



# PJM Generation Dispatch, Resource Mix, and Emissions

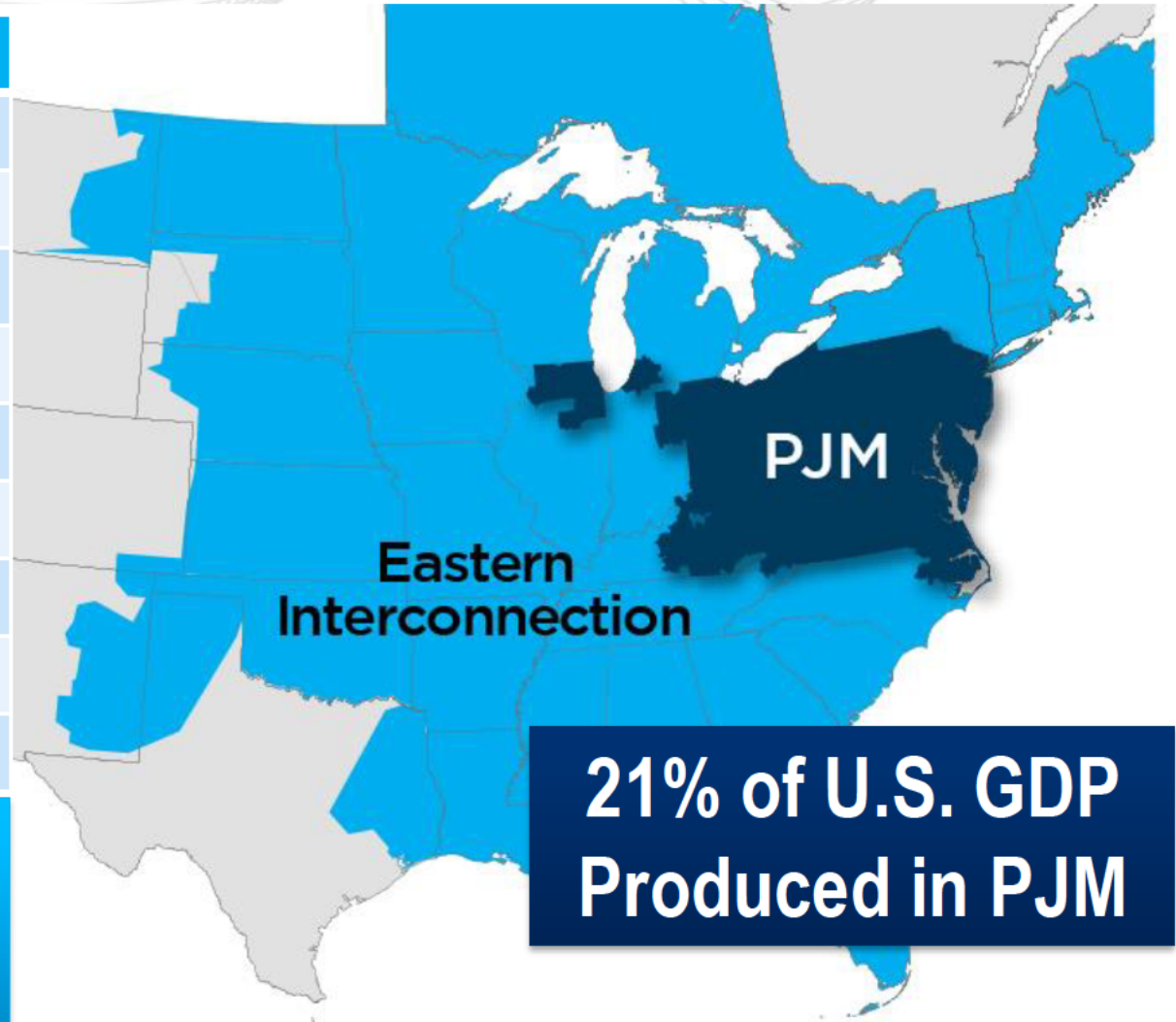
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Gary Helm  
PJM Interconnection

PA DEP Air Quality Technical Advisory Committee  
Oct. 15, 2020

## Key Statistics

Member companies	1,040+
Millions of people served	65
Peak load in megawatts	165,563
Megawatts of generating capacity	186,788
Miles of transmission lines	84,236
2019 gigawatt hours of annual energy	787,307
Generation sources	1,446
Square miles of territory	369,089
States served	13 + DC

- 27% of generation in Eastern Interconnection
- 26% of load in Eastern Interconnection
- 20% of transmission assets in Eastern Interconnection



As of 2/2020

Joined in 1927

Joined in 1956

Joined in 1965

Joined in 1981

Joined in 2002

Joined in 2004

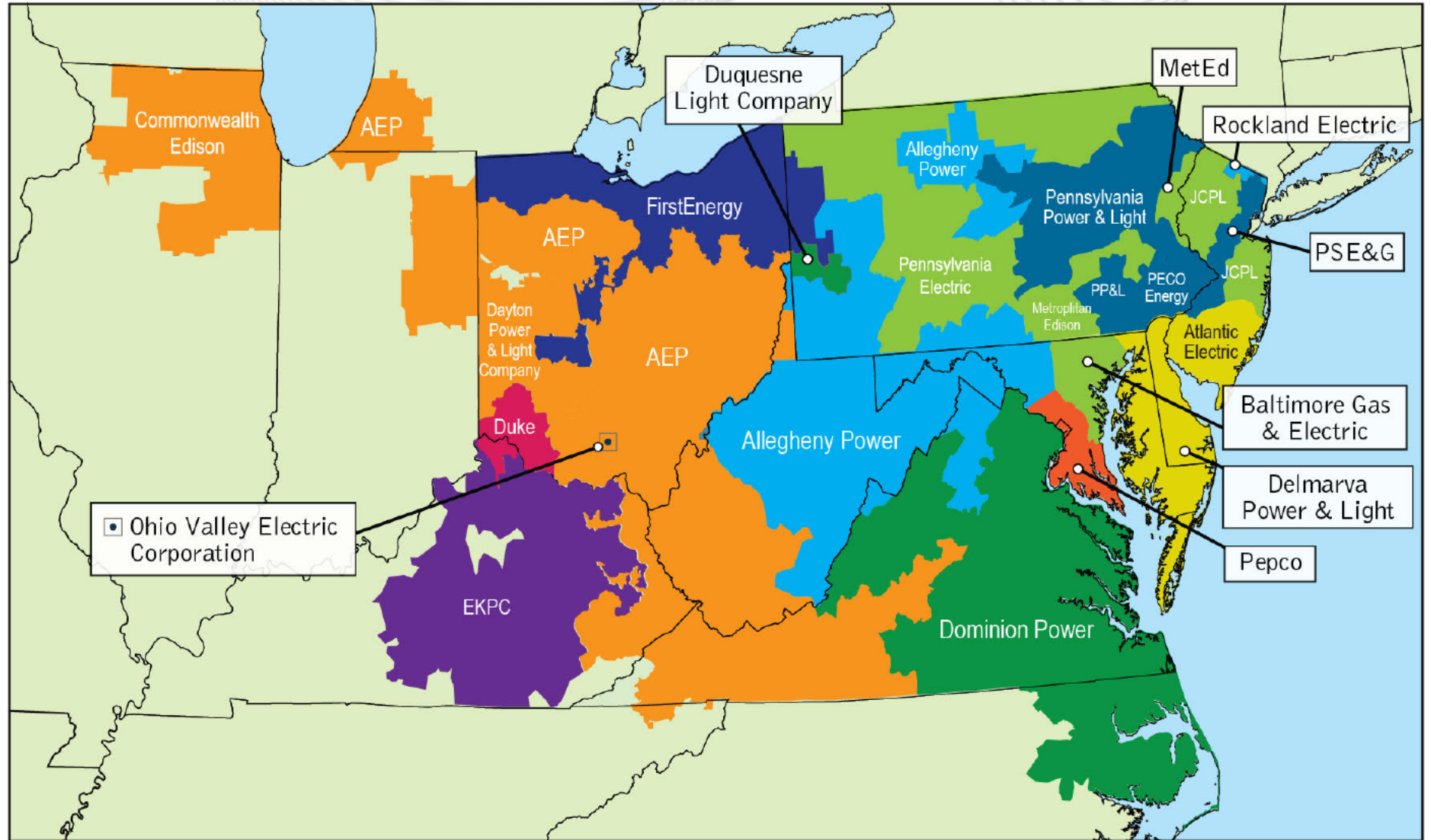
Joined in 2005

Joined in 2011

Joined in 2012

Joined in 2013

Joined in 2018



## Reliability

- Grid operations
- Supply/demand balance
- Transmission monitoring

1

## Regional Planning

- 15-year outlook

3

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## Market Operation

- Energy
- Capacity
- Ancillary services



**PJM Grid Operations**

**PJM Markets**

## ☑ Day-Ahead Market

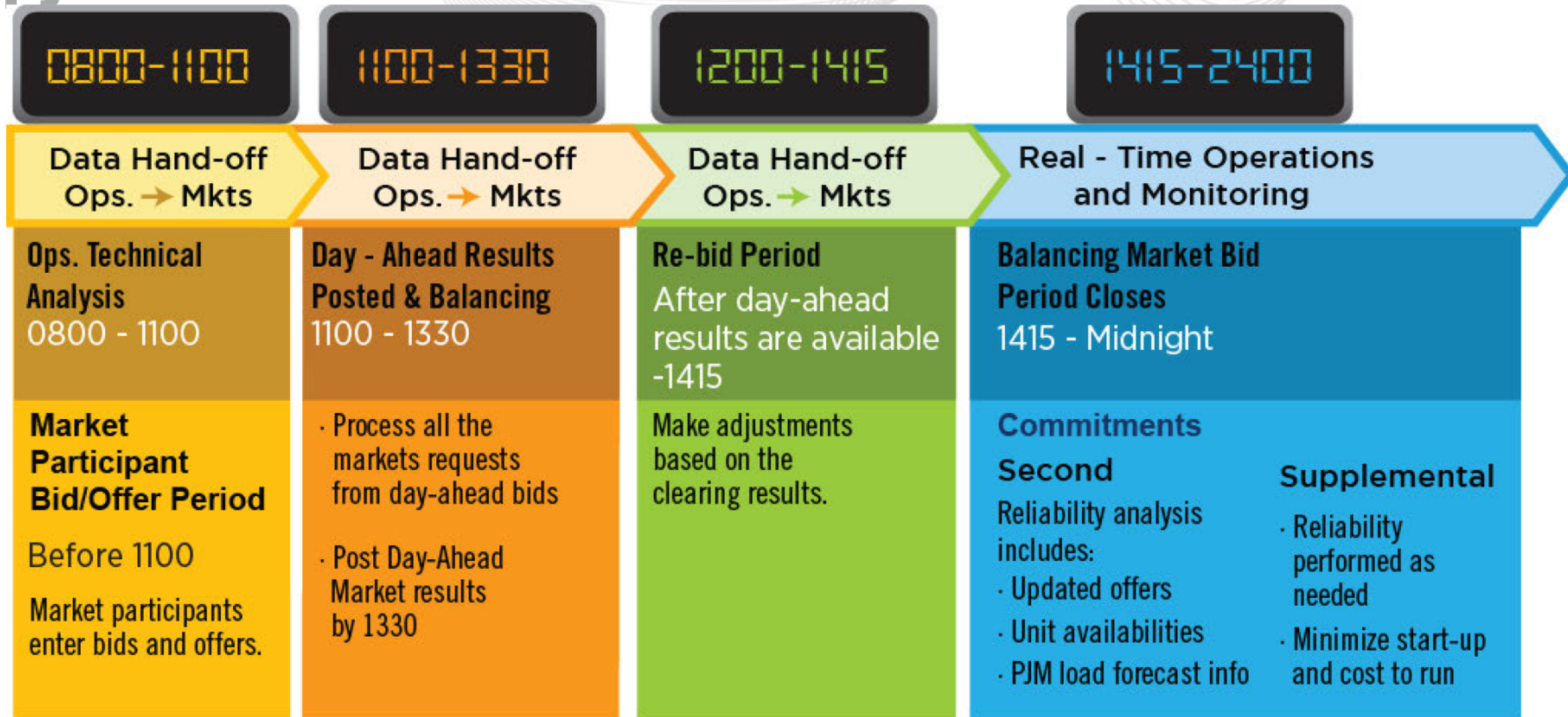
- ✓ develop day-ahead **schedule** using least-cost security constrained unit commitment and security constrained economic dispatch programs that simultaneously optimize energy and reserves;
- ✓ calculate **hourly** LMPs for next Operating Day using generation offers, demand bids, and bilateral transaction schedules;

## ☑ Day-Ahead Market Settlement

- ✓ Based on **scheduled** hourly quantities and **day-ahead** hourly prices;



- Support the Real-Time Market Clearing/Dispatch Engines
  - Security Constrained Economic Dispatch (**SCED**)
    - Intermediate Term – ITSCED
    - Real-Time – RTSCED
  - Ancillary Services Optimizer (**ASO**)
- Support the Locational Pricing Calculator Engine (**LPC**)
  - Calculates **5-minute** clearing prices for energy, regulation, and reserves (then aggregates to hourly values)
  - Posts LMPs for more than **11,000** pricing nodes (including the Energy, Loss and Congestion components)
- Perform the daily real-time price verification process
  - Validate all prices prior to posting hourly Energy **LMPs** and Regulation and Reserve market clearing prices (**MCPs**)
- Support Market-to-Market coordination process with MISO and NYISO
  - Prices are exchanged with neighboring ISO/RTOs and used in our clearing engines.

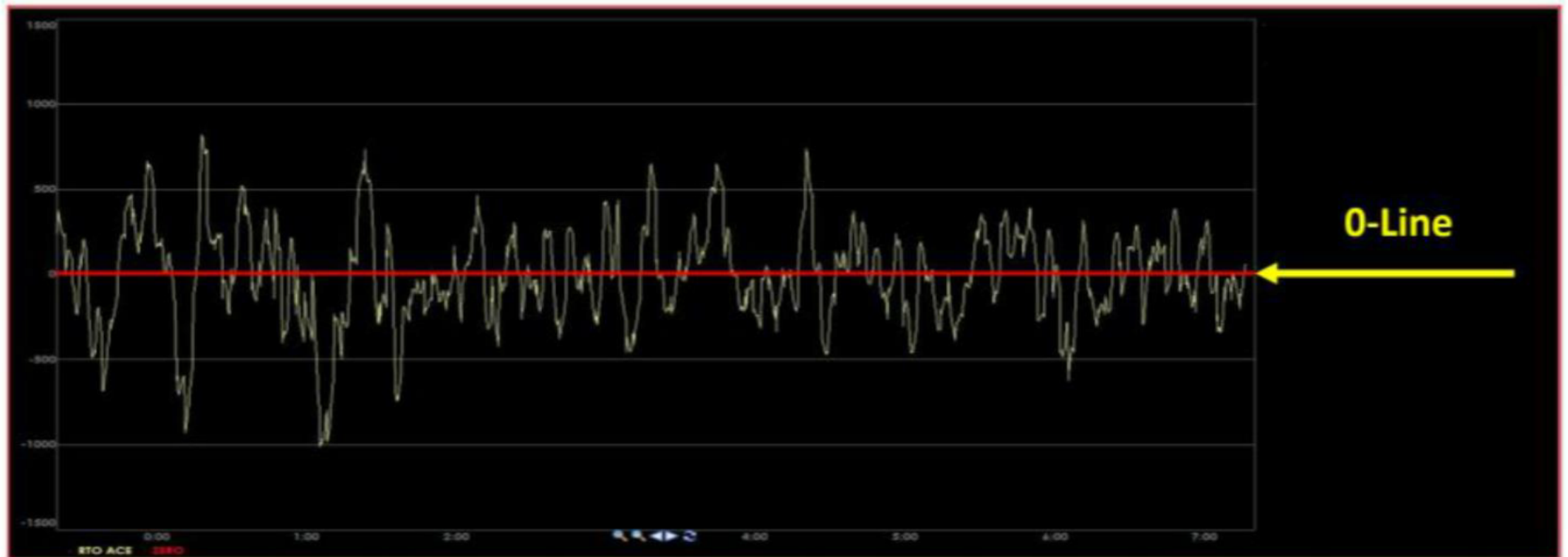




# Milford Control Room

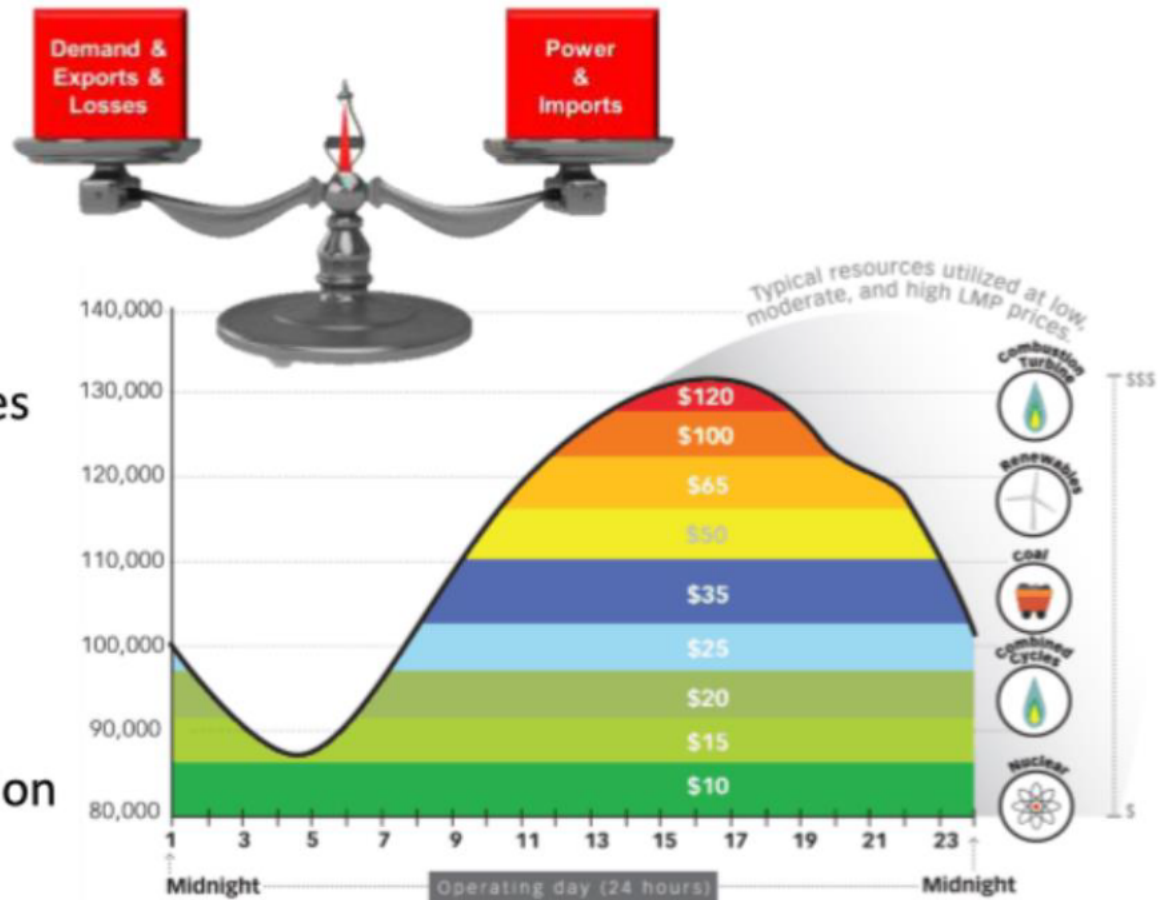


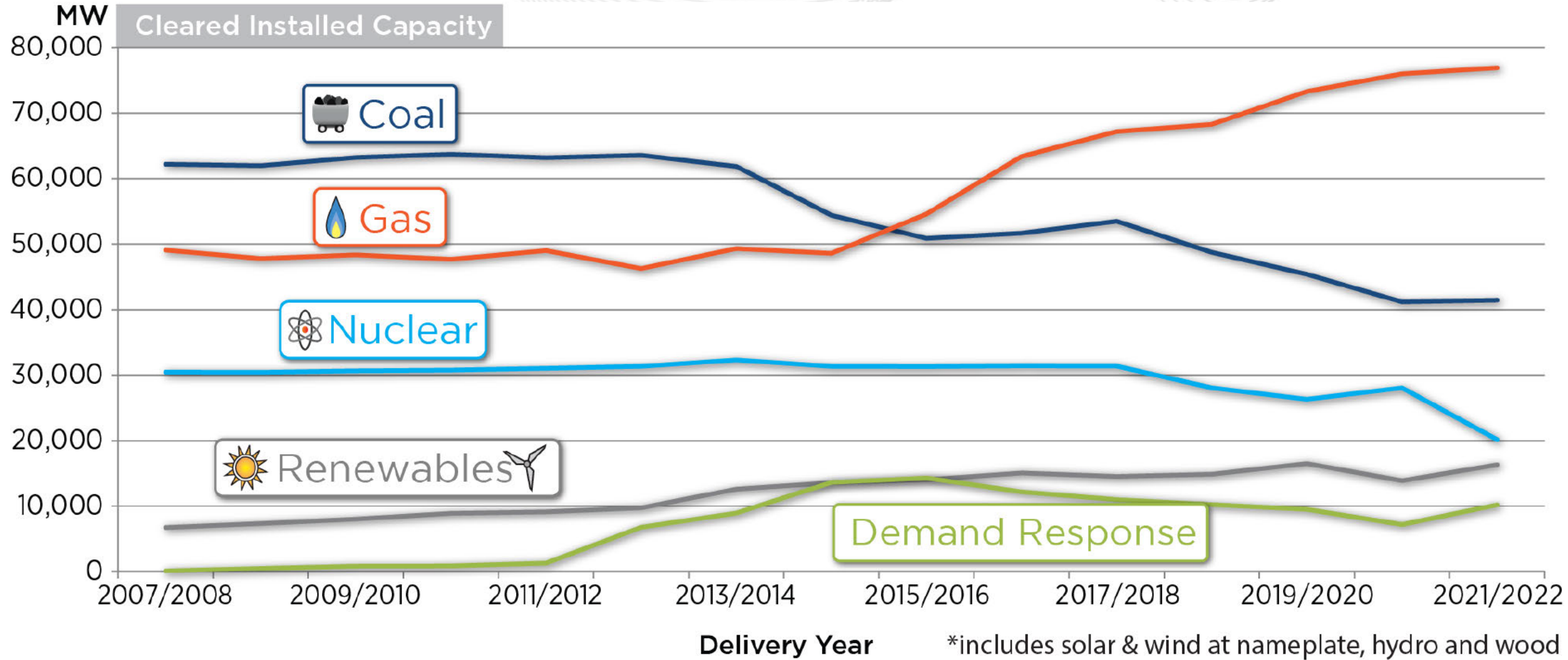
## ACE Graph

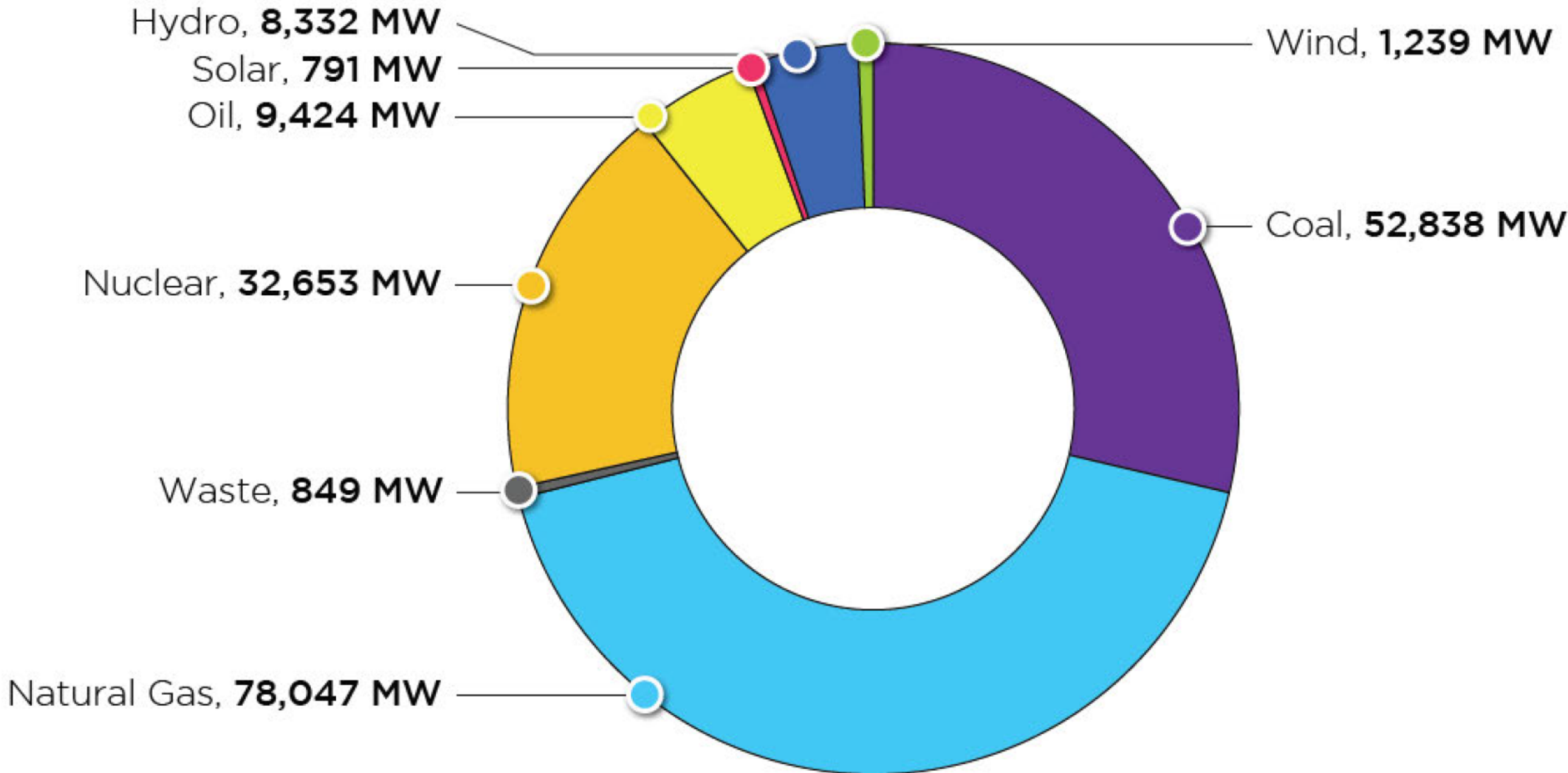


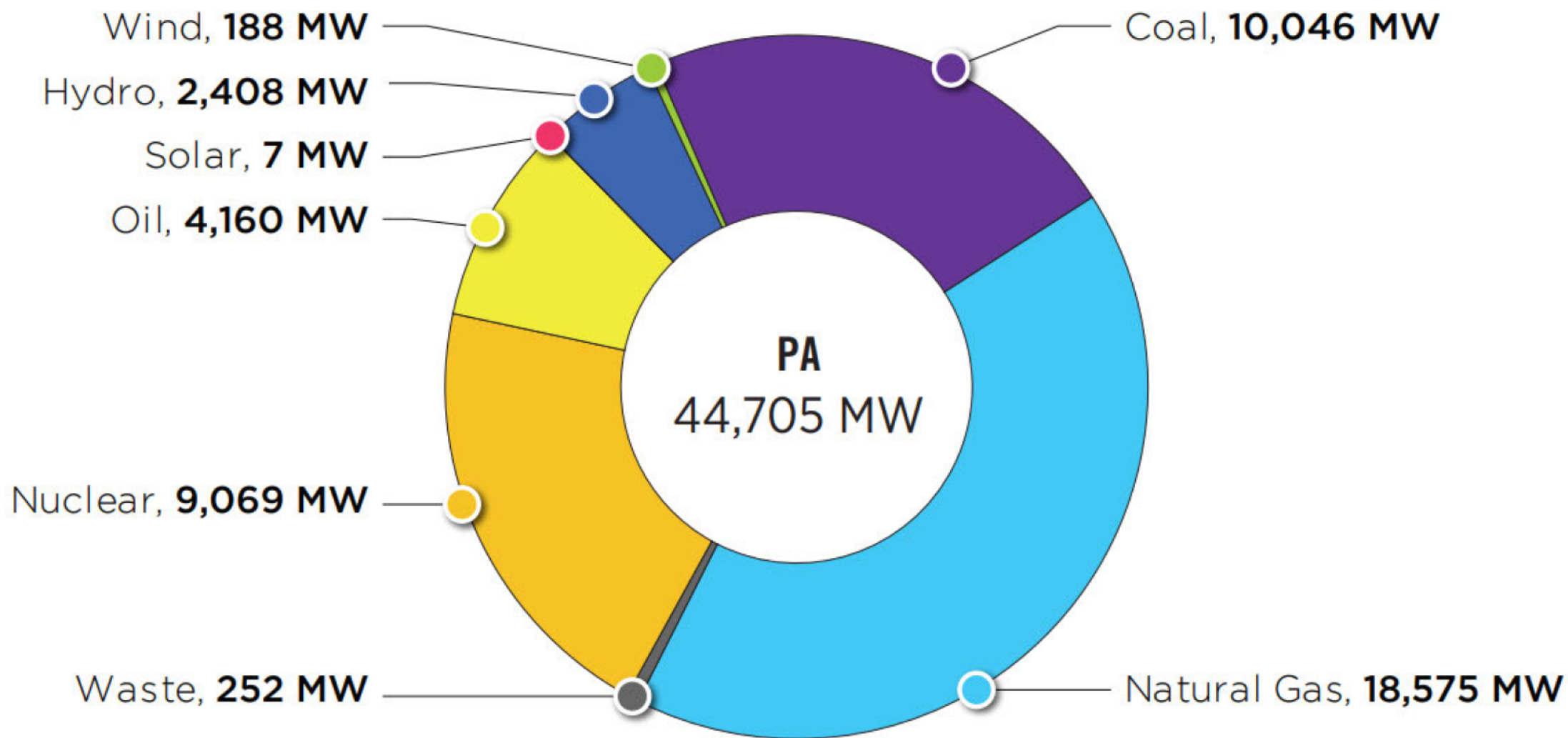
## Generation Dispatch Operations

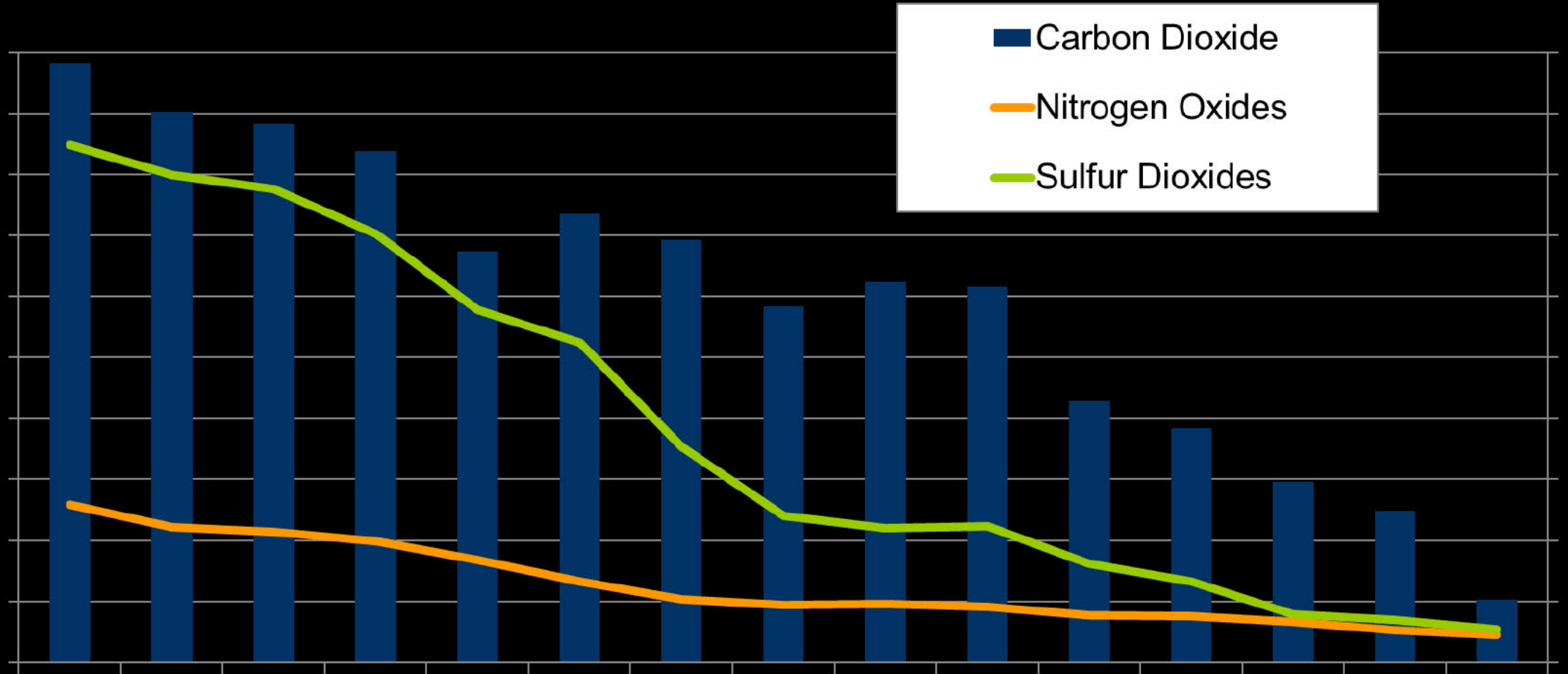
- Maintain System Control
  - Generation / Demand balance
- Maintain Adequate Reserves
  - Operate on contingency basis
- Implement Emergency Procedures
  - To keep the lights on!
- Synchronized Reserve/Regulation Market
  - Clear Market
  - Administer real-time optimization









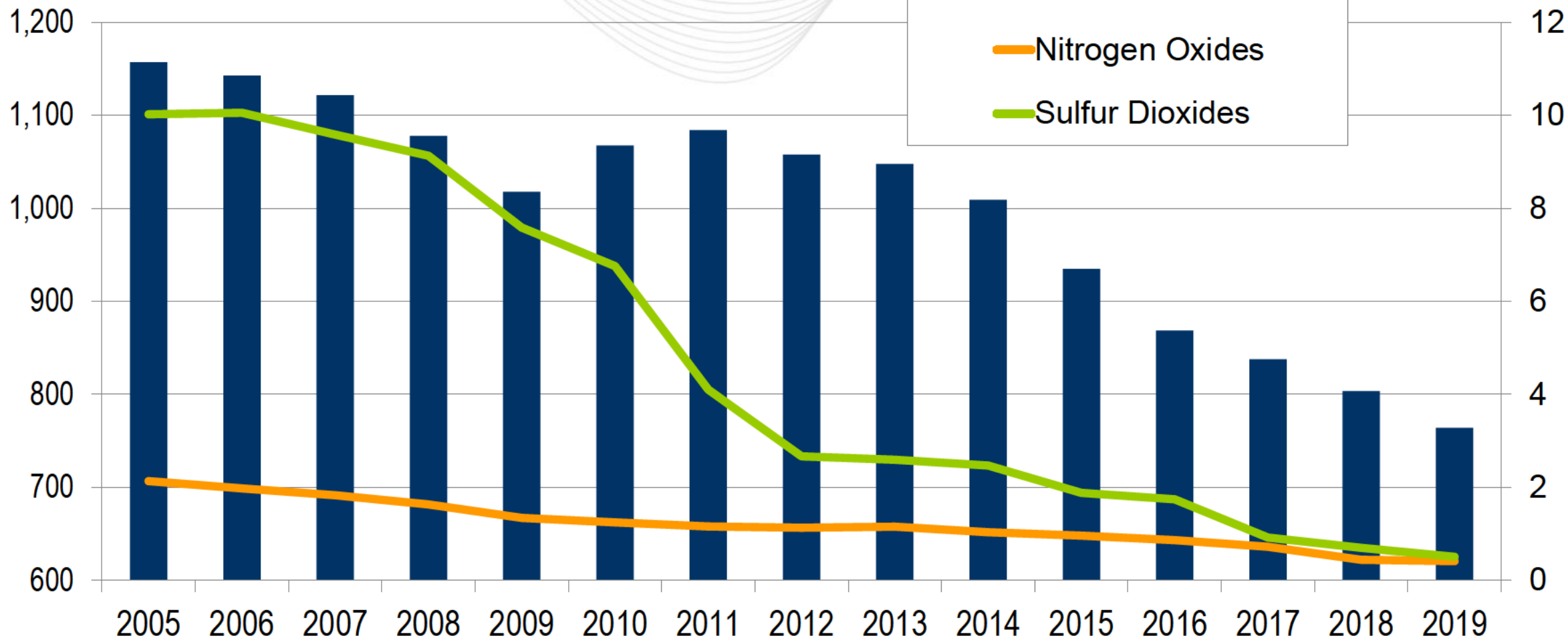


# Pennsylvania – Average Emissions (lbs/MWh)

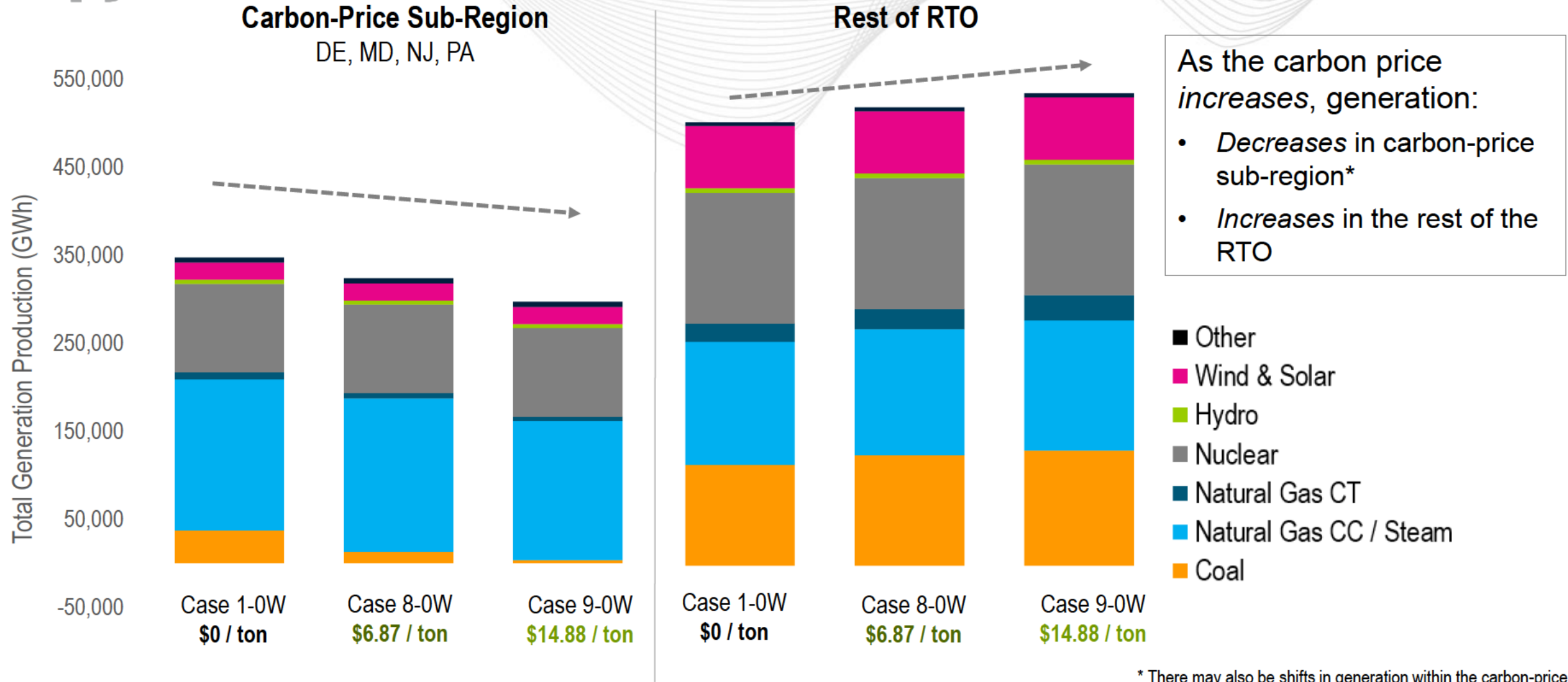
(Feb. 7, 2020)

**CO<sub>2</sub>**  
(lbs/MWh)

**SO<sub>2</sub> and NO<sub>x</sub>**  
(lbs/MWh)

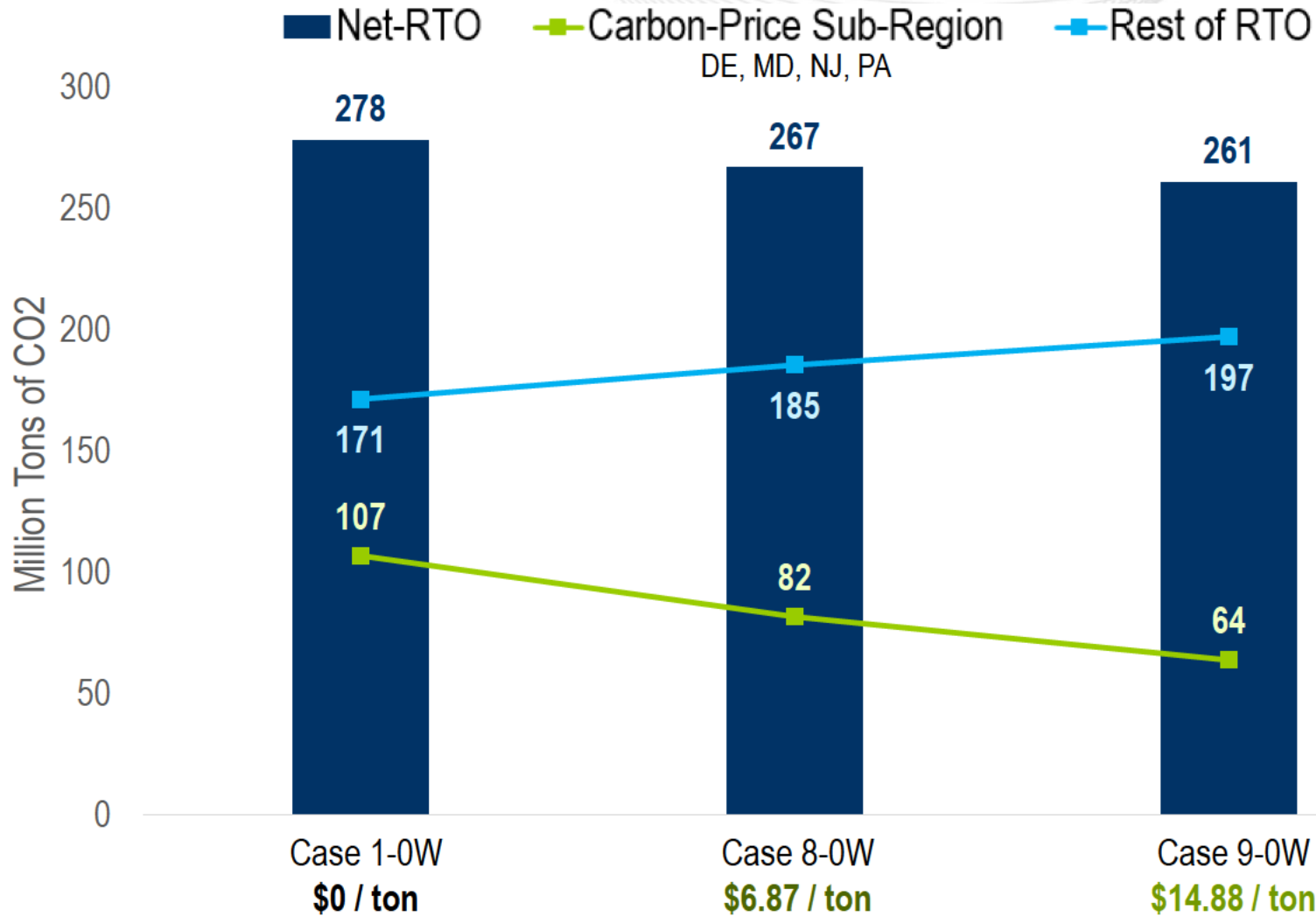


# Carbon Price Modeling – 2023 Generation Analysis



\* There may also be shifts in generation within the carbon-price sub-region, as the carbon price is only applied to RGGI generators.

# Carbon Price Modeling - 2023 Total CO<sub>2</sub> Emissions



Generation shift from increasing carbon price results in CO<sub>2</sub>:

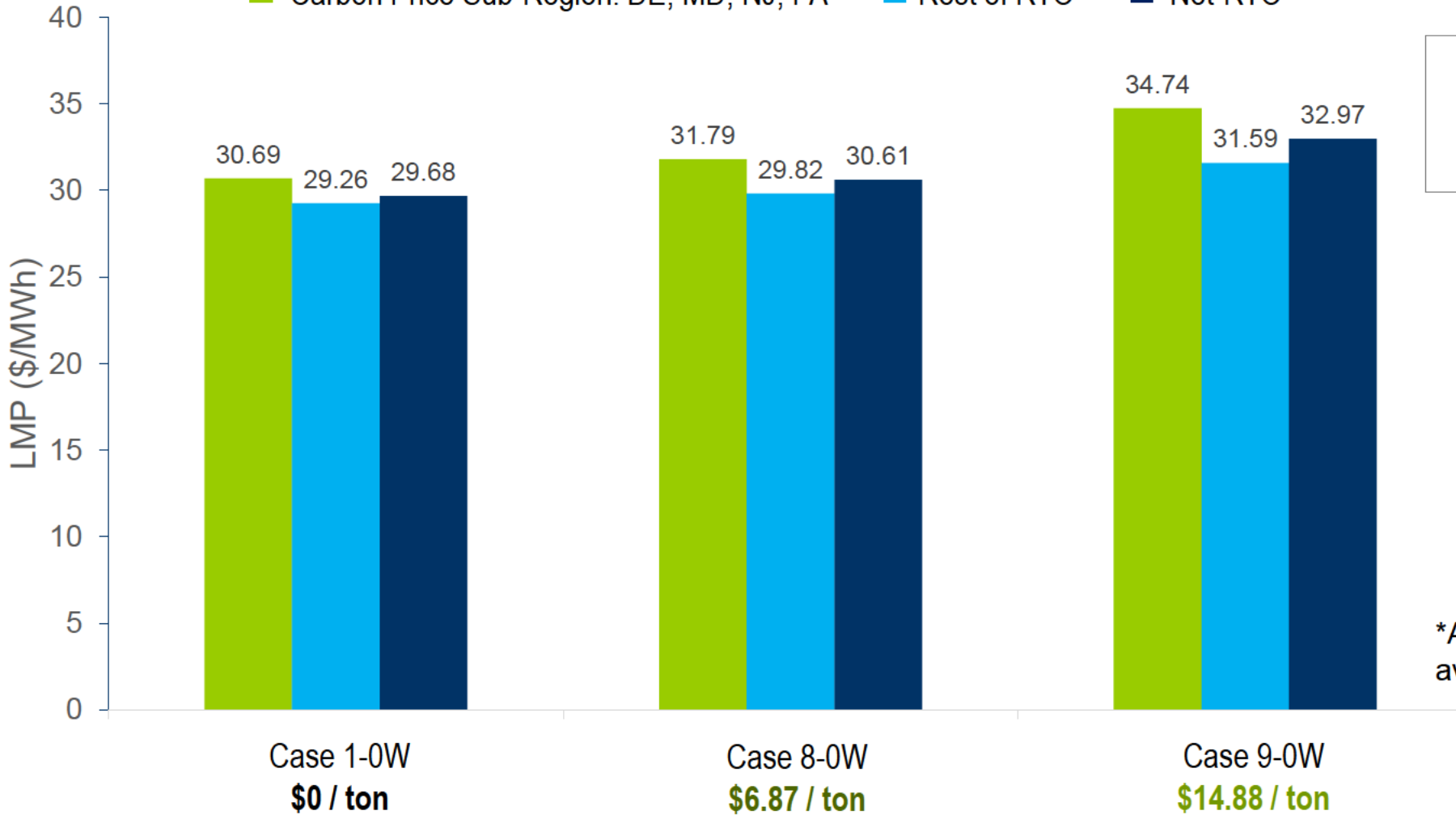
- *Decrease* in carbon-price sub-region
- *Increase* in rest of RTO (no carbon price)
- *Net decrease* across the RTO

Note:

- Emissions are for PJM only and do not account for changes in external regions
- Shifts in RTO generation and external interchange between cases are driving changes in emissions

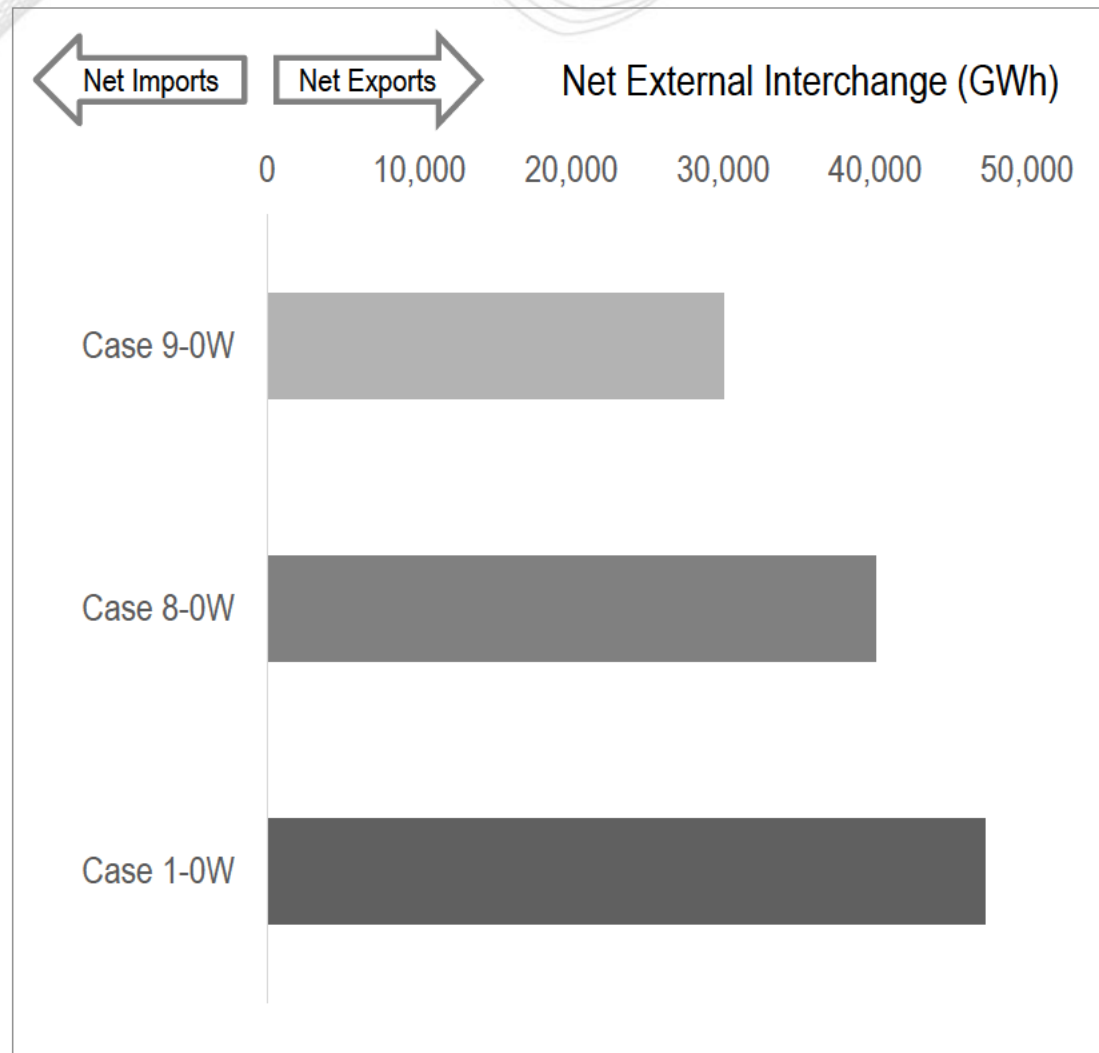
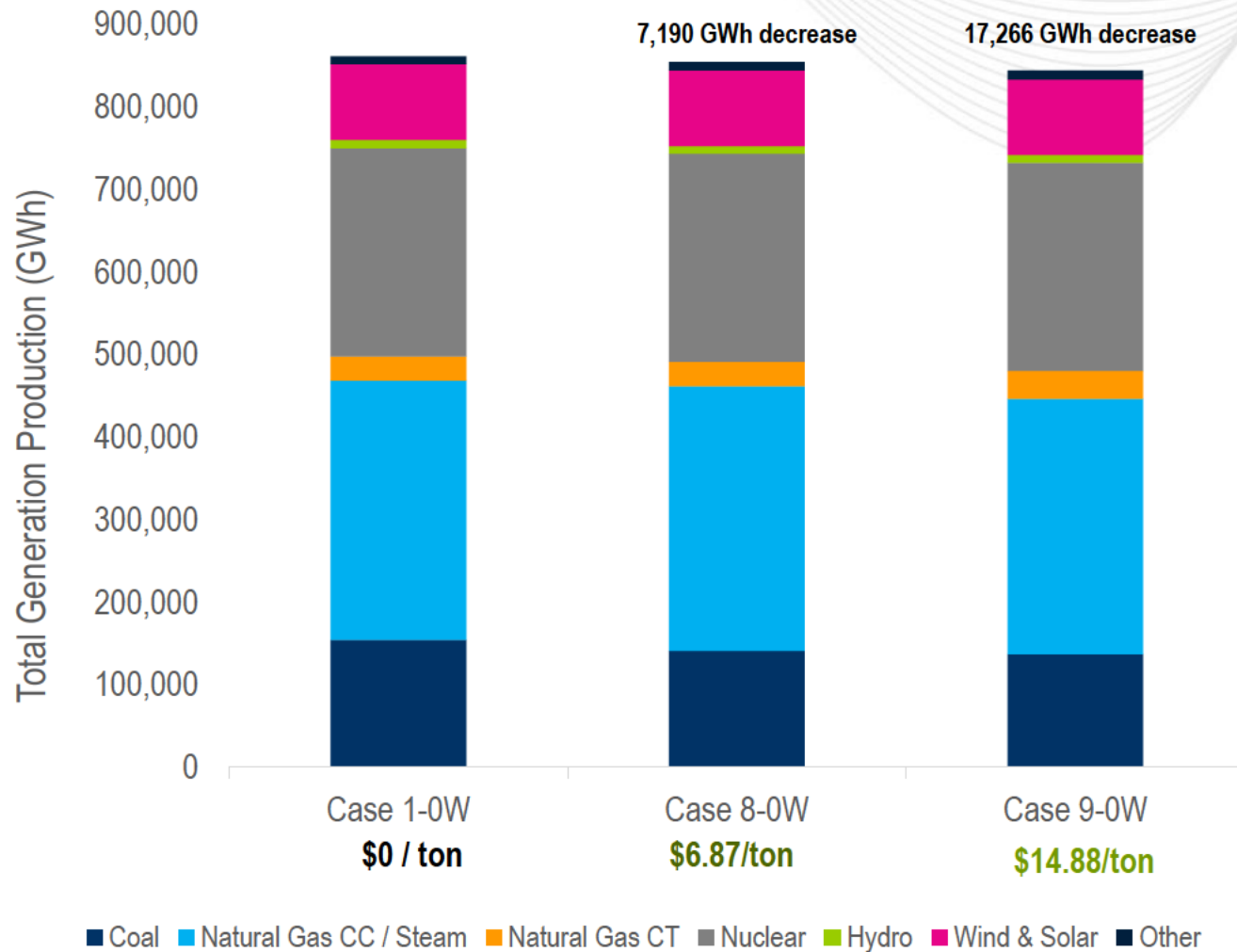
# Carbon Price Modeling - 2023 Average Yearly LMPs\*

■ Carbon Price Sub-Region: DE, MD, NJ, PA
 ■ Rest of RTO
 ■ Net-RTO



On average, LMPs increase in both sub-regions with an increasing carbon price.

\*Average yearly LMPs are time-weighted averages of load-weighted hourly LMPs.



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