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Grid Regionalization in the West: Reliability Benefits from Increased Cooperation in Electricity Markets and Operations

Michael Wara

Study Coauthors: Mareldi Ahumada-Paras

Michael Mastrandrea

Stanford | Climate & Energy Policy Program
Woods Institute for the Environment

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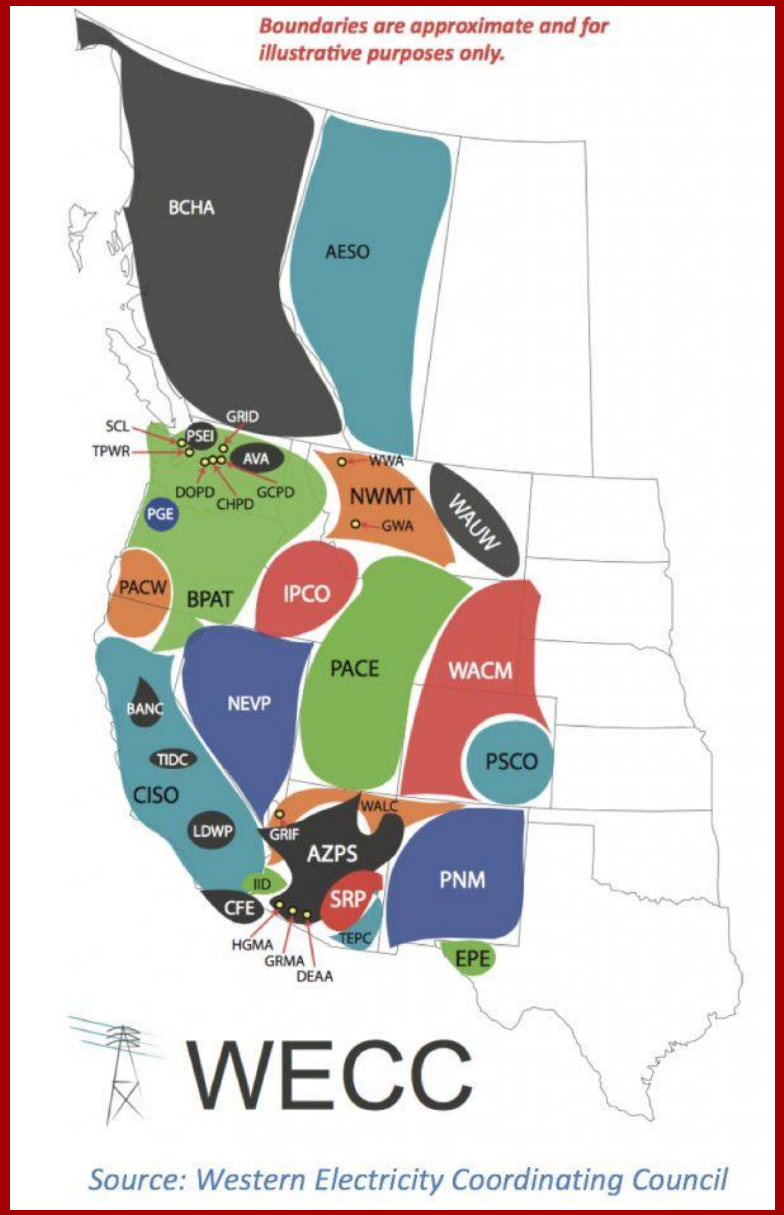
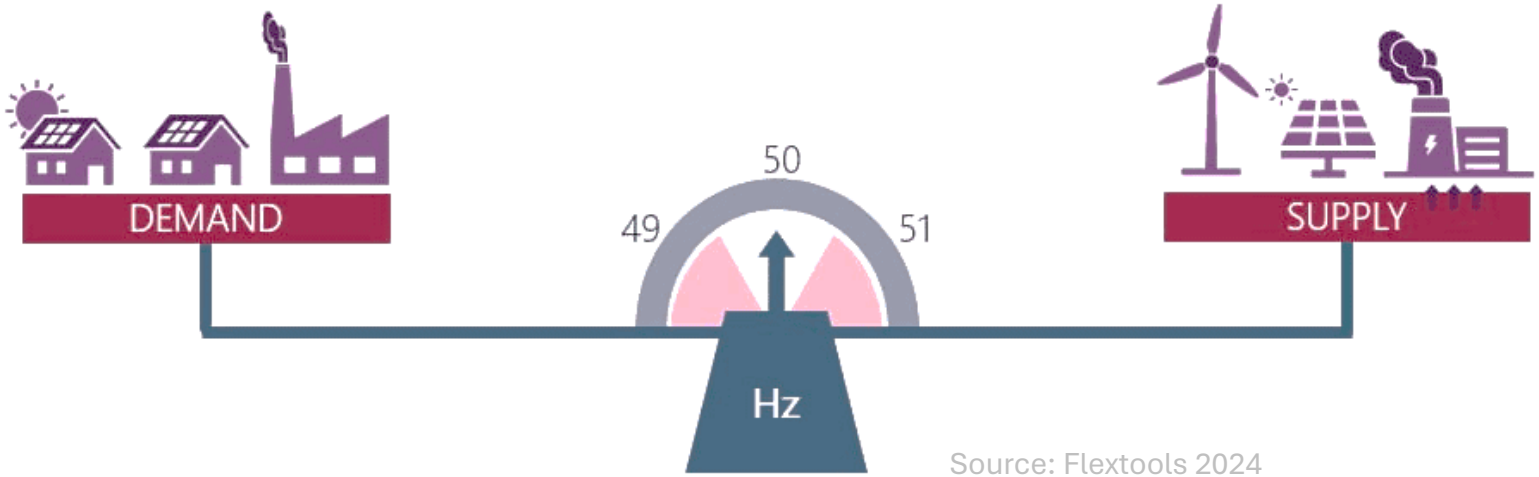
Outline

- Electric grid reliability
- Responsible entities
- Structures in the West
- Case study on increased regional cooperation under stress conditions

- Under extreme events the electric grid operates under higher uncertainty.
- Operators need to coordinate to meet demand reliably and safely.
- Greater regional cooperation can provide reliability benefits especially during extreme events.
- A West-wide regional cooperation functioning as a single entity provides the greatest reliability benefits.

Grid Reliability





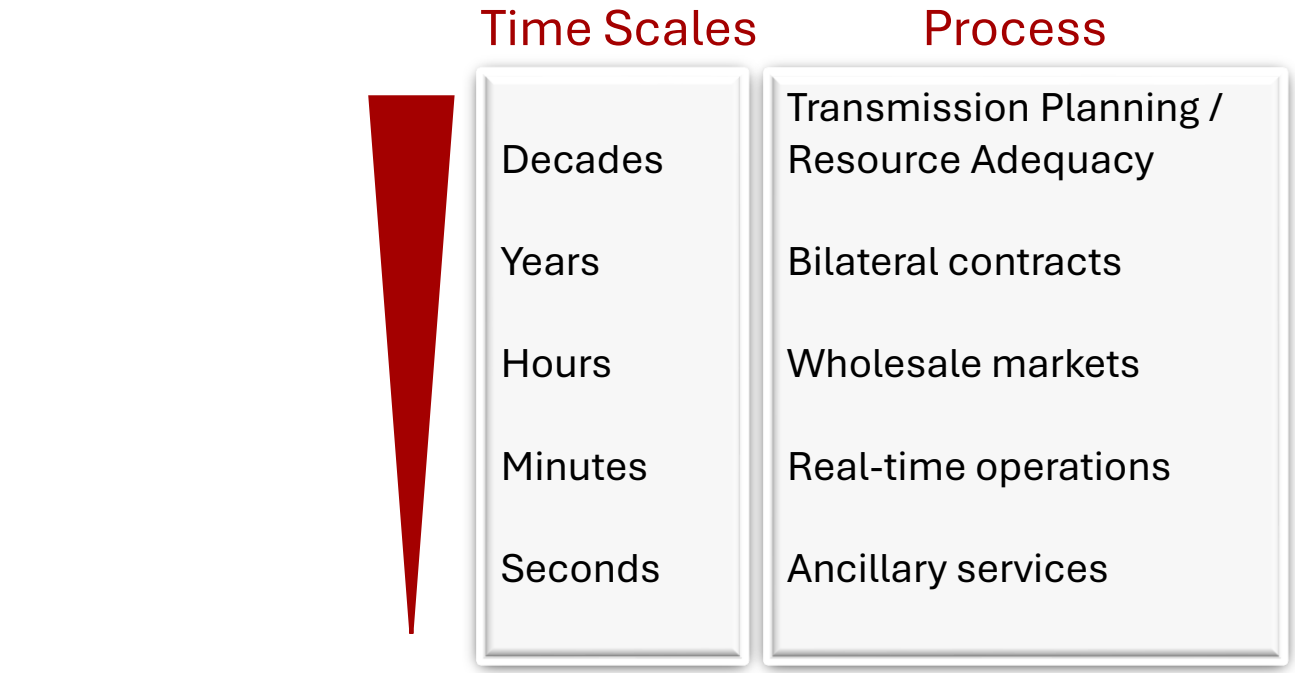
Source: Flextools 2024
https://flextools.com/grid-balancing-flexibility/

- A single synchronized machine that interconnects consumers with electricity supply.
- Deviation from a balanced system can lead to unserved customer demand.
- The Western Interconnection is currently divided into 37 Balancing Authorities (BA).

Planning and Operations

- BAs are responsible for balancing supply and demand balance within their service territory.

- Procurement of electricity:
  1. Generating units within their territory
  2. Interchange of electricity (Bilateral contracts)
  3. Wholesale electricity markets



Challenges in the West

Extreme events

- 2020, a west-wide heat event
- 2021, a heat wave and the Bootleg fire in Oregon
- 2022, record peak load of 52,061MW in CAISO footprint

Stakeholders need to adapt to

- Today's increased stress and weather extreme events
- Growth in demand and dependence on electricity with electrification efforts
- Integration of renewables
- Federal and State climate policies

Efforts in the West to increase regional cooperation

1. West-Wide Governance Pathways Initiative
2. SPP's expansion of a Western RTO

Challenges in the West

Extreme events

- 2020, a west-wide heat event
- 2021, a heat wave and the Bootleg fire in Oregon
- 2022, record peak load of 52,061MW in CAISO footprint

Typical power system models optimize dispatch by assuming:

(1) Economic rationality of all trades
(2) Perfect information
(3) Barriers to trade across BAs don't change

The lived experience of grid operators:

Dialing for megawatts on a hot summer evening

Grid Regionalization in the West: *Reliability* Benefits from Increased Cooperation in Electricity Markets and Operations

- Other studies show the economic benefits from increased cooperation through expanded day-ahead markets.
- We analyze grid operations under increasingly larger cooperation regions
- Power systems models assume perfect information, while real grid operations can deviate from the optimum.

The results from our study are illustrative and directional with the intent to support discussion around current *regionalization* efforts in the West

Model

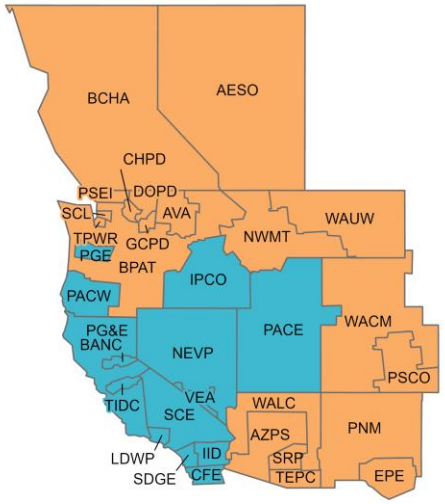
- 34 Zones (BA)
- September 2022 data*
- Simulations of one month of operation

*2024 PLEXOS WECC Zonal dataset

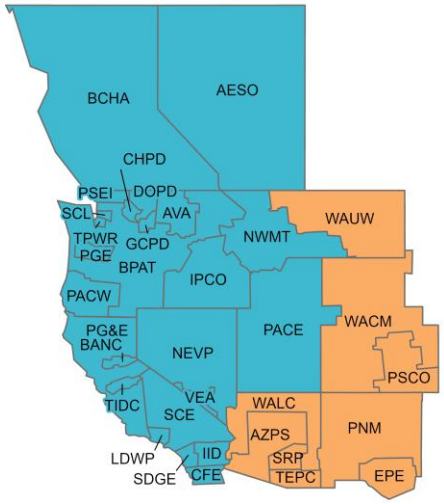
Model

- 3 cases that partition the West into operating subgrids
- No electricity interchange between subregions
- 3 levels of imposed stress

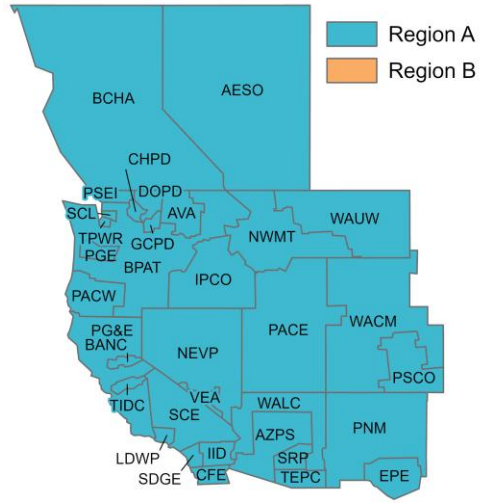
CASE 1

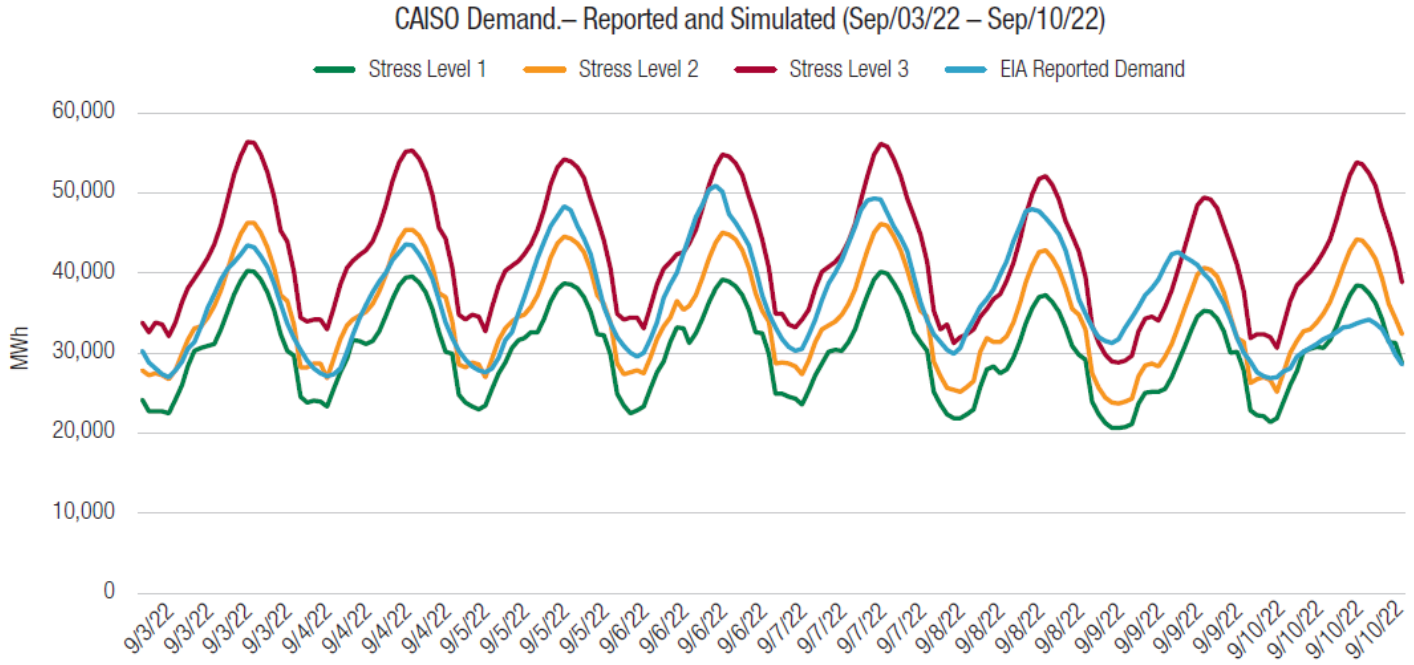


CASE 2



CASE 3
West-wide market

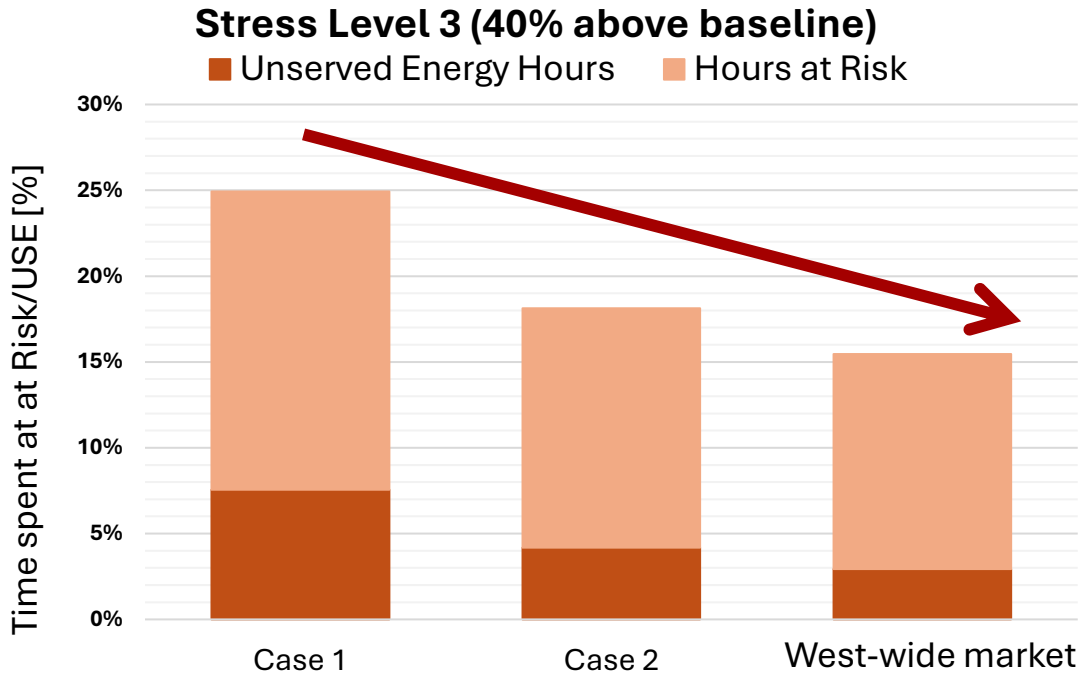




Metrics

1. **Hours at Risk (%):** The percentage of hours when the system operates in stress conditions

2. **Unserved Energy (%):** Indicates proportion of time where there is ‘loss of load’



- In the worst-case stress event, the benefits in operating in a single West-wide electricity market are greater.
- At 40% stress levels the hours at risk are reduced from 25% in case 1 down to 15% for case 3.
- Unserved energy is more than cut in half, from 1901 to 877 GWh.

Key Takeaways

This study illustrates the potential **reliability** benefits that could be achieved by greater market cooperation across the Western Interconnection under stress conditions.

- Entities in the Western Interconnection must coordinate to mitigate the growing impacts of climate related extremes.
- Larger footprints under the purview of a single electricity market create reliability benefits during extreme events.
- Restructuring into a West-wide electricity market requires resolution of multiple challenges.- governance, cost allocation, stakeholder participation, and attention to State policy goals.

Acknowledgments

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