

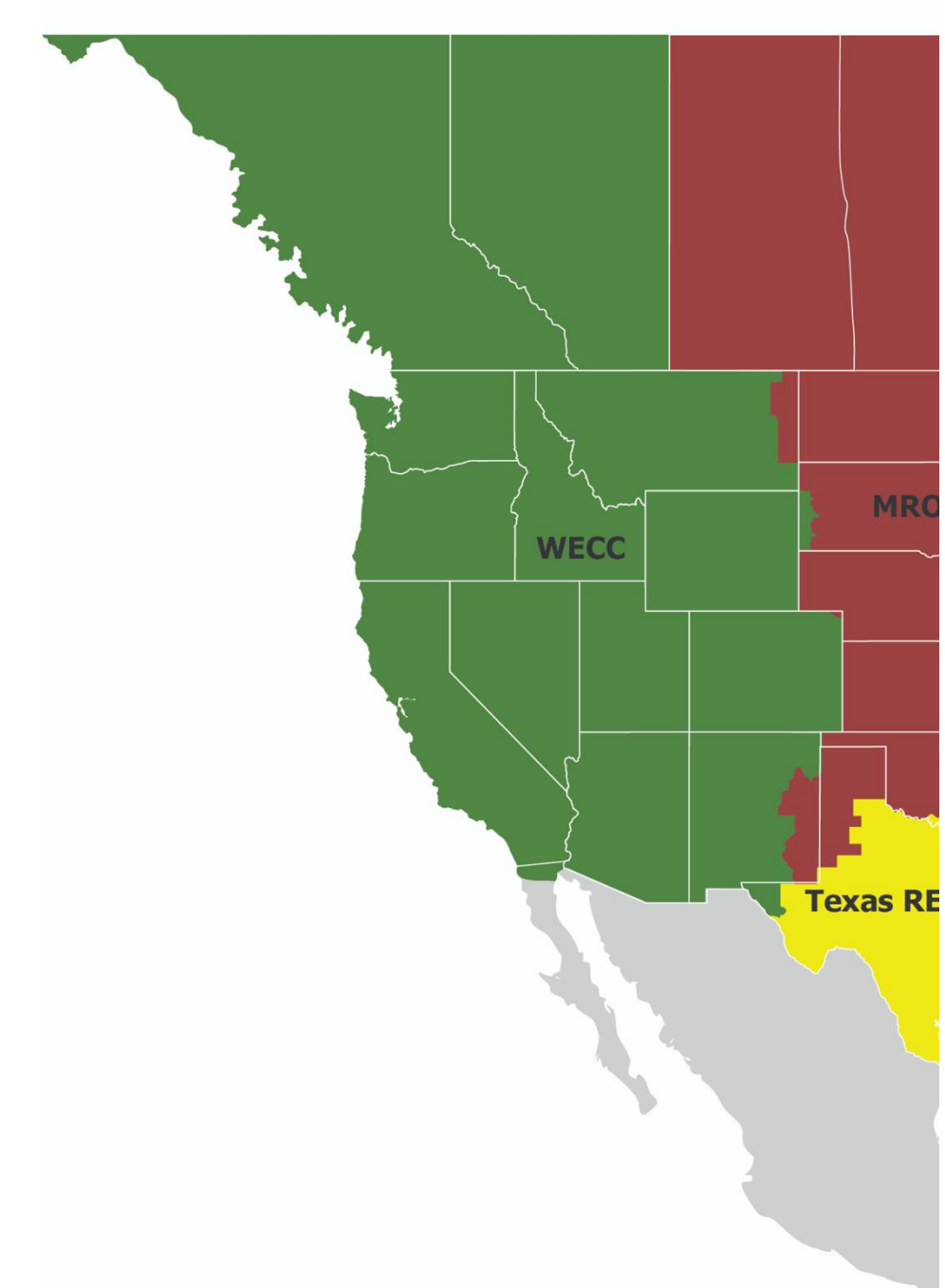
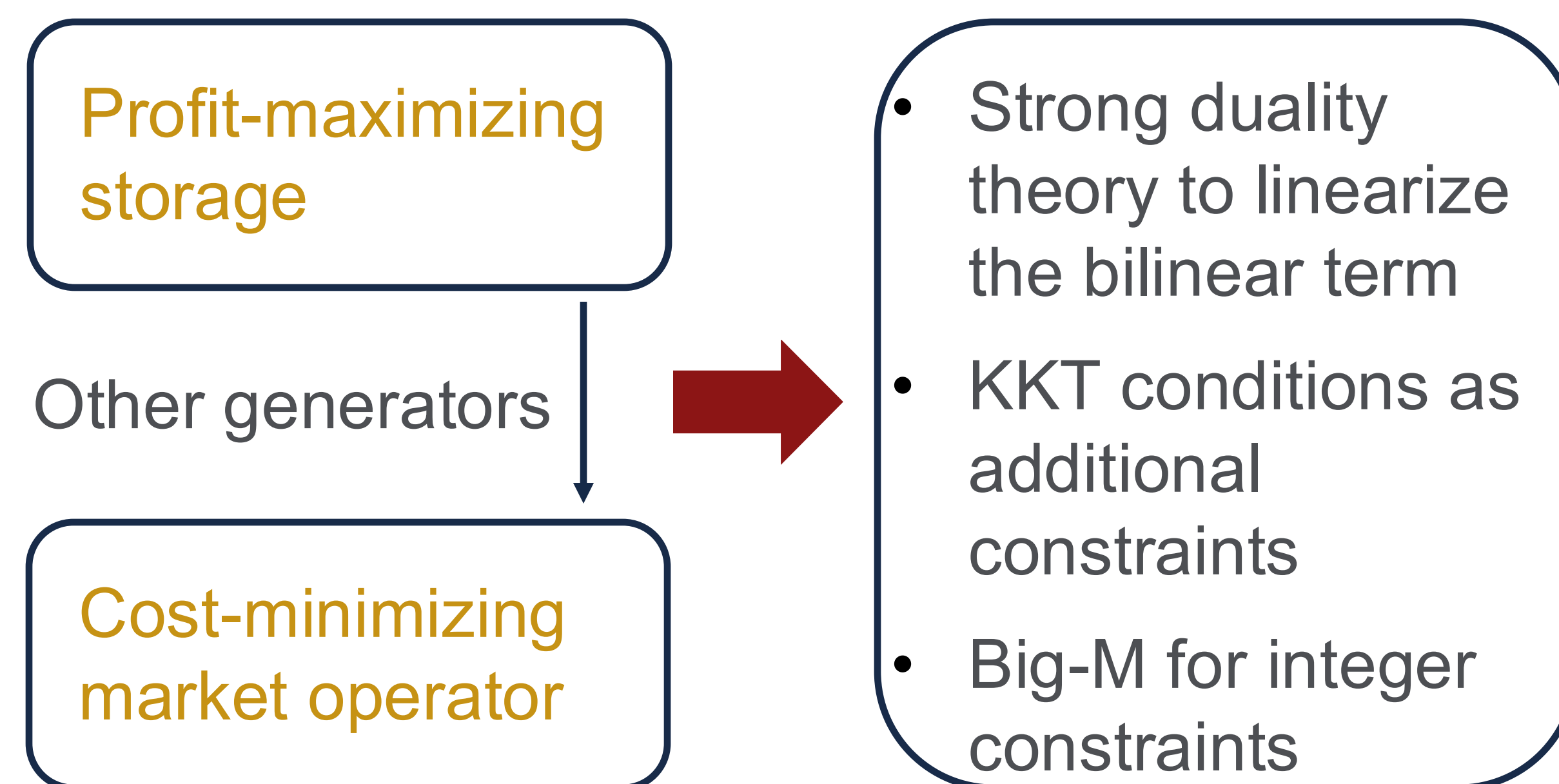
Negative Electricity Prices and Strategic Energy Storage Resources

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Motivating Questions

- Electricity markets are seeing increasing hours with negative prices, due to renewable incentives and limited system flexibility
- Studies have shown storage's role in mitigating occurrences of negative-price hours
- What if the storage system is price-making? How does that interact with renewable bidding behaviors?

Methodology: Bi-level Program



Western U.S. (WECC) as the case study, and evaluate two control cases: **Central Control, Strategic Storage**

- 140 GW peak demand and 200 GW total installed capacity
- 5-10 \$/MWh renewable PTC, 15%-80% RE share, and 20-40 GW storage

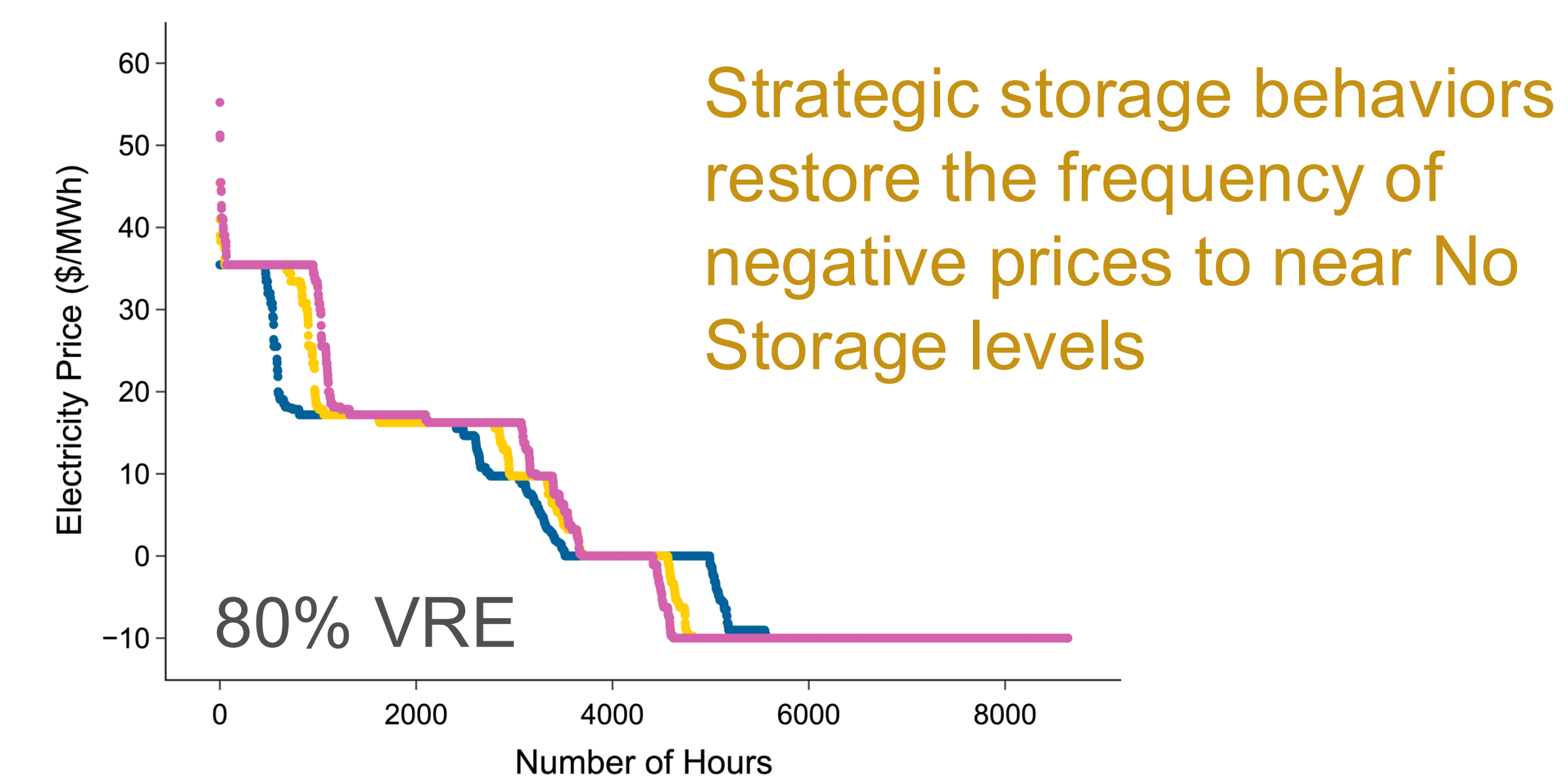
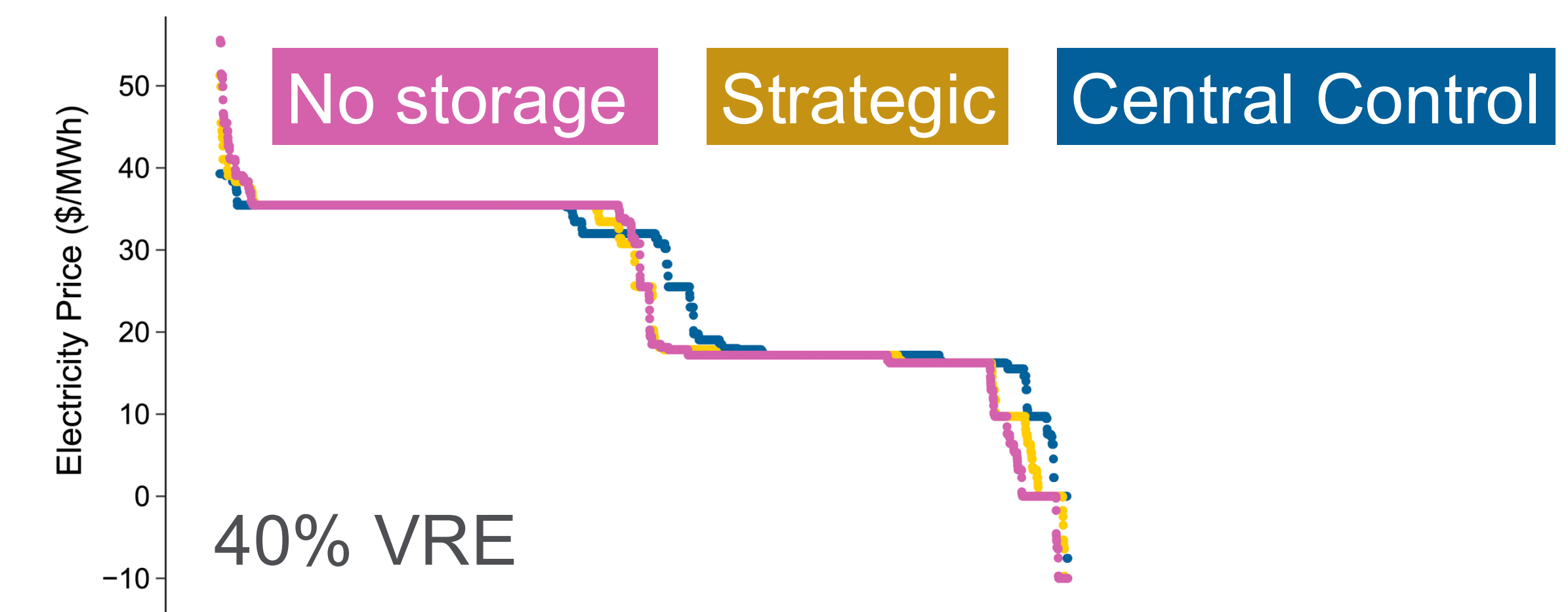
Source: NERC

Finding 1: Strategic storage behaviors can increase arbitrage profits by 22-126% when storage power capacity is 14% of peak demand.

Finding 2: We see more frequent negative prices due to capacity withholding mechanisms, which weaken storage's role in mitigating negative-pricing events.

Finding 3: Negative prices amplify the effects of strategic storage behaviors on supplier surpluses.

Price duration curves



Annual generator surpluses

