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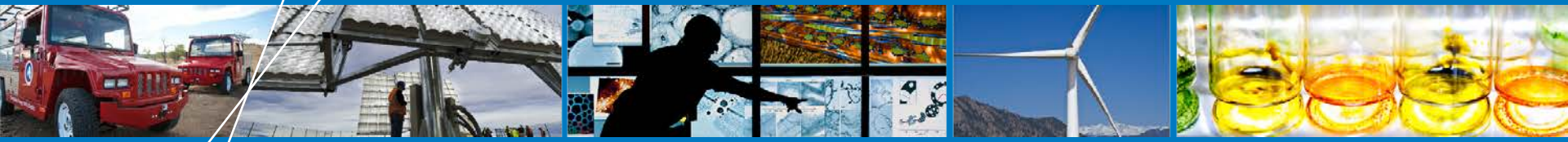
Transmission Planning in the Western Interconnection



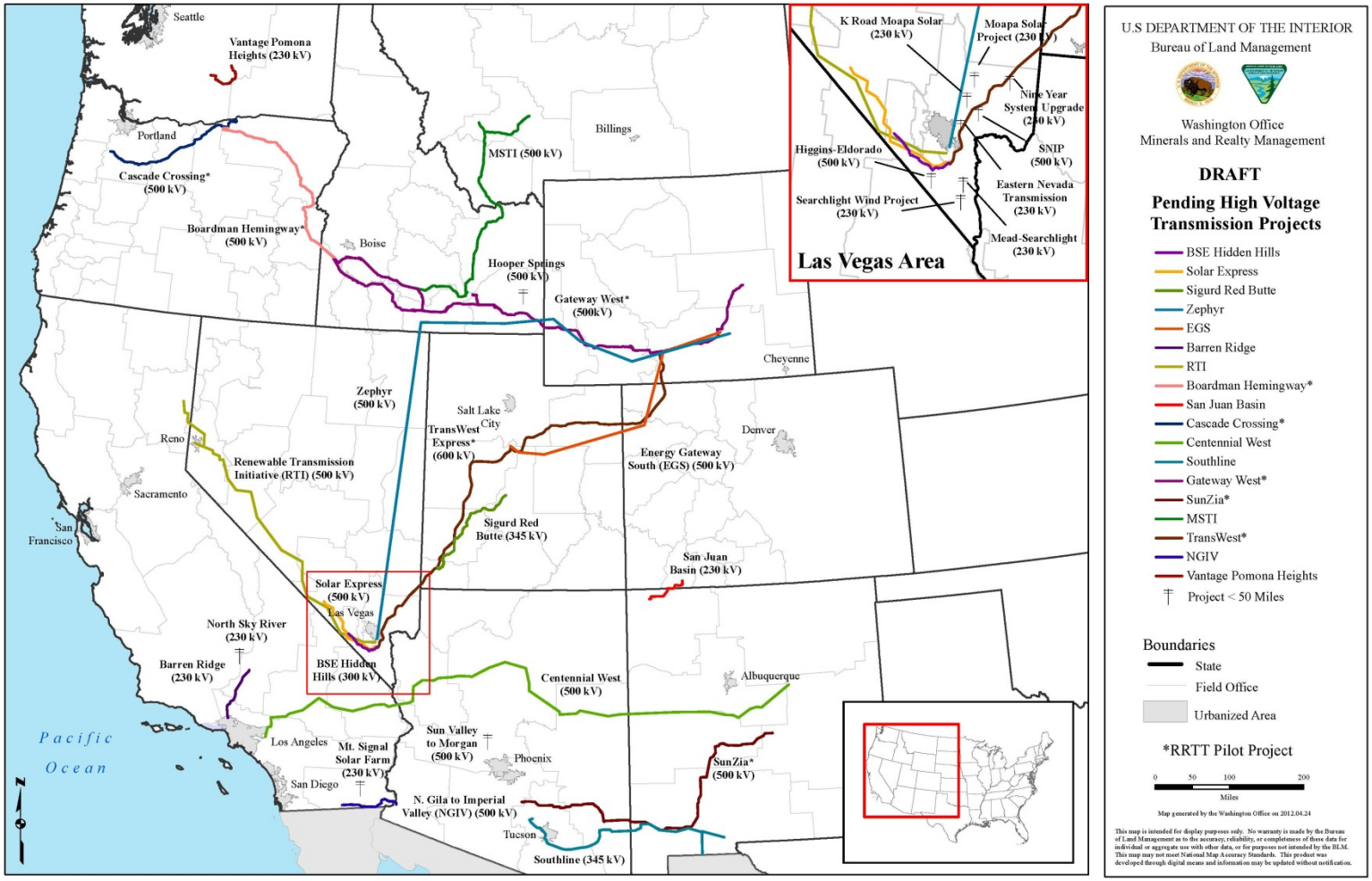
David Hurlbut

BLM Transmission Training Webinar Series

Webinar 2

November 15, 2012

MAP Pending High Voltage Lines



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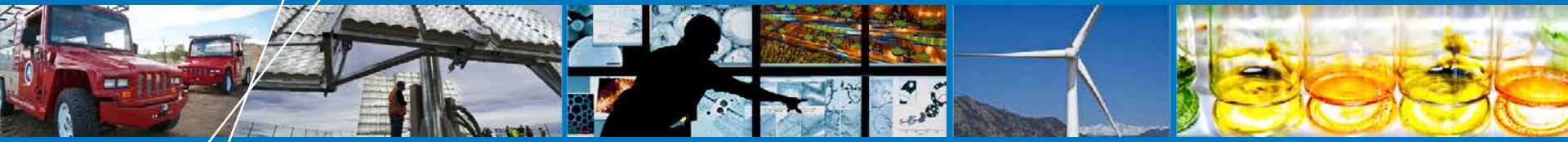

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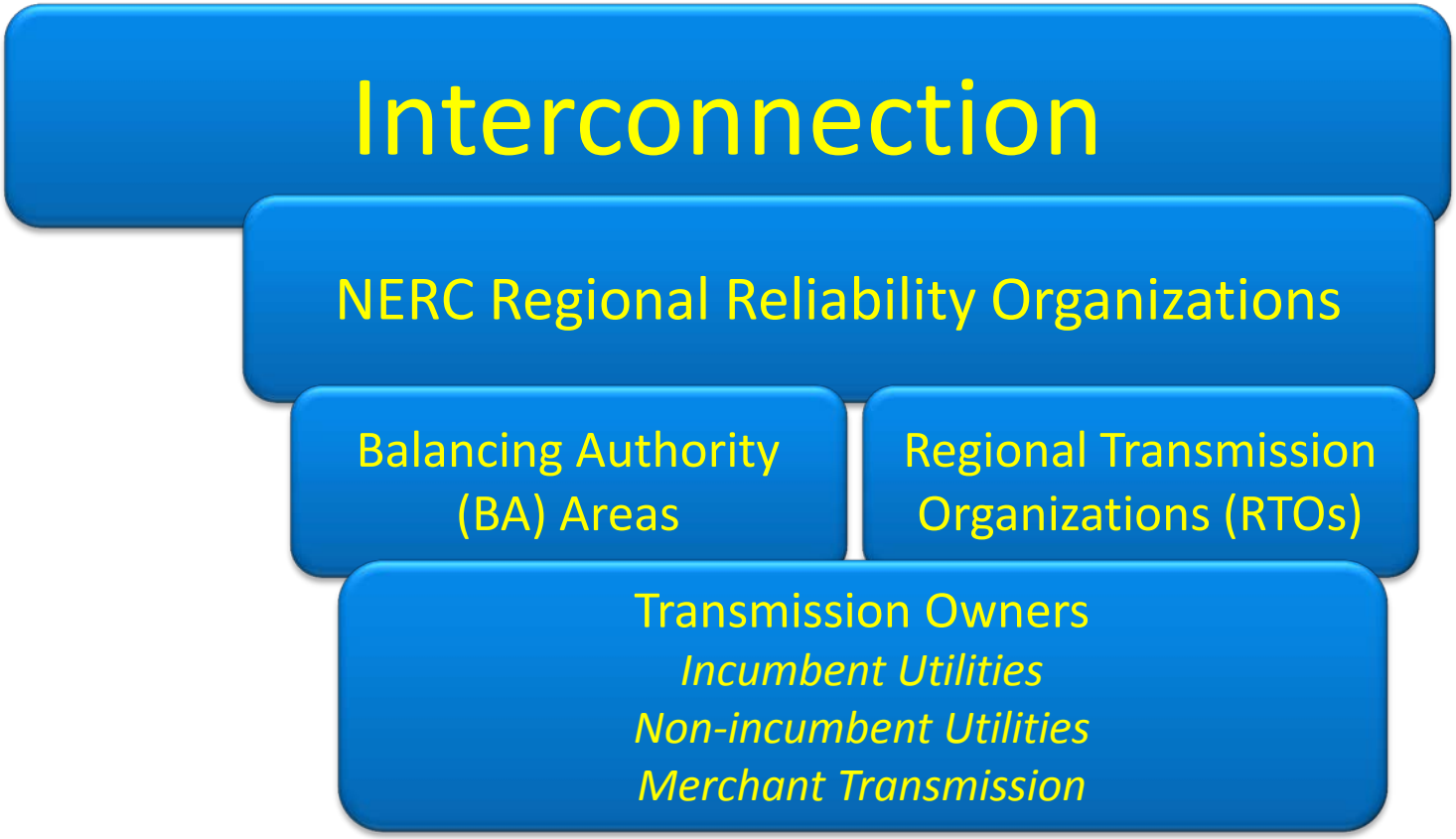
Outline

- What are the different levels of transmission planning, who does them, and which are most relevant to siting on public lands?
- How does WECC's regional planning work?
- What is WECC looking at?
- What are the challenges to moving from planning to construction?

The Pieces (by Size)



FERC Order 890

- Transmission providers shall establish a coordinated, open and transparent planning process
  - Coordinate to ensure that the system is planned to meet needs on a nondiscriminatory basis
- Planning principles
  - Coordination, openness, transparency, information exchange, comparability, dispute resolution, regional participation, economic planning studies, and cost allocation for new projects

FERC Order 1000

- **Jurisdictional transmission providers must:**
  - Participate in a regional transmission planning process
  - Consider transmission needs driven by public policy requirements established by state or federal laws or regulations
  - Coordinate to determine if there are more efficient or cost-effective solutions to their mutual transmission needs

Federal Support for Regional Planning

- **American Recovery and Reinvestment Act included $80 million for interconnection-wide transmission planning**
  - $12 million to Western Governors' Association for policy coordination
  - $14.5 million to WECC for technical studies
- **WGA and WECC coordinate closely**

Two Types of Transmission Upgrades

- **Reliability upgrades**
  - Utilities coordinate through sub-regional planning groups
- **Economic upgrades to the bulk transmission system**
  - WECC, and by regional groups (Northern Tier Transmission Group, WestConnect)

Economic Upgrades

- **Enable delivery of power at lower cost than is possible on the regional grid as it exists today**
- **Economic upgrades usually have reliability benefits as well**
- **Policy objectives: renewable energy**
- **Planning ≠ construction**
  - Many lines are studied, only some actually happen
  - Those that happen need validation through study

Planning Questions

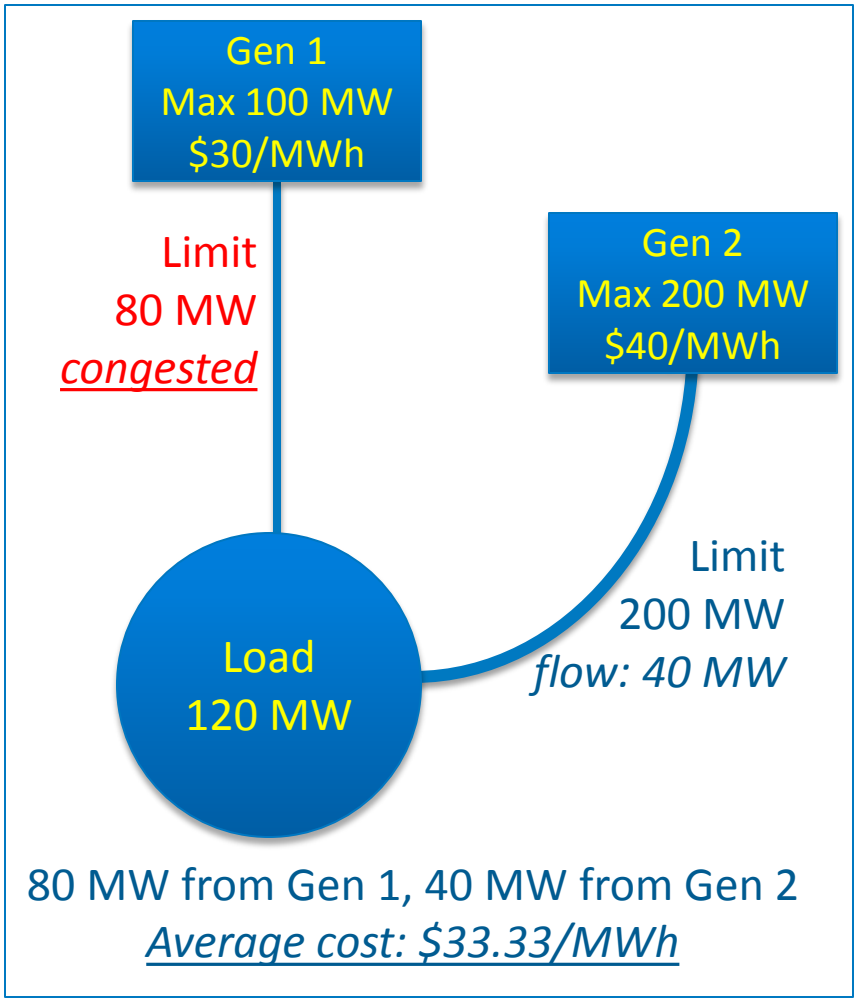
- How will load growth change utilization of the existing power system?
- Are there points on the system that will experience significant additional costs when they become stressed by additional load?
- Can the new cost points be fixed with a cost-effective line upgrade or expansion?

Planning Tool: Production Cost Modeling

- **Optimization model**
  - Simulates the conditions and operating constraints for the entire system, then solves for the least-cost dispatch of existing generating fleet, usually over the course of a year
- **Results allow comparison among different assumptions**
  - Total cost of operating the system
  - Amount of power dispatched from each unit
  - Total emissions
  - Utilization and congestion on specific lines
  - Marginal cost of electric generation at specific points

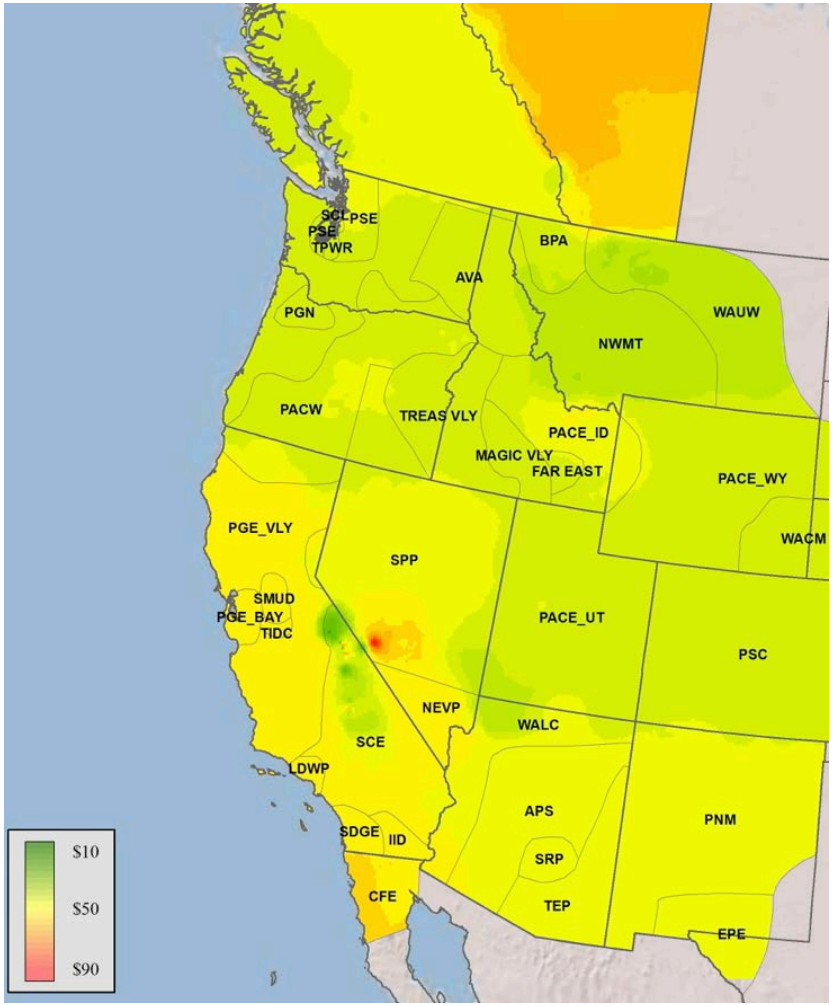
Locational Marginal Pricing (LMPs)

- **Will use next-cheapest generator if line congestion limits unit with cheapest power**
- **Locational marginal prices (LMPs)**
  - What is the value of the next MW of electricity at a given spot, accounting for congestion



Answers From Production Cost Modeling

- Do total costs go up or down when moving from one scenario to another?
- Do any lines become more congested, and how much additional cost does that create?
- Do some areas see more cost increase than others?
- Is there a change in the types of units used? (Such as switching between coal and natural gas)



What a Production Cost Model Doesn't Do

- **Does not add new generators or new transmission lines**
  - Although it can say what it would be worth to do so
- **Does not retire existing generation**
  - Although it might not use a unit
- **Does not capture capital cost**
  - Assumes the utility/owner has done whatever it takes to get the unit on line and keep it there
  - Only models variable operating cost (e.g. fuel, cost of starting the unit)
  - Assumptions about fuel costs—especially natural gas—are crucial to the outcome

WECC's Regional Planning for Renewables

- Base case: Model where renewables are economically most favorable today, using existing lines, current loading, and new lines under construction
- "Stress" the system by forcing another 6,000 MW of renewables in one state

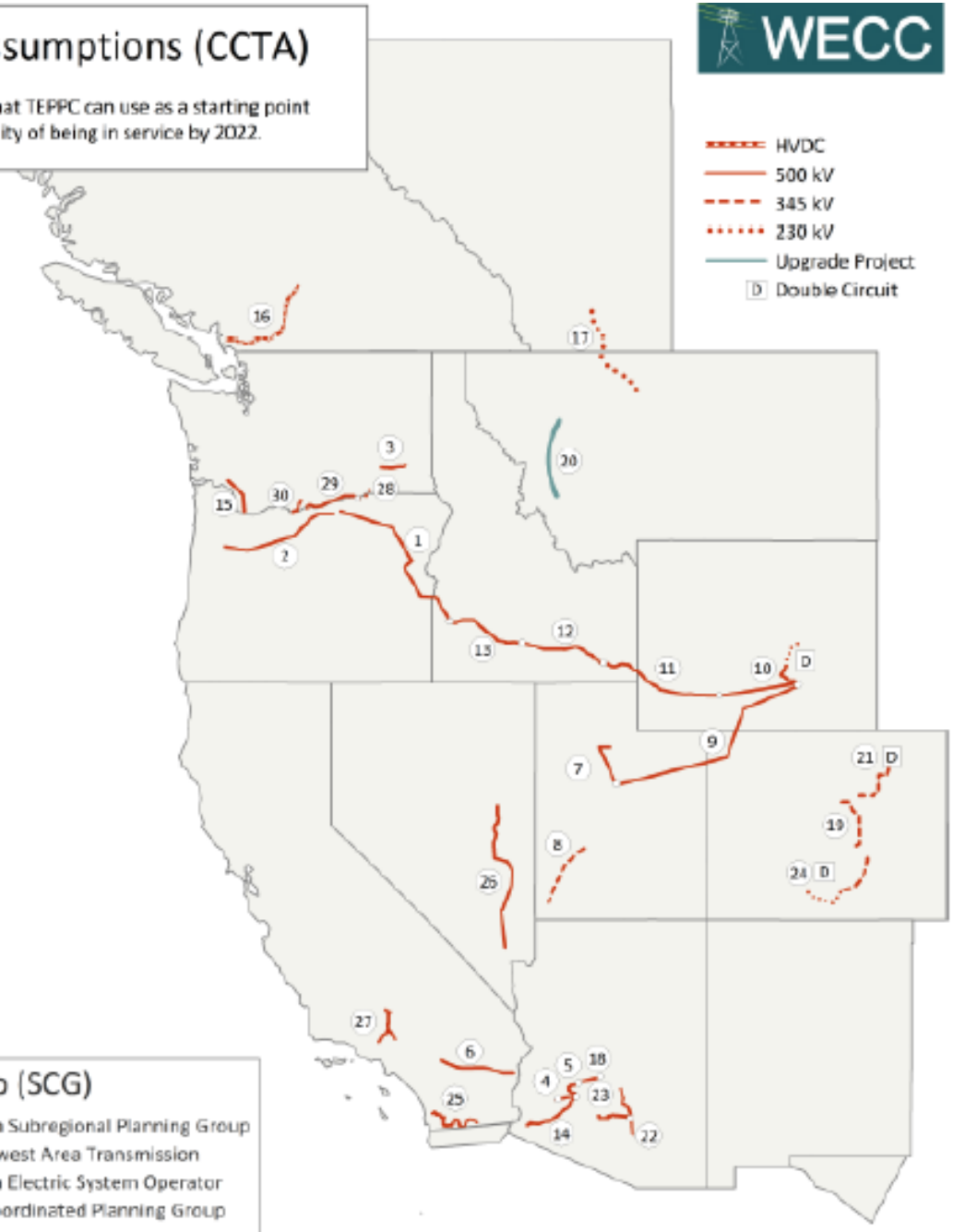
2022 Common Case Transmission Assumptions (CCTA)

The purpose of the CCTA is to provide a basic set of transmission facilities that TEPPC can use as a starting point for their own studies. The CCTA is a list of facilities that have a high probability of being in service by 2022.

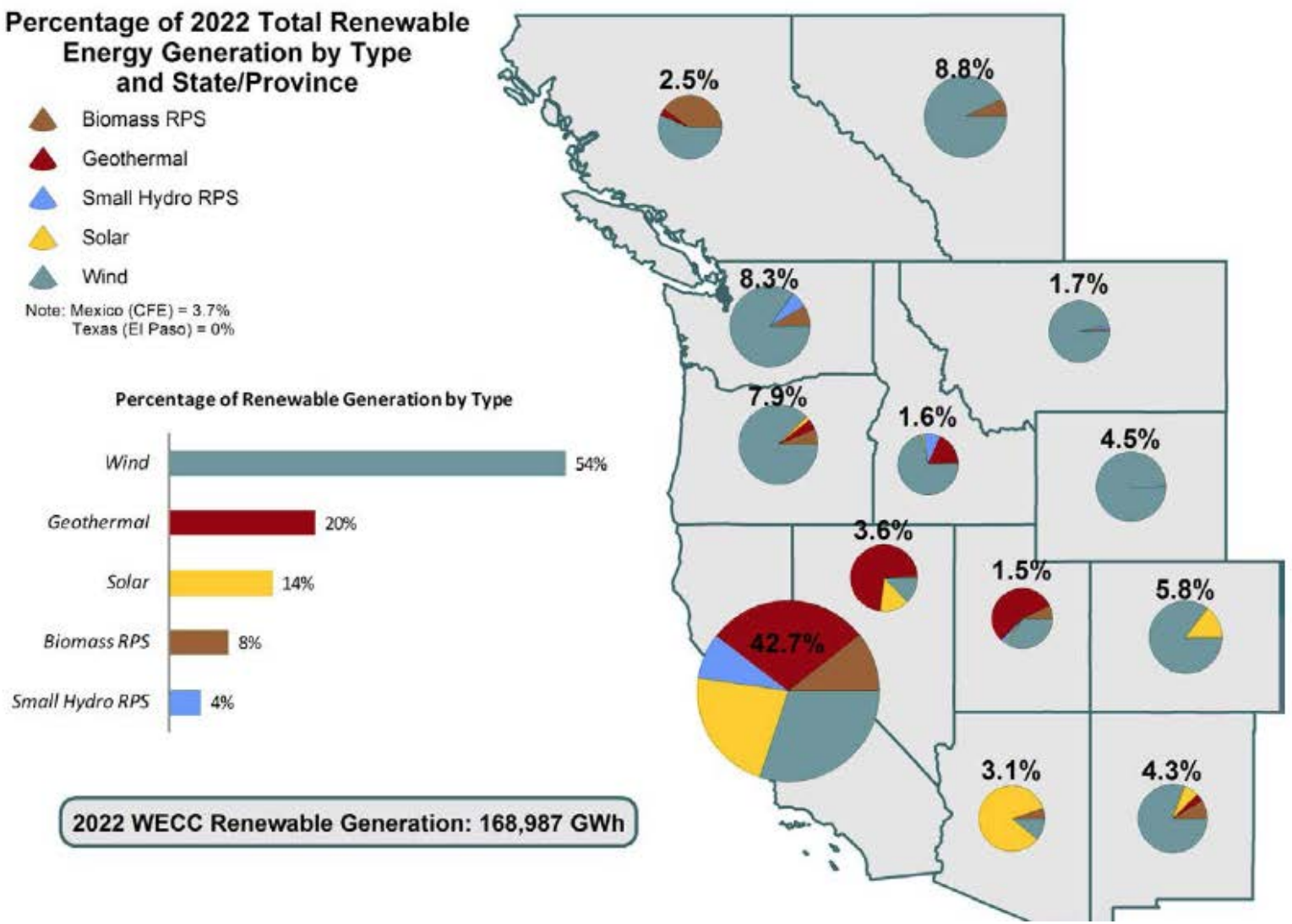
1. Boardman-Hemingway (B2H)
2. Cascade Crossing
3. Central Ferry - Lower Monumental (Little Goose Area Reinforcement)
4. Delaney - Palo Verde Line
5. Delaney - Sun Valley Line
6. Devers - Colorado River (DCR) Project
7. Gateway Central Project: Mona to Oquirrh (Segment C)
8. Gateway Central Project: Sigurd - Red Butte
9. Gateway South Project: Segment 2 (Aeolus - Mona)
10. Gateway West Project: Segment 1A (Windstar to Jim Bridger)
11. Gateway West Project: Segment 1B (Bridger - Populus single circuit)
12. Gateway West Project: Segment 1C (Populus - Midpoint)
13. Gateway West Project: Segment E (Midpoint - Hemingway)
14. Hassayampa - North Gila #2 Line
15. I-5 Corridor Reinforcement Project (Castle Rock - Troutdale)
16. Interior to Lower Mainland Transmission (ILM) Project
17. Montana Alberta Tie Project (MATL)
18. Morgan - Sun Valley Line
19. Midway-Waterton
20. Path 8 Upgrade/Colstrip Transmission Upgrade (western portion only)
21. Pawnee-Smoky Hill
22. Pinal Central-Tortolita
23. Pinal West-Pinal Central-Browning (SEV)
24. San Luis Valley-Calumet-Comanche
25. Sunrise Powerlink
26. SWIP South
27. Tehachapi Renewable Transmission Project
28. Walla Walla to McNary (Energy Gateway Segment A)
29. West of McNary Reinforcement Project Group 1 (McNary - John Day)
30. West of McNary Reinforcement Project Group 2 (Big Eddy - Knight)

Subregional Coordination Group (SCG)

CAISO - California Independent System Operator
CTPG - California Transmission Planning Group
CG - ColumbiaGrid
CCPG - Colorado Coordinated Planning Group
NTTG - Northern Tier Transmission Group
SIERRA - Sierra Subregional Planning Group
SWAT - Southwest Area Transmission
AESO - Alberta Electric System Operator
BCCPG - BC Coordinated Planning Group



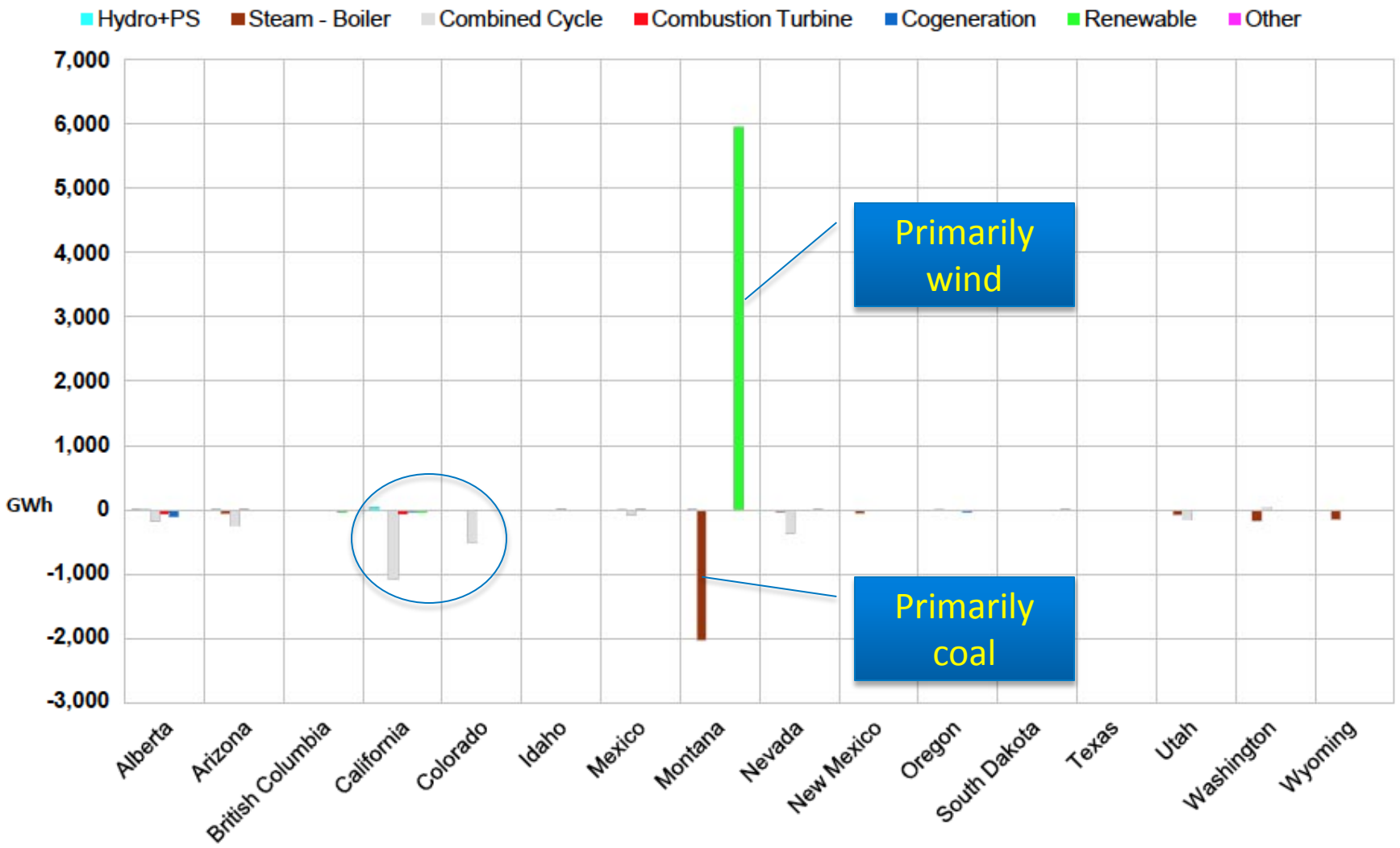
Distribution in 2022 as Modeled by WECC



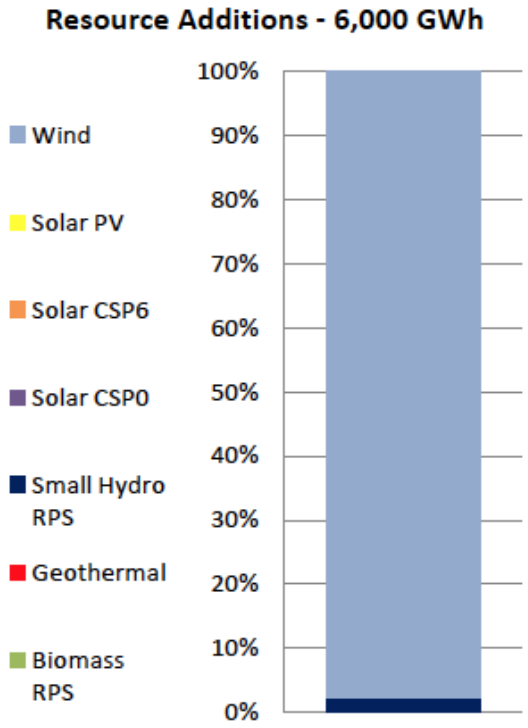
“Stress” Tests

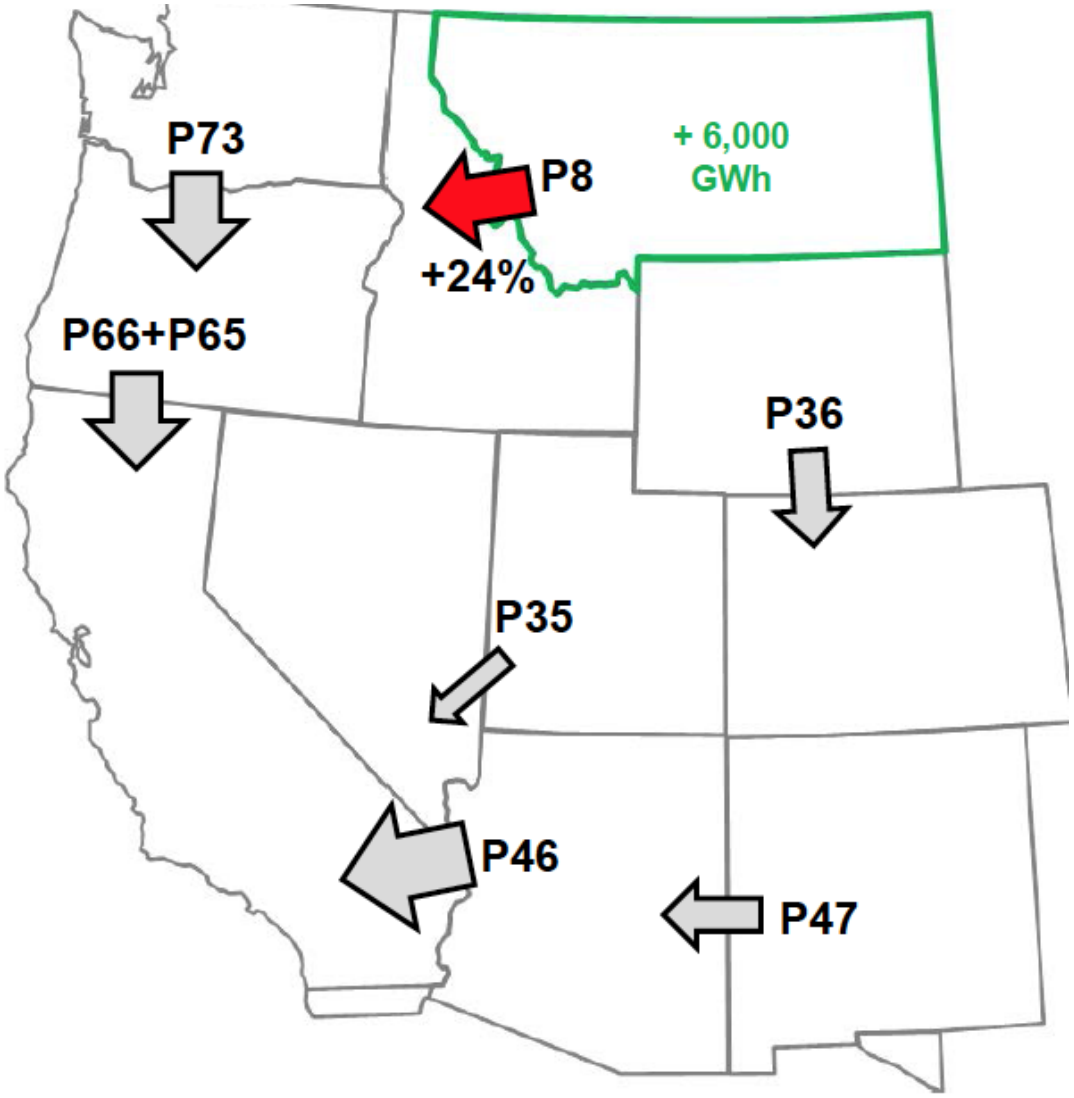
- **Add 6,000 MW to the target state’s resource portfolio based on WGA Western Renewable Energy Zones**
  - Does it create transmission congestion somewhere on the system?
  - Does it change how other generation resources are dispatched?
  - Does it cause curtailment, or does it cause thermal resources to cycle excessively?

Montana Stress Test: Generation



Montana Stress Test: Congestion





New Planning Scenario: Drought

- **Higher peak demand**
  - Temperatures are higher, cooling systems run more, electricity use increases
- **Generation**
  - Less power from hydro
  - More forced outages at coal, nuclear, natural gas plants due to less water available for cooling

Drought Scenario Results

- Greater use of combined cycle natural gas units, due to loss of hydro
- Less use of coal and other steam units in Arizona, due to greater forced outages

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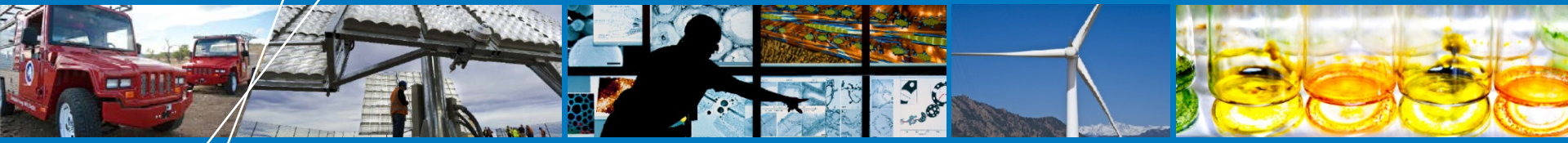


Questions so far?

Operational Changes Under Study

- Changes to address the uncontrolled variability of wind and solar
- Paying for new transmission

Variability and Managing the Grid

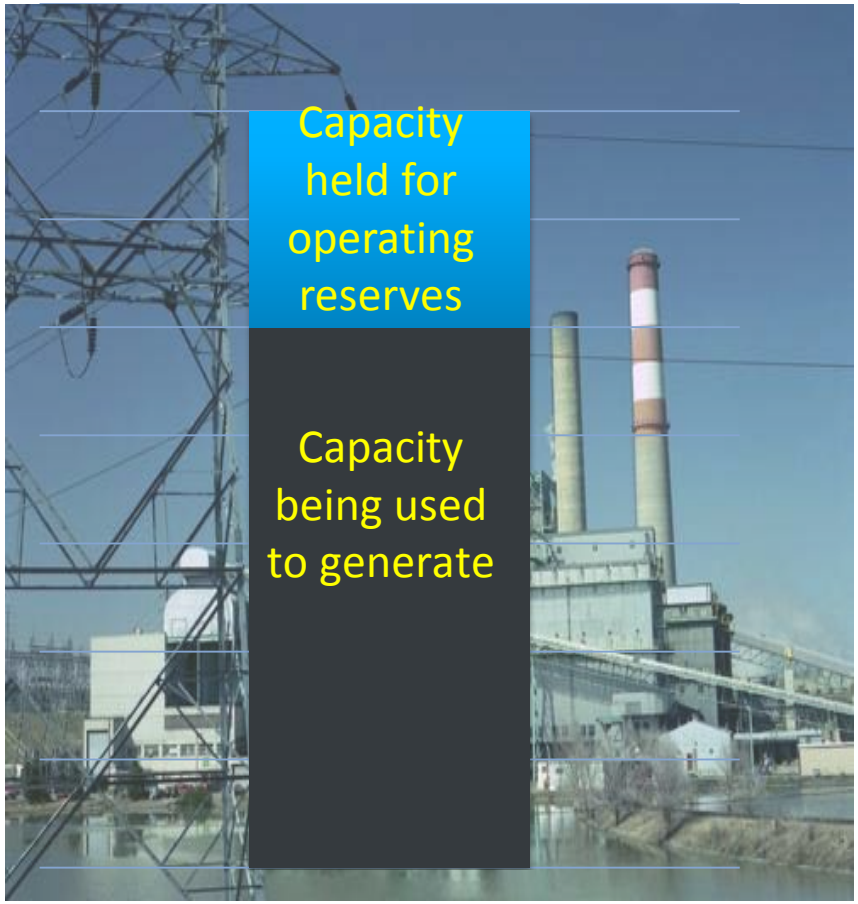
- **Variability has always been a factor in managing the grid**
  - Electricity can't be stored economically, so generation must match the amount of electricity needed moment to moment
  - Although daily load has general profiles, it can vary significantly moment to moment
  - Utilities have always kept operating reserves on hand to address load variability

Operating Reserves

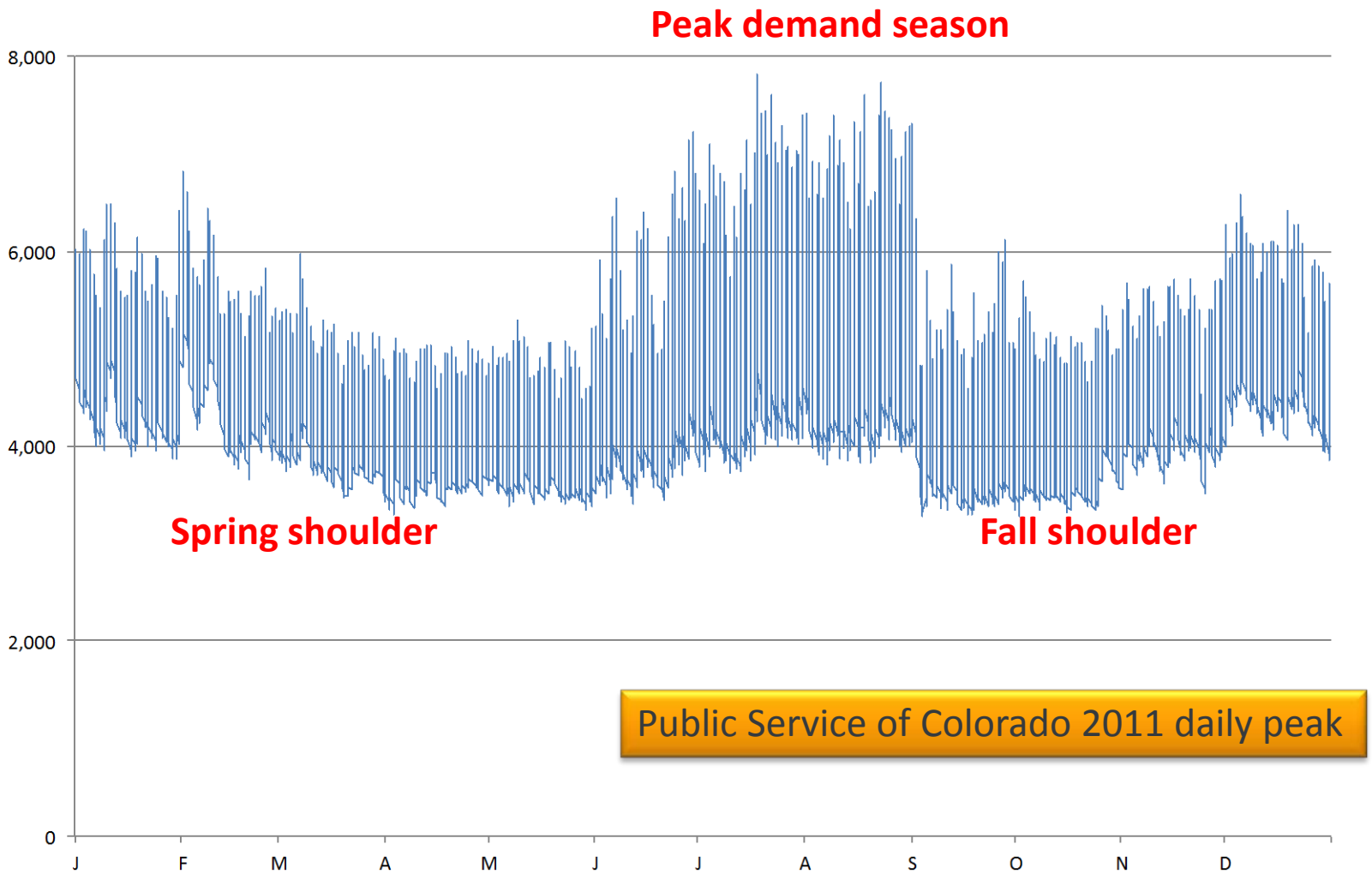
Types of resources

- Spinning reserves on units running at less than full capacity
- Quick-start units
- Demand response (DR)
  - Load that can ramp down or cycle off quickly in response to operator instruction

Spinning reserves

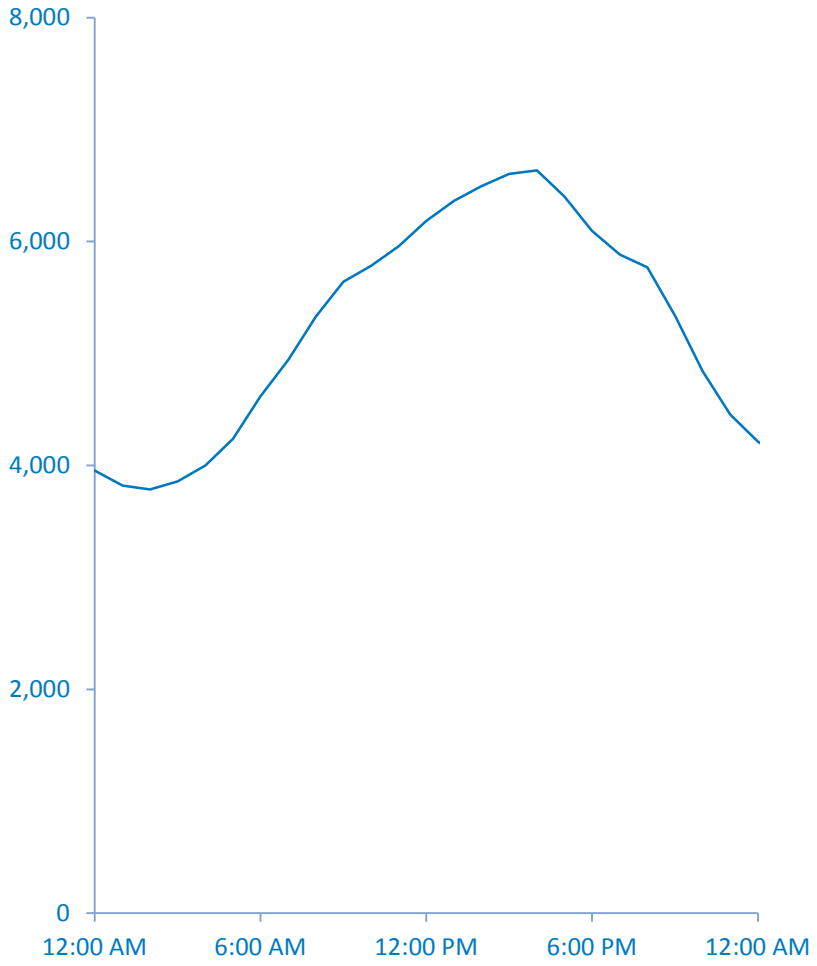


Seasonal Variability



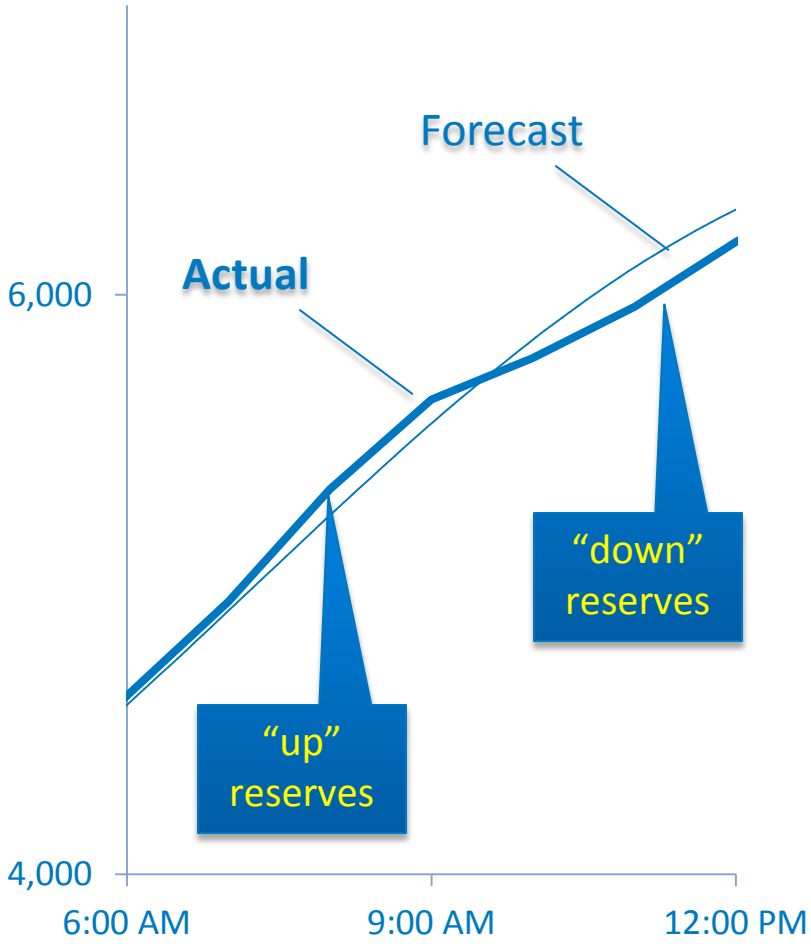
Daily Variability

- Day-ahead schedule for starting, running generators
- How much base load capacity, how much intermediate capacity, how much peaking?



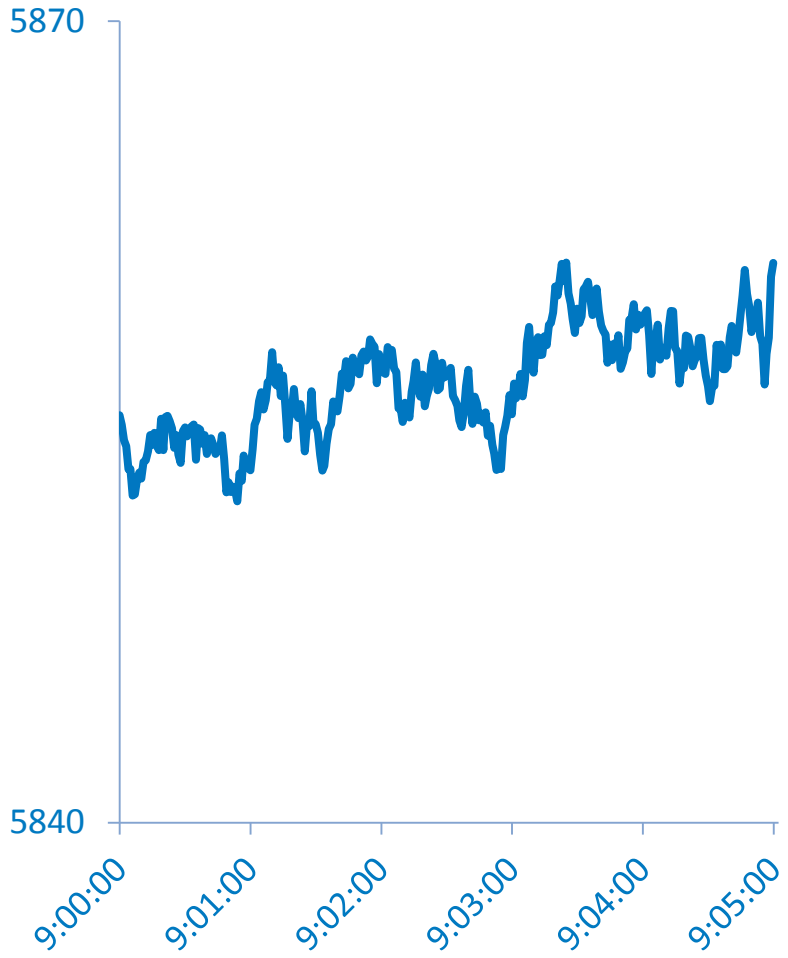
Hourly Variability

- **Load following**
  - When actual load trends higher than day-ahead forecast, deploy "up" reserves (run units slightly more)
  - When actual load trends lower than day-ahead forecast, deploy "down" reserves (run units slightly less)



Intra-hour Variability

- Maintain system frequency
- Automatic generator control

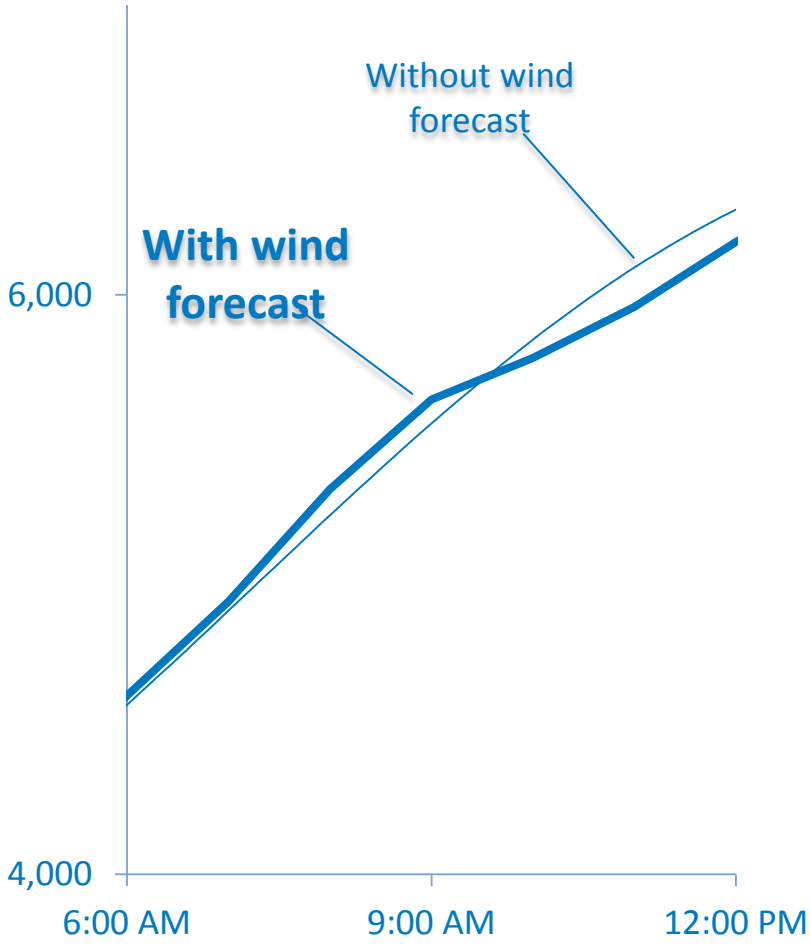


Variability of Wind and Solar

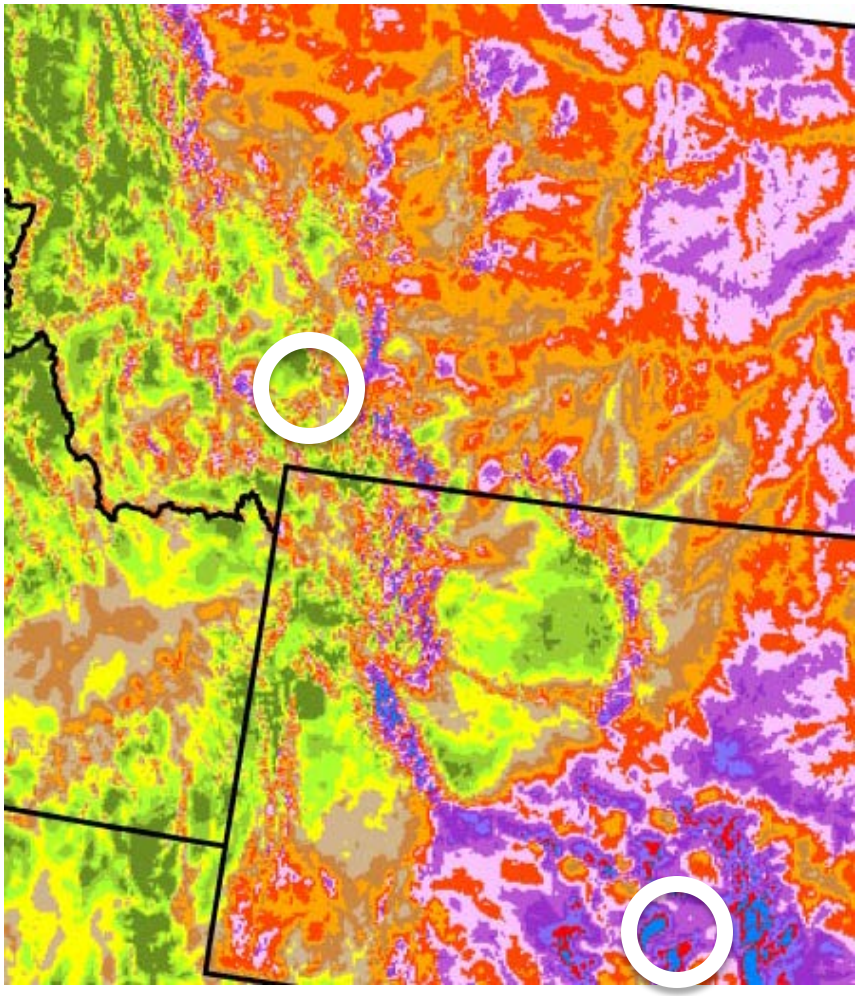
- **Wind and solar add to the variability already on the system**
- **Strategies for mitigating the additional variability**
  - Manage with operating reserves already available
  - Forecasting
  - Geospatial diversity
  - Storage (but might not be most cost-effective option)

Forecasting

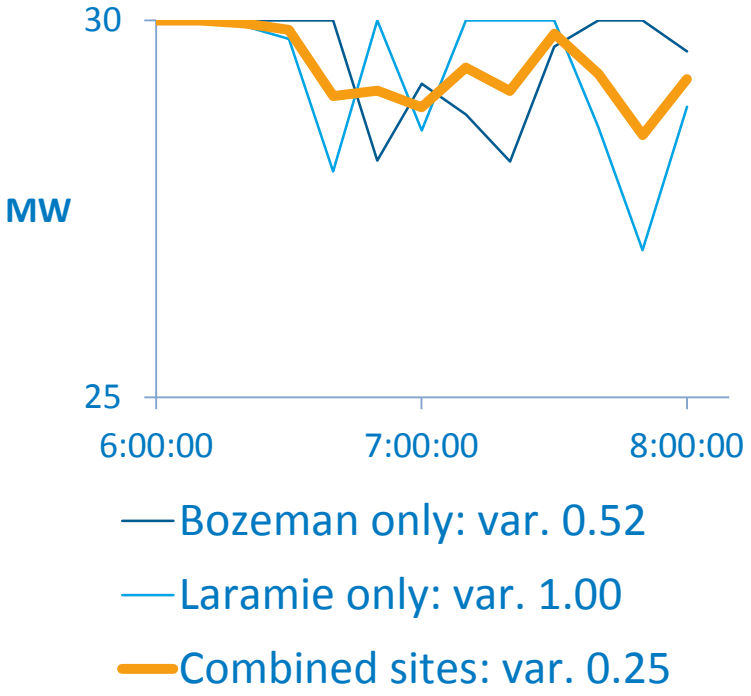
- **State-of-the-art forecasting for wind and solar can inform the day-ahead schedule**
- **If the forecast for net load fits actual net load better, hourly variability can be managed with existing reserves**
  - net load = native load – wind/solar generation
- **For purposes of day-ahead scheduling, state-of-the-art forecasting is about as good as perfect forecasting**



Geospatial Diversity: Less Variance



Same-time output from 30 MW of wind power at two sites



On the Table: Energy Imbalance Market

- Creating a formal market mechanism that will dispatch reserves by economic merit (those that impose the least cost to the system as a whole) across a large footprint
- Western EIM has been studied by WECC, WGA
- Will likely require regulatory endorsement from states; concerns about creating a "backdoor" regional transmission organization

How an EIM Would Work

- **Coordinated market among participating BAs in which scheduling errors are netted out, and reserves are shared**
- **Benefits**
  - Fewer reserves will be deployed to balance schedules,
  - The reserves deployed will cost less
- **Challenges**
  - New software, need to create central market operator
  - Perceived resemblance to an RTO
  - New way of operating for participating BAs
  - Economic benefits are not evenly distributed

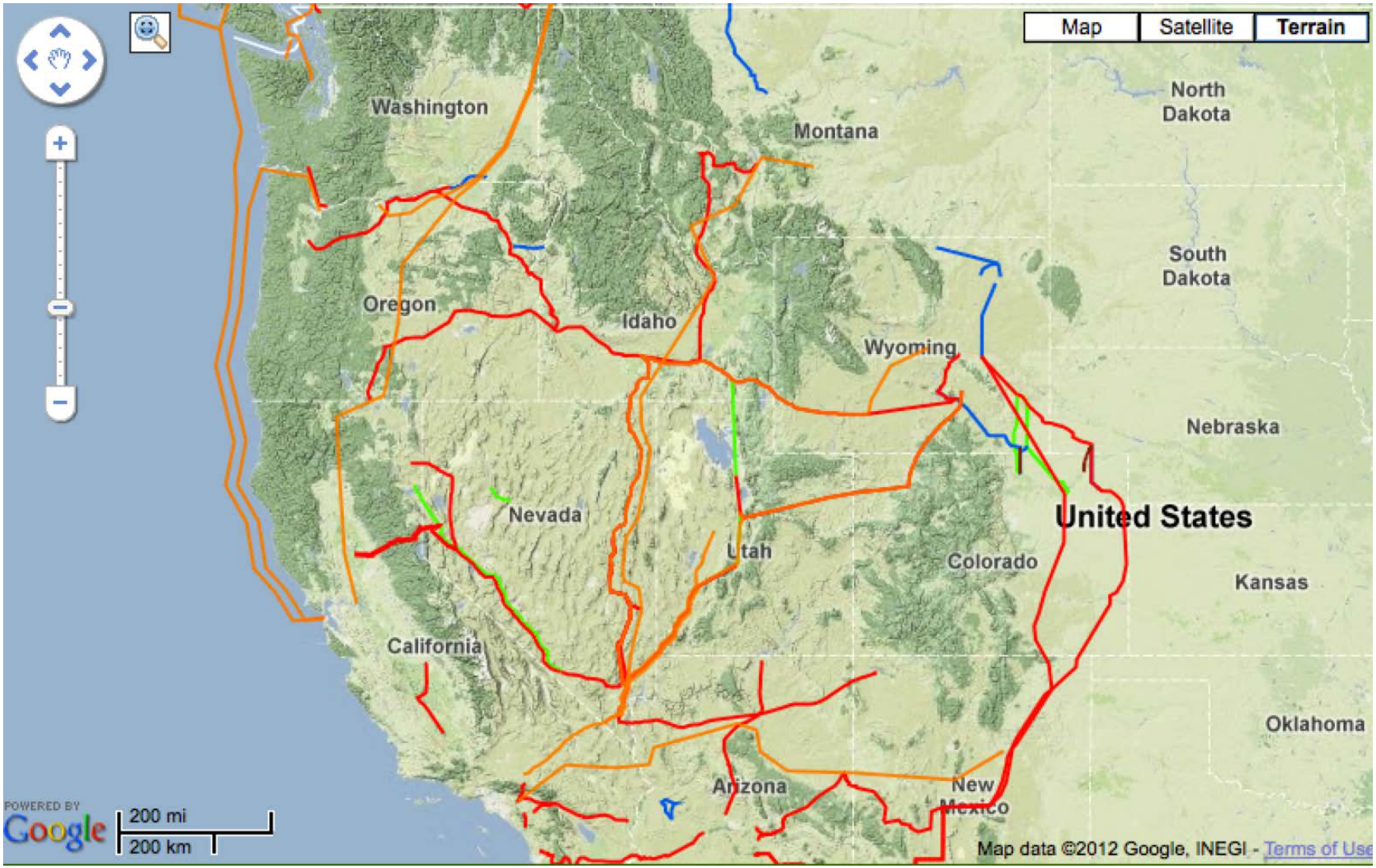
Control Area Diversity, Reserve Sharing

- Similar in purpose to EIM, but without formalized market structure
- Has been tried in the Northwest with some success

The Upshot…

- **Higher penetrations of renewable energy on the grid are feasible, but doing them efficiently might require new ways of operating**
- **Regional planning activities are examining major changes that could result in:**
  - more energy from renewable sources with less capital investment
  - a few strategically targeted large transmission projects, rather than a proliferation of smaller ones
- **Reforms will likely result in greater weight afforded to projects that go through the regional planning process, especially if the project is intended to serve regional markets rather than local load**

WECC Transmission Information Portal



http://www.wecc.biz/Planning/TransmissionExpansion/Map/Pages/default.aspx

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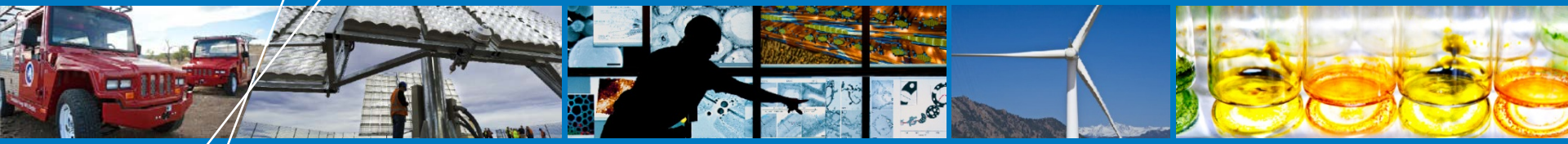

Questions?

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