

Solving the Wind Integration Puzzle

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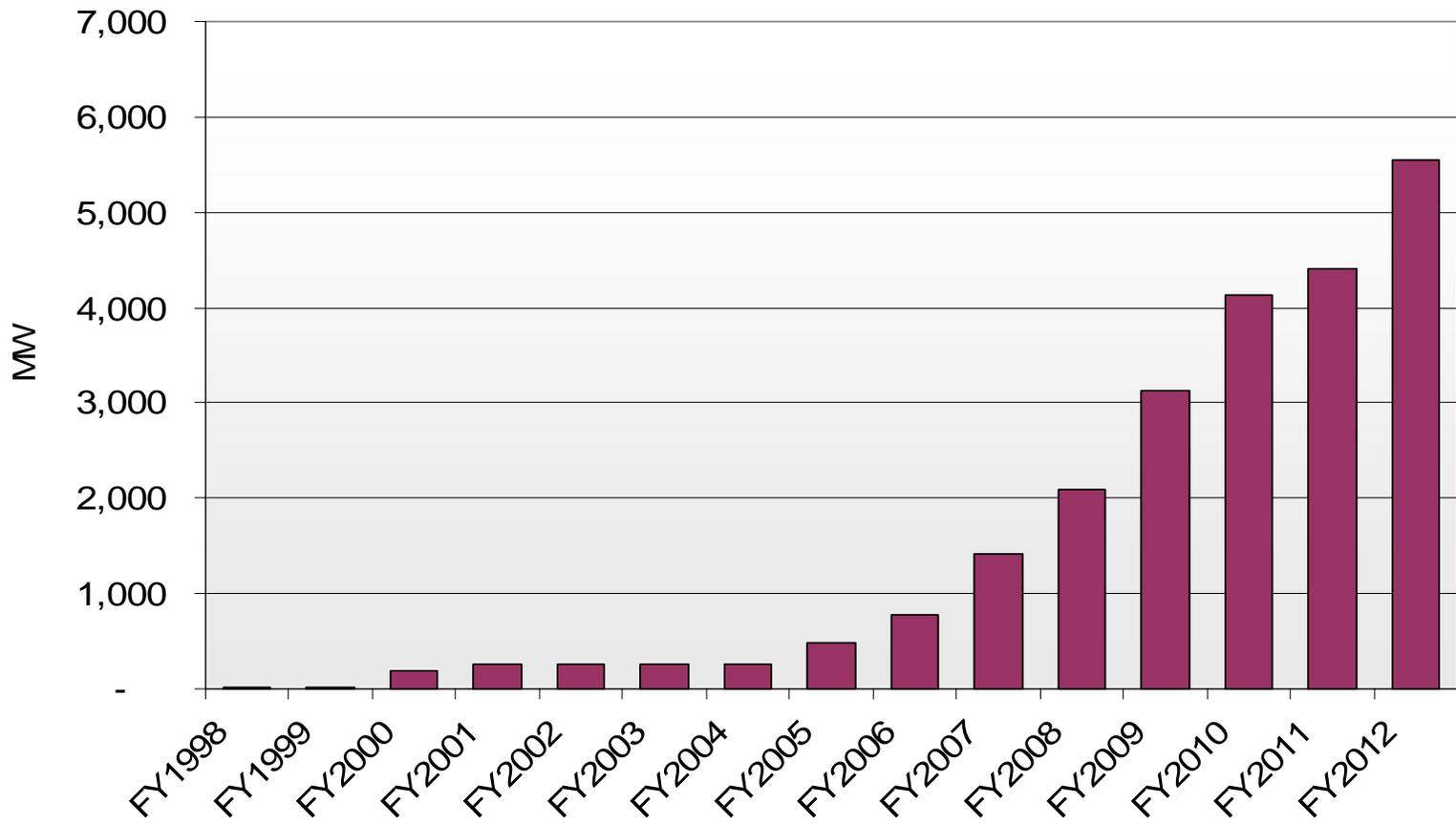
January 2010



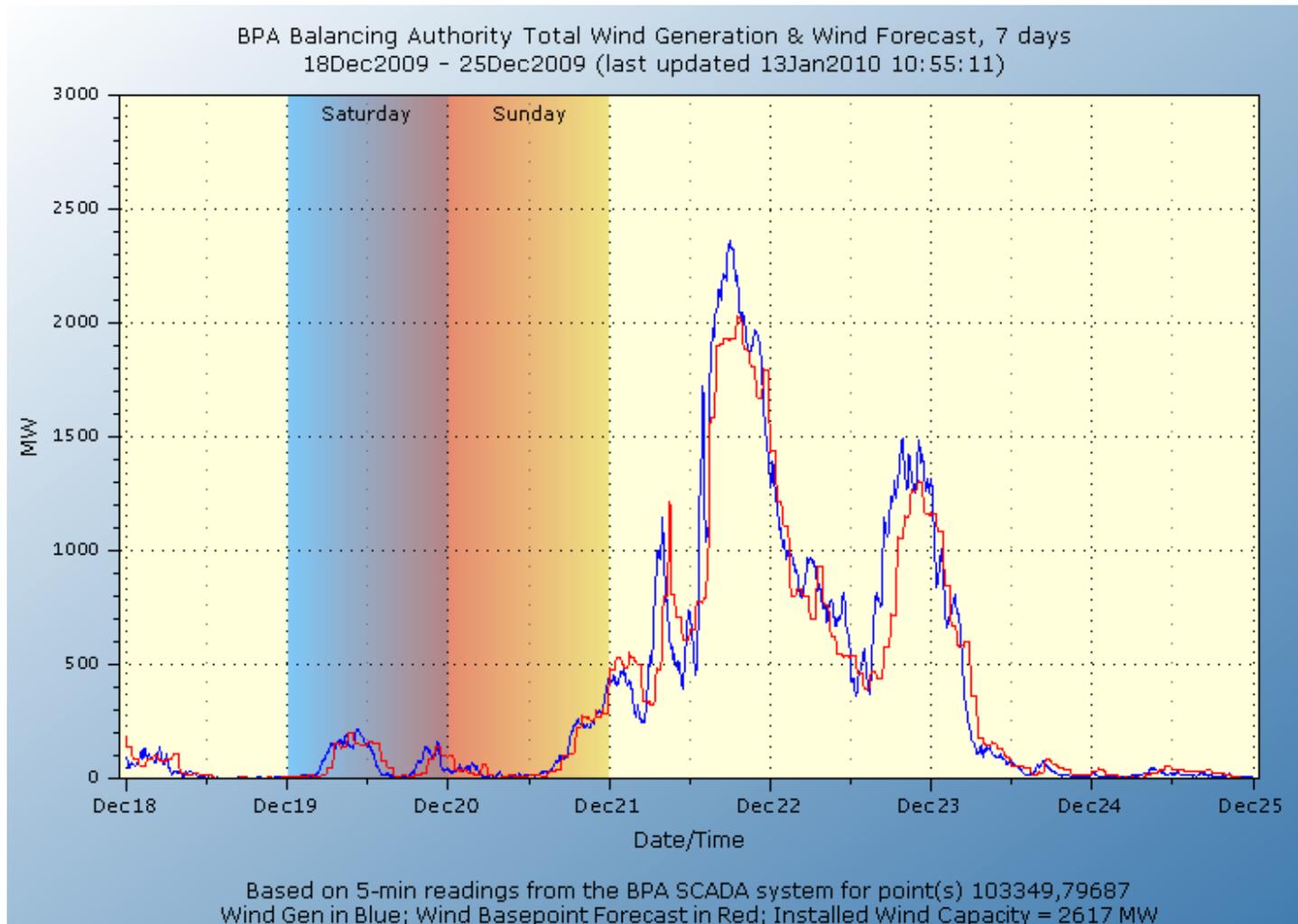
Overview of BPA's Short-Term Wind Strategy



Wind Generation Capacity Connected to BPA's Transmission System is Growing

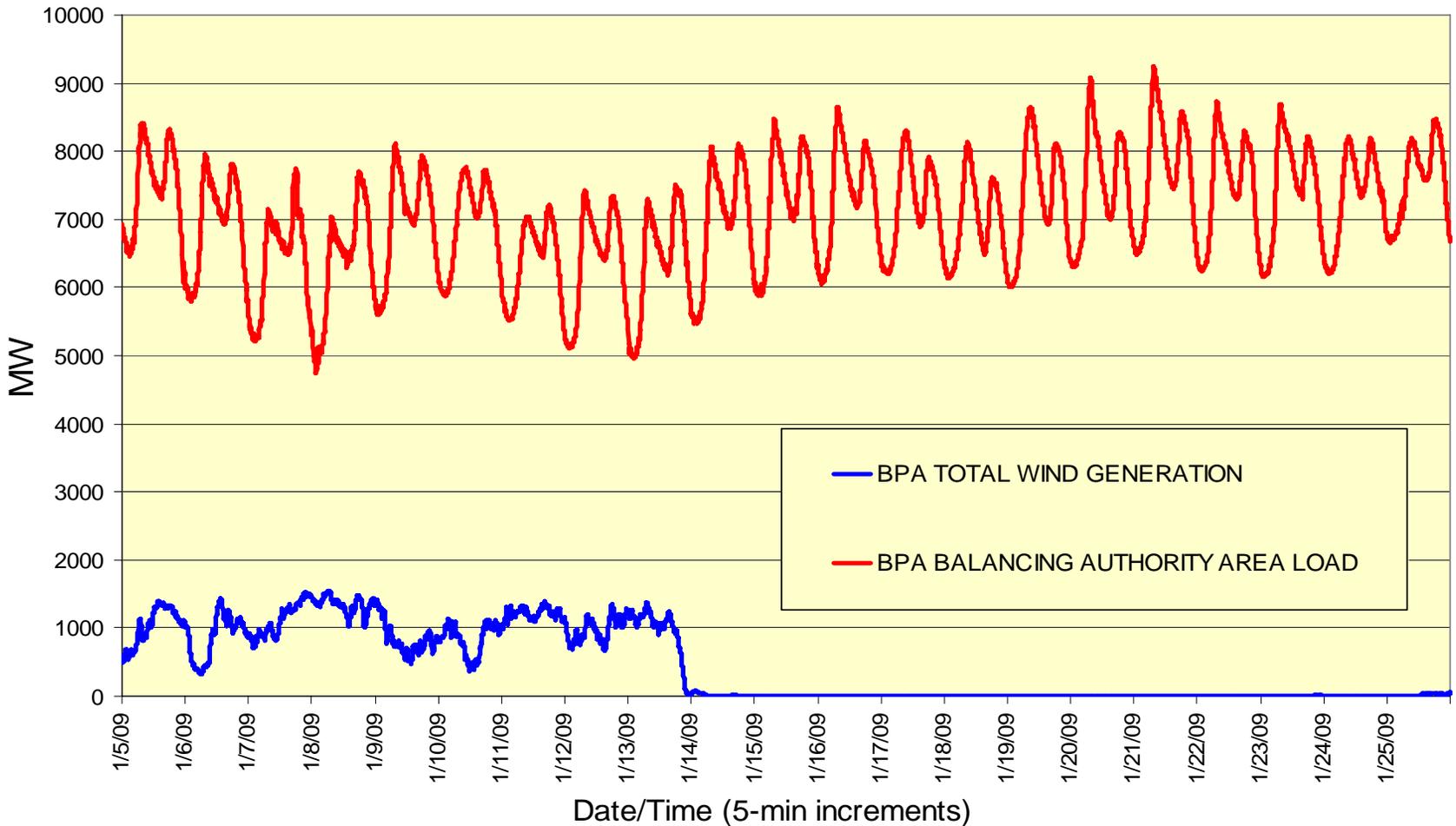


Wind Generation is Variable and Requires Other Generation Resources to Maintain Reliability



Wind Energy has Very Limited Capacity Value

BPA Balancing Authority Area Load & Total Wind Generation
Jan. 5-25, 2009



BPA's Wind Integration Strategy

BPA is committed to finding innovative solutions to meet the renewable resource objectives of the Pacific Northwest by reliably and cost-effectively extending the integration capability of the BPA Balancing Authority while honoring our statutory obligations to our preference customers and the operational limitations on the Federal hydroelectric system.

How, specifically are we planning to accomplish this?



- I. Plan & Build Transmission**
- II. Maintain Reliability**
- III. Explore Adding New Capacity**
- IV. Build Partnerships**

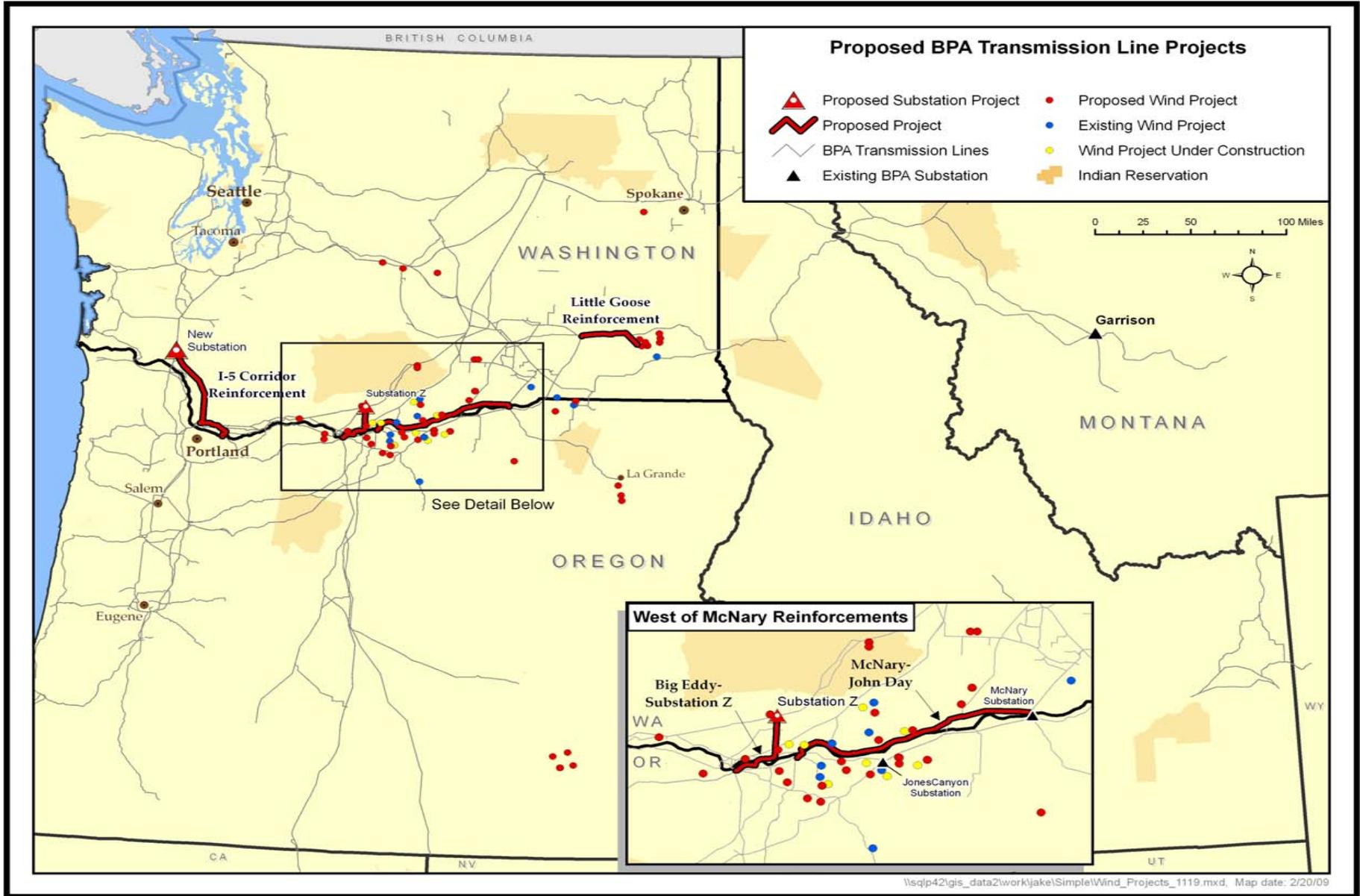
I. PLAN & BUILD TRANSMISSION

Build the BPA Transmission System to Integrate Additional Wind Generation

- Conduct Network Open Seasons to obtain customer commitments for transmission service
- Evaluate participation in other regional transmission plans to increase access to WY, ID, and MT
- Promote a more geographically diversified wind fleet



Three New Proposed Transmission Lines To Integrate 1,800 MW of New Wind Power Resources



I. PLAN & BUILD TRANSMISSION

Recover & Allocate Costs

- To date, BPA has spent \$126 million on infrastructure to integrate wind
 - 6 line taps, 5 new substations and 23 interconnection facilities
- The BPA Wind Integration Rate
 - charges wind generators for the balancing costs incurred
 - sends a price signal to encourage more efficient use
- BPA currently provides balancing service for all wind in its balancing authority area, but 80% of the wind generation is exported out of the area

II. MAINTAIN RELIABILITY

Provide Incentives to Encourage Efficient Use of System Operations



- Established new reliability protocols to require wind generators to:
 - adjust their schedules down to actual output if they substantially **under-generate** relative to schedule
 - reduce output if they substantially **over-generate** relative to their schedule

II. MAINTAIN RELIABILITY

Situational Awareness

- Installed 14 wind measurement sites
- Develop a wind forecasting system by Mar. 2010
- Add a BPA “Wind Desk” to support dispatchers in the efficient use of wind, hydro and other generation



Accurate Forecasts and Situational Awareness are Key

II. MAINTAIN RELIABILITY

Speed Things Up!

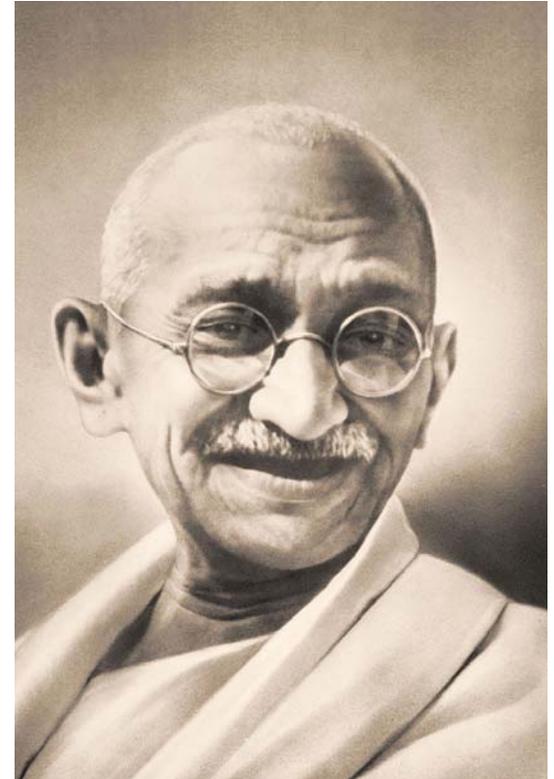


- Create **sub-hourly** transmission scheduling protocols to allow power schedule changes to better match within-hour variations in wind generation
- Pilot now underway allows wind operators to sell power when wind output quickly increases

II. MAINTAIN RELIABILITY

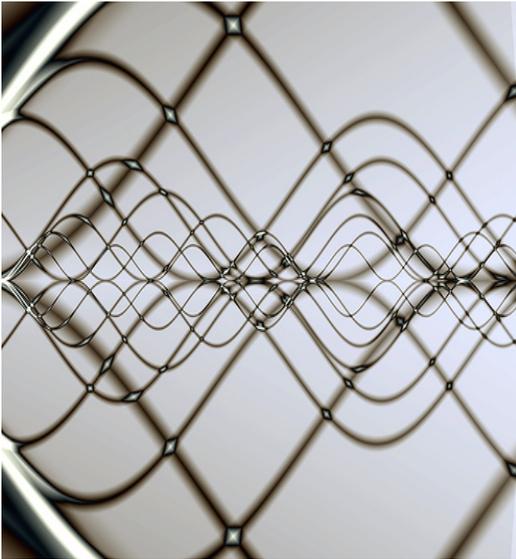
Enable Self-Sufficiency

- Permit customers to self-supply wind balancing service by Oct. 2010
 - Allow wind generators to purchase balancing capacity from suppliers other than BPA
- Requires new business policies, system upgrades and operational protocols
- Will create a third-party market for balancing services



II. MAINTAIN RELIABILITY

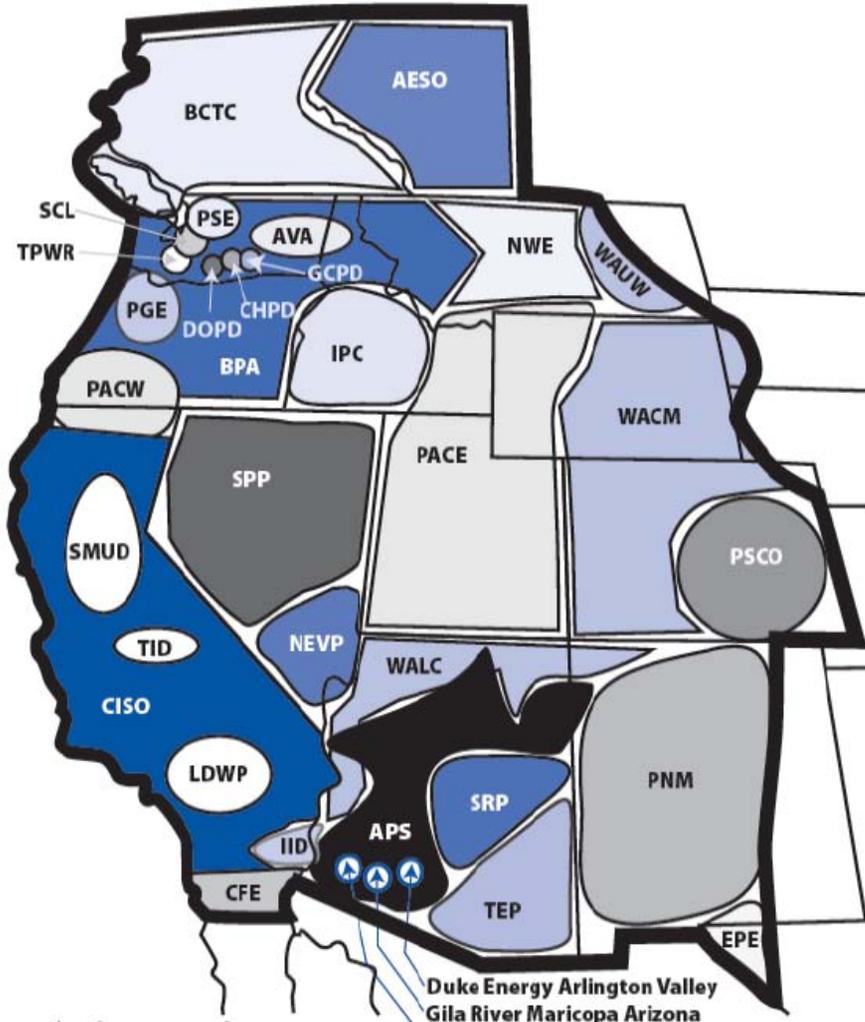
Become More Dynamic



- Study and Increase **Dynamic Transfer Capability**
 - Allows wind generators physically located on BPA's system to be remotely balanced by other utilities using electronic signals
- Evaluate the impacts on transmission capacity and reliability, including voltage stability

II. MAINTAIN RELIABILITY

Virtual Balancing Authority Consolidation



- The 17 discrete balancing authorities in NW Power Pool are inefficient:
 - 17 individual requirements to maintain a constant balance between load and generation
 - 17 system operators
- This balkanization is a major challenge for the NW

III. EXPLORE ADDING NEW CAPACITY

Energy Storage

- Explore the costs and benefits of using storage technologies to add capacity to the system



- Pumped Storage
- Compressed Air Storage
- Distributed Batteries
- Flywheels
- Sec. of Energy Steven Chu is interested in adding pumped storage to the NW

III. EXPLORE ADDING NEW CAPACITY

Smart Grid

- PNW Smart Grid Demonstration Project
 - Validation of new smart grid technologies
- A smarter grid could allow for balancing services to be procured on a real-time, distributed basis



IV. BUILD PARTNERSHIPS



National Renewable Energy Laboratory



US Army Corps of Engineers®

NERC

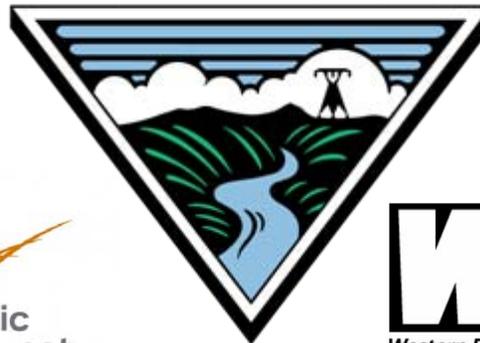
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AMERICAN WIND ENERGY ASSOCIATION



BONNEVILLE POWER ADMINISTRATION



Moving Geelong and the South West to the Future



Western Electricity Coordinating Council

Battelle

The Business of Innovation



B O N N E V I L L E P O W E R A D M I N I S T R A T I O N

