# Western Regional Market Developments:

## Impacts on Regional Resources, Prices, and Market


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**Law Seminars International: The 18th Annual Conference on Electric Power in California**
**Los Angeles, CA**

**November 3, 2016**

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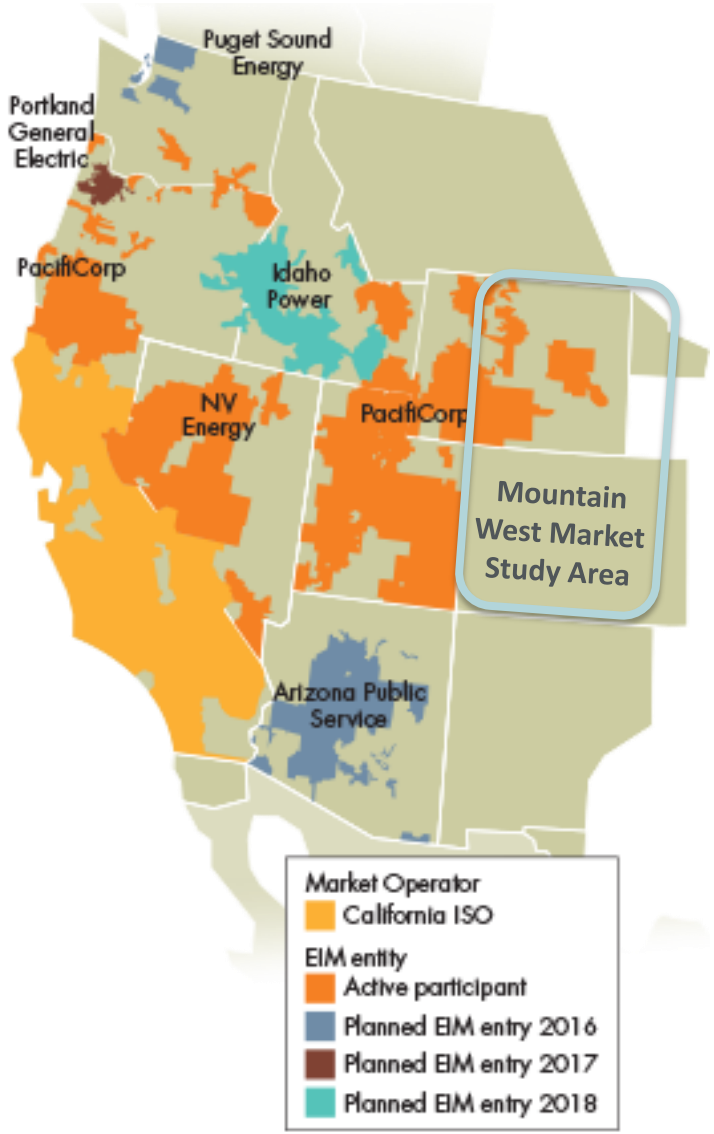
# Regional Market Efforts in WECC

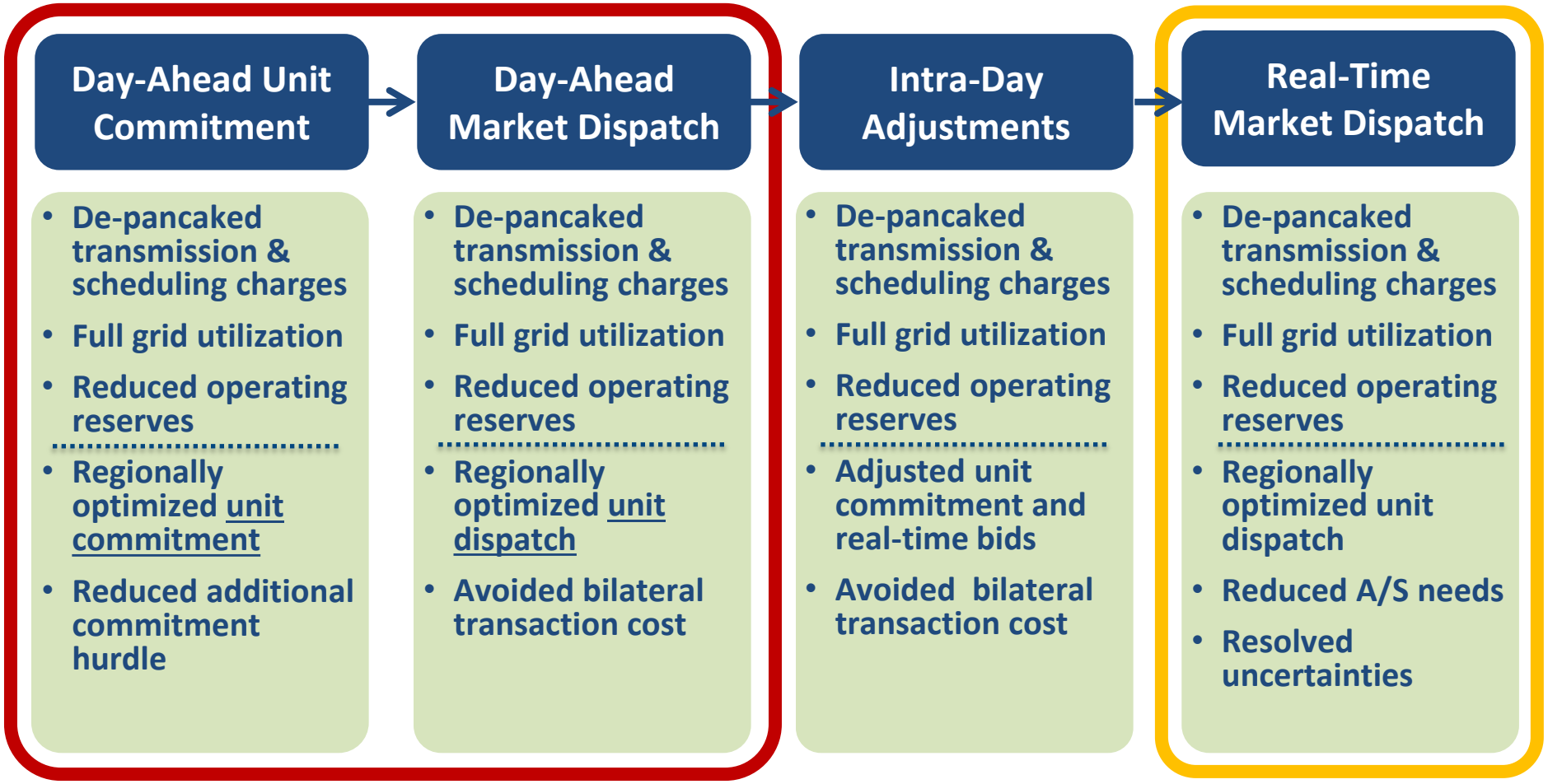
## EIM and Regional Markets




**Motivated in part by renewable balancing needs and cost savings, several regional market initiatives are on-going:**

- **Energy Imbalance Market (EIM)**:
  - CAISO, PAC, NV Energy, and APS (participating); Portland General Electric, Puget Sound Energy, Idaho Power (committed); BANC, SMUD, LADWP, Baja California Norte (intent announced and analyzing)
  - CAISO+PAC+NVE: $20-25 million savings per quarter (approx. 25% NVE, 33% CAISO)
- **CAISO-PAC Regional Market Initiative:** setting up and proposing to implement full (Day-2) RTO market that could include much of WECC (SB350 Study conducted)
- **Mountain West Transmission Group (MWTG):** Basin Electric Power Cooperative, Black Hills Corp., Colorado Springs Utilities, Platte River Power Authority, PSCo, Tri-State G&T and the Western Area Power Administration (WAPA)'s Loveland Area and Colorado River Storage projects analyzing Day-2 market in CO and WY

# Operational Scope: EIM vs. Full Day-2 Market




**Scope of Regional Day-2 Market Simulations**

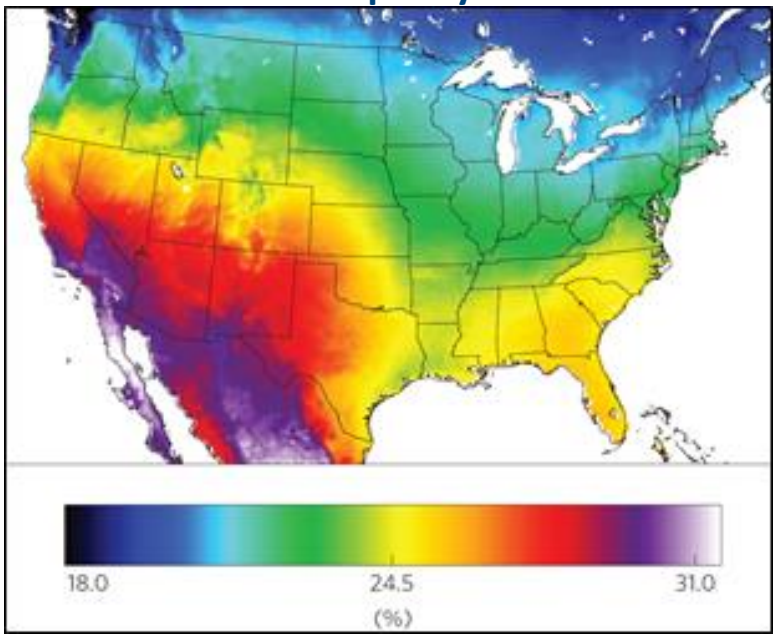
(without forecast errors, renewable uncertainty, real-time outages, etc.)

**CAISO EIM**

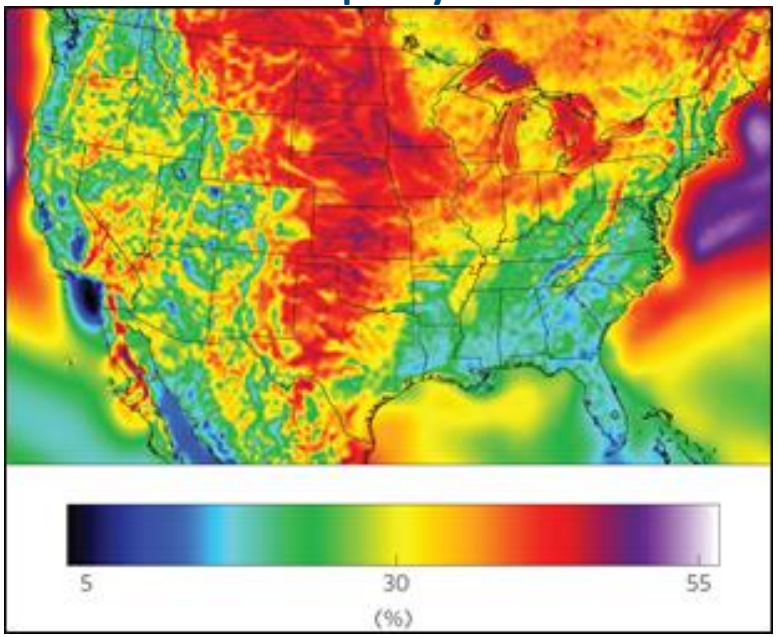
# The West is Endowed with Low-Cost Wind & Solar

- Accessing lowest-cost renewable areas of the WECC can reduce the cost of meeting RPS and carbon emissions goals across the region
- Moving forward, without a regional market, balancing high concentrations of mostly single type of resource (e.g., solar in southern CA or wind in WY) is a significant challenge for the 39 balancing areas across the WECC

**Solar PV Capacity Factors**




**Wind Capacity Factors**

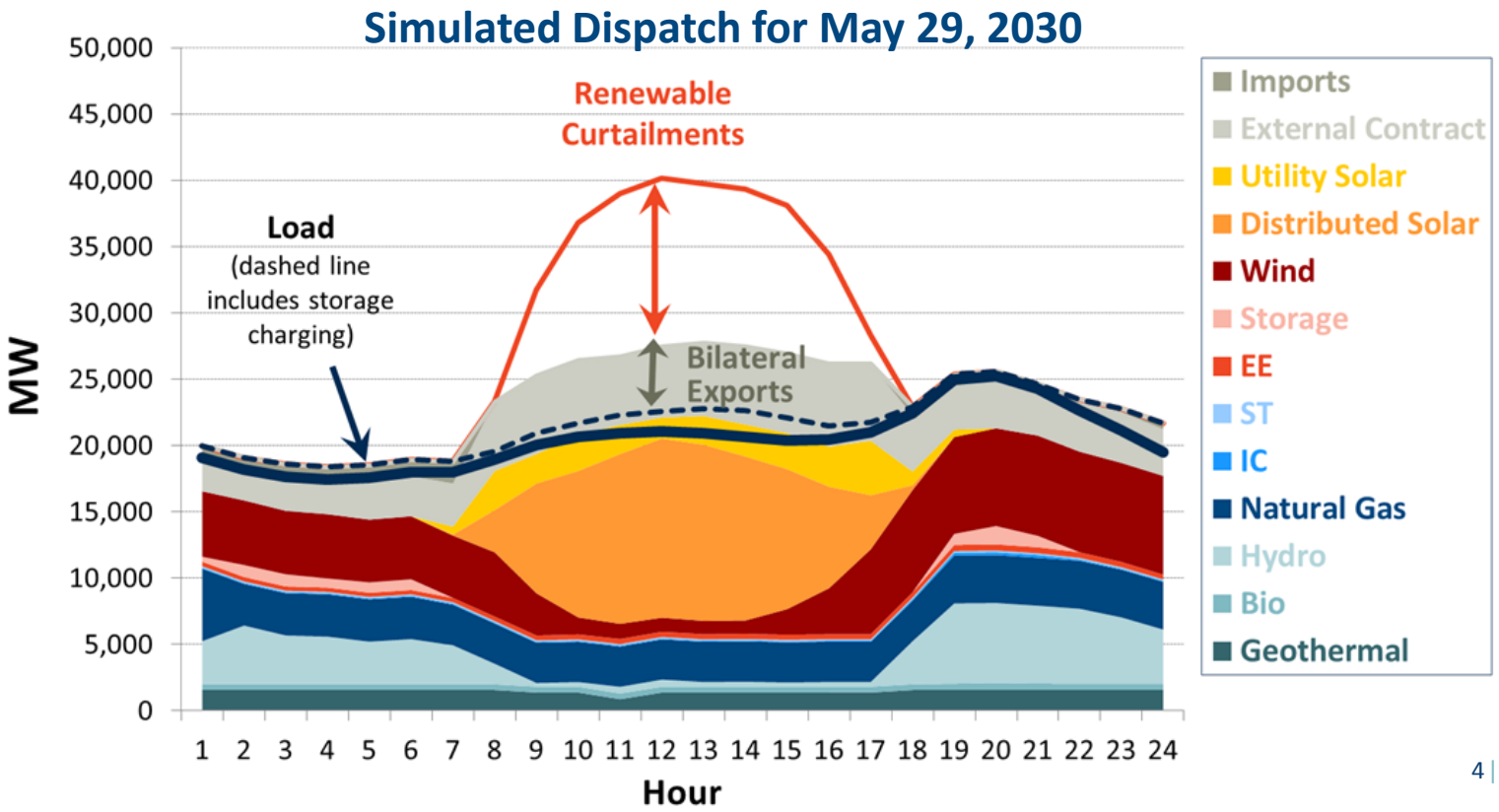



**Source:** MacDonald, Alexander E, Christopher T.M. Clack, et al., "Future cost-competitive electricity systems and their impact on US CO2 emissions," Nature Climate Change (Jan 2016): DOI: 10.1038/NCLIMATE2921. (Reproduced with permission from Earth System Research Laboratory, NOAA.

# CAISO's Extreme "Duck Curve" in 2030

For example, with substantial solar additions, California would experience an extreme "duck curve" with total renewable generation exceeding total California load by up to 10,000 MW at times (negative net load), creating:

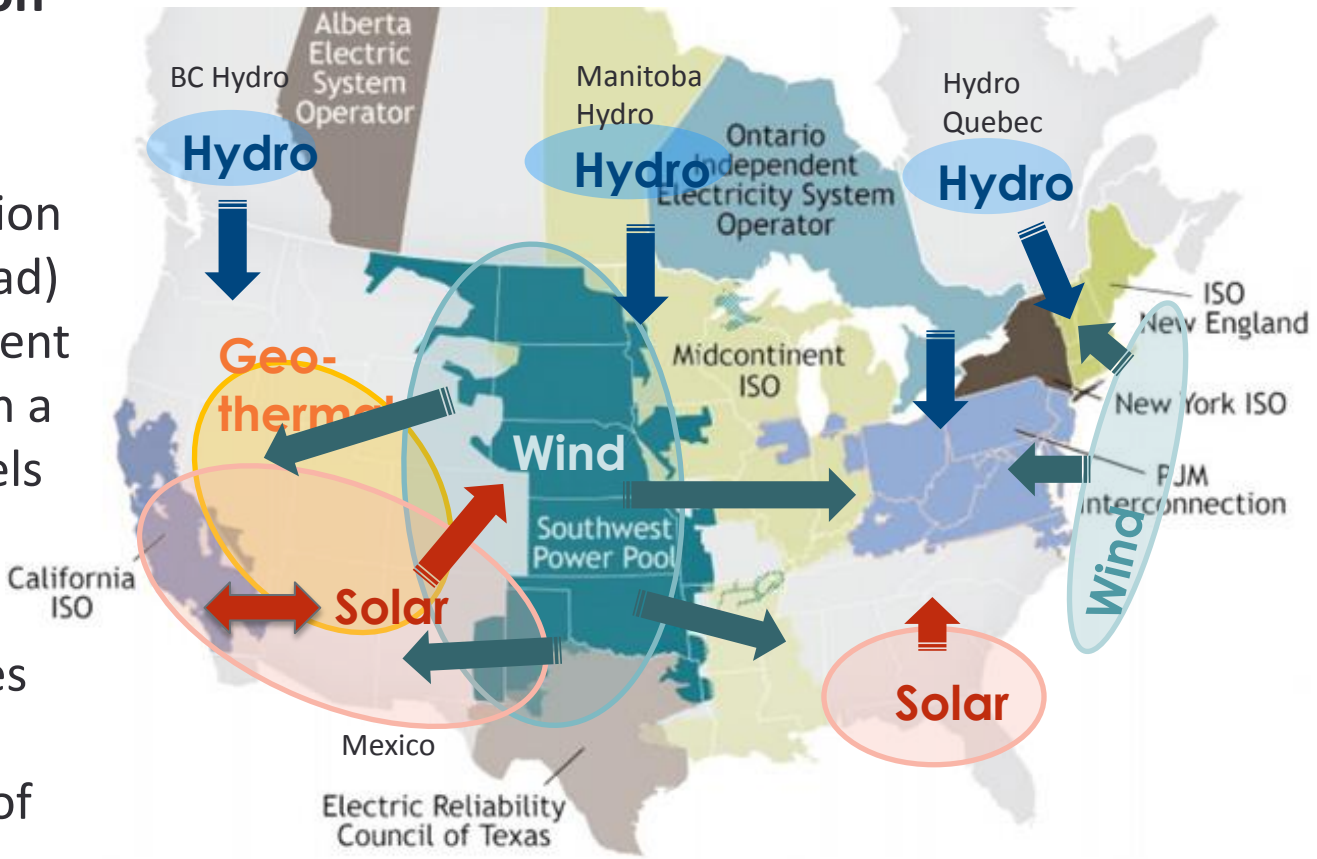
- Net imports of 5,000 MW during the night
- Net exports of 8,000 MW plus ~13,000 MW of curtailments during the day



# Diversifying Low-Cost Renewable Generation

**Thus, focusing on resource diversification can offer significant benefits:**

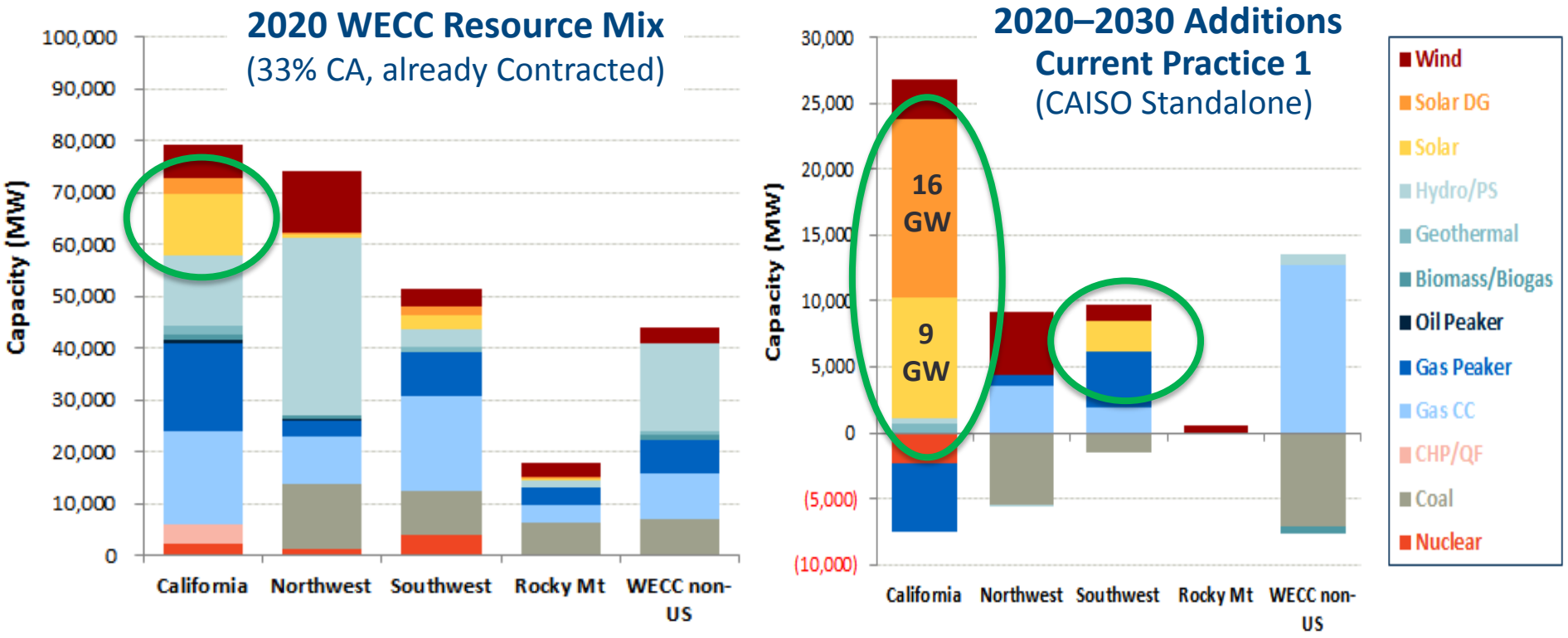
- Regional diversification of resources (and load) reduces the investment and balancing cost in a future with high levels of intermittent resources
- Diversity of resources (and load) also increases the value of transmission that interconnects them



# SB350 Regional Market Study

**The SB350 Study developed plausibly-optimal resource additions to meet California's 50% RPS by 2030 for CAISO-only and Regional-Market cases**

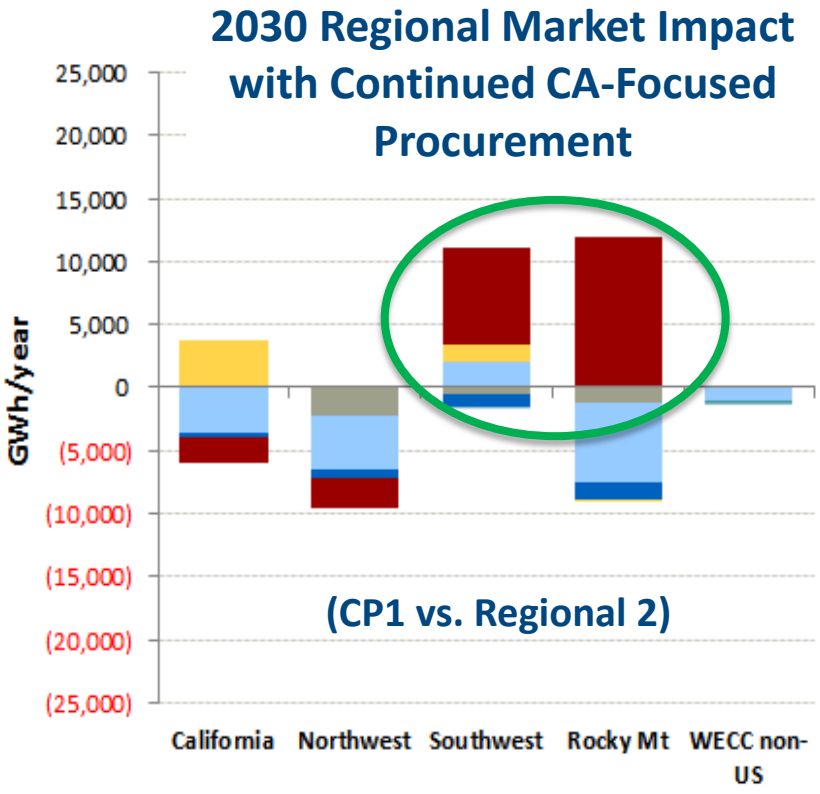
- A significant amount of solar generation will be built in or close to California, unless the rules allow for more out-of-state resources to qualify

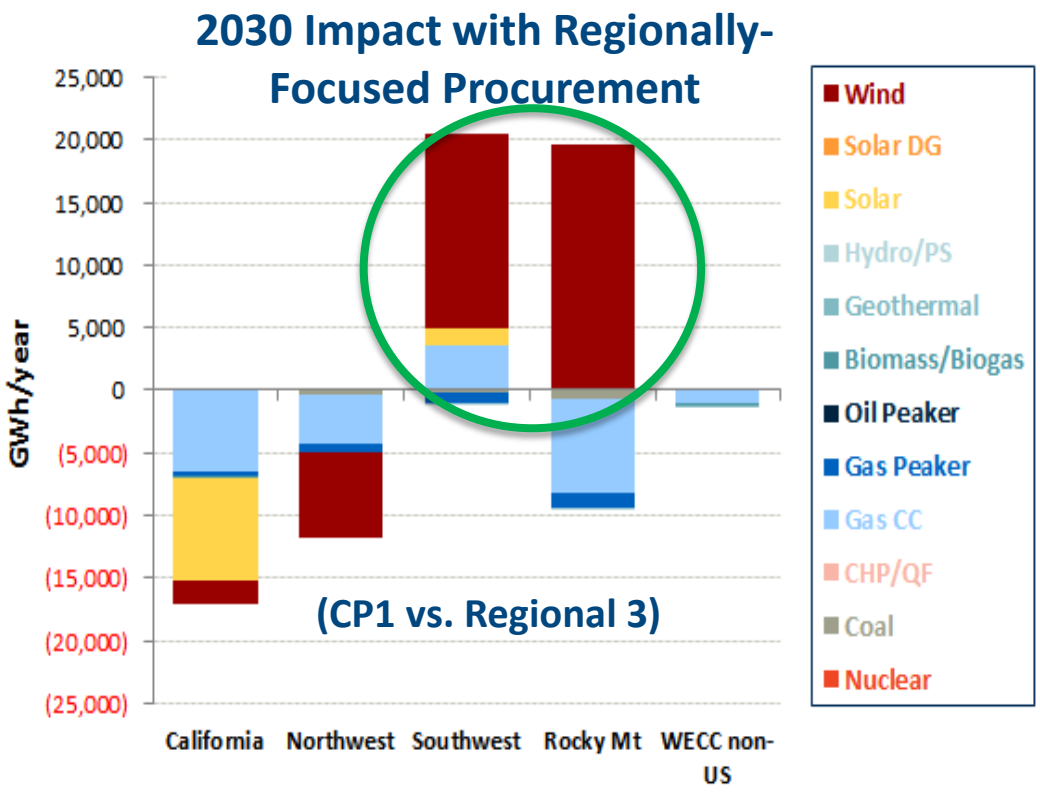


# Regional Market Impact on CA Procurement

**If California joined a sizeable Western Regional Market, the optimal renewable resource procurement could shift to lower-cost generation**

- A Western Regional Market that can integrate low-cost wind in WY and NM will also attract additional investments beyond RPS needs (e.g., 18,000 MW wind additions beyond-RPS in western ERCOT, SPP and MISO in last 5 years)



# Impact on Reliability and Integration of Renewable Energy

**A Regional market will reduce the cost of maintaining system reliability**

- Reduced operating reserves needed to meet reliability requirements
- Better real-time visibility of system conditions in larger regional footprint
- Improved management of unscheduled power flows

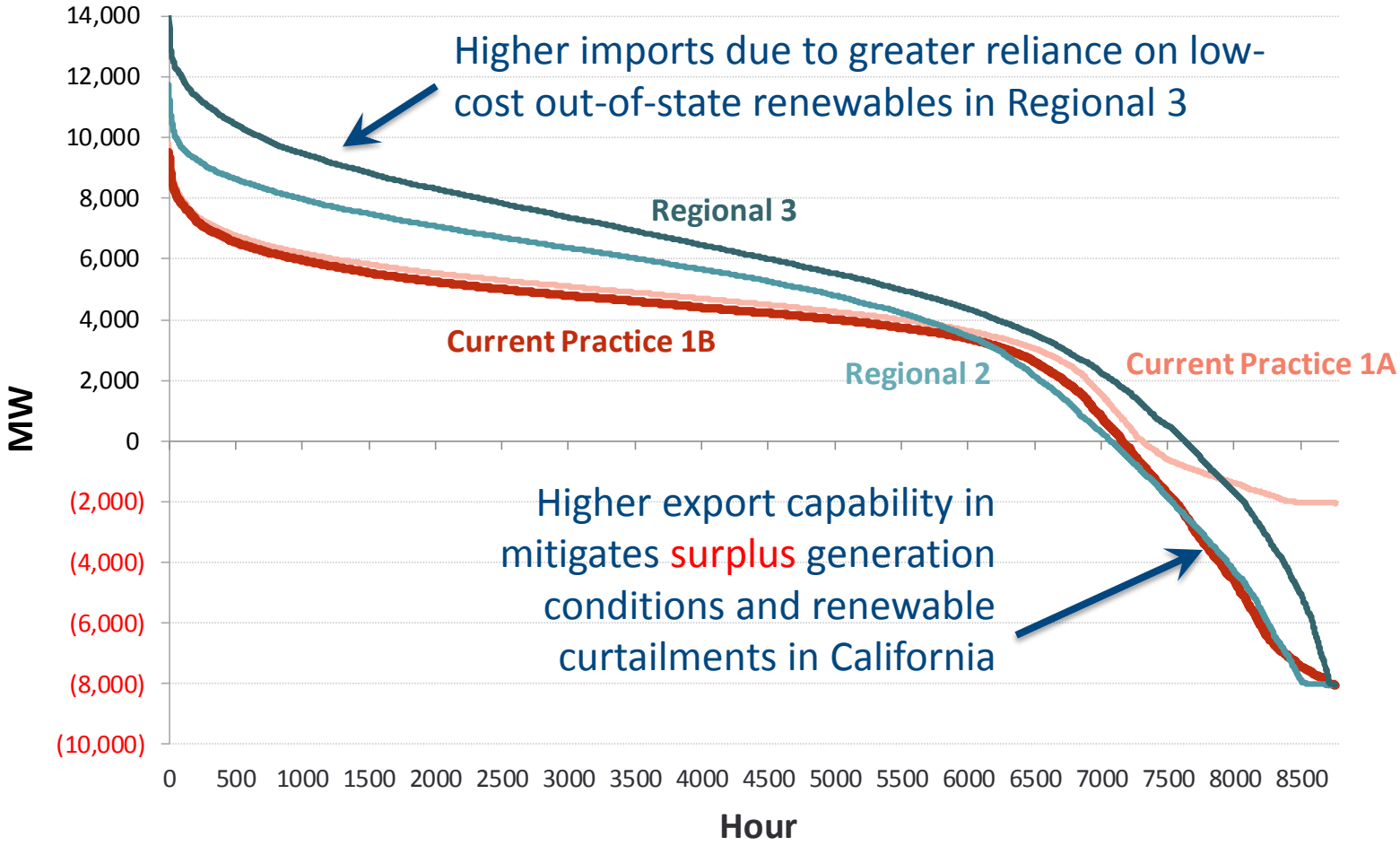
**A regional market also improves integration of renewables**

- Reduces curtailments associated with bilateral trading frictions
- Regional pooling of resources to meet flexibility reserves allows smaller areas with disproportionately high renewable generation to use region's resources to balance the intermittent output
- Improved utilization of the existing grid and better regional transmission planning will lower the transmission-related integration cost

**Regional markets facilitate low-cost renewable generation developments beyond those needed for RPS**

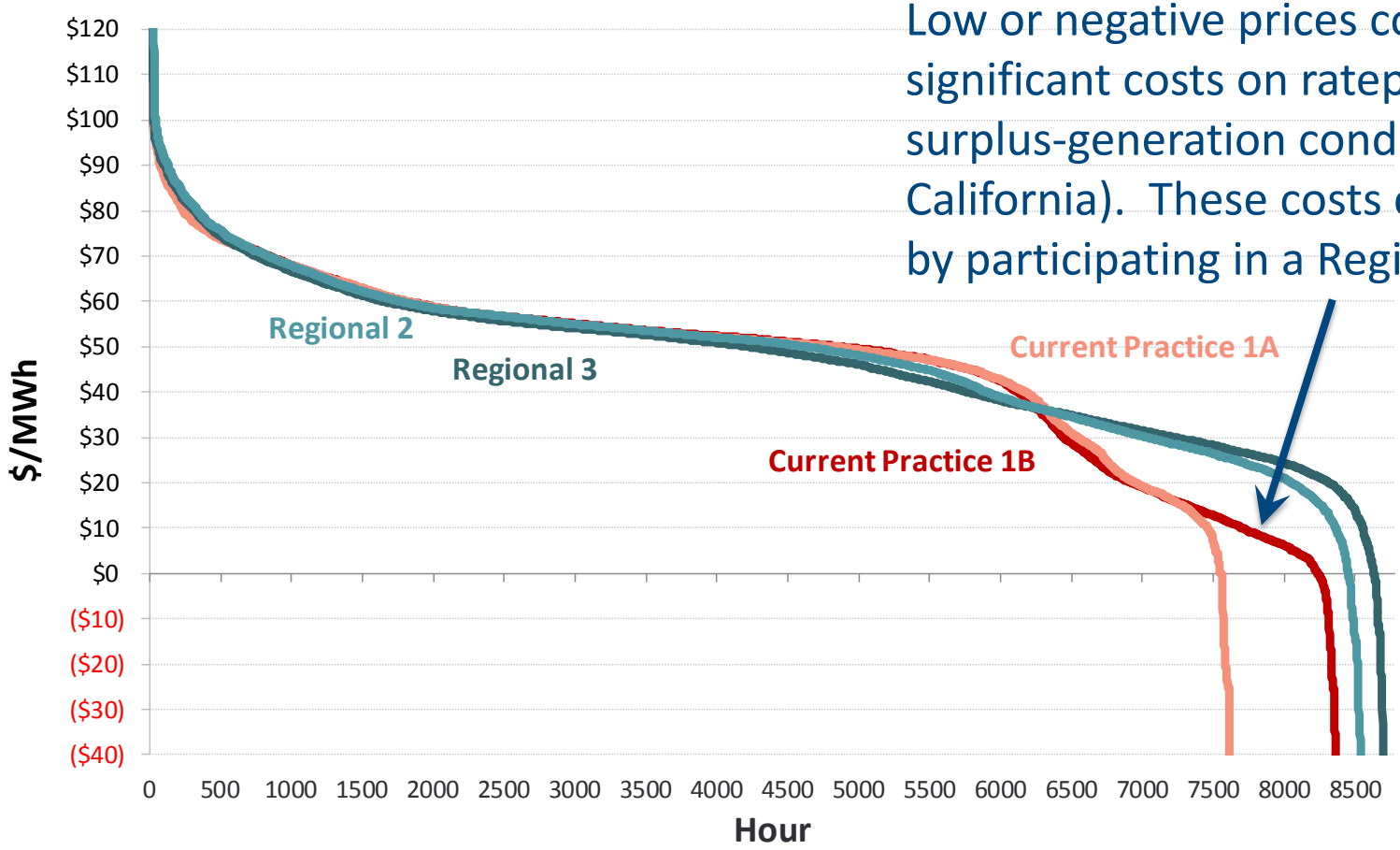
# SB350 Finding: CAISO 2030 Hourly Imports and Exports

**With substantial solar development in the state, California will shift from being a net importer in all hours (even in 2020) to approx. 1,500 hours of net exports reaching 8,000 MW by 2030**



# SB350 Finding: California 2030 Wholesale Energy Prices

**Regional market operations would significantly (1) reduce the number of curtailment hours and (2) increase prices obtained by CA LSEs during surplus generation hours**

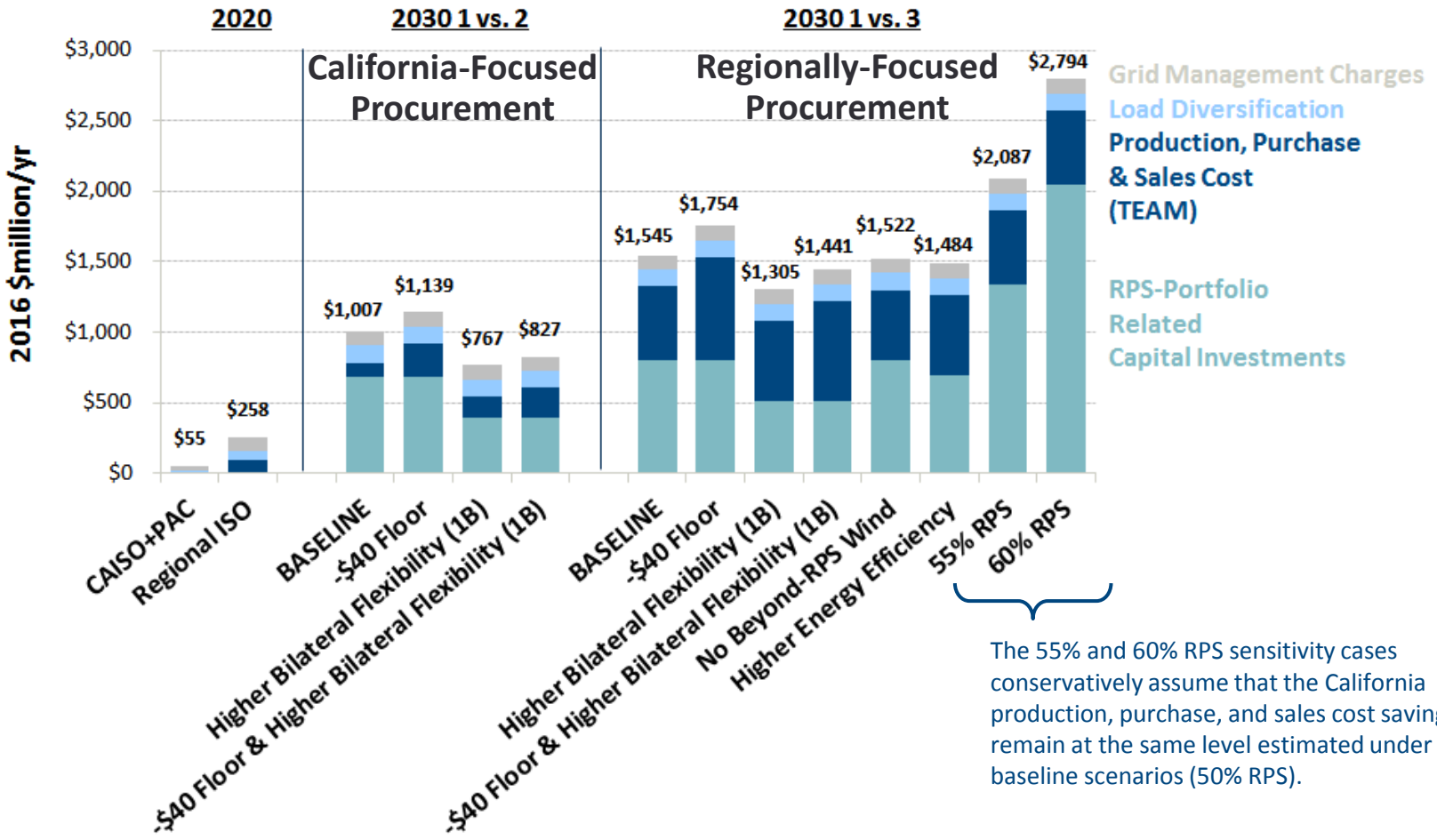



Low or negative prices could impose significant costs on ratepayers (due to surplus-generation conditions in California). These costs can be mitigated by participating in a Regional Market.

Zero or negative prices during curtailment hours

# SB350 Finding: California's Annual Savings from a Regional Market

## Savings increase with (1) higher RPS goals (from 33% → 50% → 60%) and (2) greater reliance on lower-cost out of state procurement




The 55% and 60% RPS sensitivity cases conservatively assume that the California production, purchase, and sales cost savings would remain at the same level estimated under the baseline scenarios (50% RPS).

# Industry Trends Beyond RPS or CPP Mandates

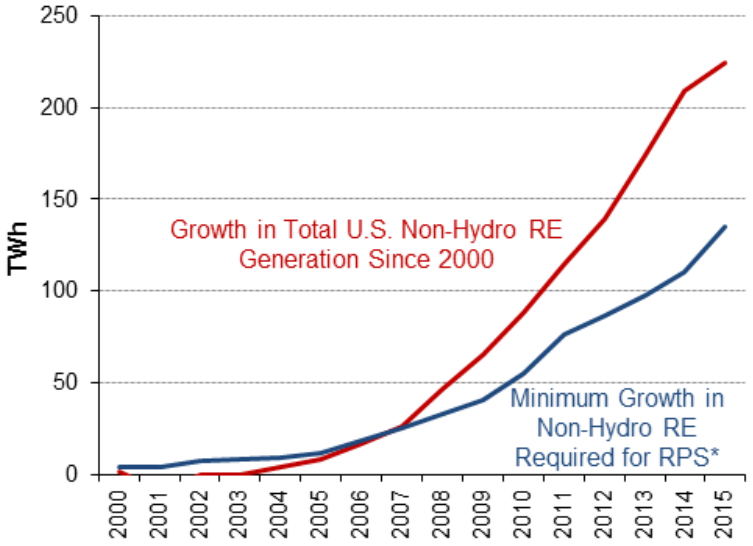
**Planning over the long-term is needed now in light of industry trends:**

- Federal and state policies provide **incentives for renewable** energy resources
- Significant **cost reductions** in solar and wind generation and innovative project financing, yielding PPA prices below $25/MWh for wind generation and below $40/MWh for solar generation
- Low **natural gas prices** place downward pressure on coal and nuclear plants
- Increased stringency in other **environmental regulations** of air emissions, water usage, waste disposal, and land use for all power plants
- **Reduced growth** in electricity consumption
- Increased **customer preferences** for energy conservation and electricity from “green” resources
- Technological advances that allow customers and electric utilities to better monitor and control electricity usage
- Increasing **electrification** of transportation

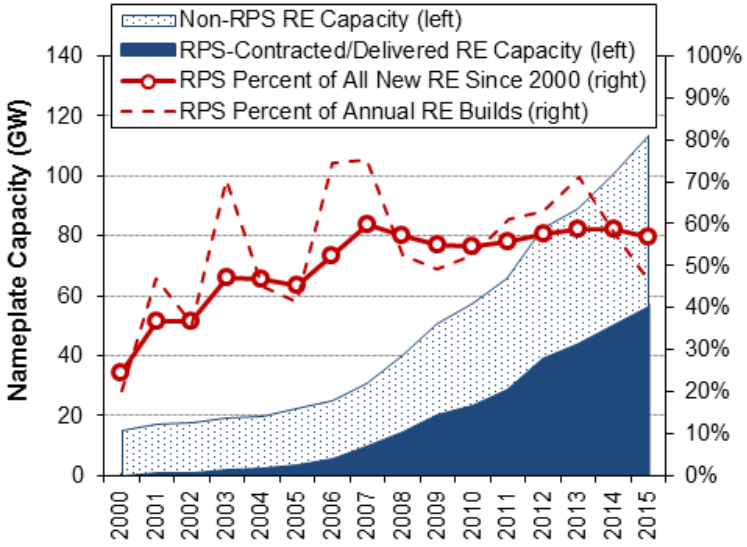
# One Major Trend Around Renewable Additions

- Since 2006, RPS mandates account for only 50–60% of total (non-hydro) renewable generation development
  - Most of the approx. 50,000 MW of additions beyond RPS is wind in low-cost RTO/ISO regions
  - In MISO, SPP, and ERCOT, the incremental RPS demand is only 1,000 MW through 2030, while over 8,000 MW of renewable generation is already permitted or under construction today

RPS requirements comprised 60% of total growth in U.S. renewable electricity generation since 2000




More than half (57%) of all new renewable generation capacity is sold to entities with RPS obligations




*Source: Barbose, Galen. 2016. "U.S. Renewables Portfolio Standards: 2016 Annual Status Report." Lawrence Berkeley National Laboratory. http://rps.lbl.gov*

# ISOs/RTOs Facilitate Renewable Development

## Main factors lead to increased support for renewables in ISO/RTO markets

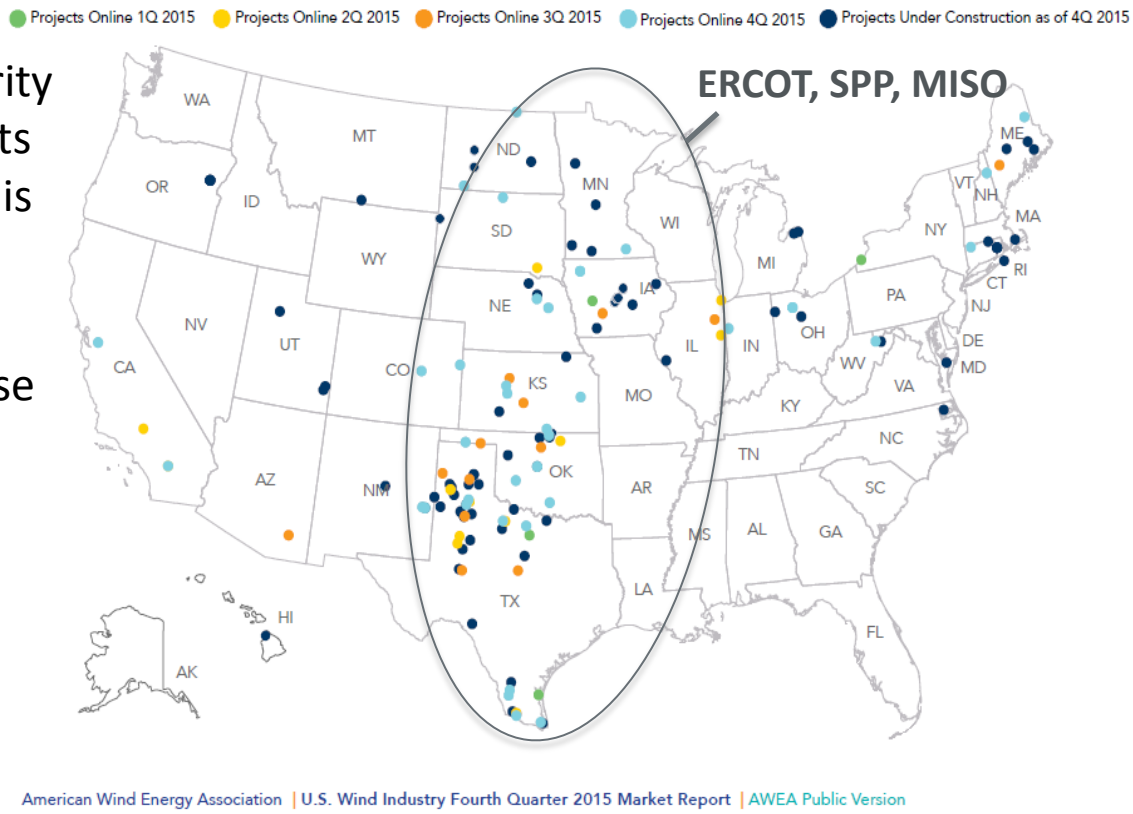
| Factor | Description |
|---|---|
| **Improved Market Designs** | • Increased granularity in time (5-minute) and location (nodal) improves price signals and stimulates efficient transmission and generation investment<br>• Increased granularity increases the ability of prices to reflect avoided cost and improves dispatch of low carbon resources<br>• ISO/RTO markets provide a mechanisms for non-transmission owners (such as most renewables developers) to hedge against congestion |
| **Larger Markets** (regional integration and coordination) | • The larger geographic reach of ISO/RTO markets allows the development of renewable resources in lower-cost locations<br>• Allows a larger set of low-cost resources to provide balancing services for renewables<br>• Large footprints of ISO/RTO markets reduce balancing costs by taking advantage of the diversity of renewables output<br>• Liquidity of RTO spot markets further reduces the cost of addressing wind's variability and uncertainty compared to illiquid markets |
| **Transparency, Open Access, and Fairness** | • Fair, transparent pricing rules give confidence to investors<br>• Markets reduce the potential for conflicts of interest in selecting new transmission projects and allocating the costs of these projects<br>• ISO/RTOs help promote Open Access to transmission, which is particularly important to the largely independent producers who develop renewables |

# 2015 Wind Additions and Construction

**Wind-rich areas with ISO/RTO markets show high market-based renewables development**

- AWEA data shows that the majority of the 2015 additions and projects under construction (shown on this map) was not related to RPS requirements
- The map shows that most of these 2015 additions occurred in areas that offer both
  - Low-cost renewable resources
  - ISO-operated markets (ERCOT, SPP, MISO)
- Little market-based (non-RPS) development in WECC today
  - No ISO/RTO markets in low-cost locations

## 2015 Wind Generation Additions and Projects under Construction




* Source: http://awea.files.cms-plus.com/FileDownloads/pdfs/4Q2015%20AWEA%20Market%20Report%20Public%20Version.pdf

# Transmission Planning: Current Practice

## Western Sub-Regional Planning Groups


**Transmission planning is currently a undertaken by the CAISO and each of the many utilities in the West**

- Sub-regional planning requires coordination of utility planning efforts through four transmission planning groups
  - CAISO, WestConnect (and its three subregions), Northern Tier Transmission Group, and Columbia Grid
- Interregional planning requires coordination across the four regional transmission planning groups
- Coordination is time consuming, imperfect, and focused primarily on reliability-related transmission projects (not as much on economically-driven or public policy projects) even with FERC Order No. 1000
- Challenging cost allocation for valuable interregional transmission projects

Source: http://www.westerngrid.net/western-sub-regional-planning/

# Forward-Looking Transmission Planning To Serve Needs Across WECC

- **Serve growing load:** declining load forecasts, EE and DR, electrification
- **Load diversity:** reduce overall reserve margins and generating capacity needed to ensure resource adequacy
- **Congestion relief/production cost savings:** reduce congestion and increase access to lowest-cost generation to reduce fuel costs and wholesale energy prices
- **Access to low-cost renewables:** access to regions with low-cost wind, solar, geothermal, and hydro resources
- **Renewable energy and fuel diversity:** diversify short and long-term variability of wind, solar, and hydro generation; diversify fuel mix and cost variances within and across uncertain futures
- **Increasingly stringent environmental policies:** increase regional "boundaries" to reduce the cost of environmental compliance in a range of possible futures
- **Aging infrastructure:** replace or upgrade facilities built during major infrastructure expansion in the 60s and 70s

**Just this week, the RETI 2.0 process just produced a report that states that California system will need about $5.8 billion investments to meet its goal the 50% renewable by 2030.**

# Speaker Bio and Contact Information

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**Note:**

**The views expressed in this presentation are strictly those of the presenter and do not necessarily state or reflect the views of *The Brattle Group, Inc*.**

Ms. Judy Chang is an energy economist and policy expert with a background in electrical engineering and 20 years of experience in advising energy companies and project developers with regulatory and financial issues. Ms. Chang has submitted expert testimonies to the U.S. Federal Energy Regulatory Commission, U.S. state and Canadian provincial regulatory authorities on topics related to transmission access, power market designs and associated contract issues. She also has authored numerous reports and articles detailing the economic issues associated with system planning, including comparing the costs and benefits of transmission. In addition, she assists clients in comprehensive organizational strategic planning, asset valuation, finance, and regulatory policies.

Ms. Chang has presented at a variety of industry conferences and has advised international and multilateral agencies on the valuation of renewable energy investments. She holds a BSc. In Electrical Engineering from University of California, Davis, and Masters in Public Policy from Harvard Kennedy School, is a member of the Board of Directors of The Brattle Group, and the founding Director of New England Women in Energy and the Environment.

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Johannes (Hannes) Pfeifenberger is an economist with a background in power engineering and over 20 years of experience in the areas of public utility economics and finance. He has published widely, assisted clients and stakeholder groups in the formulation of business and regulatory strategy, and submitted expert testimony to the U.S. Congress, courts, state and federal regulatory agencies, and in arbitration proceedings.

Hannes has extensive experience in the economic analyses of wholesale power markets and transmission systems. His recent experience includes the benefit of regional markets in the West, capacity markets and resource adequacy designs, testimony in contract disputes, and the analysis of transmission benefits, cost allocation, and rate design. He is advising a wide range of clients, including investor-owned utilities, independent system operators, transmission companies, regulatory agencies, public power companies, and generators across North America.

Hannes received an M.A. in Economics and Finance from Brandeis University and an M.S. in Power Engineering and Energy Economics from the University of Technology in Vienna, Austria.

# SB350 Study – Authors and Contributors


http://www.caiso.com/Documents/SB350Study_AggregatedReport.pdf


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