Wind Energy Development in the Pacific Northwest

Checking Facts, Connecting Dots

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Presentation Objectives

1. Review the fundamentals concerning our current wind fleet and the regulatory demand for renewables by 2020.
2. Explain the three interrelated challenges of balancing, oversupply, and flexibility adequacy in the context of the region's broader load/resource balance.
3. Review the multiple regional activities that address these challenges and for which additional solutions may be available over time.
4. Consider the role of additional transmission in the solution set.

Rapid Growth of Wind Generation

State Renewable Standards

Montana

- 5% for 2008 - 2009
- 10% for 2010 – 2014
- 15% for 2015 and beyond

Washington

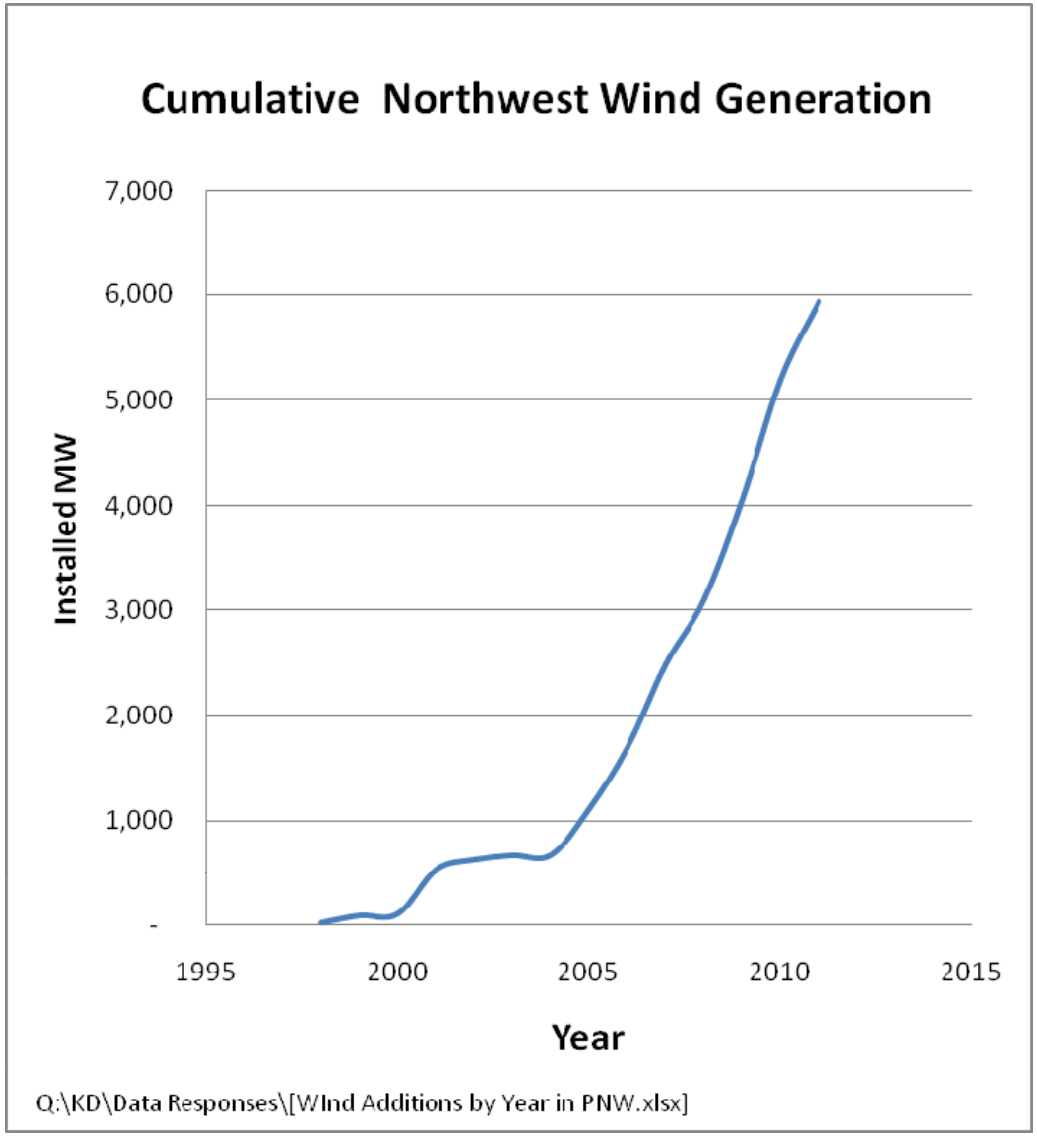
- 3% by 2012
- 9% by 2016
- 15% for 2020 and beyond

Oregon

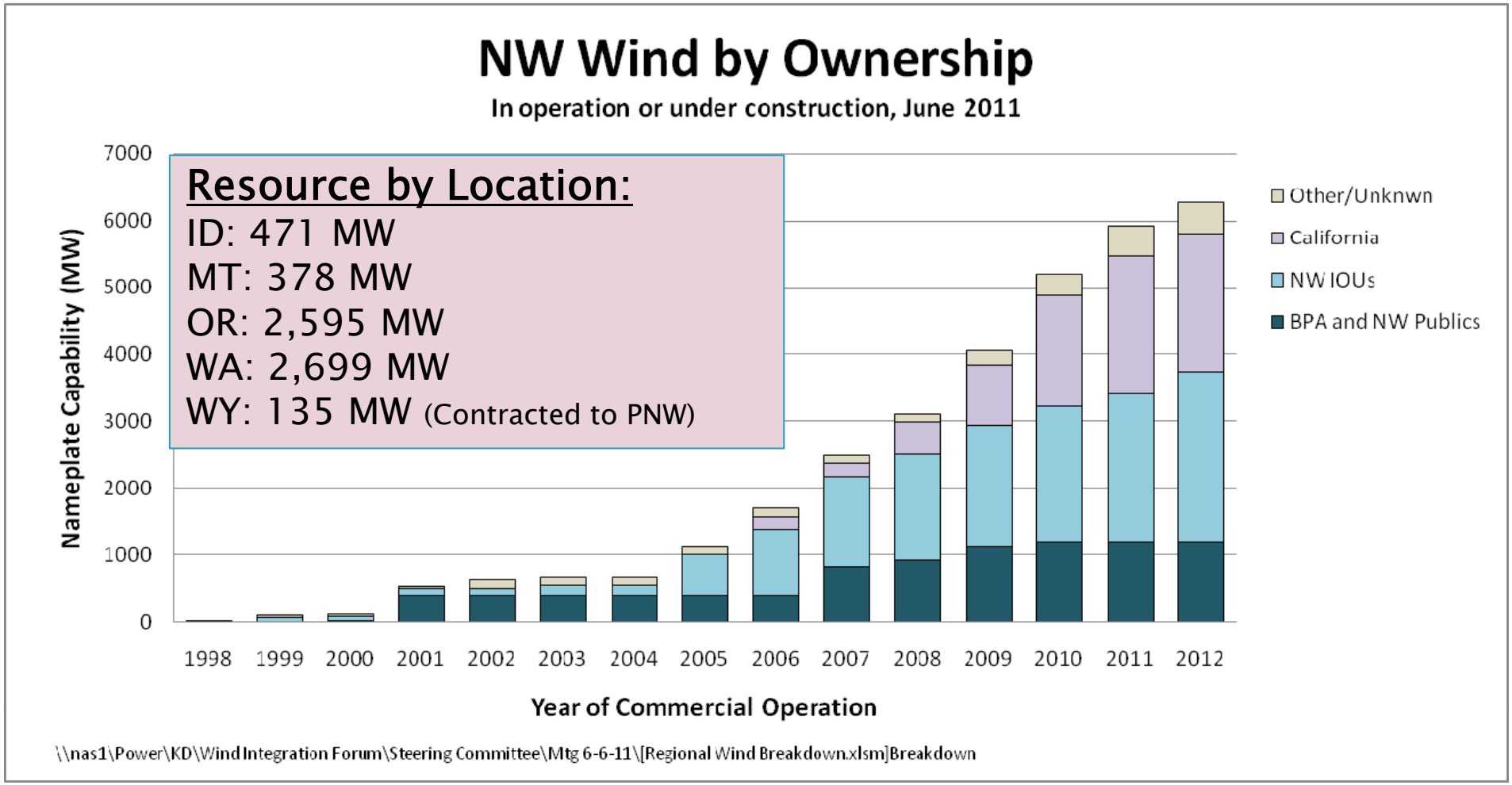
- 5% by 2011
- 15% by 2015
- 20% by 2020
- 25% for 2025 and beyond

California

- 20% by 2013
- 25% by 2016
- 33% by 2020

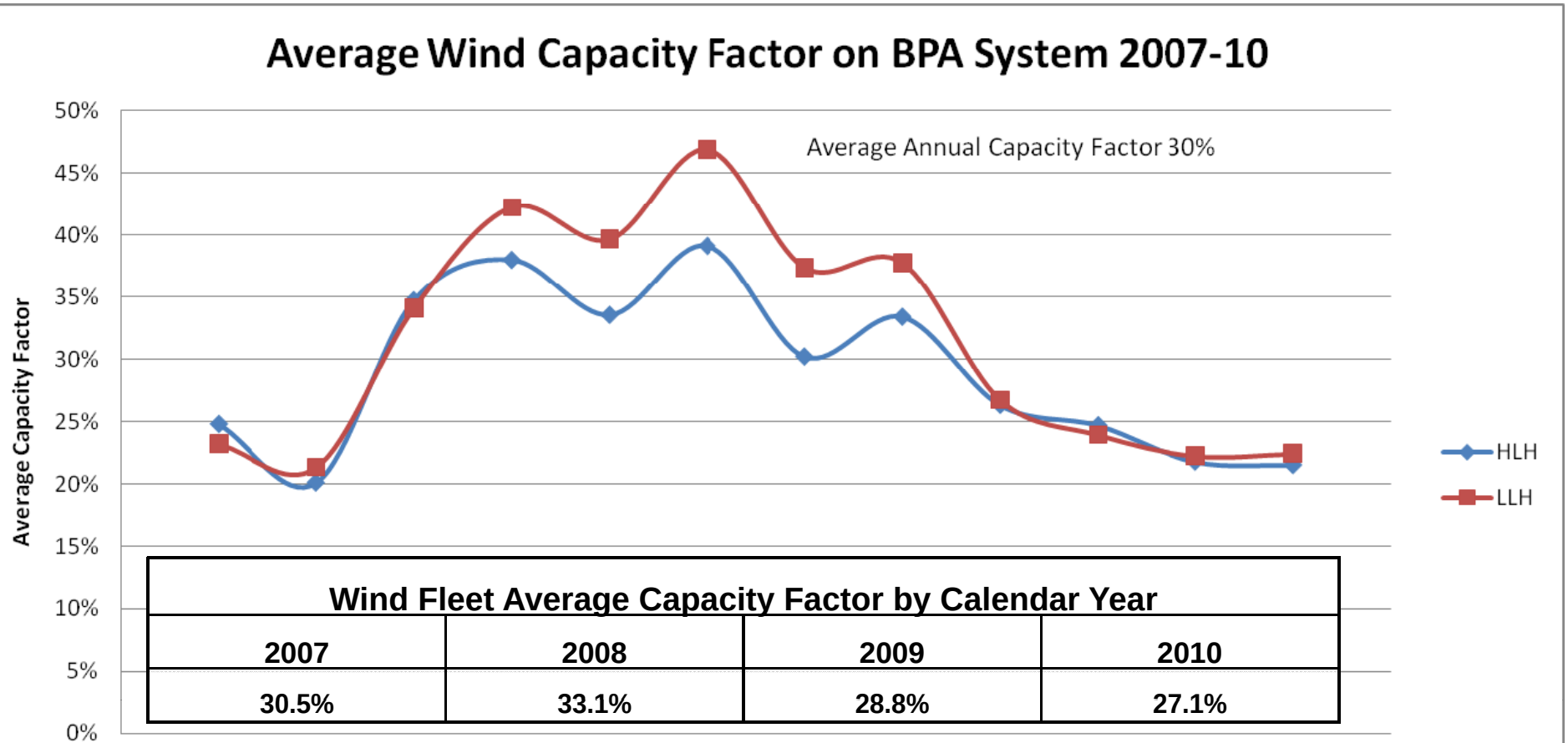


Breakdown of NW Wind Generation



\\nas1\Power\KD\Wind Integration Forum\Steering Committee\Mtg 6-6-11\[Regional Wind Breakdown.xlsm]Breakdown

Wind Fleet Capacity Factors



Wind Fleet Average Capacity Factor by Calendar Year			
2007	2008	2009	2010
30.5%	33.1%	28.8%	27.1%

Q:\KD\Wind\Wind Data\[BPA Wind and Load Hourly

Economic and Environmental Benefit Estimates

- Economic Benefits:
  - $30 to $60 million annual tax revenues
  - $12 to $30 million annual royalty payments
  - 350 to 650 new permanent jobs
  - Average of ~300 temporary construction jobs each year
  - $12 billion capital investment
- Environmental Benefits:
  - CO_2 emissions reduced nearly 30 million tons
    - 2011 reduction equivalent to removing 1 million cars.
  - Nitrogen oxide emissions reduced 450 tons

National Renewable Energy Laboratory. Jobs and Economic Development Impact (JEDI) Wind Model. July, 2009. Available from: http://www.nrel.gov/analysis/jedi/about_jedi_wind.html. and Costanti, Mike and Beltrone, Peggy. US Department of Energy and National Renewable Energy Laboratory. Wind Energy Guide for County Commissioners. November, 2006. Available from: http://www.nrel.gov/docs/fy07osti/40403.pdf.

U.S. Environmental Protection Agency (EPA). eGRID2010 Version 1.0 Year 2007 GHG Annual Output Emission Rates. http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2010V1_0_year07_GHGOutputRates.pdf

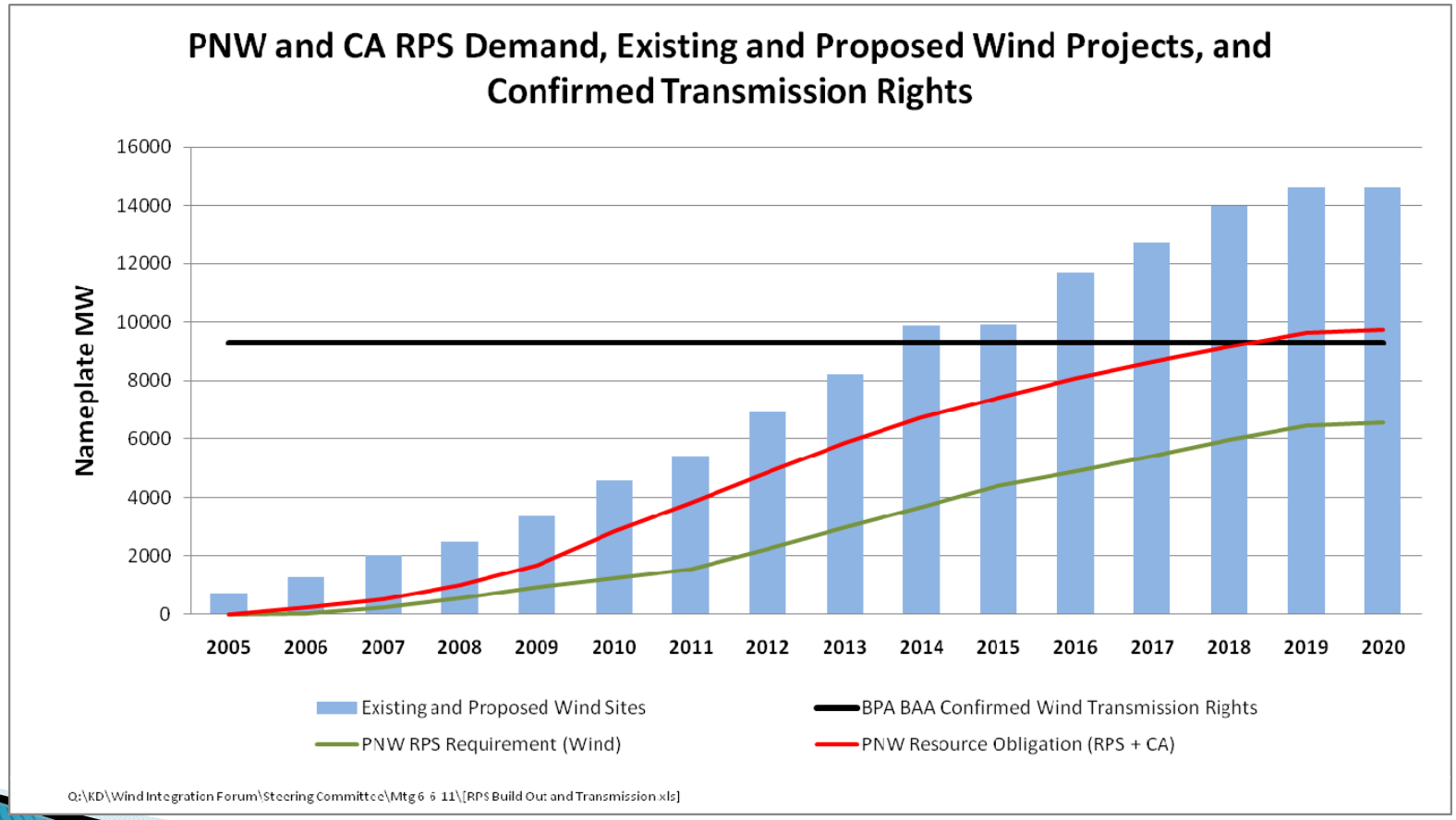
Q:\KD\Wind Integration Forum\Steering Committee\Mtg 6-6-11\WInd Additions and Econ Impacts by Year in PNW (2).xlsx

The Cost Ledger

- Utility procurement costs and associated rate impacts.
- Wind integration charges and balancing costs.
- Increasing wind generation lowering wholesale energy prices.
  - Lower prices benefit short buyers, hurt long sellers
  - Council analysis suggests RPS resources reduce annual average wholesale market prices by 4-8%, as much as 20% during the spring.
- Possible increased wear and tear on balancing units, especially hydro.
- A better understanding of these impacts requires additional information and analysis.

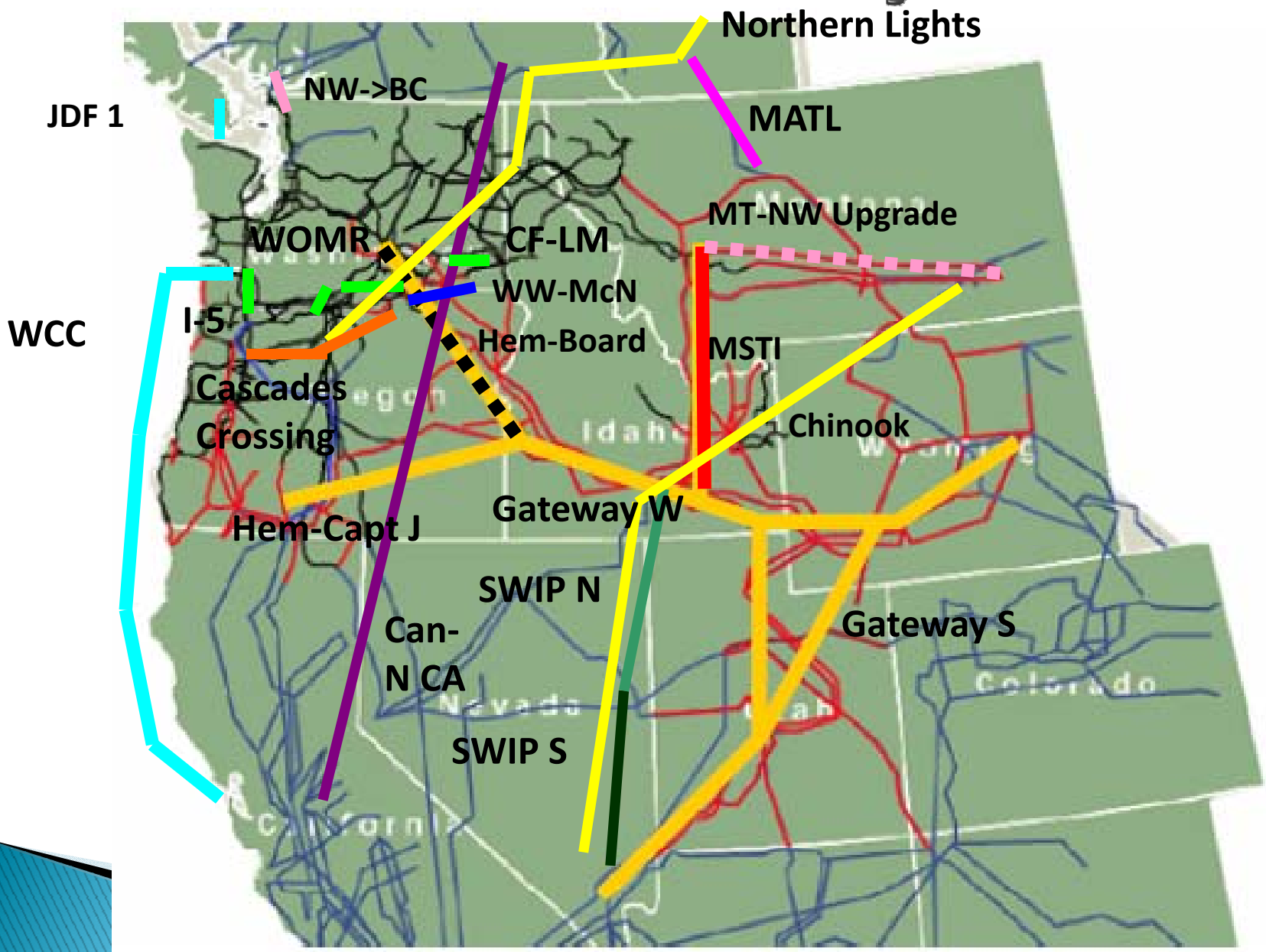
Wind Resources to 2020

- PNW and CA RPS targets would require ~10,000 MW of installed NW wind by 2020.
  - Nearly 6,000 MW currently operating or under construction.
- At least 14,400 MW of supply between existing projects and interconnection requests.
  - Significant excess supply relative to 2020 regulatory demand.
  - BPA has offered ~ 9,300 MW of transmission service to wind projects.



Based on BPA's wind interconnection queue and work done by E3

Proposed Major NW Transmission Projects



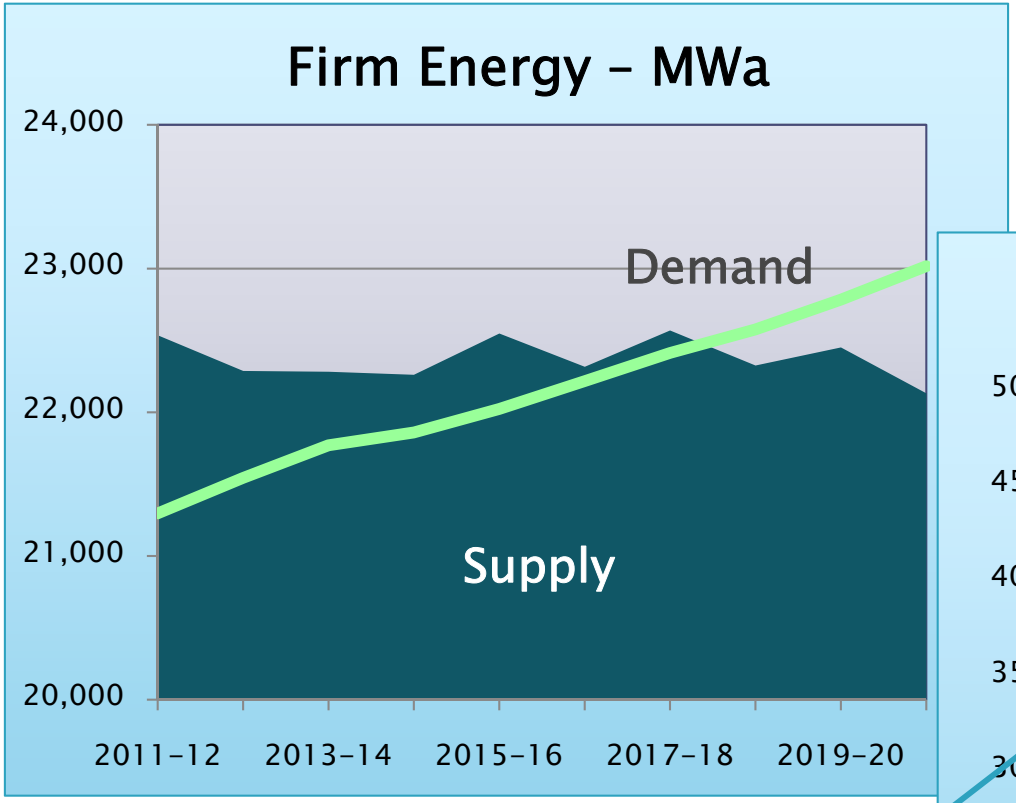
NW Resource Adequacy Situation

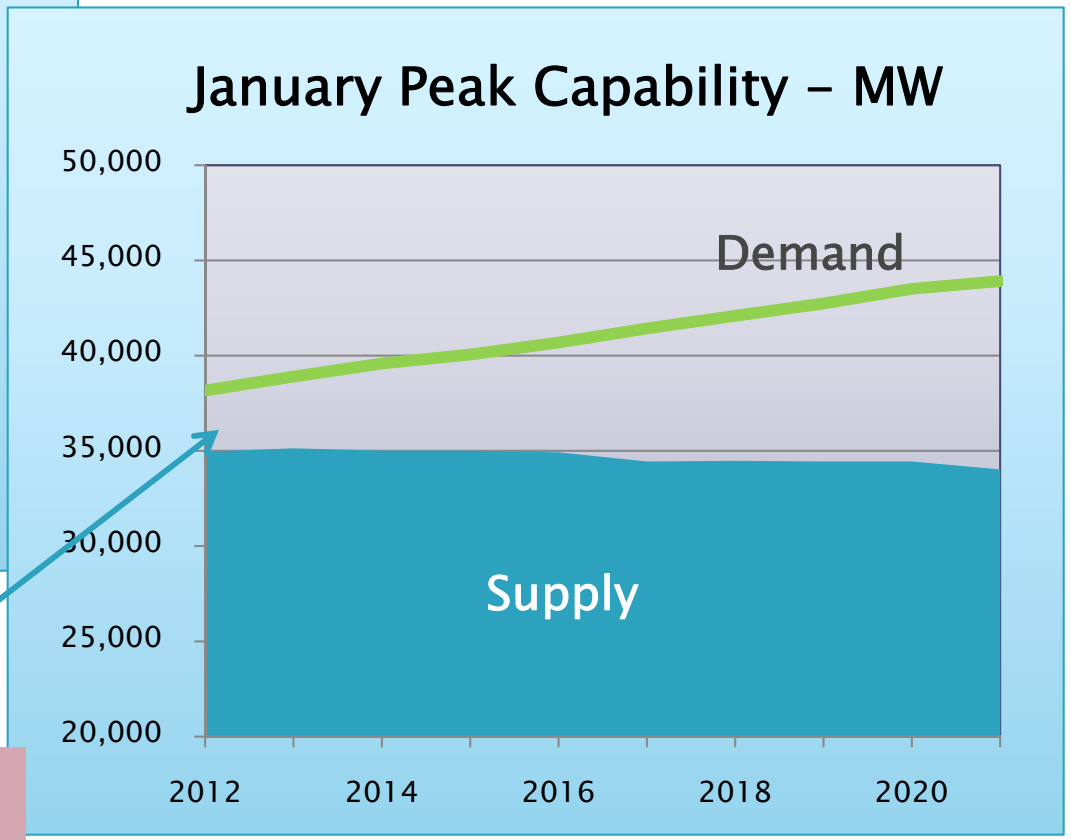
- Resource Adequacy Forum Findings
  - System is expected to have sufficient energy and peaking capability to meet demands through 2015 (existing resources, projected energy efficiency).
  - System has moved from being primarily energy constrained to about equally constrained by energy and peaking capability.

LOLP (%)	Winter Cap	Winter Eng	Summer Cap	Summer Eng
New Base	1.9	0.5	0.5	1.0

Adequacy Standard = 5% (one in twenty)
2015 analysis of existing generation, additional conservation per Council Sixth Power Plan.

Another Look
Critical Water, Firm Resources



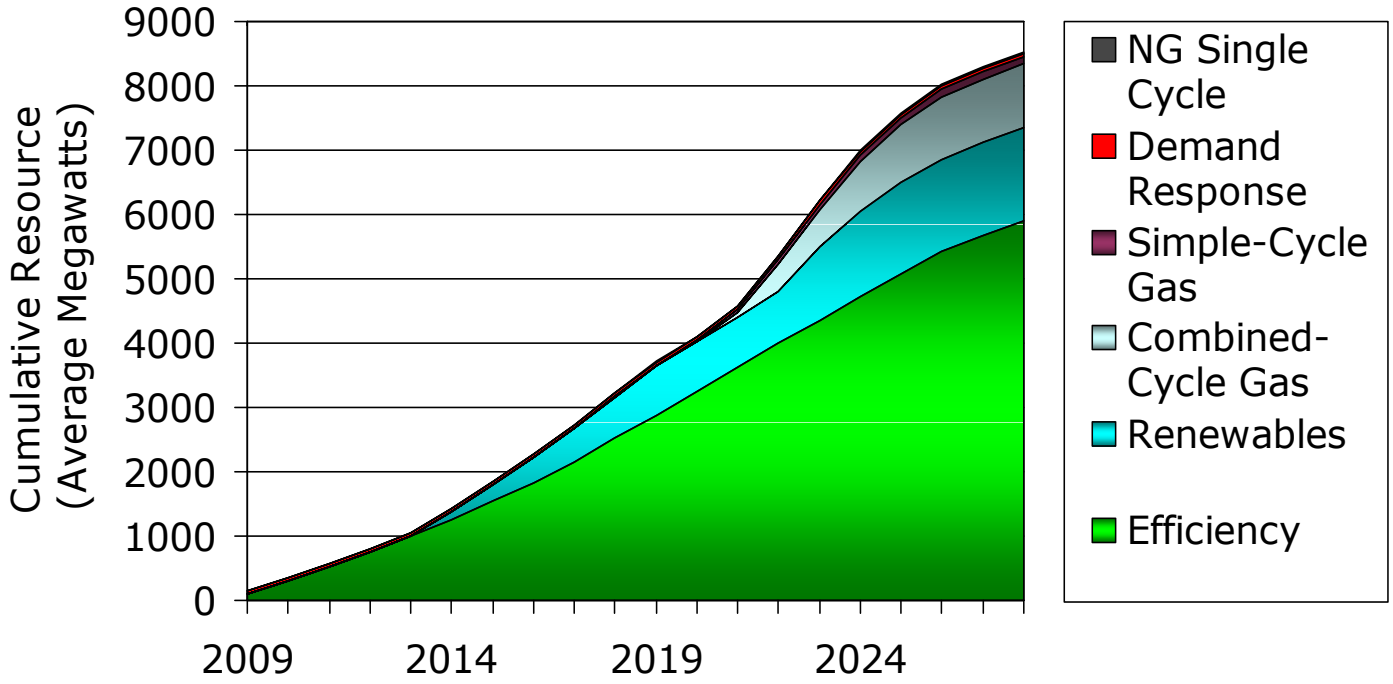


Attendant Energy Shortage in Winter Months.

Looking Forward

Sixth Plan Resource Portfolio*

*Expected Value Build Out. Actual build out schedule depends on future conditions



Replacing ~2,000 MWa coal plant generation:

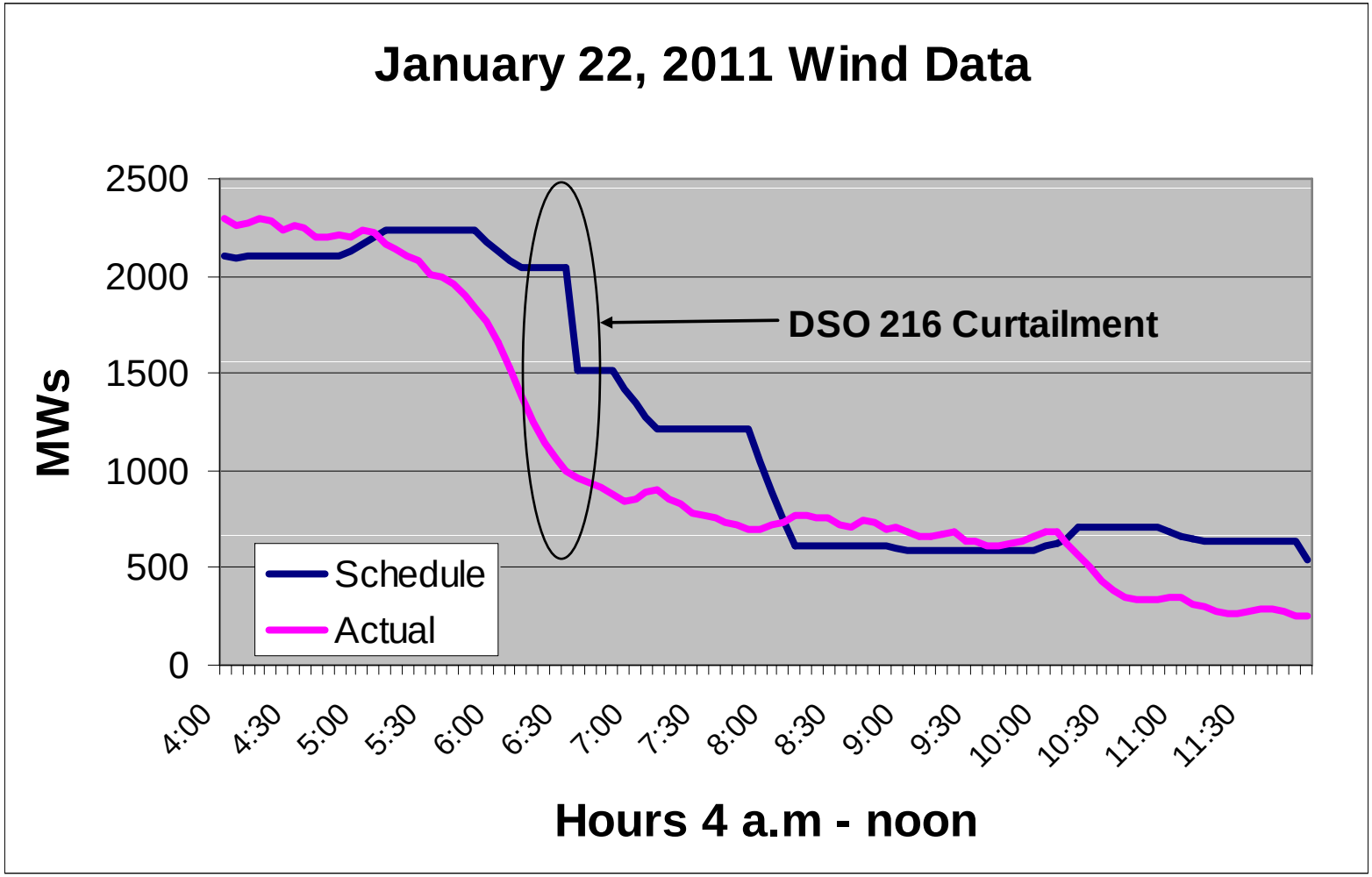
- **Reduce exports (~50% of lost energy)**
- **Increase use of existing gas plants (~17%)**
- **Ramp up efficiency programs (~16%)**
- **Increase renewable energy (~1%)**
- **Build new gas generation (~18%)**

Coal Plant Replacement in Sixth Power Plan, Morlan, NPPC 6/2011

Three Interrelated Challenges

- Provision of Balancing Services
  - How can we manage wind variability in a reliable, efficient manner while recognizing the limits on the region's hydro flexibility?
- Oversupply
  - How can we reliably and equitably manage high hydro/high wind conditions?
- System Flexibility
  - How much do we have, how much will we need?

DSO 216
Curtailing transmission schedules



Balancing Initiatives

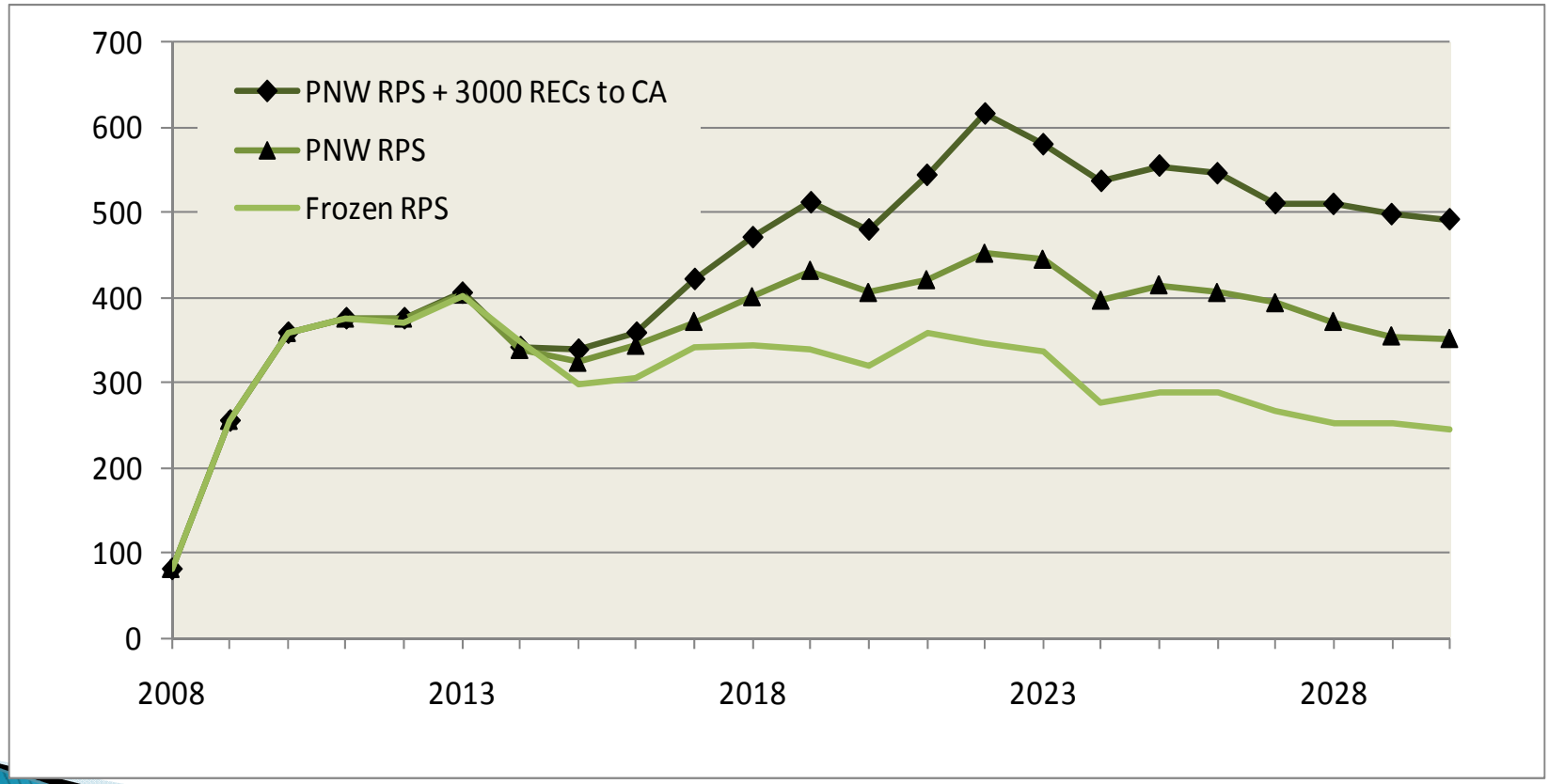
- Improved wind forecasting and state awareness
- Intra-hour scheduling/ITAP/Dynamic Scheduling System
- BPA Committed Intra-hour Scheduling Pilot
- Iberdrola Self-Supply Pilot
- NW Power Pool Combined Reserve Task Force
- BPA/other purchase of third party supplied balancing reserves
- WSPP Ancillary Service Schedule Filing
- WECC Energy Imbalance Market (EIM) cost-benefit analysis
- Dynamic Transfer Capability Study Group
- Ace Diversity Initiative and Reliability-Based Control
- SmartGrid/Demand Response

Environmental Redispatch Numbers

- Reduce output of non-variable resources within BPA's control area to minimum generation level.
  - About 6,348 MW-hrs of reduced generation through June 2.
  - Remaining non-variable generation in BPA's balancing authority is around 100 MW (out of 7000 MW nameplate).
- ER has been implemented nightly since May 18 except for May 25 and June 1.
  - About 55,235 MW-hrs of wind generation has been replaced by FCRPS hydro generation since May 18.
  - About 15% of the wind generation was reduced due to Environmental Redispatch during this period.
  - ER has been implemented in the range of 4-7 hrs per night.

Future of Oversupply Events

- Power and Conservation Council analysis suggests that the likelihood of oversupply events has increased significantly since 2008, but will remain roughly constant as load growth catches up with renewable build-out.



From Power and Conservation Council draft, "The Effects of an Increasing Surplus of Energy Generating Capability in the Pacific Northwest," paper, 2011-01.

Oversupply Initiatives

- Refine BPA/Council oversupply forecasting and financial evaluation
- Continue short-term measures that can reduce need for Environmental Redispatch
  - Maximize displacement of thermal generation
  - Optimize transmission maintenance schedules
  - Maximize storage/draft flexibility with Corps of Engineers, Bureau of Reclamation, and Canada.
  - Maintain open communication through Friday Spring Operations call
- Evaluation of other suggested physical, market and institutional alternatives
  - New intertie transmission
  - Storage/load control
  - Reducing dissolved gas levels (e.g., flow diverters, temperature control)
  - Pumping load
  - Fuel substitution (e.g., steam processes).
  - Resistive (dummy) load banks.
  - Encourage diverse wind, or non-wind renewable resource development.
- Alternative cost-allocation/legislative approaches

Flexibility: Observed Ramping

The absolute magnitude of ramps on BPA's system is increasing, although ramping as a percentage of the installed wind capacity is declining a bit (reflecting some diversity value).

30-Minute timeframe

Ramps Up

Largest in MWs -> 1120 MW (40%, 2010)

Largest % of nameplate -> (51%, 2008)

Ramps Down

Largest in MWs -> -937 MW (34%, 2010)

Largest % of nameplate −> (-49%, 2008)

60-Minute timeframe

Ramps Up

Largest in MWs -> 1580 MW (57% 2010)

Largest % of nameplate -> (67% 2008)

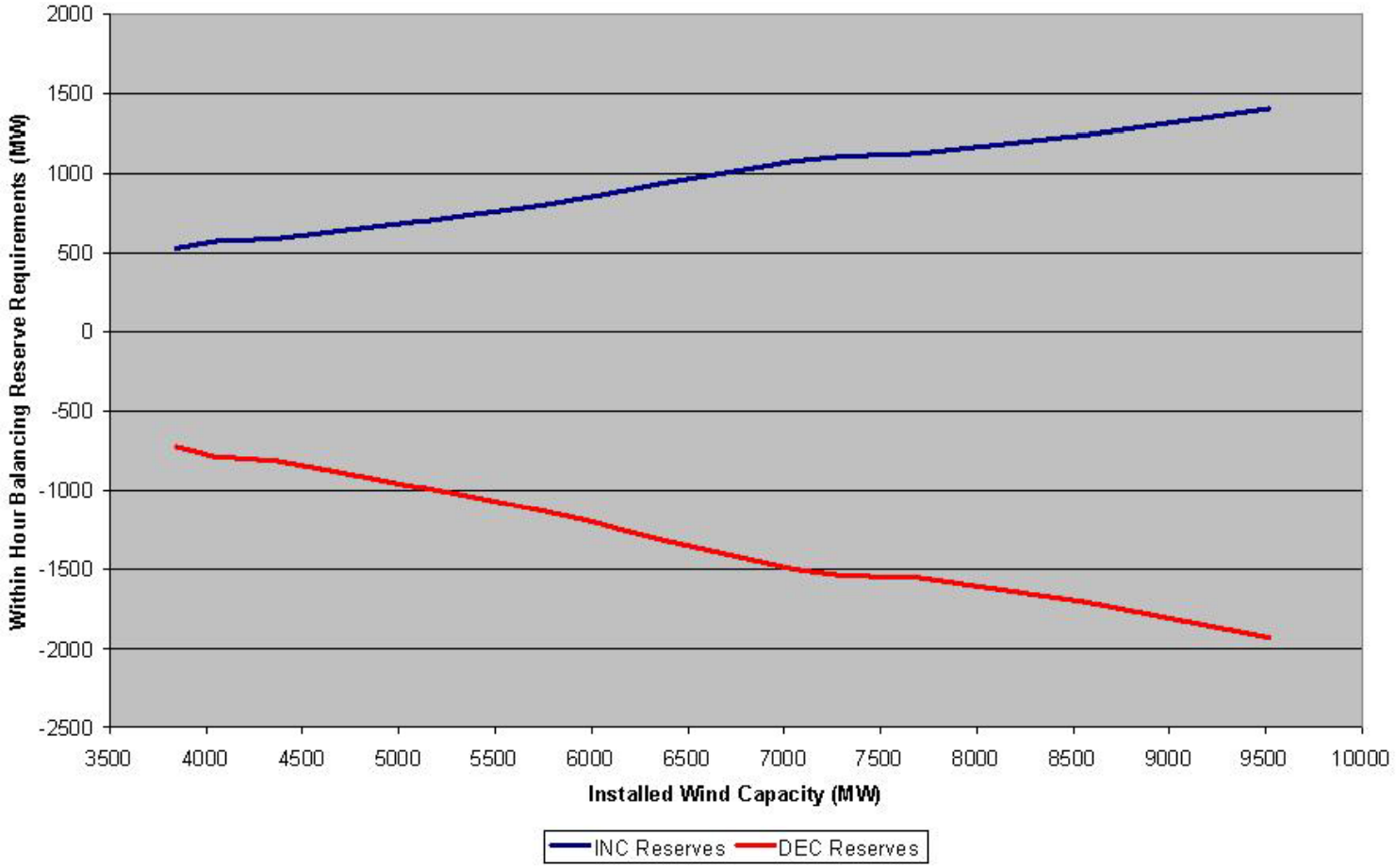
Ramps Down

Largest in MWs -> -1161 MW (42% 2010)

Largest % of nameplate -> -49% (2008)

Increase in Needed Balancing Reserves as Wind Fleet Grows

Balancing Reserves Allocated to Wind on BPA's System



BPA projection based on 30-minute persistence wind schedules and 60 minute operating periods.

Flexibility Adequacy Initiatives

- NW Resource Adequacy Forum evaluation of contribution of wind to regional reliability and development of flexibility adequacy metric;
- PNUCC System Planning Committee review of capacity, energy and flexibility definitions and planning requirements;
- Utilities beginning to explicitly address flexibility requirements in their IRPs.
- Manufacturers responding with more flexible/efficient generators.
- SmartGrid and Demand Response Initiatives looking for flexibility on the load side of the equation.

Key Takeaways

- With the region already approaching 6,000 MW, the potential supply of additional wind energy significantly exceeds total 2020 RPS demand of ~10,000 MW.
- Region appears to have identified and subscribed the necessary transmission builds to support RPS for 2020 and likely beyond.
- Economics of large-scale intertie expansion are questionable.
- Springtime oversupply is our most acute challenge today, but the efficient provision of balancing services will require continued coordinated, focused attention.
- While there are challenges, they don't appear insurmountable if we work together to address them.

Questions and Discussion