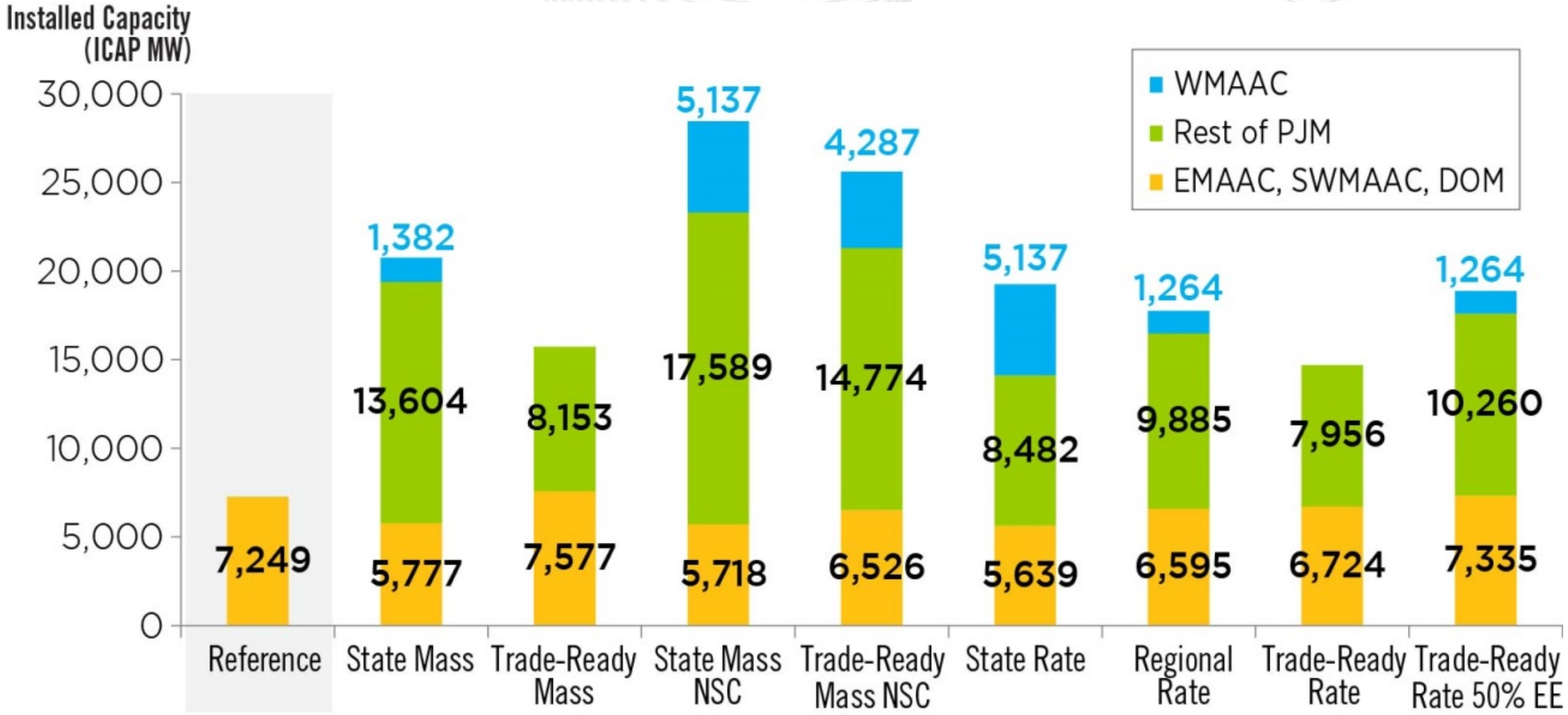
Distribution of Coal Retirements by Location by 2025



Distribution of New Generation by Location by 2025

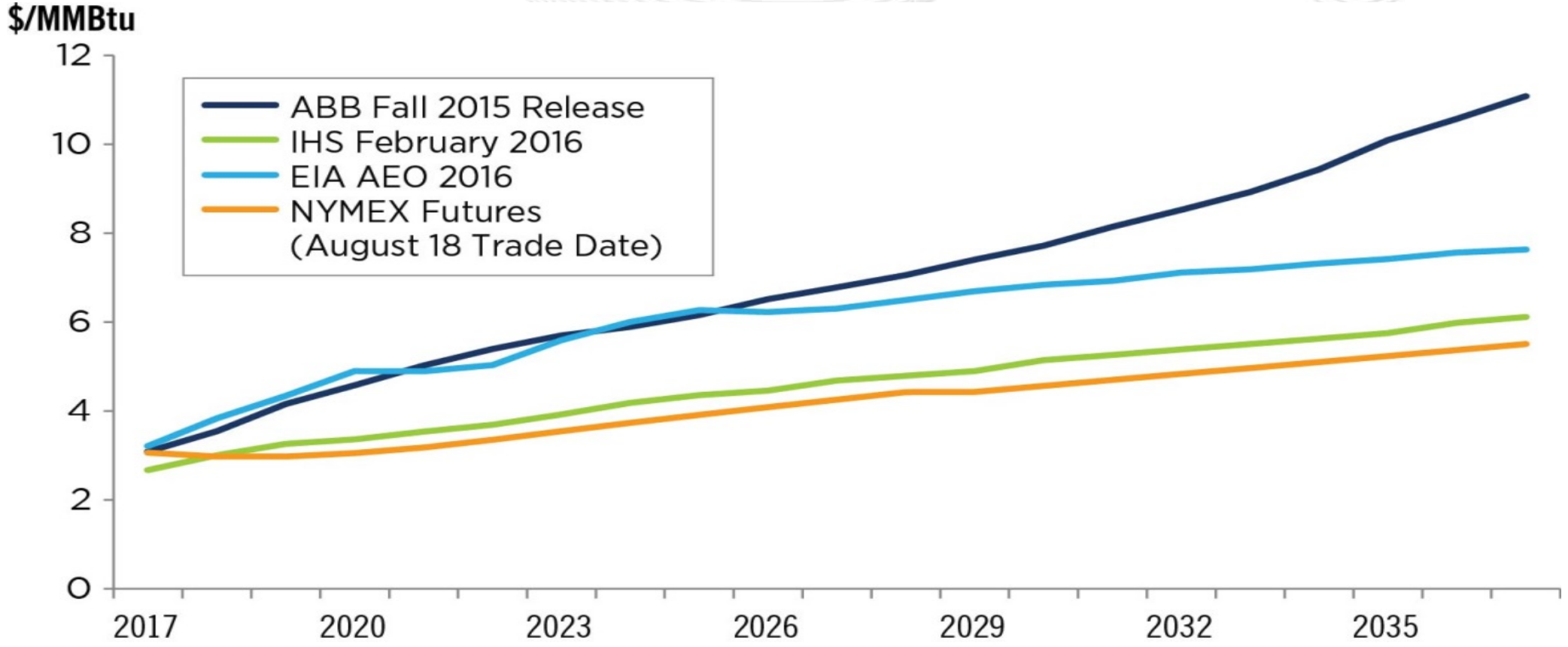


Distributional Effects on Generator Retirements (2018–2037)



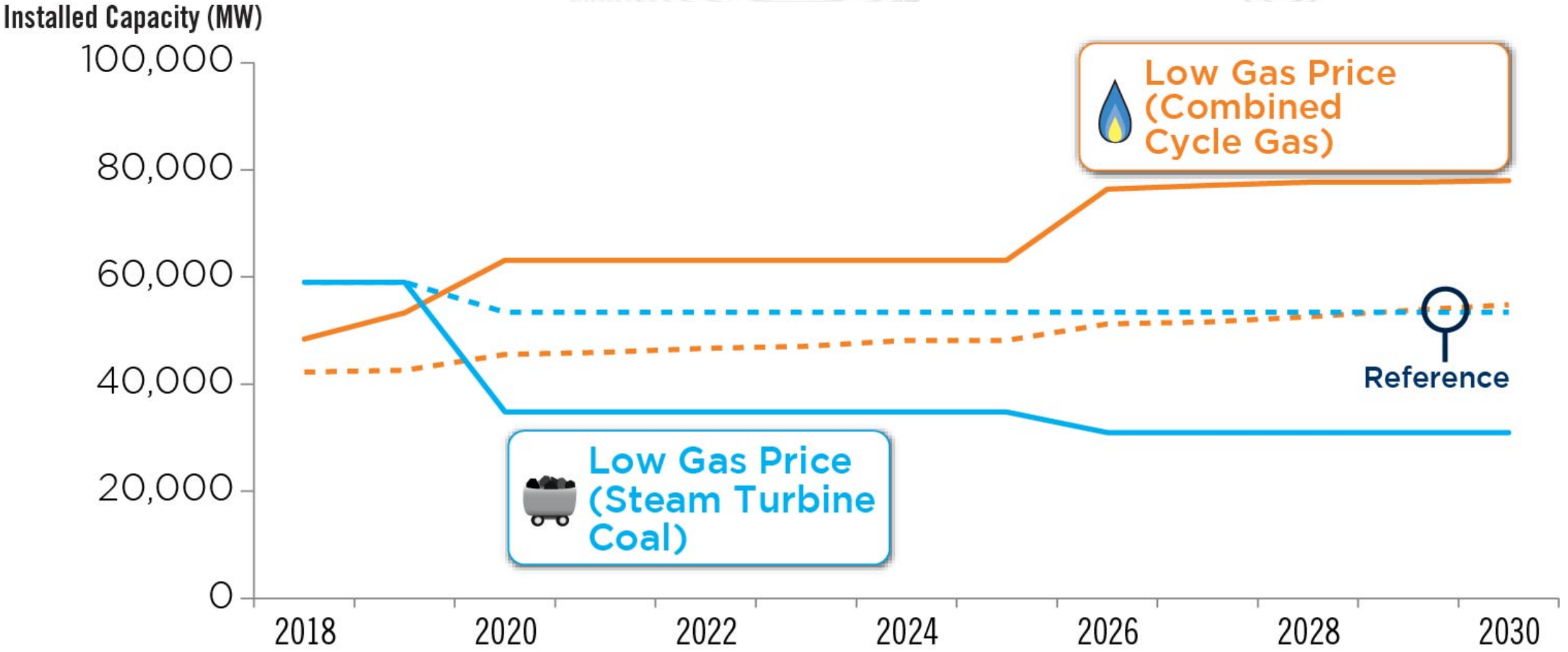
Low Gas Price Sensitivity

Henry Hub Natural Gas Price Comparison

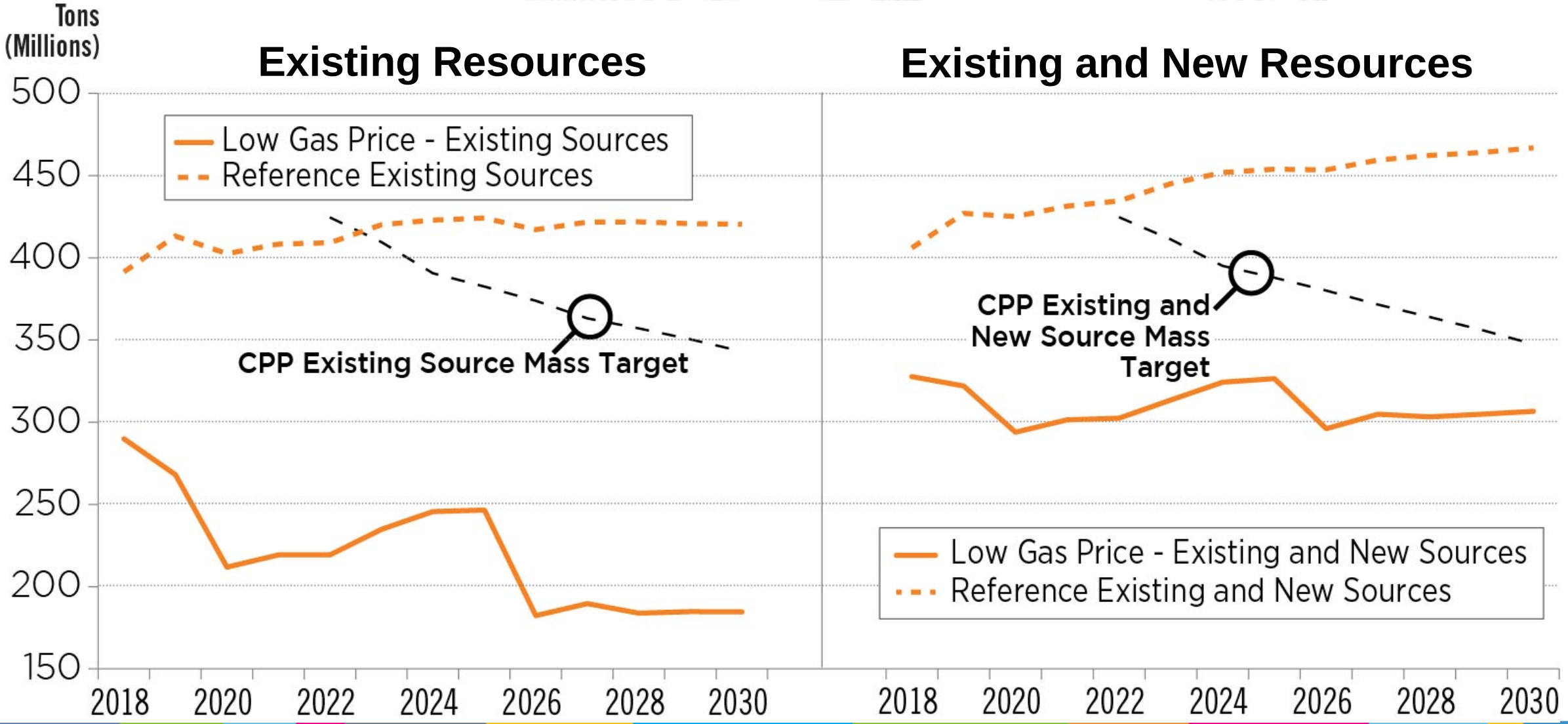


Source: IHS Inc.

Low Gas Price Sensitivity: Transition to more Combined Cycle Natural Gas

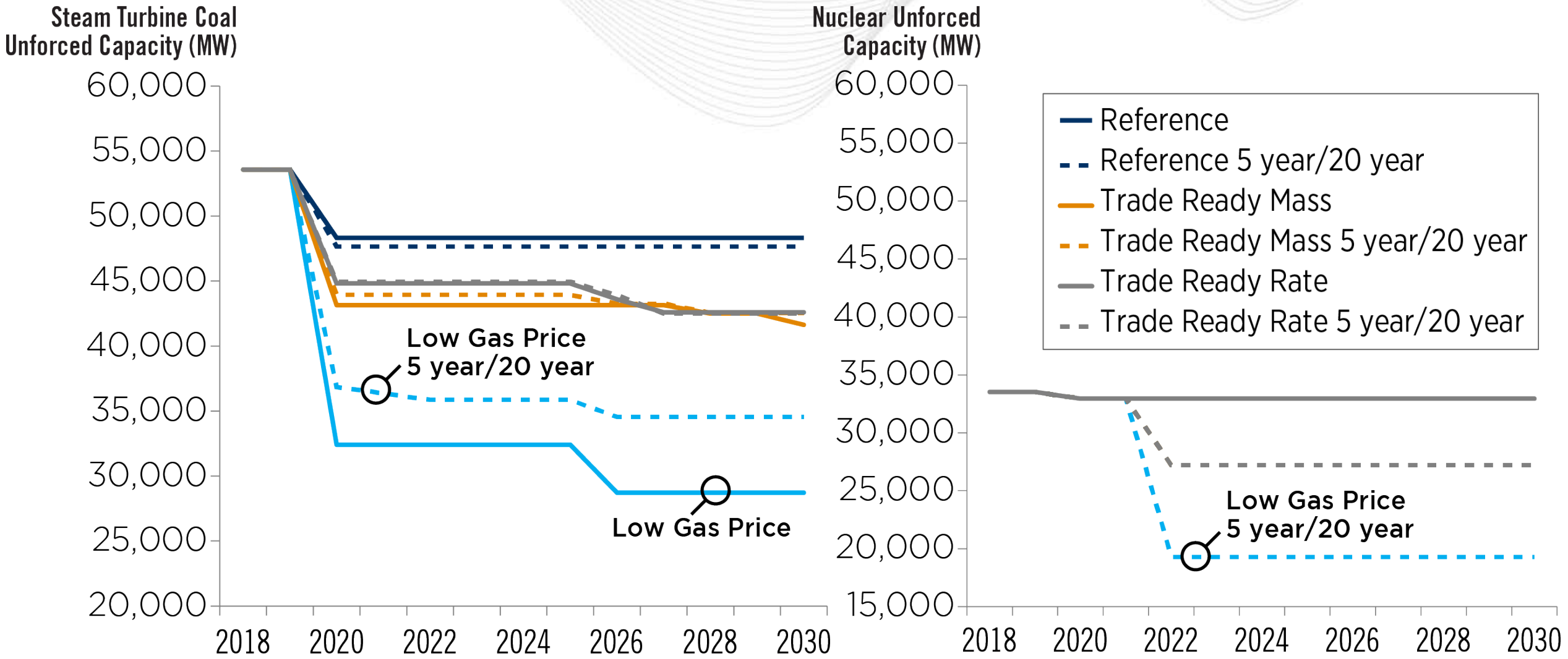


Low Gas Price Sensitivity: CO_2 Emissions

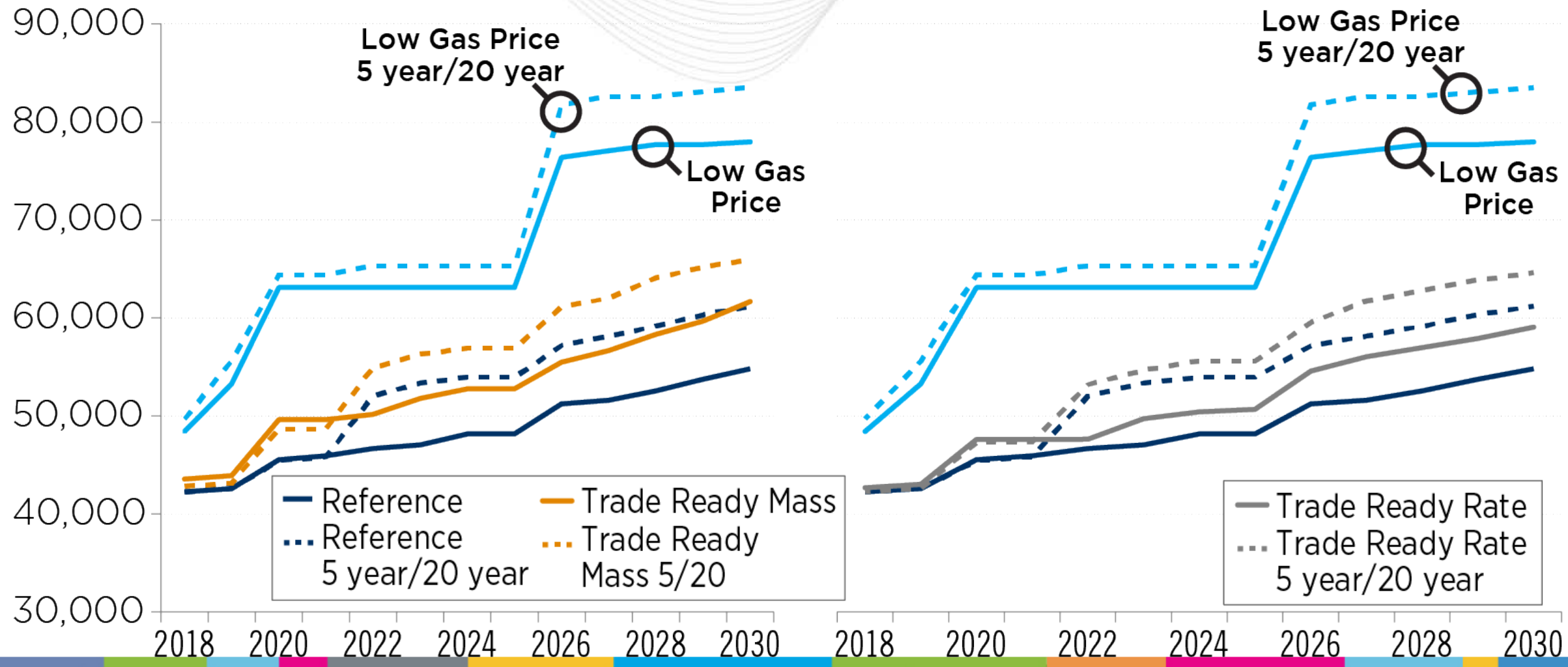


Initial 5 Year Horizon on Retirement and Go Forward Decisions

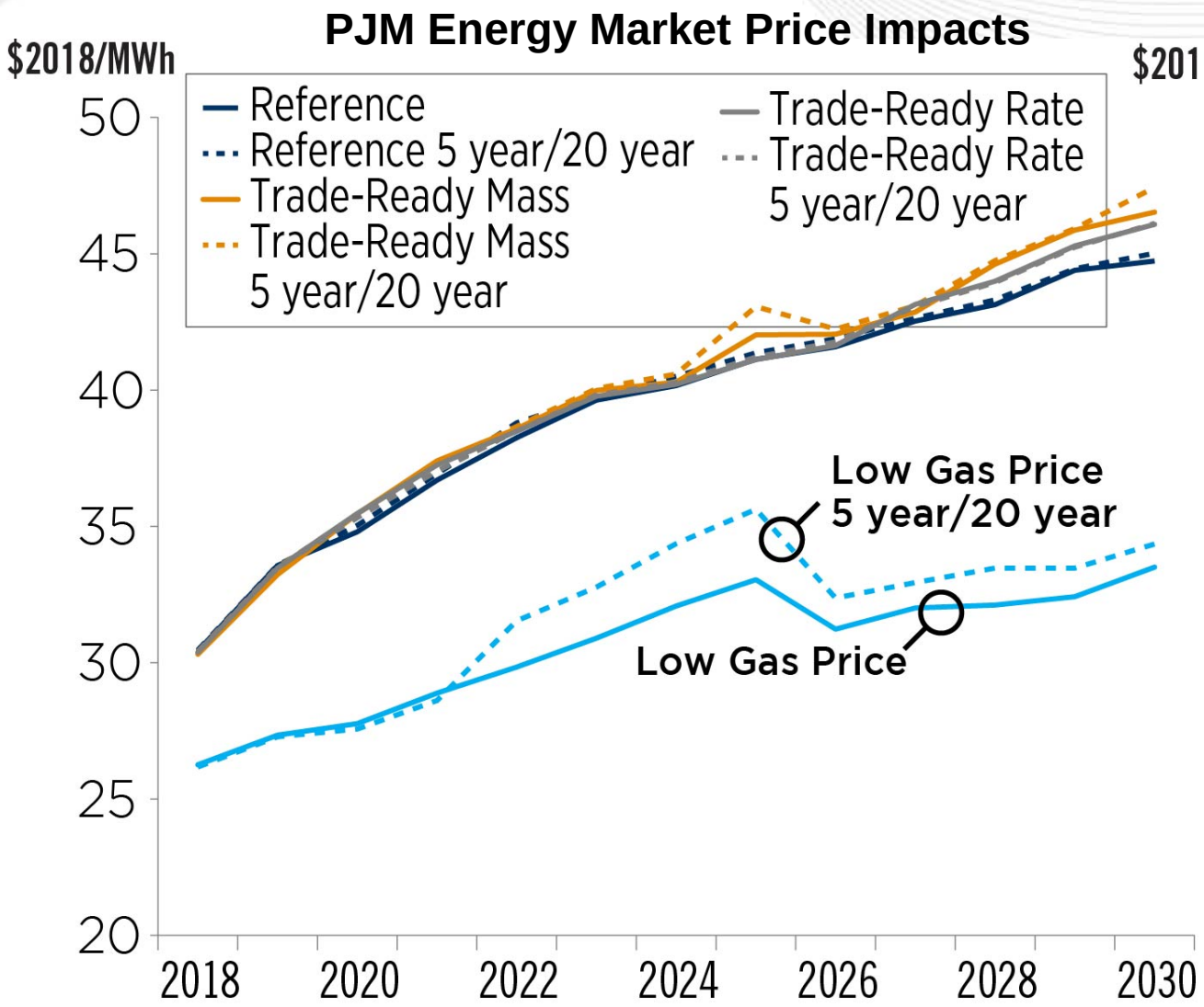
5 Year Horizon on Retire/Go Forward Decisions for Existing Resources

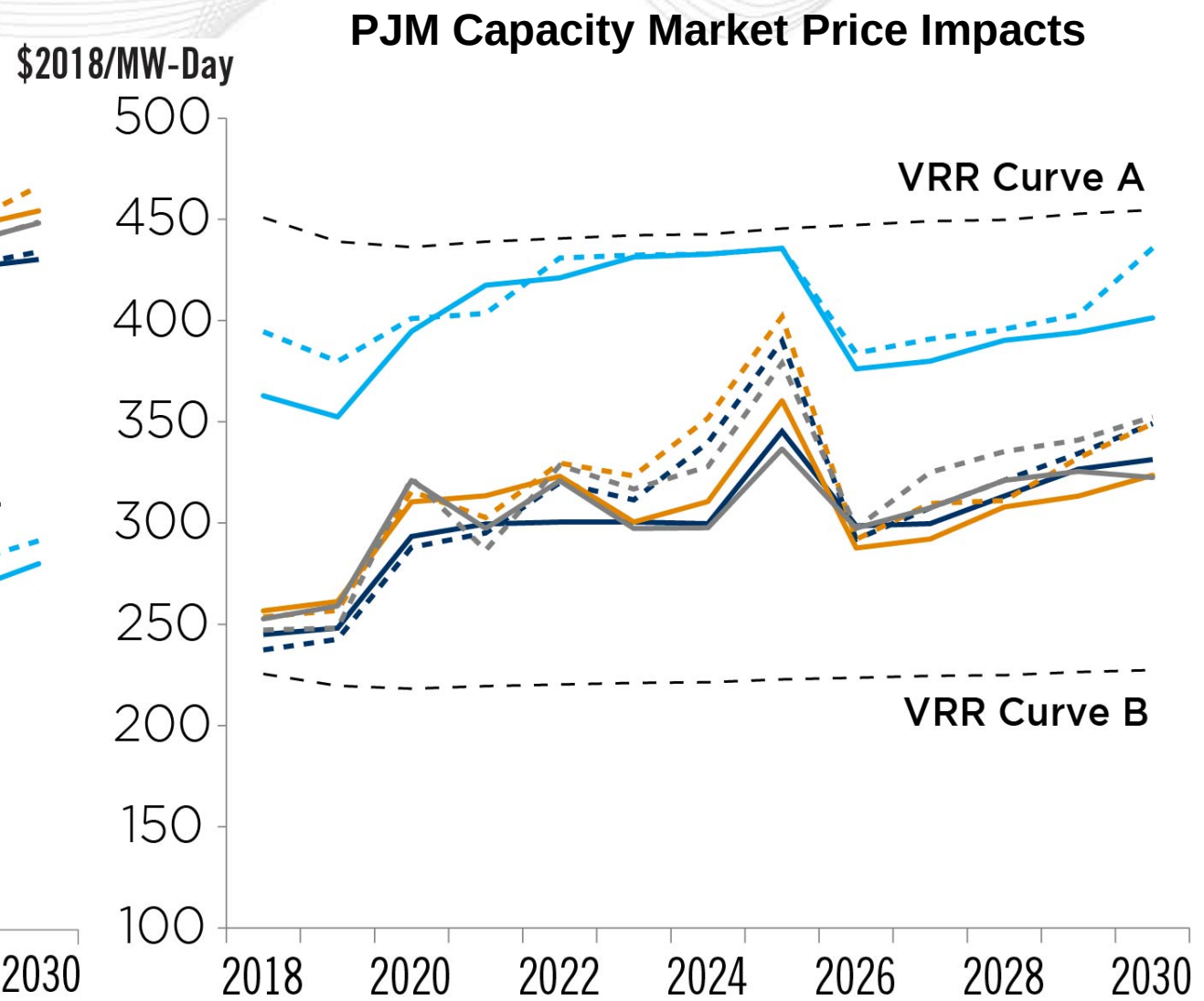


Resulting Gas Combined Cycle Entry with 5 Year Retirement/Go Forward Horizon

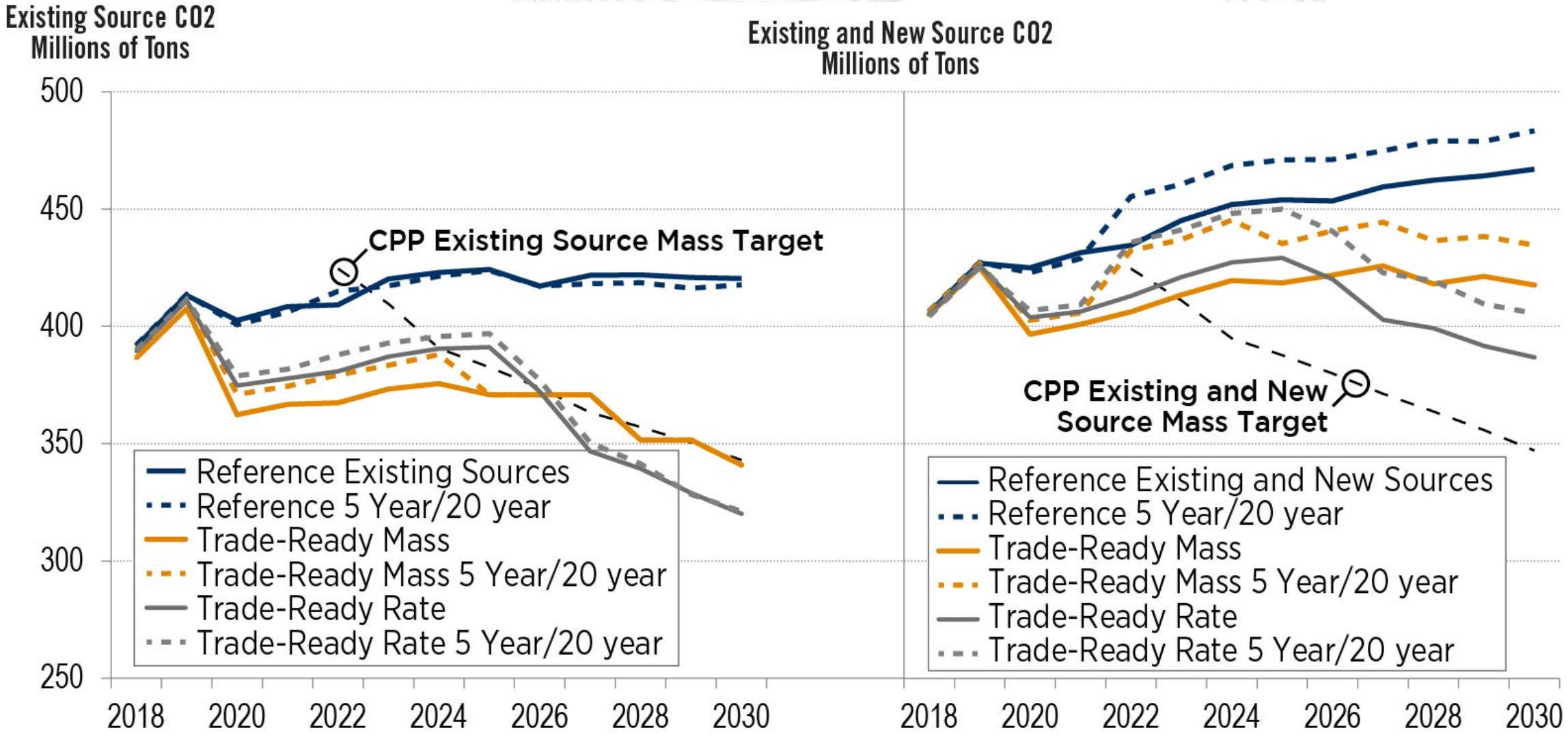


Market Effects of the 5 Year Retirement/Go Forward Horizon

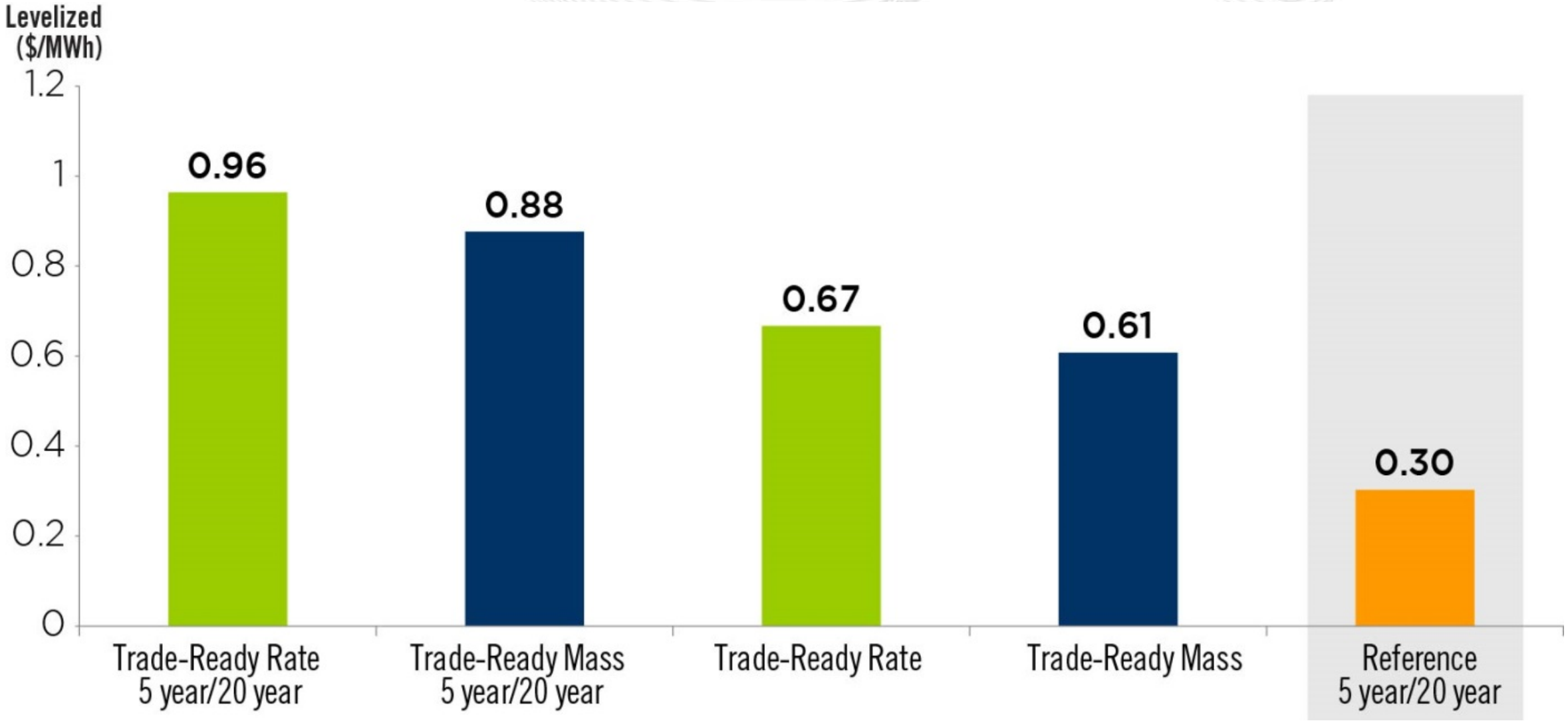




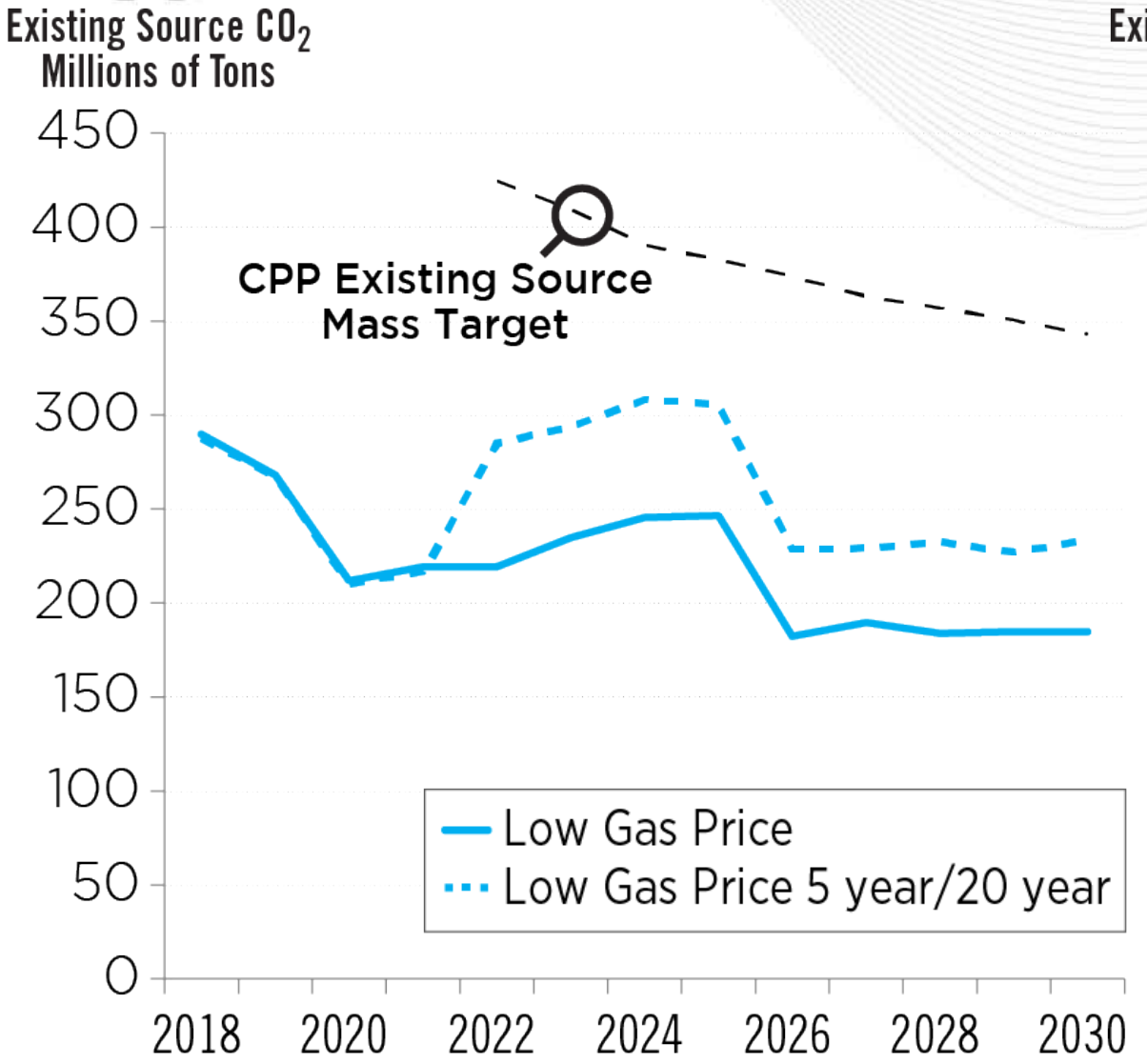
5 year Retirement/Go Forward Horizon: States Still Comply with the CPP Emission Targets

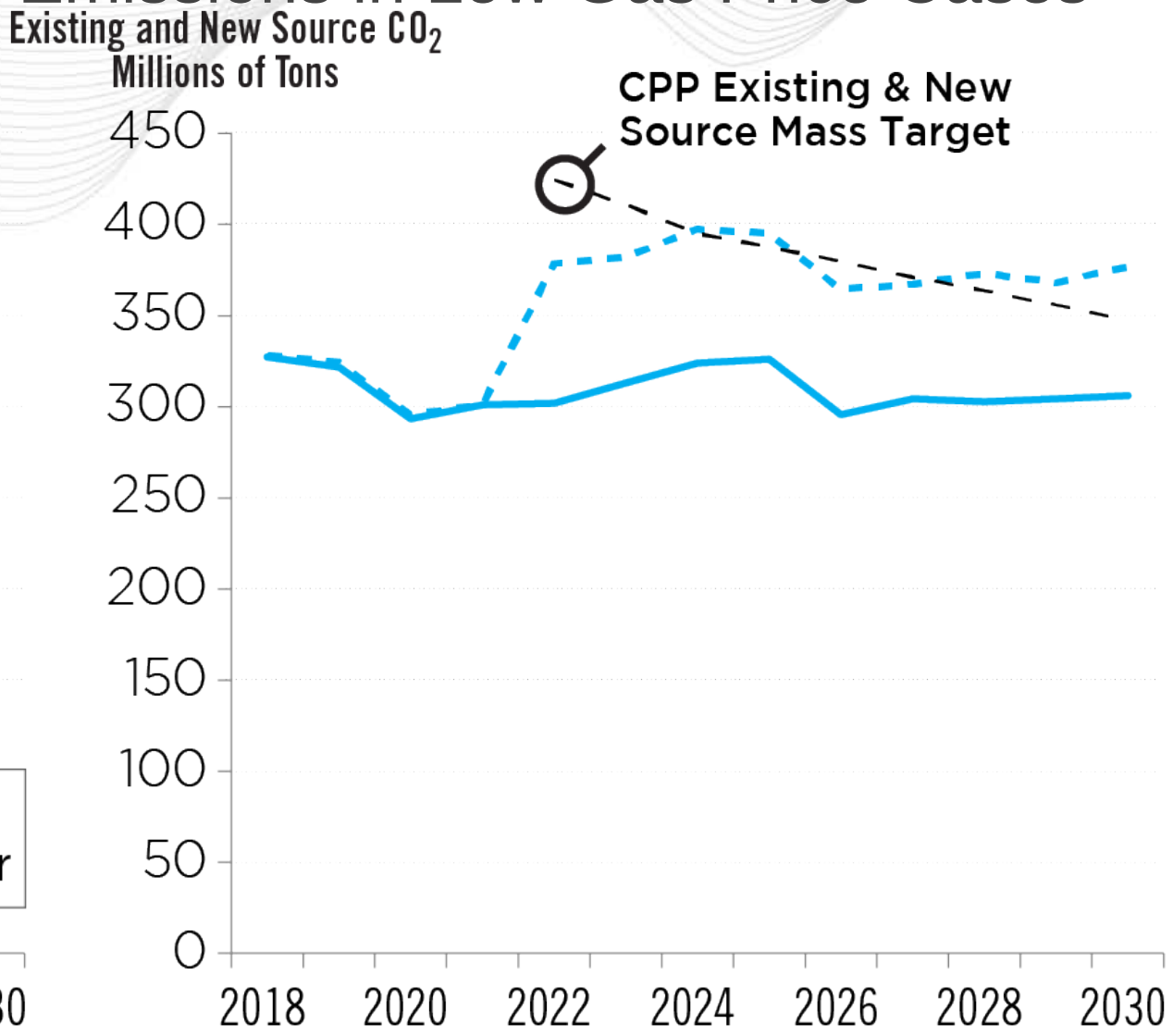


5 Year Retirement/Go Forward Horizon: Compliance Cost Goes Up in Reference Gas Scenario



5 Year Retirement/Go Forward Horizon: Emissions in Low Gas Price Cases



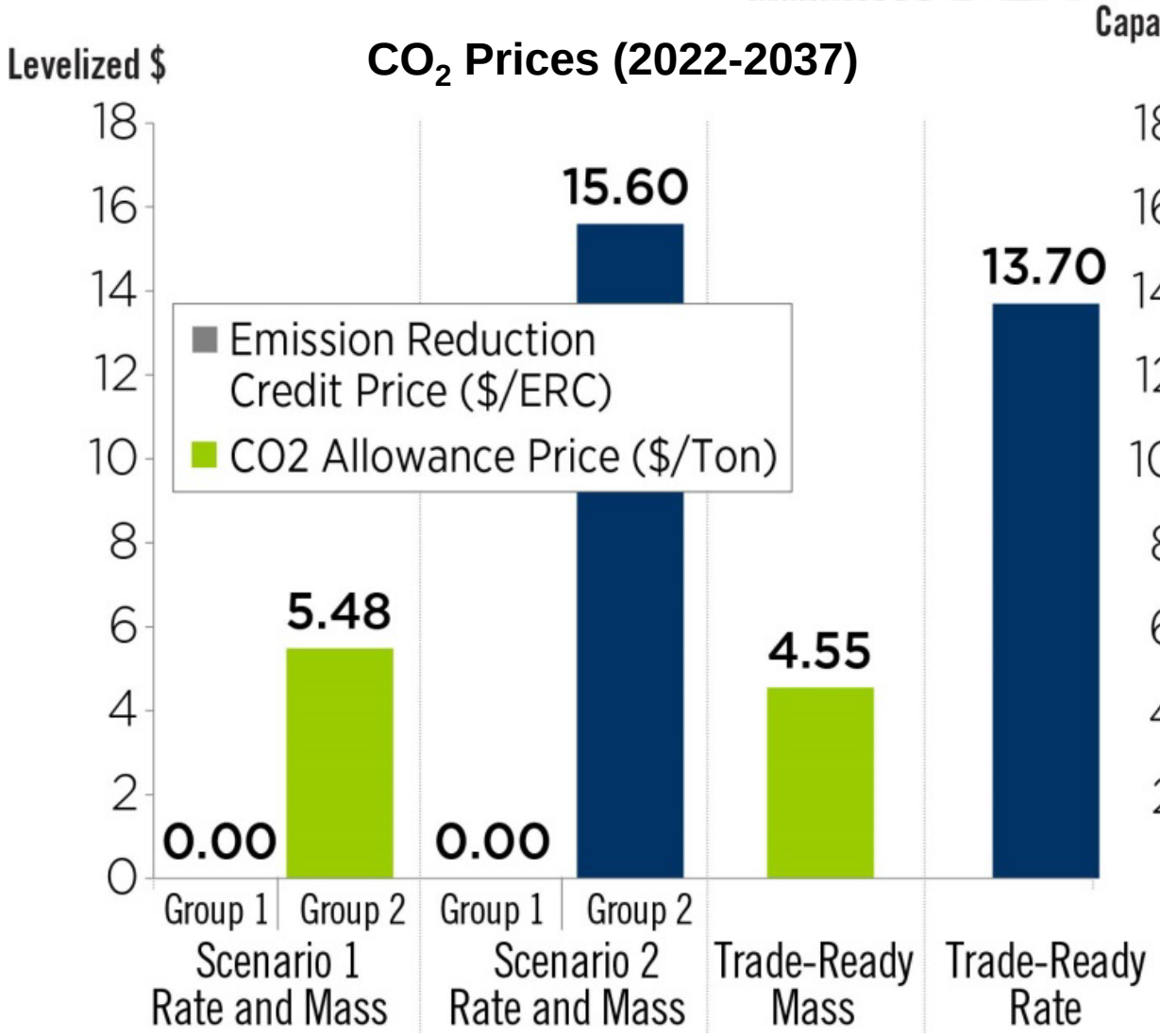


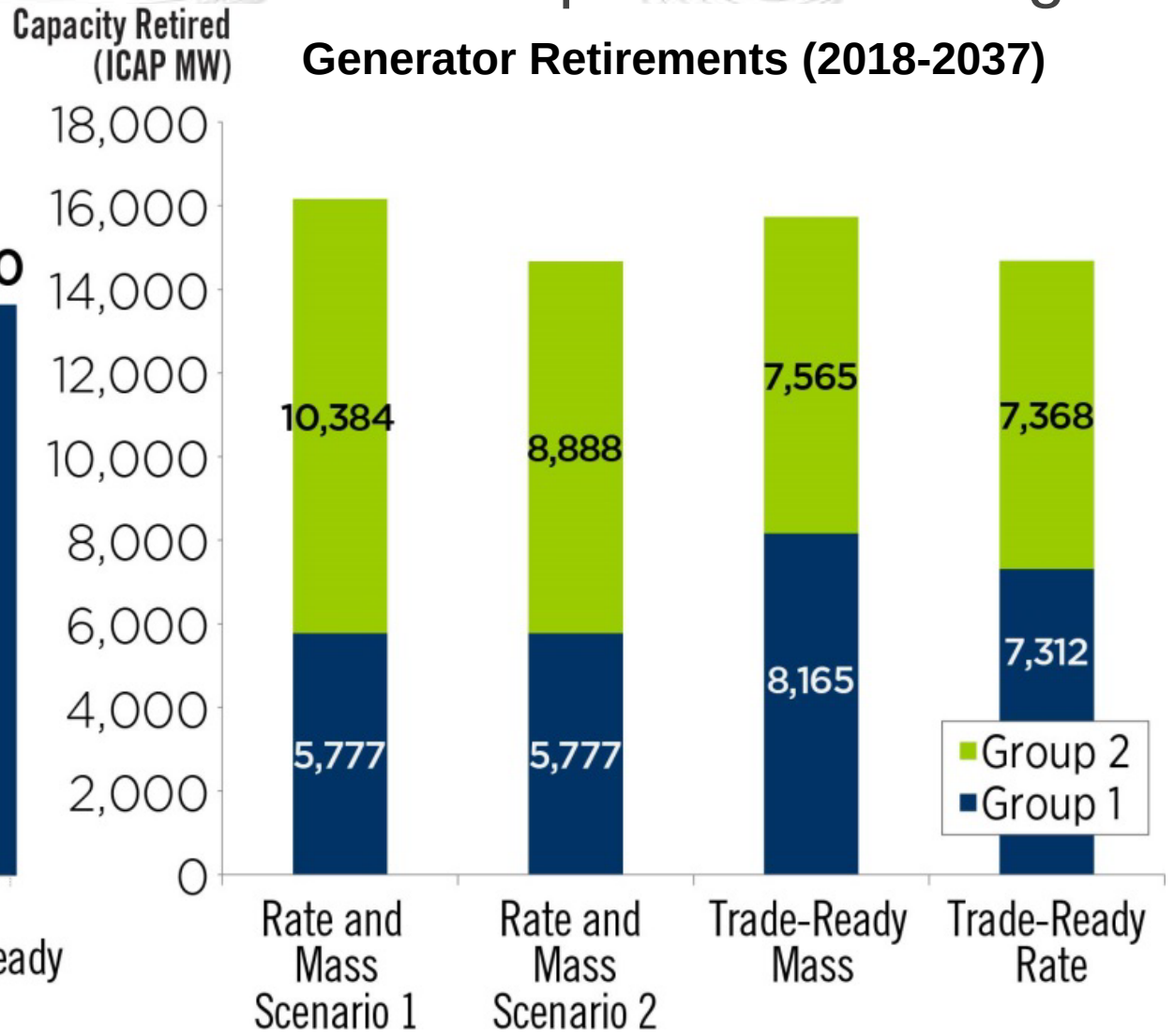
Rate and Mass Sensitivity

Sensitivity: States Form Multi-State Mass and Rate-based Compliance sub-Regions

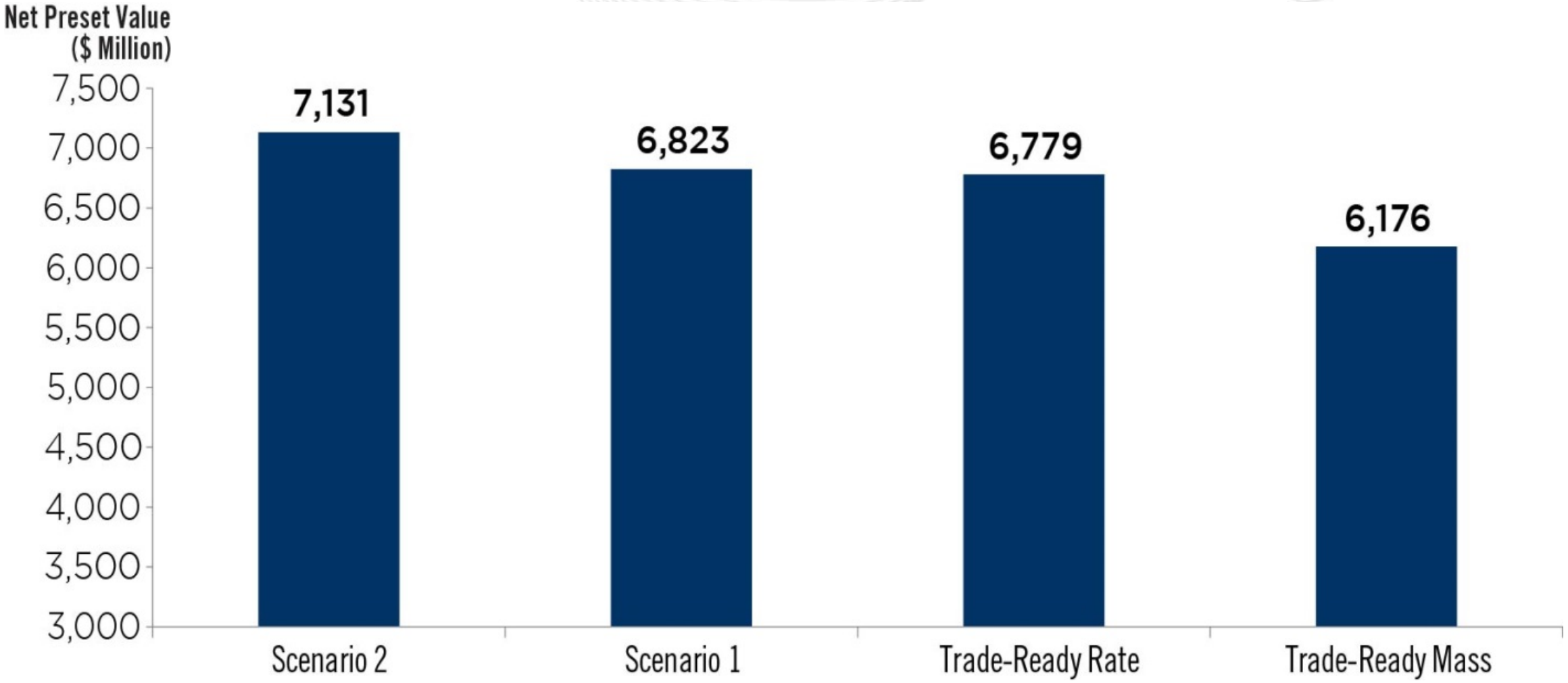
	Group ID	States	Compliance
Scenario 1	Group 1 States	MD | DE | VA | NJ | PA	Multi-State Rate with Sub-Category Rate Targets
	Group 2 states	IL | IN | KY | MI | NC | OH | WV	Multi-State Mass
Scenario 2	Group 1 States	MD | DE | VA | NJ | PA	Multi-State Mass
	Group 2 states	IL | IN | KY | MI | NC | OH | WV	Multi-State Rate with Sub-Category Rate Targets

States Form Multi-State Mass and Rate-based Compliance sub-Regions





If States Form Multi-State Mass and Rate-based Compliance sub-Regions, Compliance Cost (2018-2037) Goes Up

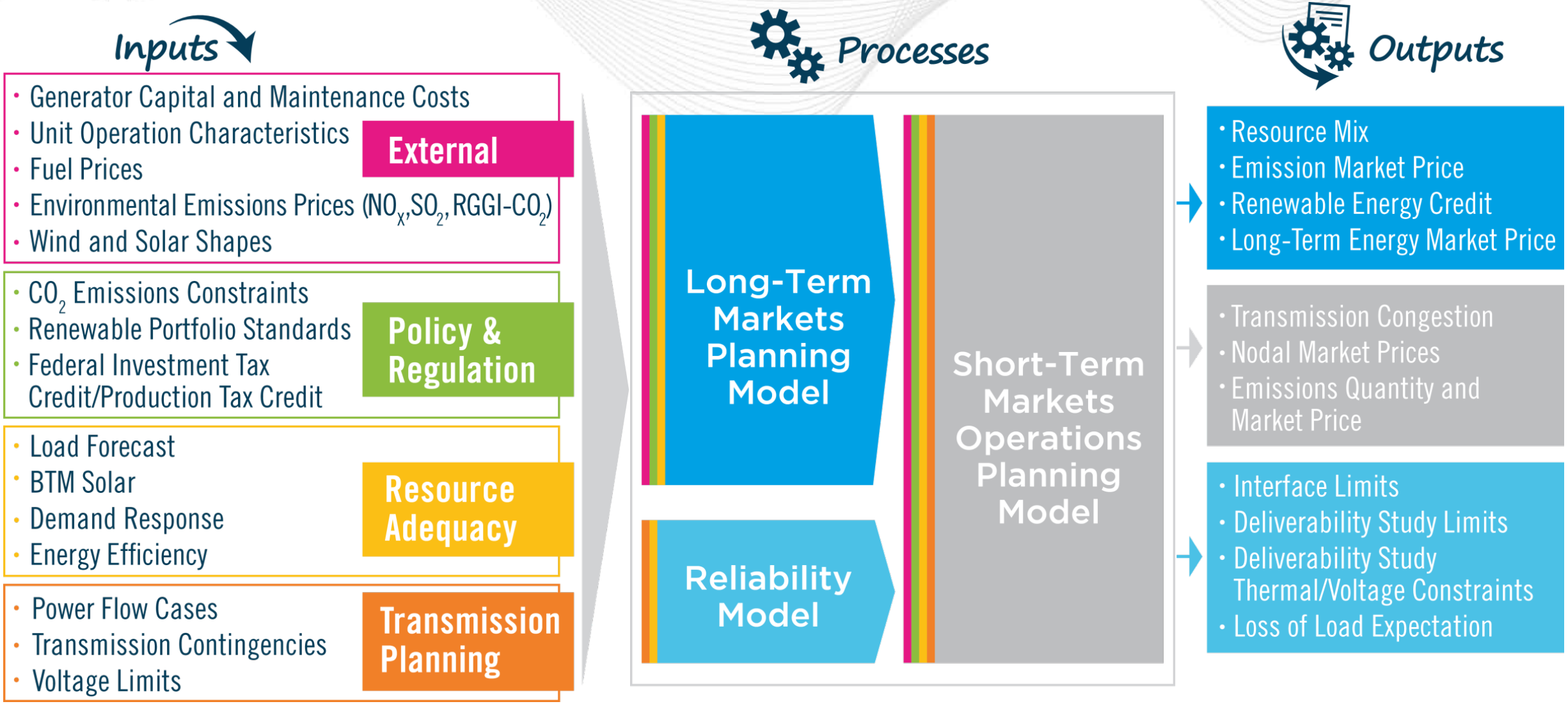


Next Steps

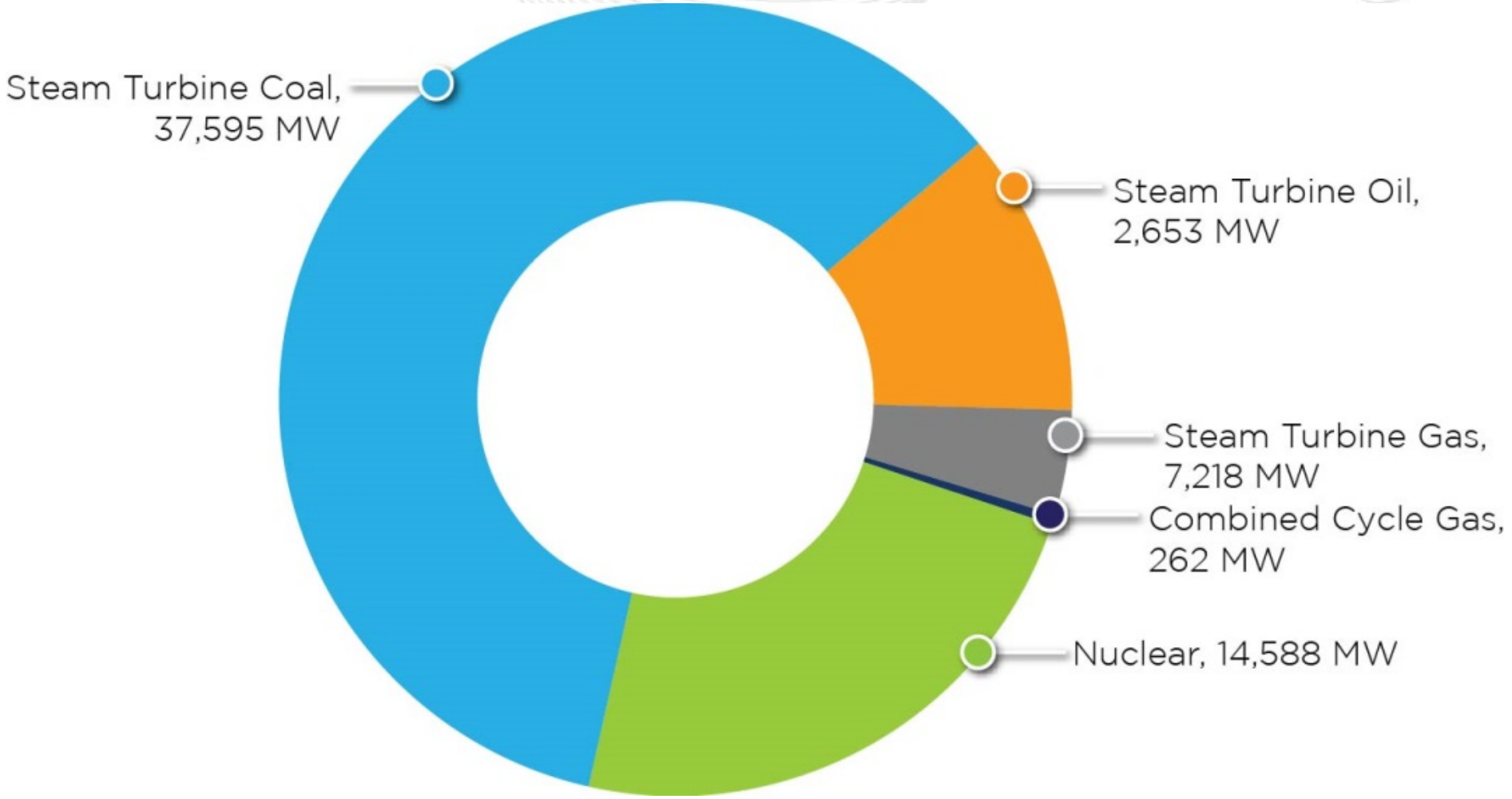
- Continue PJM state and stakeholder outreach
- PJM Reliability Analysis of resource retirements – End of year
- PJM/MISO Coordinated Analysis underway – End of year

Appendix: Key Model Inputs

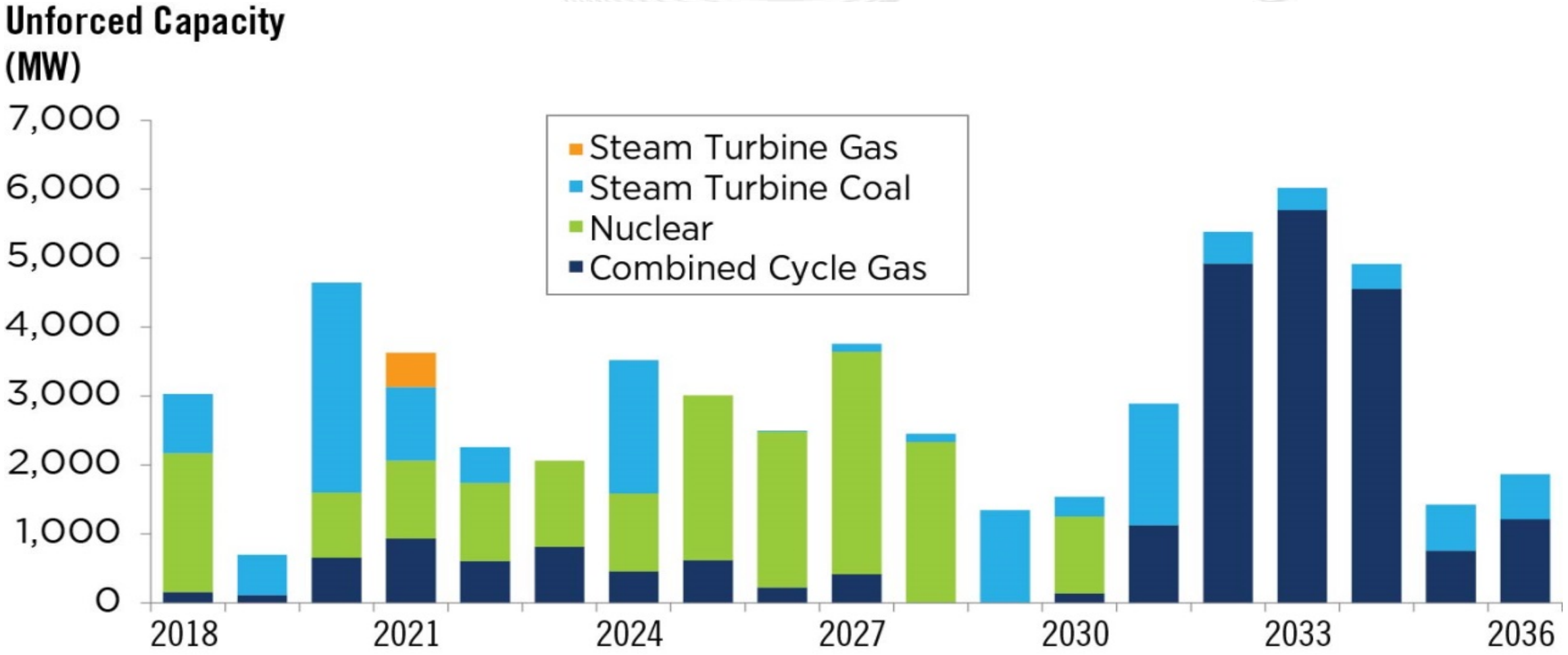
Modeling Procedure for Evaluation of the Clean Power Plan



Steam Turbine and Nuclear units older than 40-years, Combined Cycles older than 30-years by 2018



Distribution of Existing Thermal Generating Units in PJM
Reaching the end of their 40-year or 30-year Technical Life



Potential Economic Generating Capacity Additions in the PJM footprint