Market Study for Mountain West Transmission Group

Presented to

Western Area Power Administration Stakeholders

Presented by

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THE Brattle GROUP

Two-Phased Approach

Near-term Analysis

- Analyze changes from today's bilateral market
- Analyze the impact of depancaking the transmission charges
- Analyze the impact of going to a full Day-2 Nodal Market

Longer-term Analysis

- Focus on how changes in the market may affect Mountain West Group and each utility
- Analyze future scenarios for Mountain West in a market situation

Simulation Using Production Cost Model

Day-Ahead Unit Commitment →

- De-pancaked transmission & scheduling charges
- Full grid utilization
- Operating reserves
- Regionally optimized <u>unit commitment</u>
- Reduced additional commitment hurdle

Day-Ahead Market Dispatch →

- De-pancaked transmission & scheduling charges
- Full grid utilization
- Operating reserves
- Regionally optimized <u>unit dispatch</u>
- Avoided bilateral transaction cost

Intra-Day Adjustments →

- De-pancaked transmission & scheduling charges
- Full grid utilization
- Reduced operating reserves

- Adjusted unit commitment and real-time bids
- Avoided bilateral transaction cost

Real-Time Market Dispatch

- De-pancaked transmission & scheduling charges
- Full grid utilization
- Reduced operating reserves

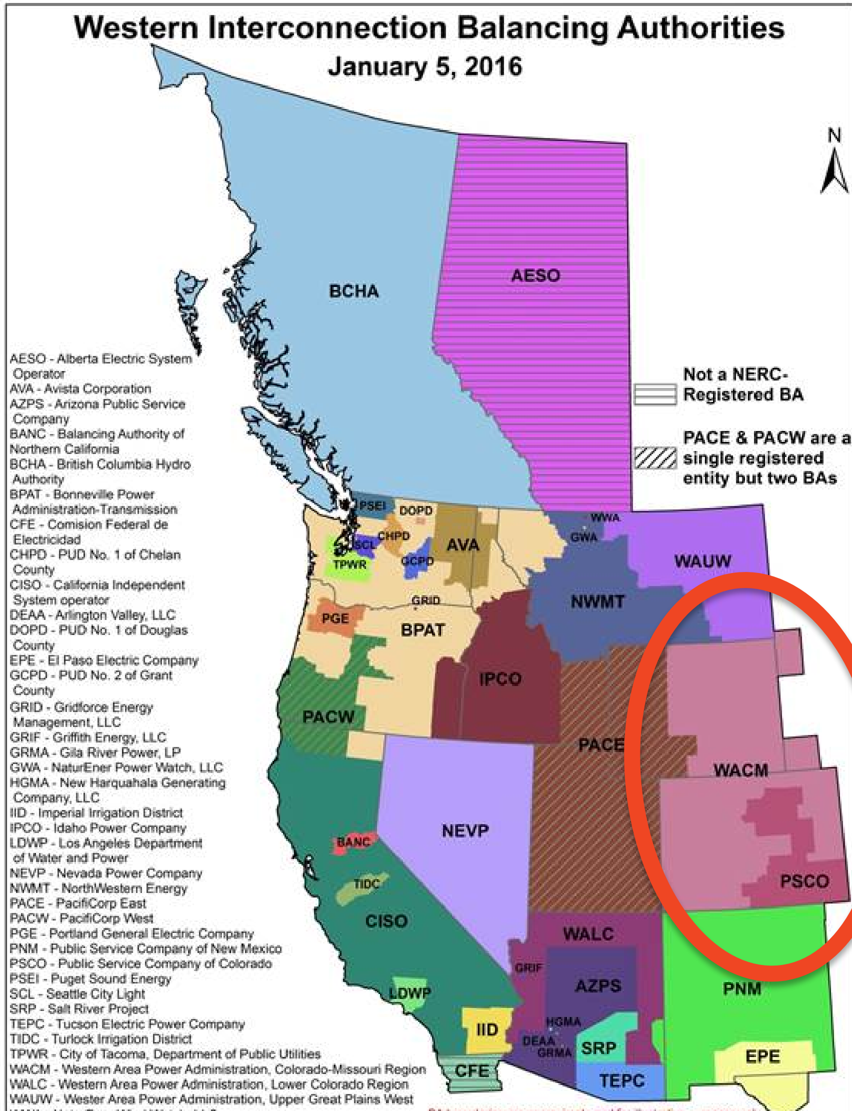
- Regionally optimized unit dispatch
- Reduced A/S needs
- Resolved uncertainties

Scope of Production Cost Simulations
(without forecast errors, renewable uncertainty, real-time outages, etc.)

Steps for Phase I (Near Term Analysis)

1. Define the Mountain West region in detail under current bilateral market
2. Simulate region with bilateral trading
3. Benchmark against prices at major and regional trading hubs
4. Measure the impact of depancaking and going to market
5. Analyze the potential benefits for each utility and Mountain West

Detailed Mountain West Representation



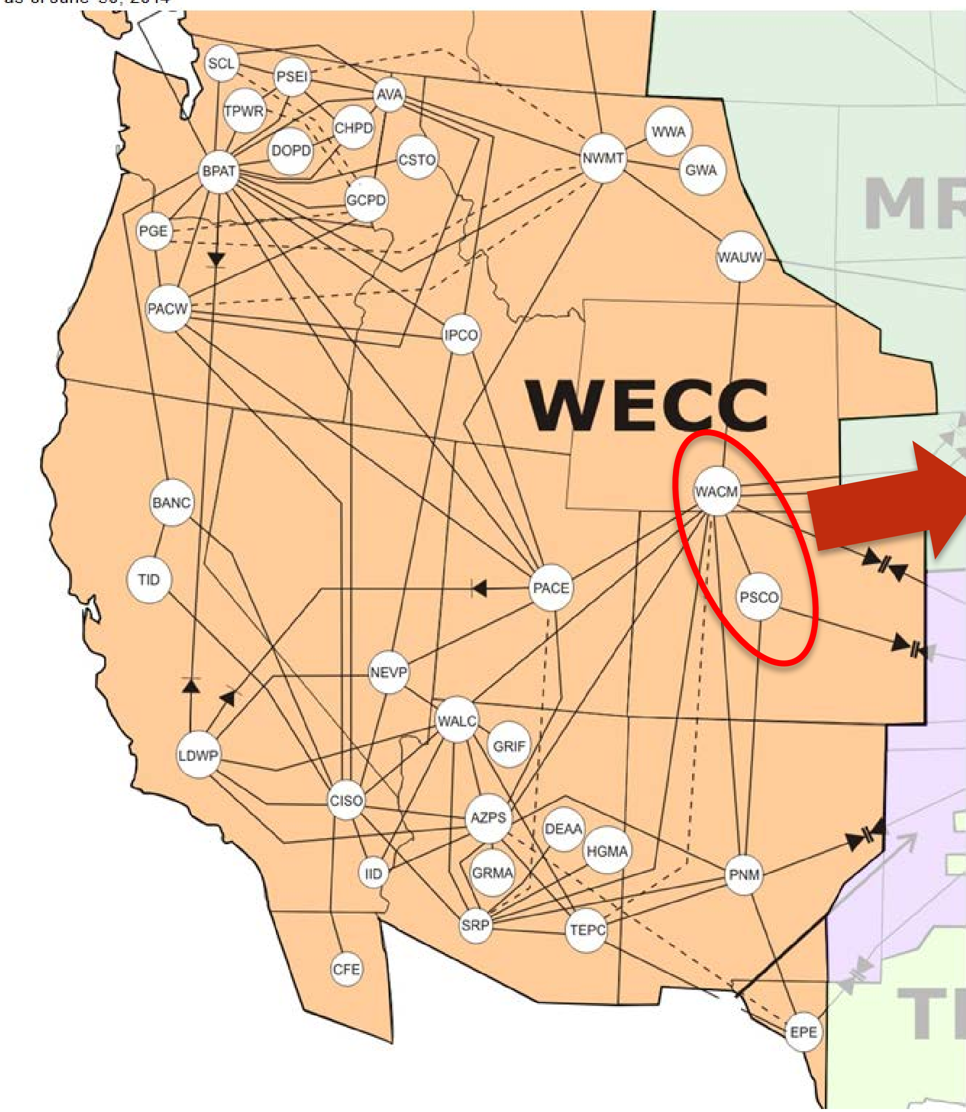
Created utility-level areas from the PSCO & WACM BAs:

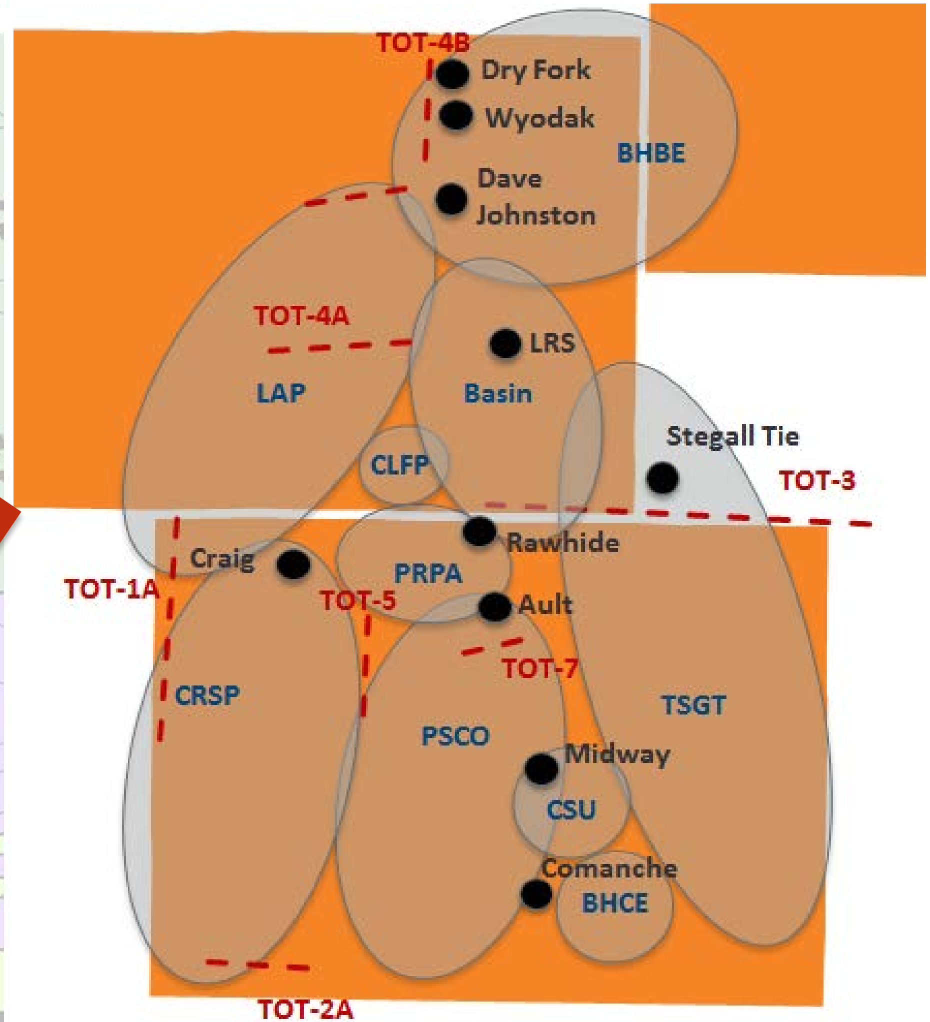
- Created load areas by mapping load buses to utility
- Mapped generation units by ownership and contract
- Identified connections to simulate transfer capabilities across utilities within the Mountain West Group
- Built in bilateral trading capabilities between Mountain West utilities
- Assigned transmission wheeling rates based on OATTs

WECC BAs and Contract Paths / Mountain West

U.S. electricity balancing authorities in the Western Electricity Coordinating Council (WECC) electric reliability region
as of June 30, 2014

eia





Near-Term (2016) Analysis

- **Status quo**
  - Modeled existing transmission charges within Mountain West, applied hurdle rates to simulate bilateral transactions across areas, realistic path ratings
  - Created utility-level areas and physical/contractual links to simulate the pancaked transmission charges
- **Joint Transmission Tariff**
  - No transmission charges between Mountain West utilities
  - Full "interconnectedness" within Mountain West region, increased path ratings
  - Maintain other bilateral trading hurdle rates
- **Regional market**
  - Joint unit commitment and dispatch, joint operating reserves, removes remaining bilateral hurdles within Mountain West footprint, full WECC path ratings
  - Removed must-run requirement
  - Keep the rest of WECC as it is today by maintaining transmission hurdle rates (and unit commitment and dispatch hurdle rates) between balancing areas

Experience from Other Regional Markets

- Most studies of regional market benefits show **production cost savings of 2-8%**
  - After-the-fact studies uniformly show higher benefits than prospective studies
    - SPP: 3.2% from full EIS; 8% from full Day-2 market
    - MISO: 1.4% from Day-1; 4% from full Day-2 market
- In addition to production cost savings, studies show regional markets also **reduce investment costs**, roughly doubling benefits
  - Reduced need for resource adequacy capacity
  - Improved access to lower-cost renewable resources and reduced the investment costs of meeting RPS goals
  - Reduced need for and cost of balancing resources to address variable renewable generation output

Metrics for Near-Term Analysis

Generation Dispatch and Locational Prices at Gen Buses

- Unit hourly generation, bus price, annual cost and emissions statistics

Transmission Flow and Congestion

- Bus prices at key locations and trading hubs
- Flows and congestion costs on Mountain West paths

Mountain West Regional Data

- Hourly load-weighted price for areas
- Hourly flows between other areas

Simplified Cost Impact calculation

- "Adjusted Production Costs" (APC) = variable generation costs, plus cost of net purchases (at load area price), less revenues of off-system sales (at gen-weighted price for area)

Steps for Phase II

1. Qualitatively describe future scenarios to analyze; Prioritize scenarios to analyze
2. Simulate region under “Current Trends” future under current bilateral market versus Day-2 market
3. Simulate a select few future scenarios under Day-2 market
4. Assess the impact of regional policy, resource mix and transmission changes on Mountain West
5. Analyze the potential benefits for Mountain West and each utility

Progress on Analysis

Current status

- Provided Mountain West group the regional results
- Provided individual utilities results
- Completing Phase I results reporting
- Began Phase II definition of future scenarios

Next Steps

- Defining assumptions to simulate a limited number of future scenarios (internally consistent futures, not just sensitivity analyses)
- The scenarios include:
  - Current Trends
  - Carbon Constrained Future
  - High Gas Price
  - Stress Case: High Gas, High Load, Low Hydro Future

Appendix

Limitations of Production Cost Simulations

The production cost simulations are limited in capturing some impacts of regional market operations (which yields a conservative estimate of benefits)

1. Simulated only "normal" weather, hydro, and loads for entire WECC
2. No transmission outages or operational de-rates; no extended generation outages
3. No unusual/challenging market conditions
4. No improved regional optimization of hydro resources (almost identical hydro dispatch in all cases)
5. Assumed perfectly competitive bidding behavior (does not capture competitive benefits)
6. Did not simulate benefit of regional market operations in addressing uncertainties in real-time load and renewable generation
7. Many contracts (such as coal and intertie contracts) are not explicitly modeled
8. Used only "generic" TEPPC and plant and fuel cost assumptions for rest of WECC, which understate the true variance in plant efficiencies and fuel costs
9. Assumed all BAs in WECC already utilize an ISO-like optimized security-constrained economic unit commitment and dispatch even today
10. Derated transmission paths in rest of WECC (by 10%), but did not simulate scheduling constraints that limit transmission availability below actual physical constraints
11. Other than for hurdle rates and reduced path ratings, simulations do not capture inefficiency of bilateral trading blocks (25 MW 6x16 HLH vs. LLH), contract path scheduling, and unscheduled flows

Transmission Costs and Interties Between Areas

Case	Wheeling Rate	Combined Administrative, Trading, and Commitment Hurdle	Area Connections
Status Quo	**Source Outside Mountain West**: Off-peak export hurdle rate. **Source Inside Mountain West**: Average of on- and off-peak export hurdle rates	**Source Outside Mountain West**: $6/MWh commitment adder, $2/MWh dispatch adder **Source Inside Mountain West**: $8/MWh commitment adder, $4/MWh dispatch adder	Base case assumptions provided by Mountain West constituent areas
Joint Tariff	**Source Outside Mountain West**: Same as Status Quo **Export From Mountain West**: Average of each area's on- and off-peak export hurdle rates, weighted by the area's ATRR **Intra-Mountain West Connections:** No hurdle	**Source Outside Mountain West**: Same as Status Quo **Export From Mountain West**: $8/MWh commitment adder, $4/MWh dispatch adder **Intra-Mountain West Connections:** $7/MWh commitment adder, $3/MWh dispatch adder	• Unlimited connections added between all areas within Mountain West • Any external area which connected to at least one area in Status Quo now connects to all constituent areas • All de-hurdled external connections maintained
Regional Market	Same as Joint Tariff	**Source Outside Mountain West**: Same as Status Quo **Export From Mountain West**: Same as Joint Tariff **Intra-Mountain West Connections:** No adders	Same as Joint Tariff

Existing Transmission Contracts

Existing transmission contracts modeled as wheeling-free trading connections

- Mountain West Group provided information on long-term transmission contracts
- Certain trading relationships defined in the model based on this information
  - These relationships have no wheeling fees
- Conversations with each entity to confirmed these arrangements

To simulate depancaked transmission, intra-Mountain West trading is simulated without transmission wheeling charges

The contract path "layer" is separate from the physical capability of system:

- Independently of transmission contracts and bilateral schedules, the model monitors actual physical power resulting from generation dispatch and enforces physical transmission limits (path ratings)

Review of Assumptions for Each Case

Case	Transmission Fees	Wheeling Rates	Path Limits	Must Run	Reserves
Status Quo	Trading margin, administrative fee, commitment and dispatch adders	Individual areas assess individual rates	Path limits restricted based on conversation with the group.	Several large units set as Must Run to mimic reported operation levels	Individual requirements assessed on individual areas
Joint Tariff	Remove $1/MWh administrative fee within Mountain West	No wheeling rates within Mountain West, individual rates averaged by ATRR for external hurdle	Path limits increased, but below WECC limits	Must Run status maintained to replicate existing bilateral market	Same as Status Quo
Regional Market	No fees within Mountain West	Same as Joint Tariff	Path limits increased to WECC limits	No must run units in the Mountain West	Reserves are pooled across Mountain West and provided by the most economic units

Summary of Benefits Estimated in Other Studies

Type of Benefit		Estimated Savings as % of Total Production Costs
Savings Captured by Real-Time Energy Imbalance Markets (similar to EIM)	[1]	0.1% – 1%
Other Production Cost Savings Estimated by Prospective Studies	[2]	0.9% – 2%
Total Production Cost Savings Estimated by Prospective Studies	**[3]**	**1% – 3%**
Plant Efficiency and Availability Improvement	[4]	2% – 3%
Additional Real-Time Savings (Considering Daily Uncertainties)	[5]	1% – 2%
Additional Operational Savings with High Renewables (experience to date)	[6]	0.1% – 1%
Additional Production Cost Savings Estimated by Some Studies	**[7]**	**3.1% – 6%**
Load Diversity Benefits (Generation Investment Cost Savings)	[8]	1% – 1.4%
Renewable Capacity Cost Savings (experience to date)	[9]	1% – 4%
Total Investment Cost Savings (Expressed as Equivalent to % of Production Costs)	**[10]**	**2% – 5.4%**
Total Savings as Share of Total Production Costs	**[11]**	**6% – 13%**

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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, the founding Director of New England Women in Energy and the Environment, and former director of the Massachusetts Clean Energy Center.

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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 reviews of RTO capacity market and resource adequacy designs, testimony in contract disputes, and the analysis of transmission benefits, cost allocation, and rate design. He has performed market assessments, market design reviews, asset valuations, and cost-benefit studies for 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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Mr. John Tsoukalis is an Associate at The Brattle Group with experience across a board range of issues in electric utility economics. These include electric utility strategic planning, market participant's bidding behaviors across electricity markets, and electric transmission development. He has assisted electric utility clients in developing their strategic plans for participation in wholesale markets and in confronting regulatory uncertainty. John is engaged with utility clients to determine their regulatory exposure due to bidding practices in the wholesale electricity markets. He has helped develop tests to detect the presence of uneconomic behavior and to assess the potential price distortion caused by this behavior. He is assisting several clients in defending against investigations or enforcement actions for allegedly manipulative behavior. He has supported the development of testimony to assist regulatory agencies with their design of appropriate tariff provisions to properly allow for adequate cost recovery while identifying and mitigating potentially manipulative behavior.

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We combine in-depth industry experience and rigorous analyses to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

Our services to the electric power industry include:

- Climate Change Policy and Planning
- Cost of Capital
- Demand Forecasting Methodology
- Demand Response and Energy Efficiency
- Electricity Market Modeling
- Energy Asset Valuation
- Energy Contract Litigation
- Environmental Compliance
- Fuel and Power Procurement
- Incentive Regulation
- Rate Design and Cost Allocation
- Regulatory Strategy and Litigation Support
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