Western Regional Market Developments: Impact on Renewable Generation Investments and Balancing Costs

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The West is Endowed with Low-Cost Wind & Solar

- Focusing on lowest-cost areas of the WECC can substantially reduce the investment cost of meeting RPS and carbon emissions goals
- Balancing high concentrations of mostly one type of resource (e.g., solar in southern CA or wind in WY) is a significant challenge for the 39 balancing areas in the WECC



Solar PV 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.

Wind Capacity Factors

Diversifying Low-Cost Renewable Generation

Resource diversification in the West offers significant benefits that can be realized

- 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



Regional Market Efforts in WECC



Motivated in large part by renewable balancing needs and cost savings, several regional market initiatives have materialized:

Energy Imbalance Market (EIM):

- CAISO, PAC, NV Energy, and APS (participating);
 PGE, Puget, Idacorp (committed); LADWP, Baha Mexico (announced)
- CAISO+PAC+NVE: \$20-25 million savings per quarter (approx. 25% NVE, 33% CAISO)
- CAISO-PAC Regional Market Initiative: stetting up and studying a full (Day-2) RTO market that could include much of WECC
 - SB350 Study to support CA decision
- Mountain West Transmission Group (MWTG): PSCo, WAPA (CRSP, LAP), Tristate, Black Hills, Basin Platte River, CO Springs studying Day-2 market in CO and WY

Operational Scope: EIM vs. Full Day-2 Market

Real-Time Day-Ahead Unit **Day-Ahead Intra-Day** Market Dispatch Commitment Market Dispatch **Adjustments De-pancaked De-pancaked De-pancaked De-pancaked** transmission & transmission & transmission & transmission & scheduling charges scheduling charges scheduling charges scheduling charges • Full grid utilization **Full grid utilization** Full grid utilization • Full grid utilization **Reduced operating Reduced operating** Reduced operating **Reduced operating** • reserves reserves reserves reserves Regionally Adjusted unit Regionally Regionally commitment and optimized unit optimized unit optimized unit real-time bids commitment dispatch dispatch Avoided bilateral Avoided bilateral **Reduced A/S needs Reduced additional** commitment transaction cost transaction cost • Resolved hurdle uncertainties

Scope of SB350 Regional Day-2 Market Simulations

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

EIM

SB350 Regional Market Study

The SB350 Study developed plausibly-optimal resource additions to meet California's <u>50% RPS</u> 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



2020-2030 Additional Procurement for CA RPS

In a regional market, procurement needs and costs to meet California RPS would be reduced by (1) avoided in-state curtailments; and (2) access to lower-cost resources in the larger region

- Large solar competes with roof-top solar and low-cost wind in WY and NM
- 2020-30 Solar cost: \$1.40/W in base case and \$1.00/W in low-cost sensitivity case
- A regional market that provides access to lowest-cost locations will also attract additional investments beyond RPS needs (e.g., 18,000 MW wind additions beyond-RPS in western ERCOT, SPP, and MISO in just the last five years)

		Regional Market Impact (Base Case)			Regional Market Impact (Low-Solar-Cost Sensitivity)	
	"Current	"Regional 2"	"Regional 3"	"Current	"Regional 2"	"Regional 3"
	Practice 1"	(Continued CA-	(More Regional	Practice 1"	(Continued CA-	(More Regional
	(CA Standalone)	focused Procurement)	Procurement)	(CA Standalone)	focused	Procurement)
CA Utility-Scale Solar	7,600	200	(4,200)	9,700	(200)	(5,700) MW
SW Utility-Scale Solar	1,000	500	500	1,000	500	500 MW
Total California Resources	11,100	(900) (400)	(5,300)	13,200	(1,800)	(7,400) MW
Total Out of State Resources	5,000	(400)	2,100	5,500	200	5,000 10100
Total Renewable Resources	16,700	(1,300)	(3,100)	17,100	(1,600)	(3,600) MW
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Source: E3 RESOLVE simulations in SB350 Study

CAISO's Extreme "Duck Curve" in 2030

- The substantial solar additions create 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



CAISO 2030 Hourly Imports and Exports

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



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



California's Annual Savings from a Regional Market

Savings increase with (1) higher RPS goals (e.g., $33\% \rightarrow 50\% \rightarrow 60\%$) and (2) greater reliance on lower-cost out of state procurement



SB350 Regional Market Study: Overall Findings

The SB350 Study of the impacts of a California joining a regional market found:

- 1. Overall benefits to **California ratepayers**
- 2. Lower emissions of greenhouse gases and other air pollutants
- 3. Creation or retention of **jobs** and other **benefits to the California economy**
- 4. Reduced **Environmental** impacts in California and elsewhere
- 5. Reduced impacts in disadvantaged communities
- 6. Improved Reliability and integration of renewable resources

Analyses were undertaken with substantial stakeholder review and input. Modeling results, including all assumptions and inputs underlying the modeling, have been made available for public review.

http://www.caiso.com/informed/Pages/RegionalEnergyMarket/BenefitsofaRegional EnergyMarket.aspx

Speaker Bio and Contact Information



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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.*

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.

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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.

SB350 Study – Authors and Contributors

Senate Bill 350 Study

The Impacts of a Regional ISO-Operated Power Market on California

Executive Summary

PREPARED FOR

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Energy+Environmental Economics



Aspen Environmental Group http://www.caiso.com/Docum ents/SB350Study Aggregated Report.pdf

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