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Optimization: How much is too much?

ESIG Webinar – Keynote Session

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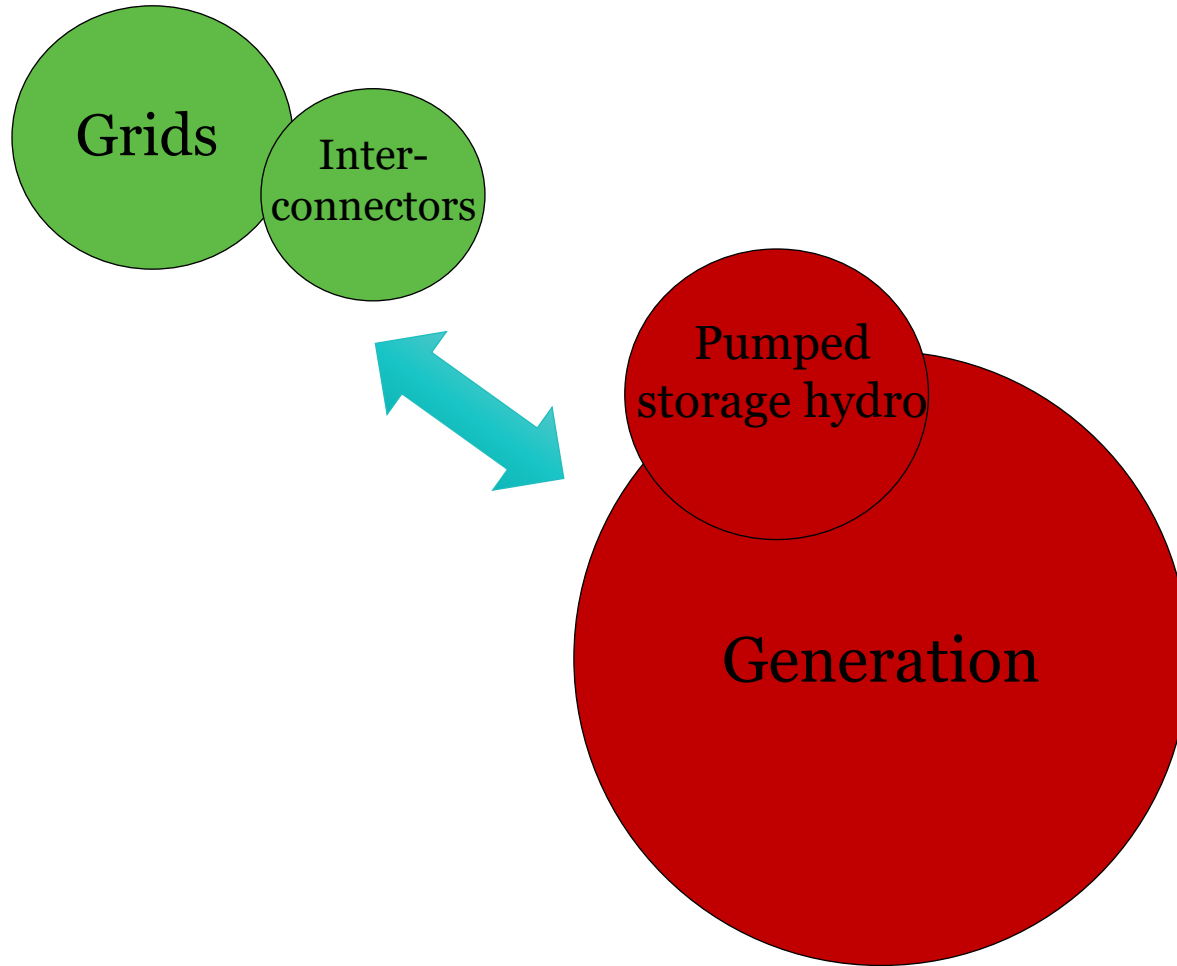
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Expected benefits of optimization

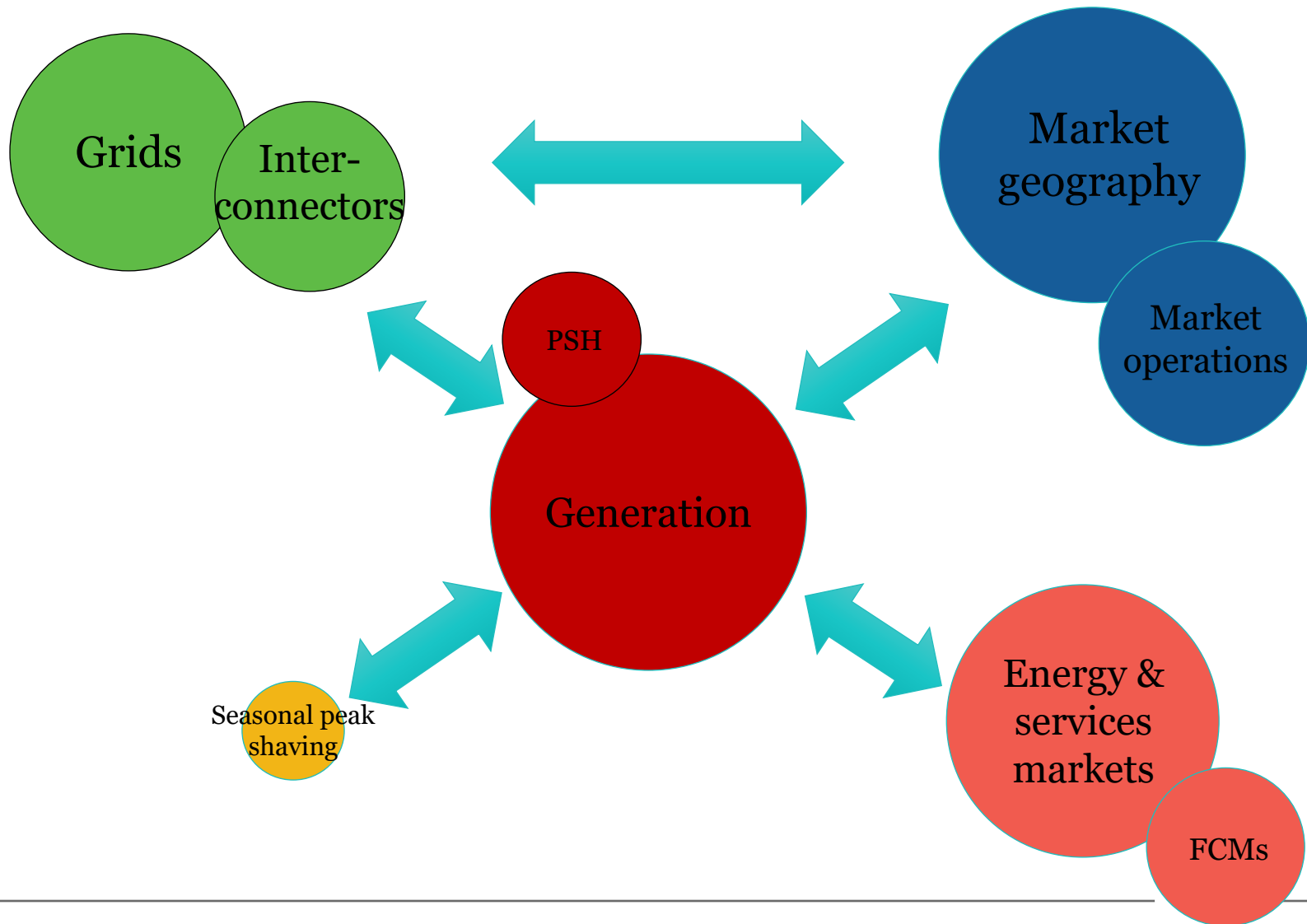
- Operational cost efficiency
- System flexibility
- Investment cost efficiency

But optimizing what? Based on what information?

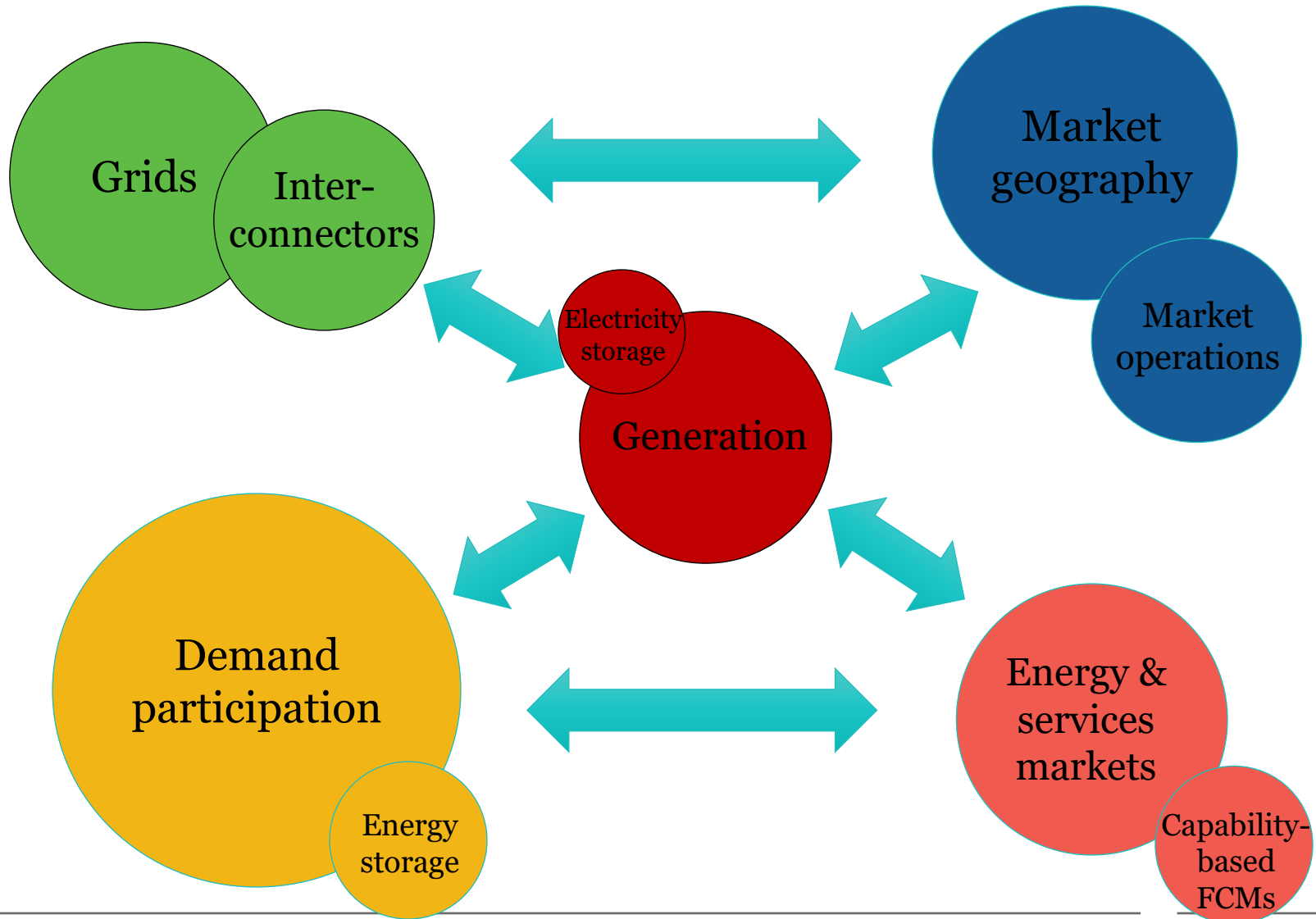
Traditional monopoly optimization field



Supply-side ISO/RTO optimization field

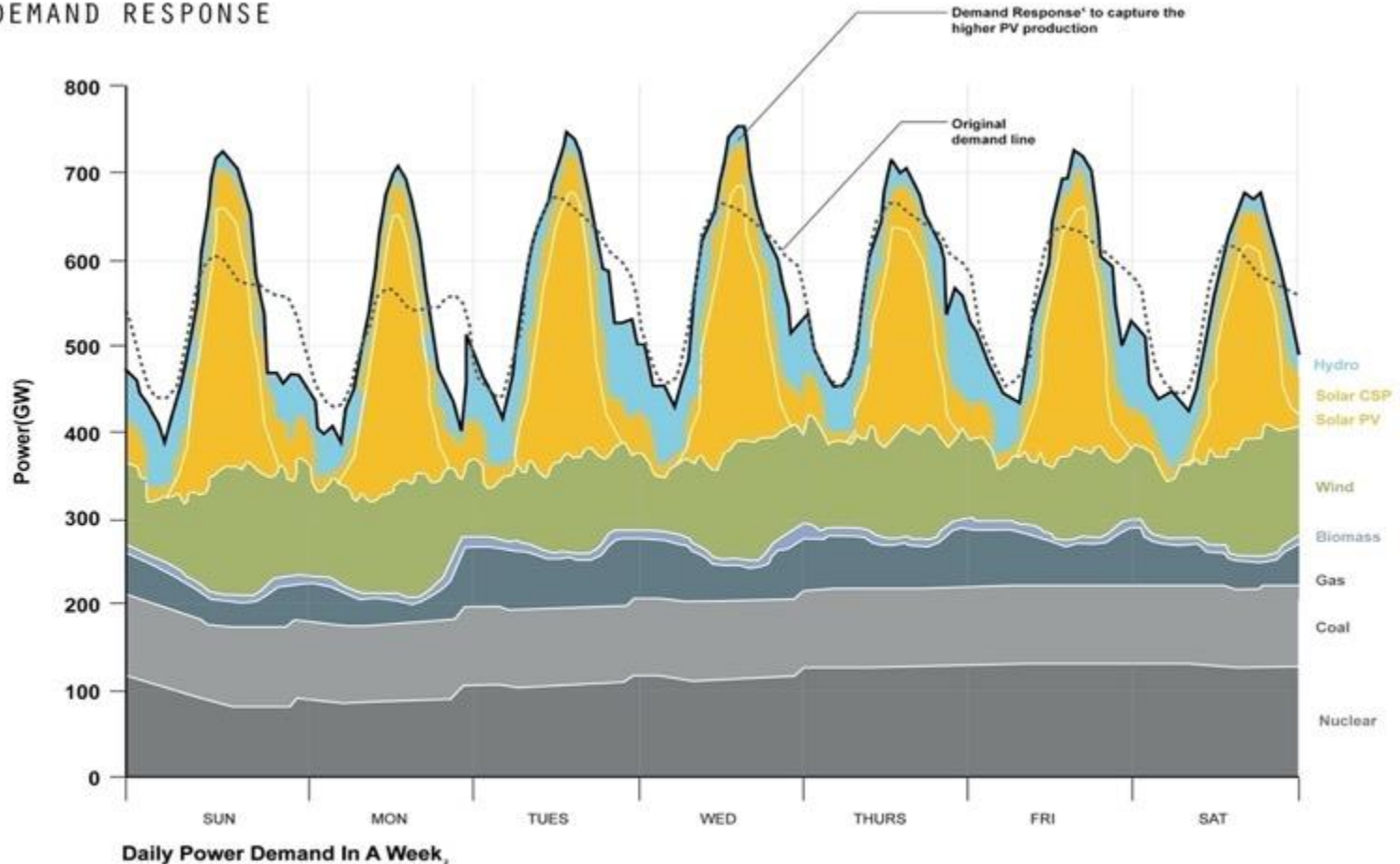


Bottom-up 360° optimization field



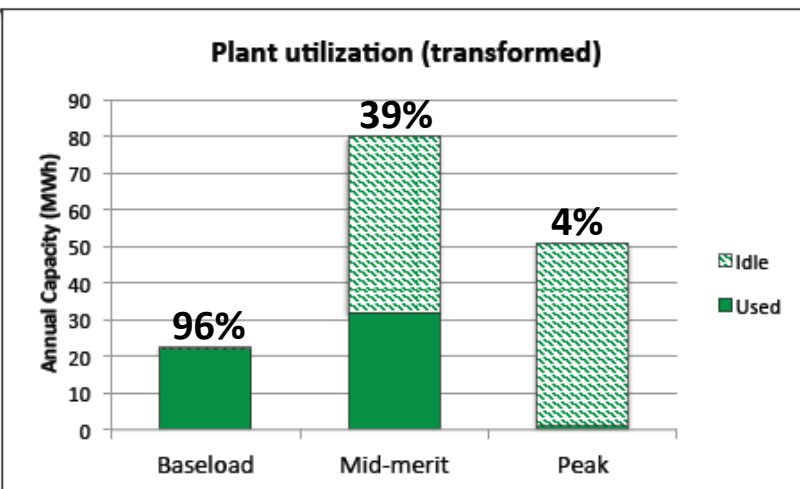
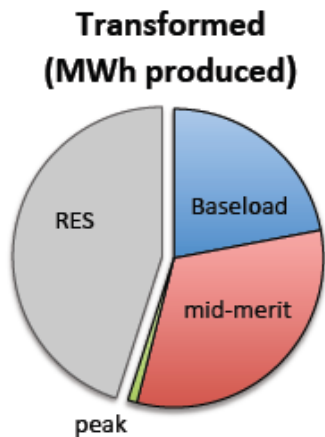
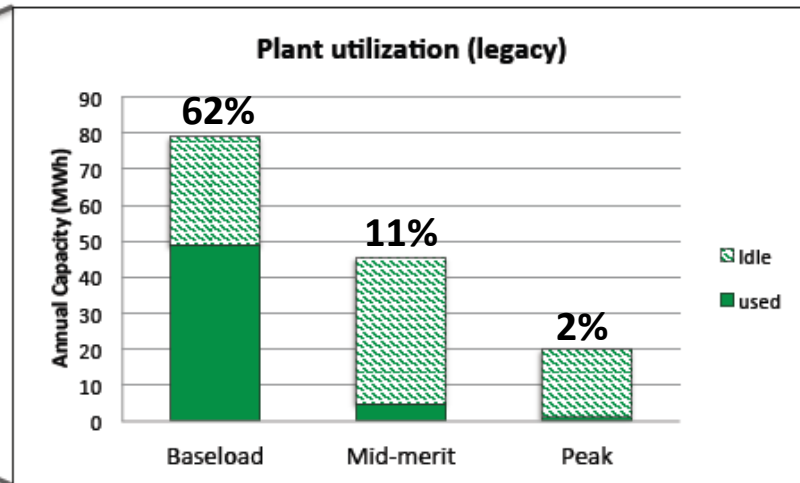
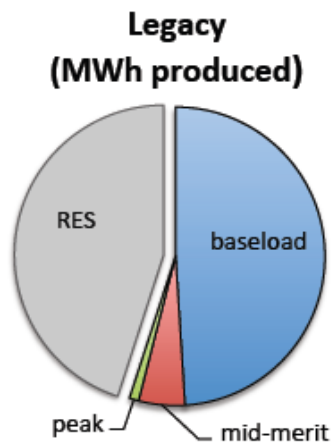
Summer week, 35% annual variable RES

DEMAND RESPONSE

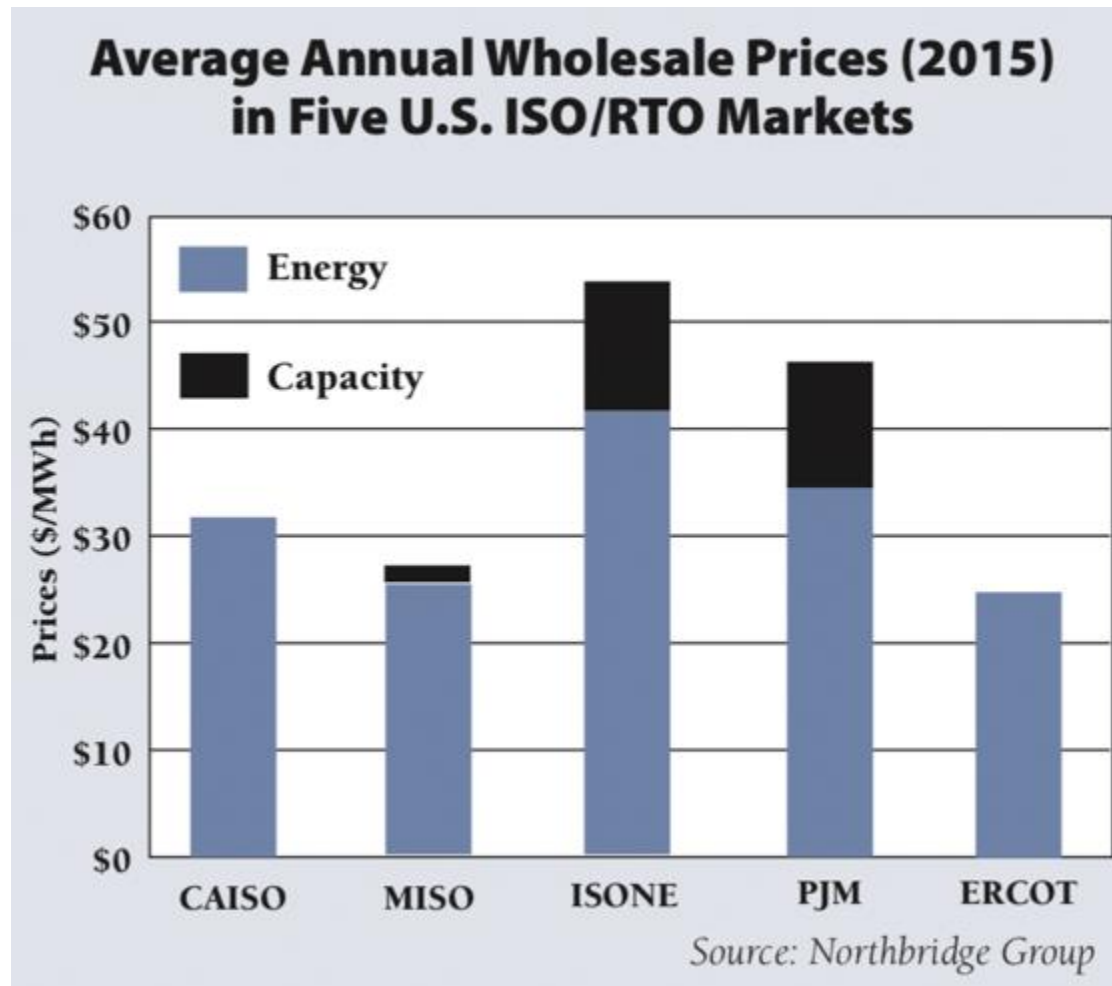


Demand response as used in this paper refers to changing a customer's electricity demand in response to dispatch instructions or price signals through communications technologies. In the Volume 1 analysis, it is assumed that any such changes retained the total energy consumed within the day, that is, moved or shifted demand rather than reduced total daily consumption.¹⁾ The graph shows how the original demand line (dashed) is shifted to a higher level (solid line) by DR to capture the higher PV production.
¹⁾ 90% RES; 20% DR, Week 32 - Sunny week
 SOURCE: Roadmap 2050 Technical Analysis

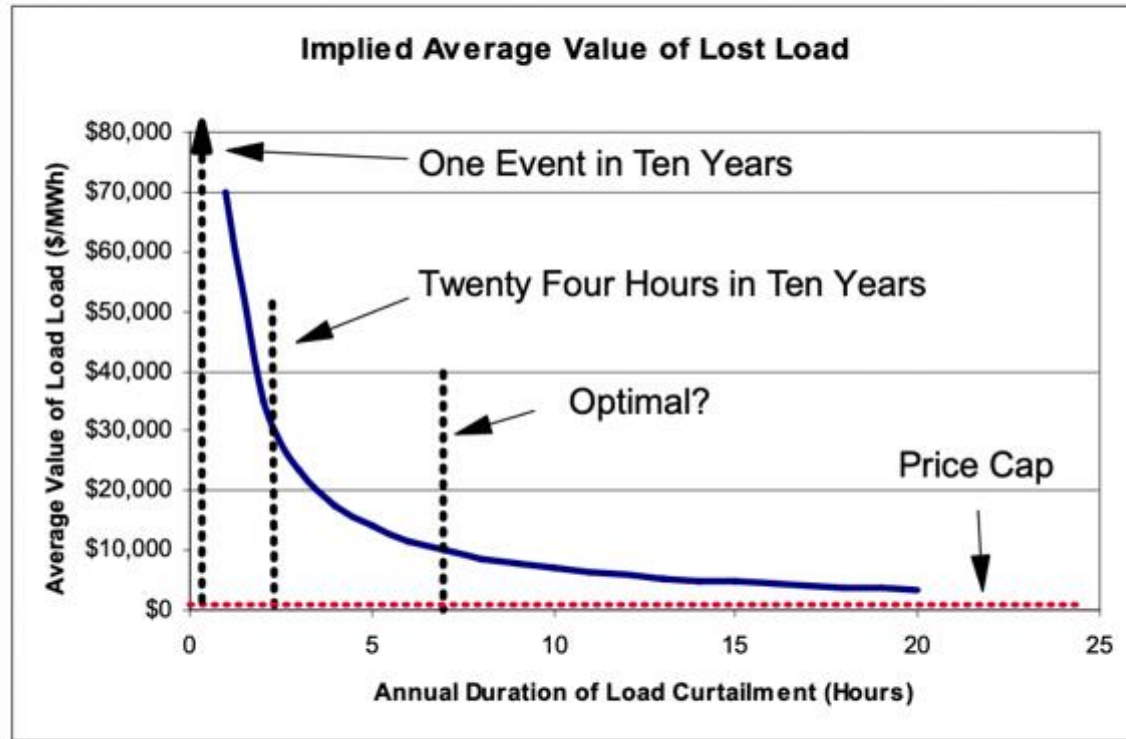
“How much?” depends on “what kind?”



Limits of operational optimization?



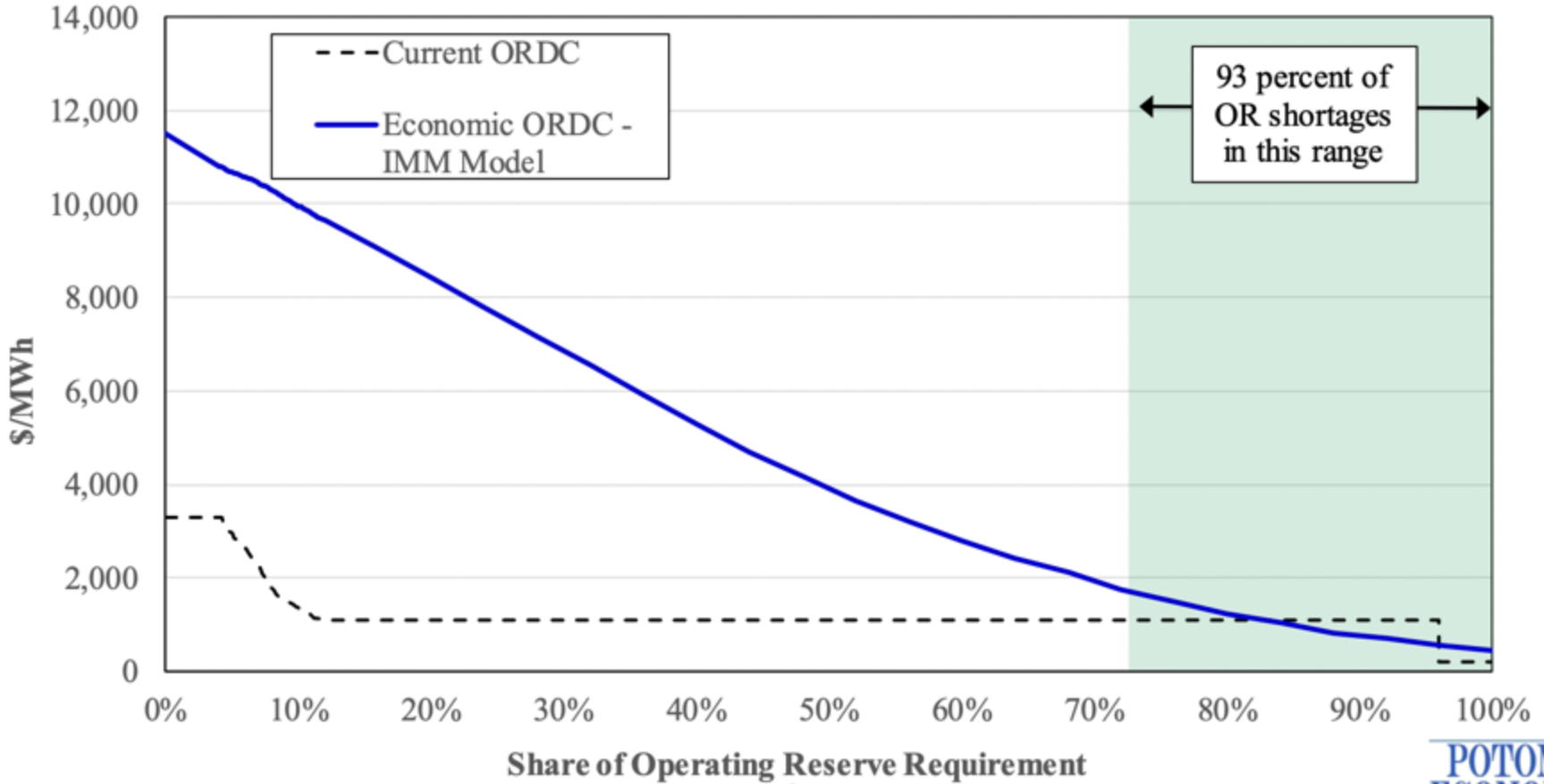
Reliability Standard and Market Disconnect



Peaker fixed charge at \$65,000/MW-yr.

Source: Hogan, W., *Electricity Resource Adequacy* (2007)

MISO Operating Reserve Demand Curve (scarcity pricing function)

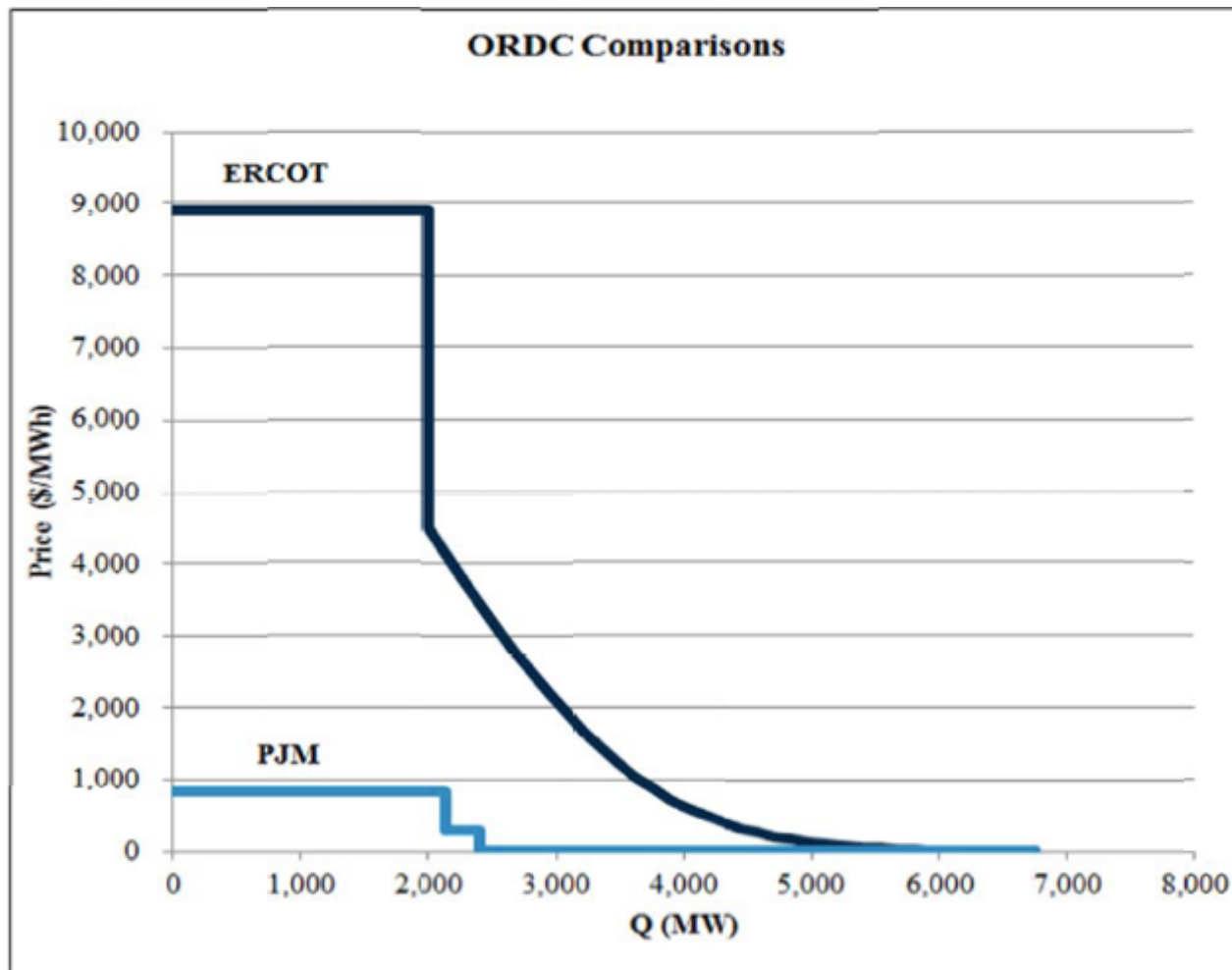


© 2018 Potomac Economics

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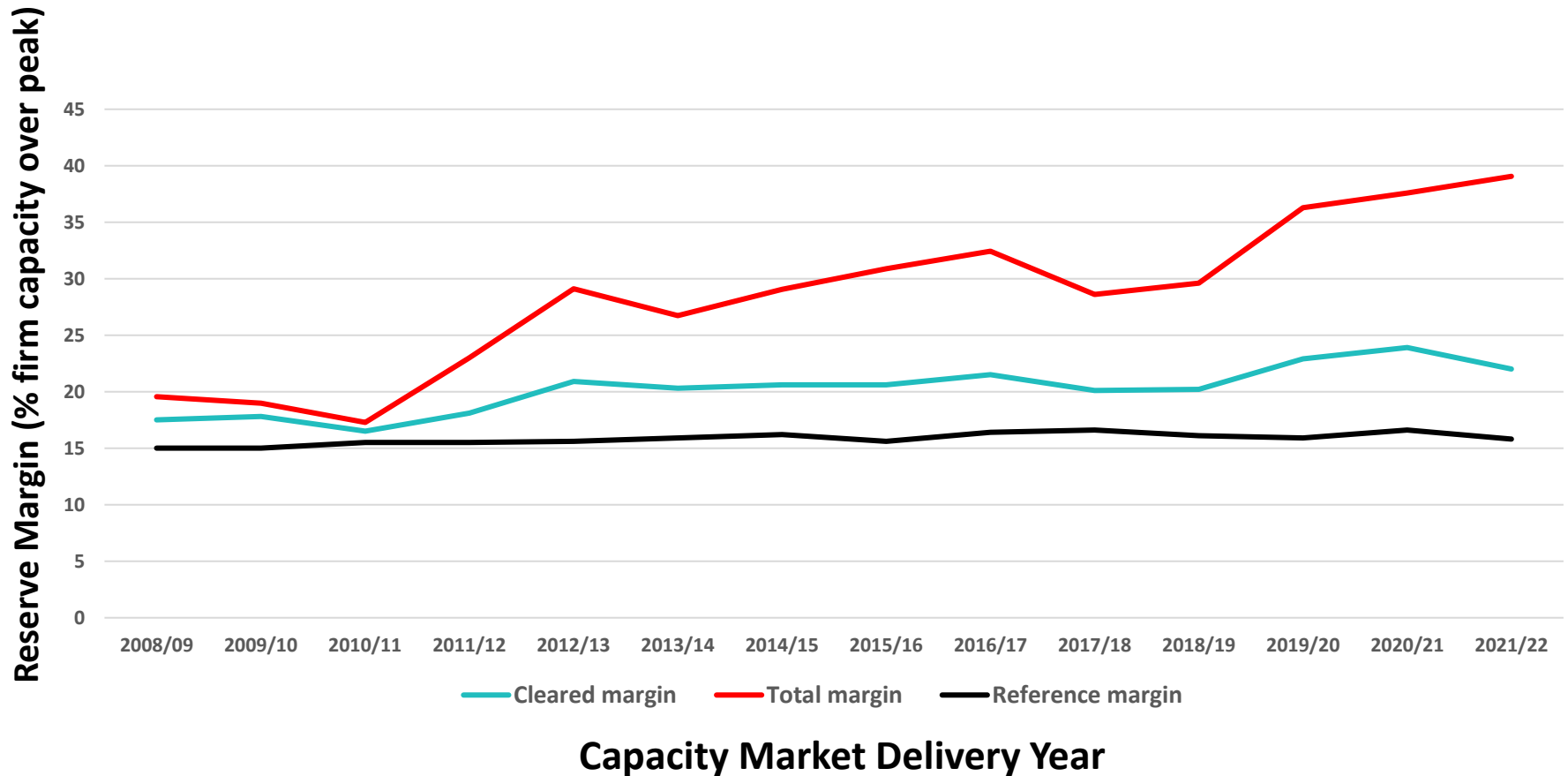


Source: Potomac Economics, *Resilience and emerging issues in wholesale electricity markets* (2018)



Garbage in...*a lot of* garbage out

PJM reserve margins since the inception of the capacity market



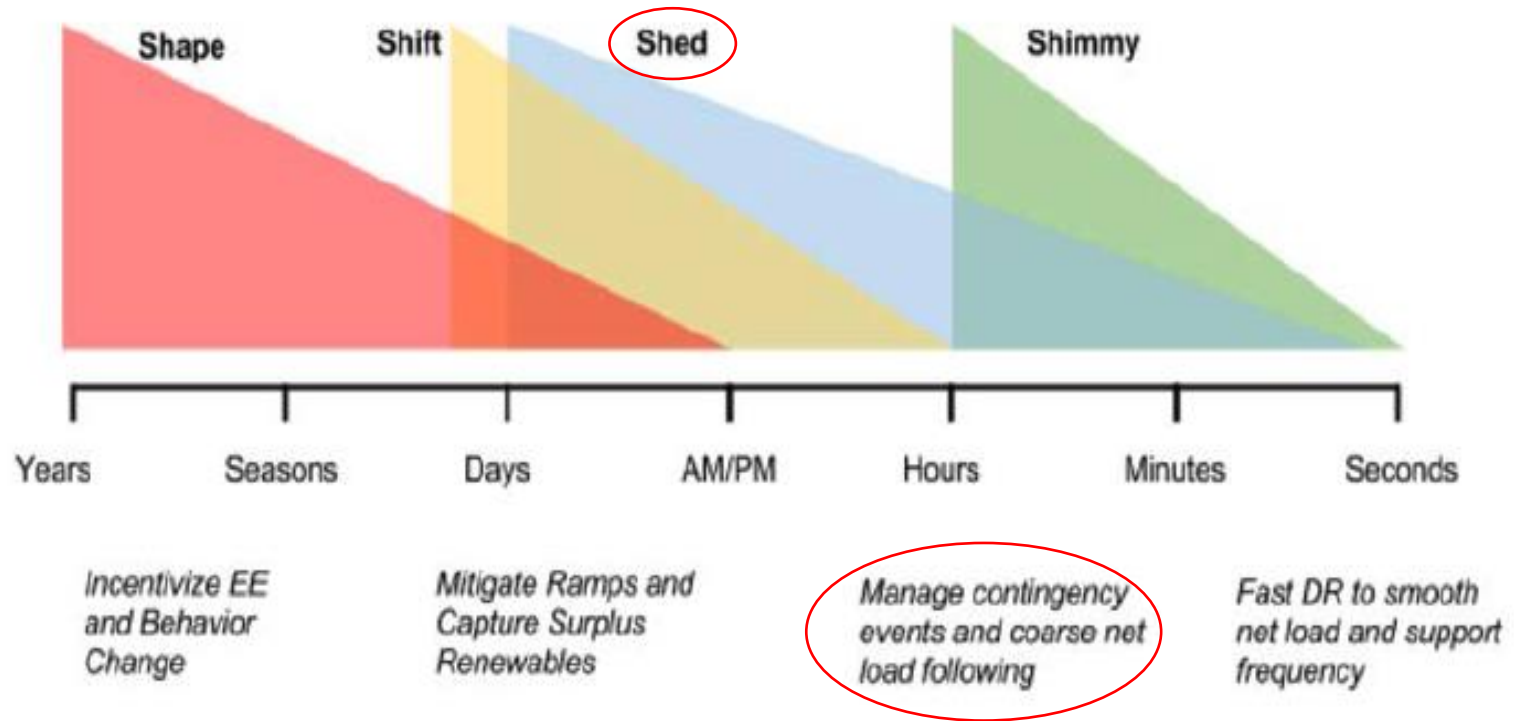
Source: Published data from PJM, NERC

The real costs in marginal cost pricing

System Resource	Full Marginal Cost (€/MWh)
Generation capacity	20-250
Imports	20-1,000
Secondary (operating) reserves	250-5,000
Emergency generation	500
Primary (regulation) reserves	500-9,000
30-minute responsive back-up	1,400
30-minute controllable demand response	2,400
10-minute controllable demand response	2,600
10-minute responsive back-up	3,700
Emergency load-shedding	9,000

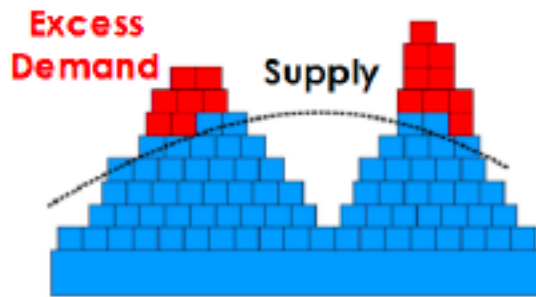
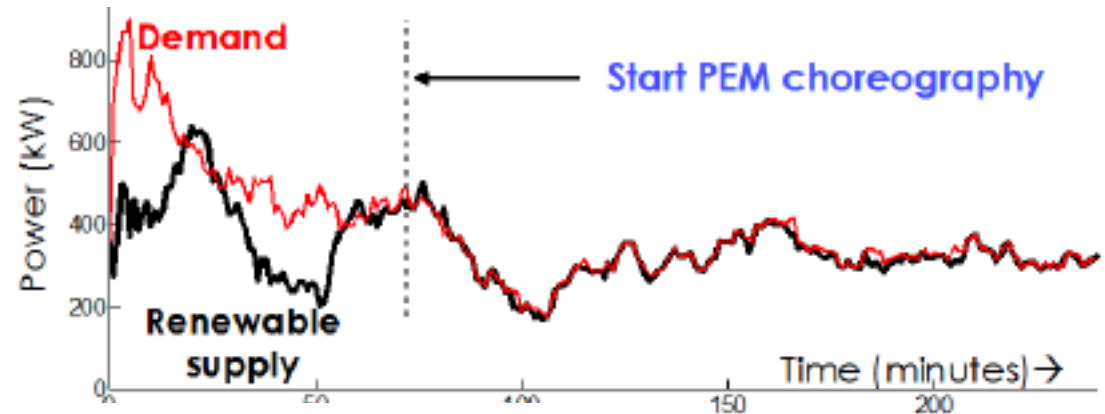
Source: Adapted from Brattle Group

“Capacity” blocks most valuable DR potential

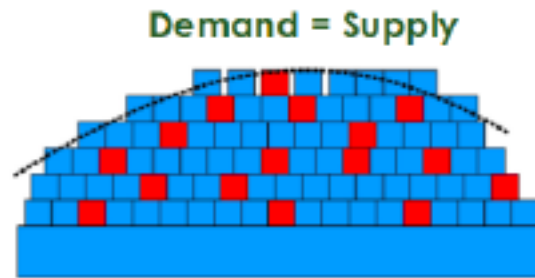


Source: 2015 California Demand Response Potential Study, LBNL, November 2016

Innovation: 3rd party access is essential



Uncoordinated



PEM Coordination

Conclusions:

- Centralized, top-down, operating-cost-based optimization might have worked well in 1980
- As we move toward zero-carbon electricity, distributed, bottom-up, price-based optimization will be required
- Optimization without good energy price formation creates false precision and the illusion of expected benefits

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

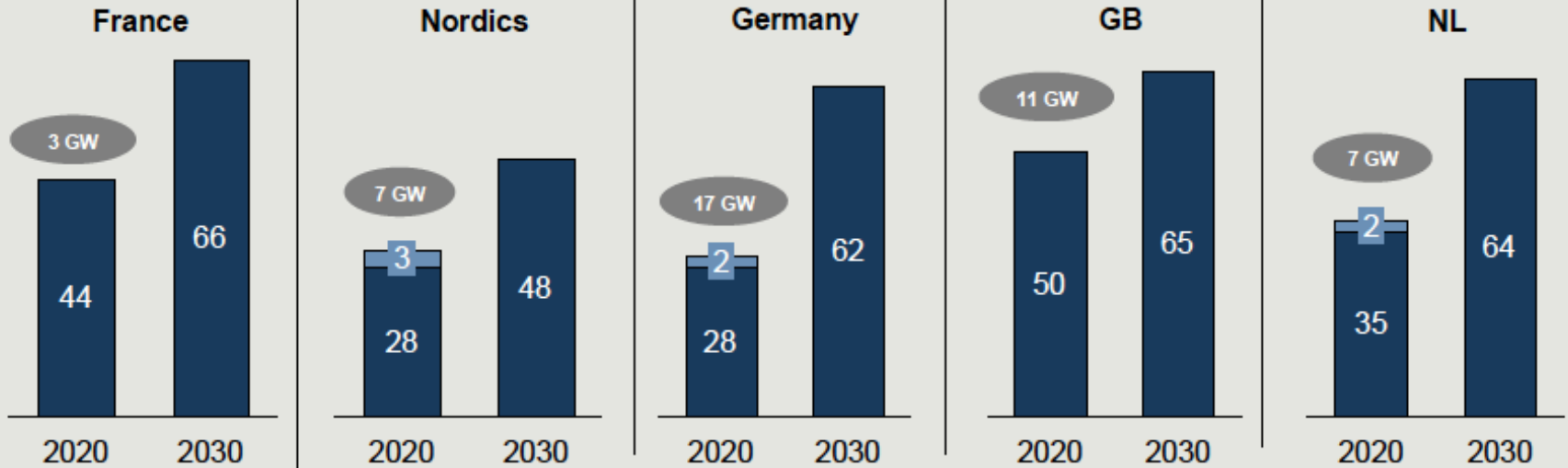


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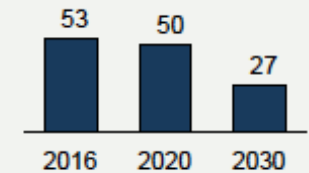
Average day ahead prices (EUR15/MWh)



Coal in Germany

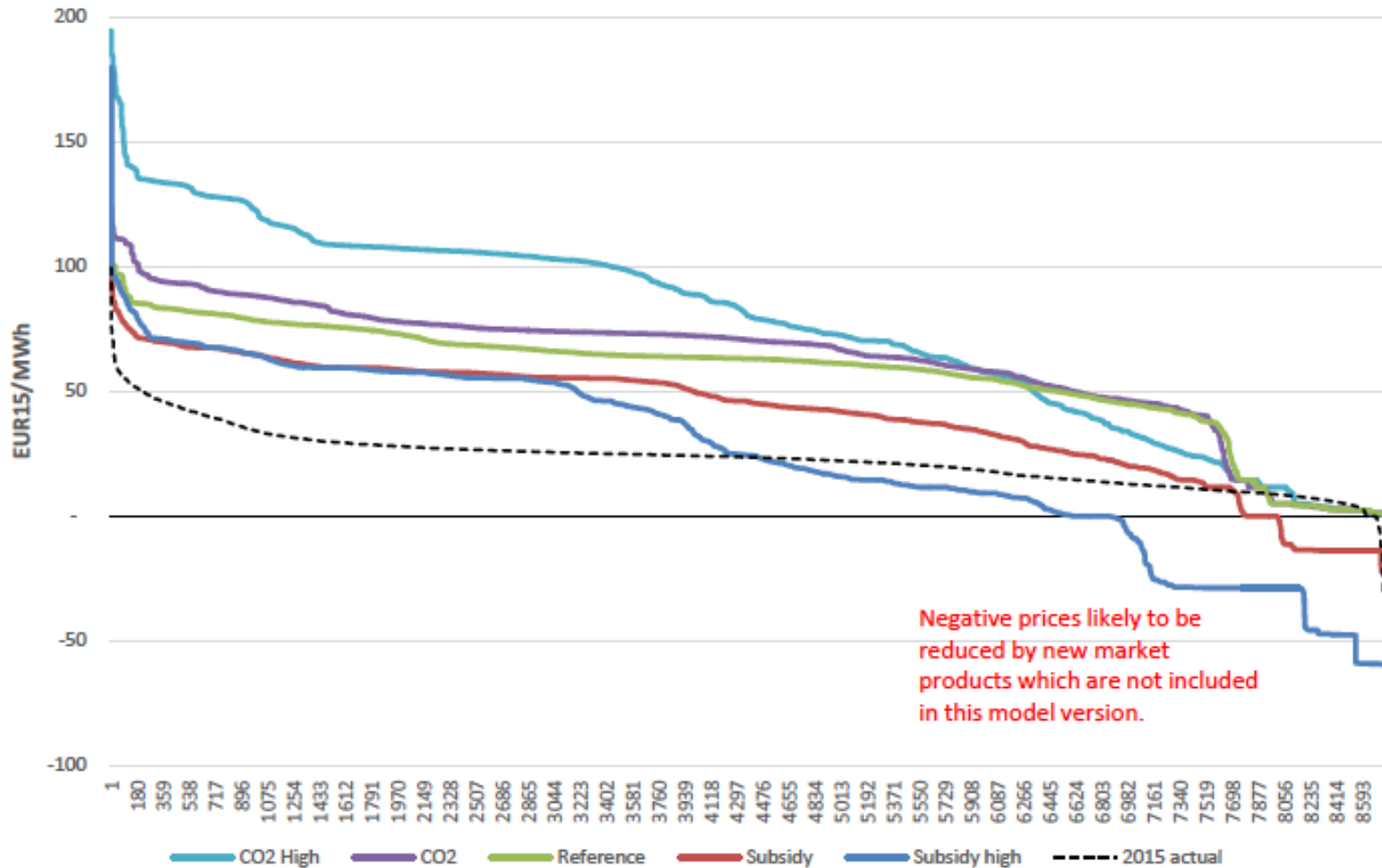
- Mainly gas decommissioned towards 2020 due to low CO2 price => limited electricity price impact
- Mainly coal decommissioned towards 2030 => doubling of electricity price
- Fast decommissioning of coal, through CO2 price or other measures is key to electricity price

Installed coal capacity, GW

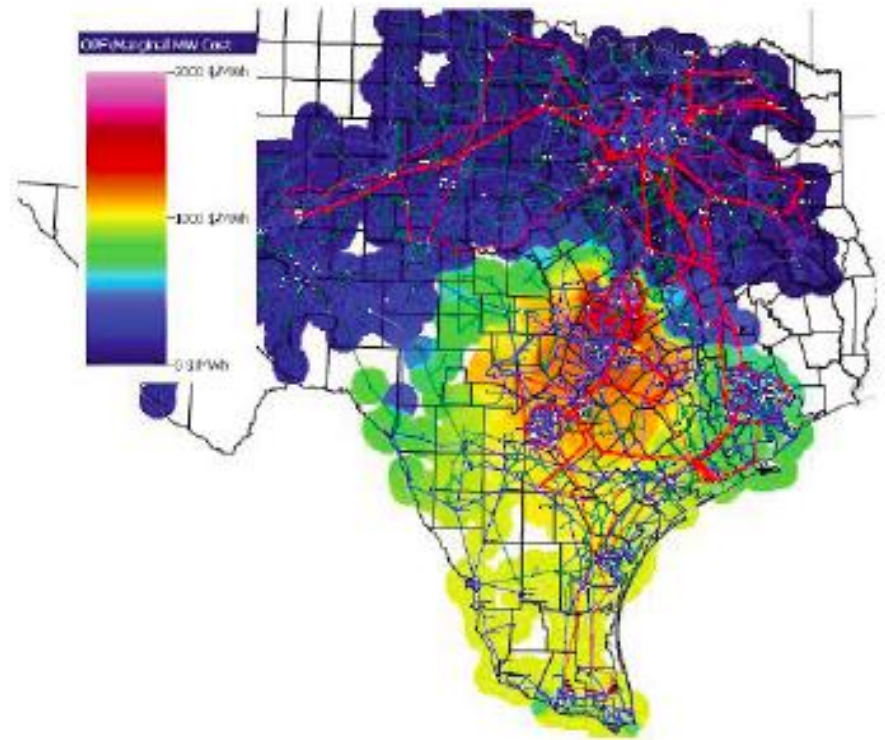
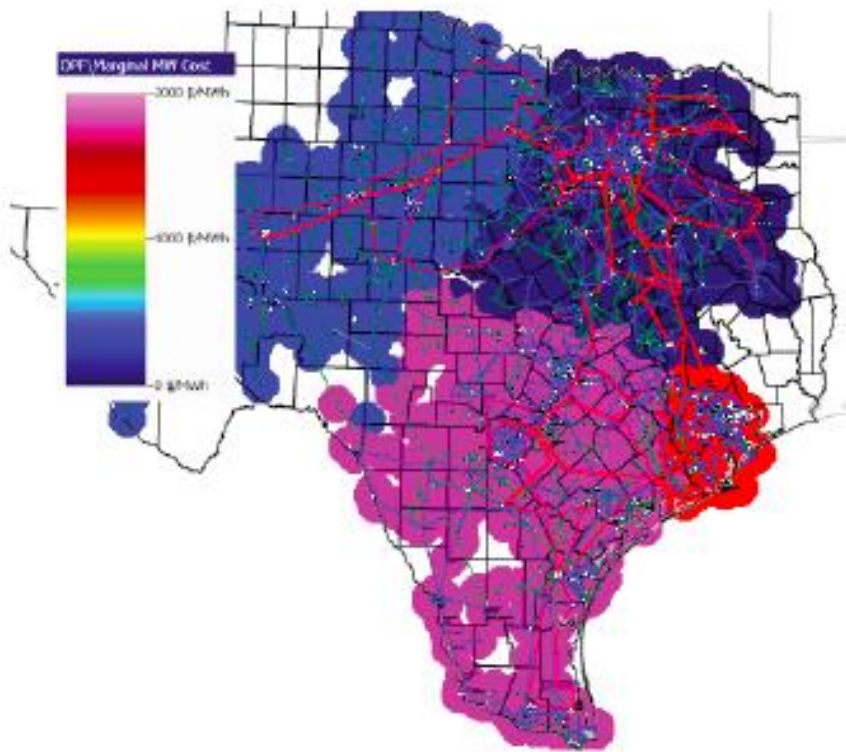


Source: DONG Energy/Orsted

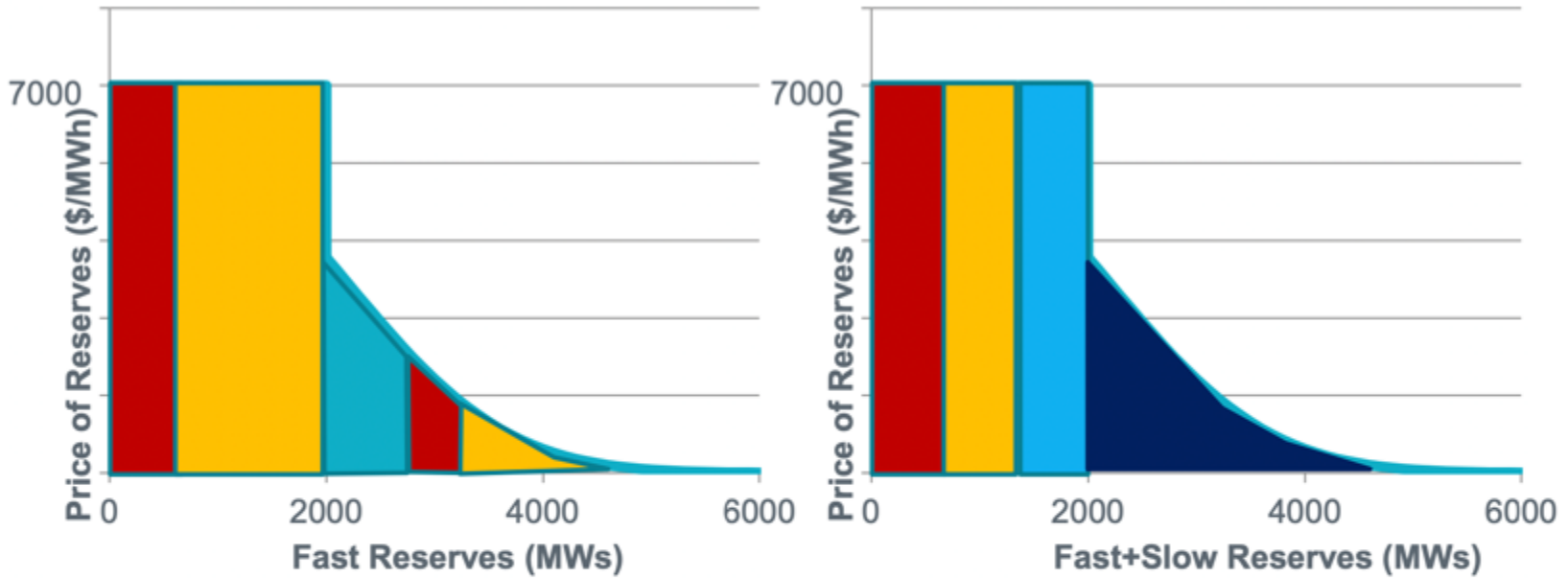
Price duration curves with 70% RES



Source: DONG Energy/Orsted



Source: Hogan, W. & Pope, S. for FTI Consulting & ERCOT



- RegUp
- RRS
- SOR
- NSOR

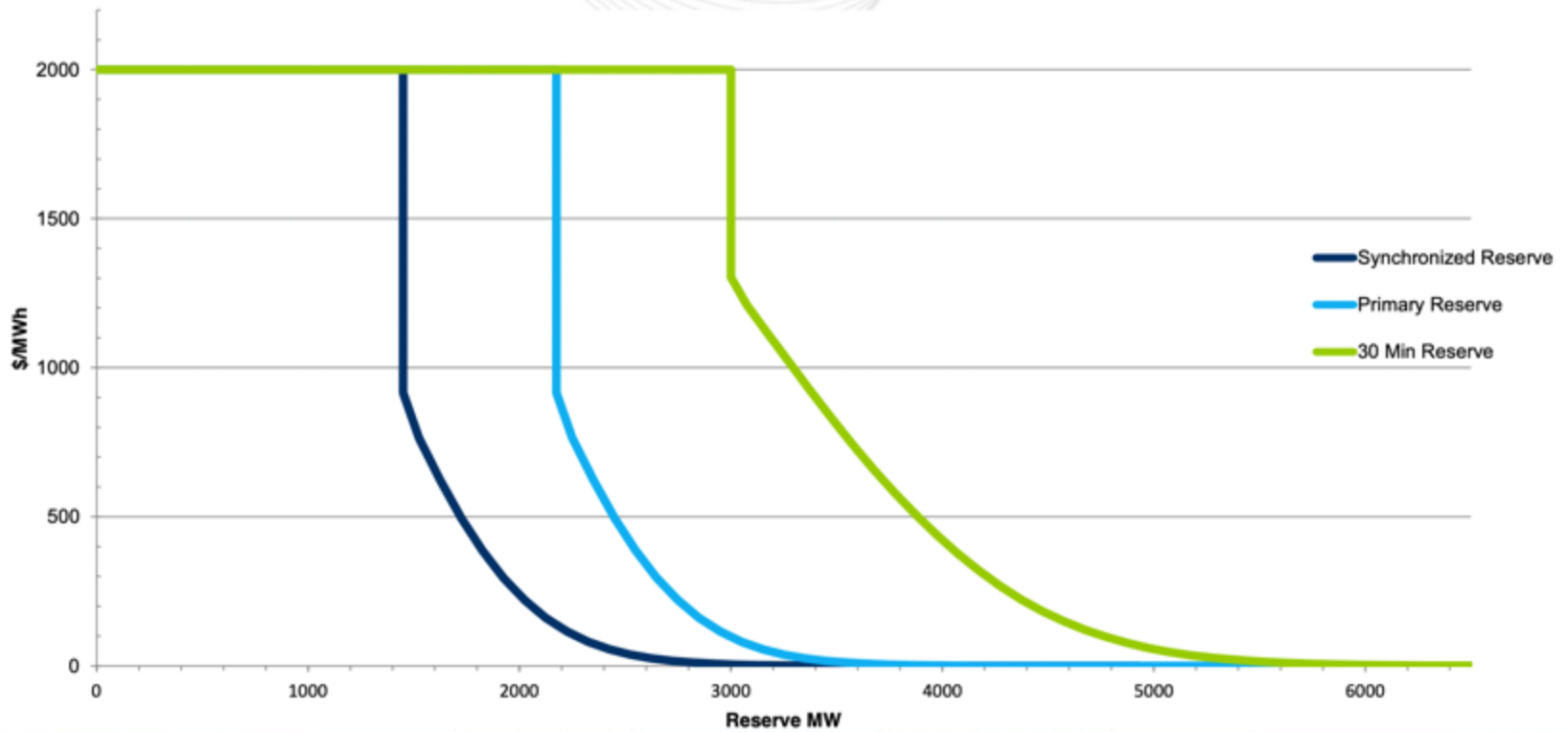
0.5 weightage applied to each ORDC during disaggregation to AS Demand Curve



Source: ERCOT, Scarcity pricing using ORDC for reserves



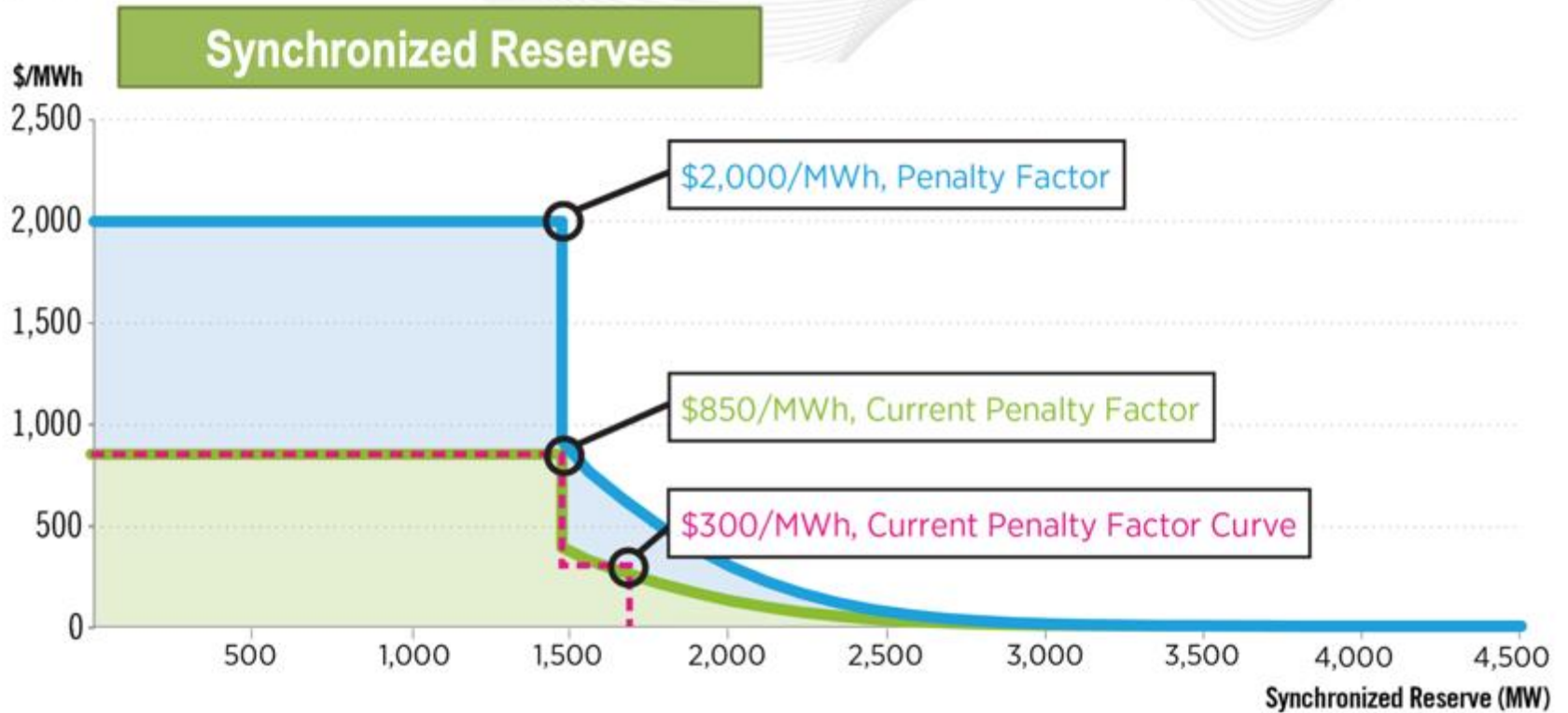
Reserve Product ORDC Comparison



Source: PJM, *Proposed reserve market enhancements*
(2018)



Synchronized Reserve Demand Curve



Source: PJM, *Use of penalty factor for the ORDC (2019)*