Northwest Power and Conservation Council

October 1, 2008

MEMORANDUM

TO: Power Committee

FROM: Maury Galbraith

SUBJECT: Introduction to Providing Ancillary Services

At the Power Committee Meeting on September 16, 2008, staff presented an overview of how power system operators use ancillary services to balance loads and generation, deal with sudden outages, and maintain system frequency and stability. The presentation focused largely on two specific ancillary services: regulation and load following. Staff explained how increased penetration of wind generation in the region's resource supply mix could result in an increase in demand for these services.

At the Power Committee Meeting on October 15, 2008, staff will make the second in a series of presentations on projecting the region's future supply and demand for ancillary services. During this presentation, staff and the Power Committee will discuss the following supply-side issues:

- The characteristics that electricity generating units need to have in order to be good providers of regulation and load following services;
- The resources currently available in the region that provide regulation and load following services;
- The resources in the region which do not currently provide regulation and load following services, but could in the future;
- Institutional changes, such as intra-hour markets for load following, that have the potential to improve the economic efficiency of the region's use of ancillary services; and
- Generation technologies that are good candidates for addition to the region's supply mix as providers of regulation and load following services.

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Adding Incremental Flexibility to the Pacific Northwest Power System?

Maury Galbraith

Northwest Power and Conservation Council

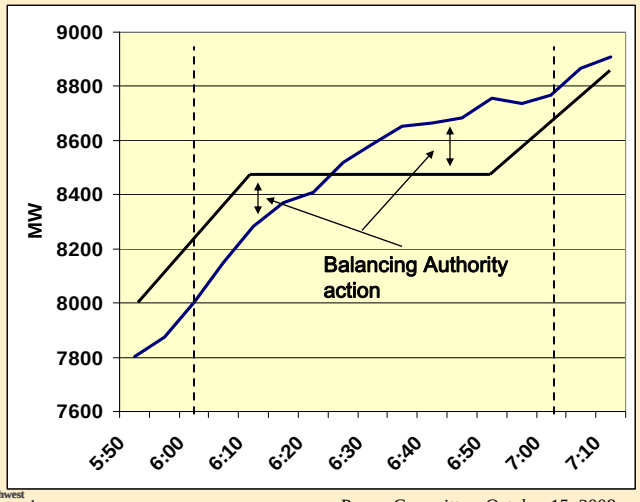
Power Committee Meeting

Missoula, MT

October 15, 2008

Recap – Illustration of Hourly Scheduling

BPA 7 Jan 08 6:00-7:00 a.m.



Recap – Illustration of Regulation and Load Following

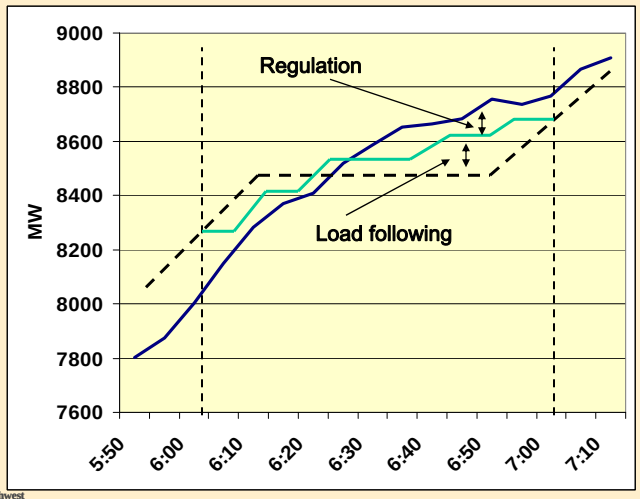
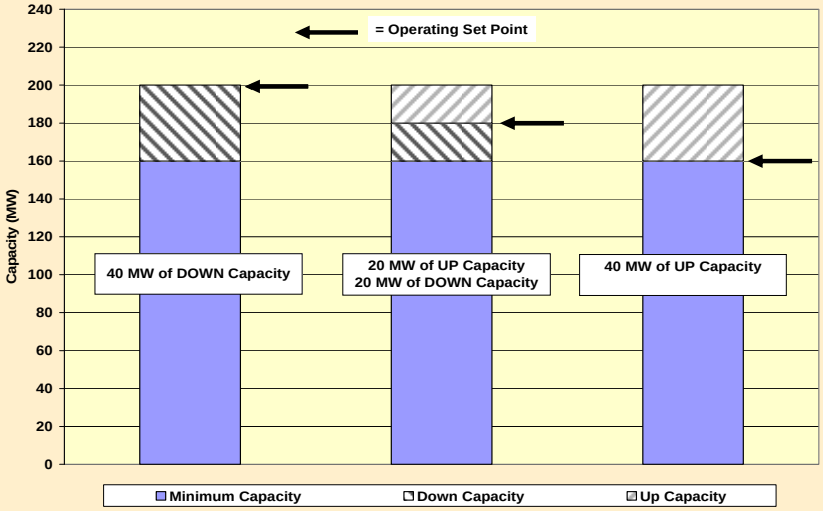


Illustration of Reserving Capacity on a 200 MW CCCT for Within-hour Balancing



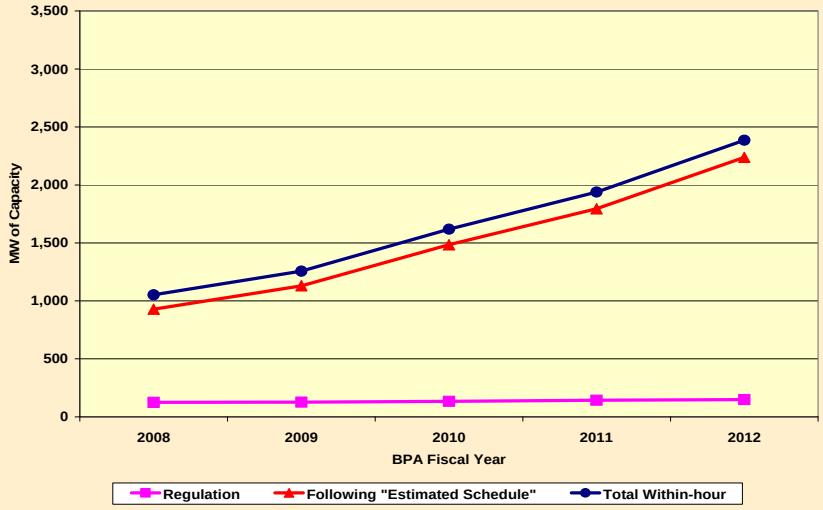
Capacity for Within-hour Balancing:

- How much do we need?
- How much do we have?
- How do know when to add more?
- What technologies provide more?

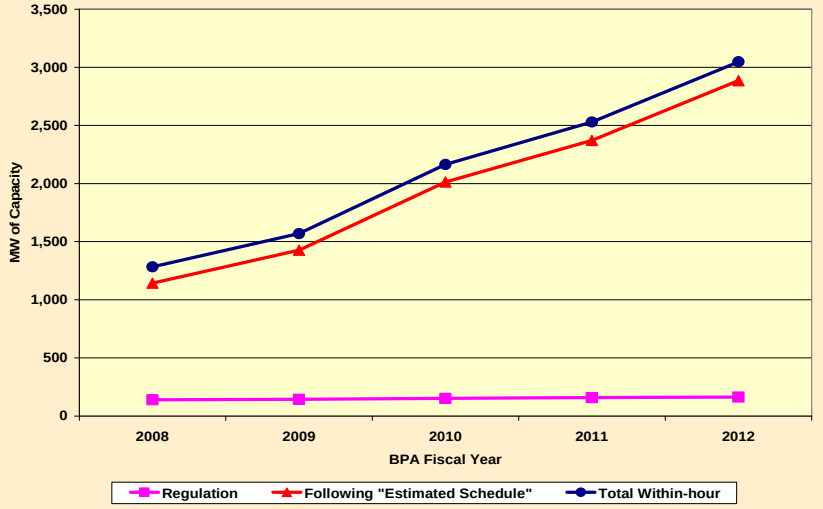
BPA Wind Integration Team
September 10, 2008 Report

- Part of the 2010 Rate Case
- Report is "pre-decisional" and "for discussion only"
- Report is focused on calculating the capacity needed for within-hour balancing during FY 2008 - 2013
  - Given projected future load growth, and
  - Planned wind generation in the BPA Balancing Authority Area
    - (1,424 MW in 2008 increasing to 6,670 MW in 2013)
- NO statement or assumption regarding the ability of current BPA resources to cover the capacity requirements
- FCRPS hydro resources currently provide capacity for within-hour balancing

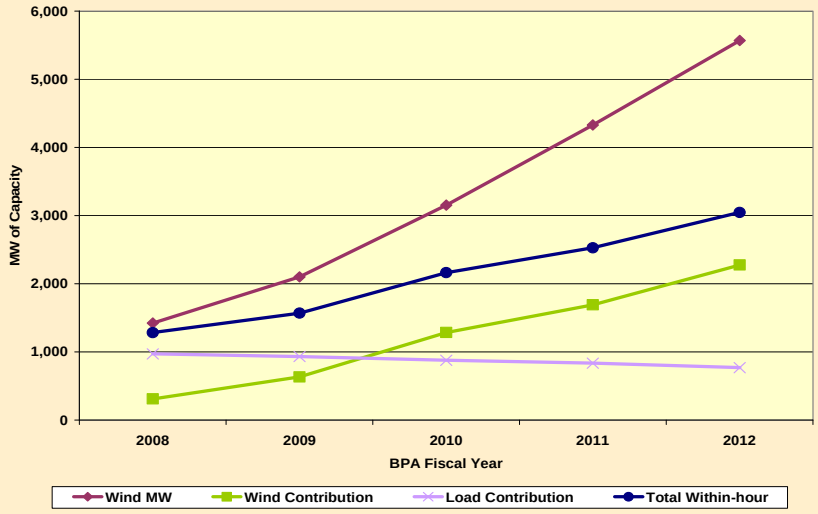
2,400 MW of UP Capacity Needed by 2012
Load Following is the Bigger Need



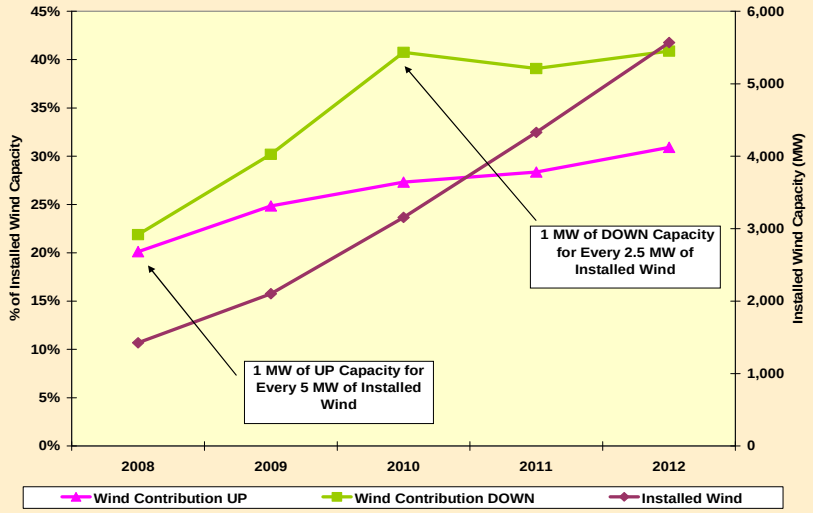
3,000 MW of DOWN Capacity by 2012
Regulation Need is "Flat"



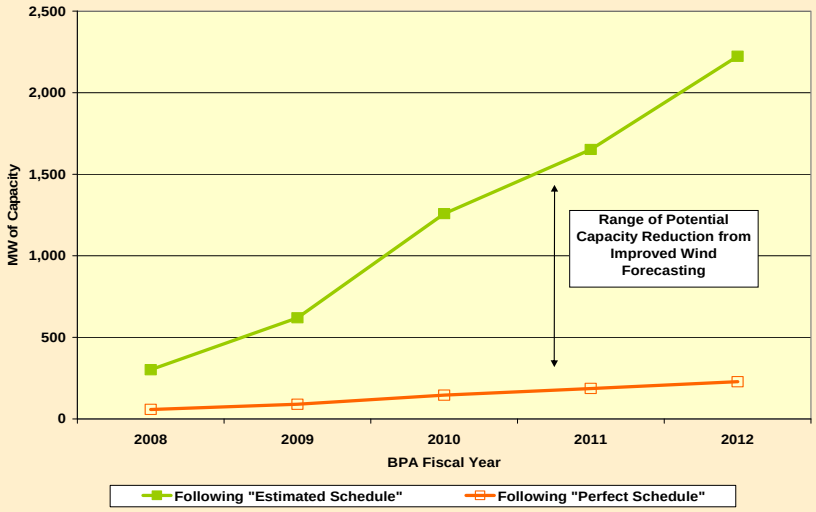
Wind's Contribution to DOWN Capacity Overtakes Load's Contribution in 2010



Wind's Contribution to UP and DOWN Capacity as a % of Installed Wind Capacity



Improved Wind Scheduling Could Significantly Reduce Capacity Required for Load Following



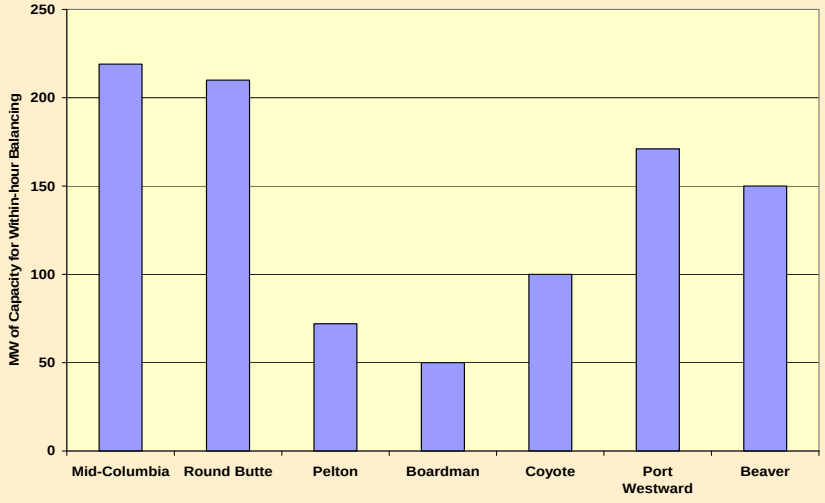
Summary of BPA WIT Report

- BPA forecasts a capacity need in 2012 of:
  - 2,500 MW for within-hour UP balancing; and
  - 3,000 MW for within-hour DOWN balancing
- Likely overstated due to assumption that future scheduling of wind generation will continue to mimic current practice
- NO statement or assumption regarding the ability of current BPA resources to cover these capacity requirements

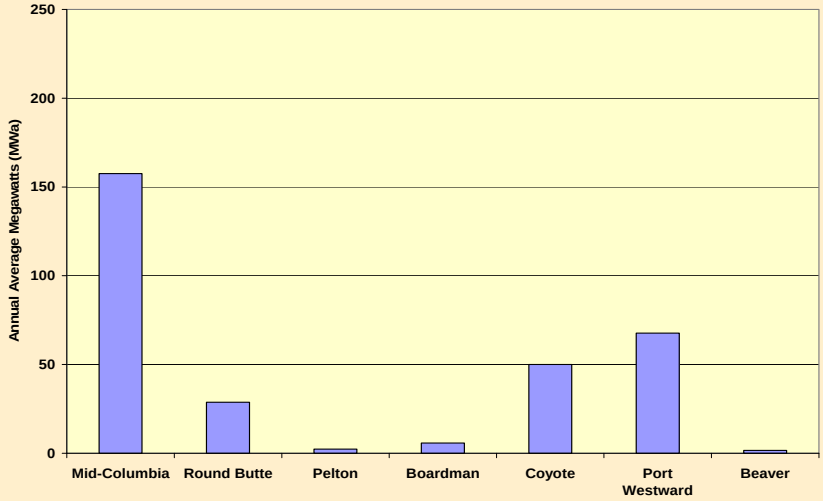
PGE Wind Integration Study
Public Presentation September 19, 2008

- Study focused on cost of PGE self-integration
  - PGE does not currently integrate Klondike II or Biglow I
- Examined integration of 1,100 MW of installed wind capacity in 2014
  - ~ 26% penetration of system capacity
- Explicitly estimated the capability of **ALL** resources available to PGE to provide ancillary services
  - Some thermal plants would require addition of AGC at "modest" cost
  - Reflects diminished hydro capacity of Mid-C Contracts in 2014
- Cost of PGE Integration: $11.75 per MWh (in 2008$)
  - Will use for final short list scoring of Renewable RFP

PGE Resources Available to Provide UP and DOWN Balancing: 972 MW in 2014



PGE Resources Forecast to Provide UP and DOWN Balancing: 314 MWa in 2014



Ideal Characteristics for Resources that Provide Capacity for Within-hour Balancing:

- Operate "on AGC" – Automatic Generation Control, part of the Balancing Authority's energy management system
- Operate over a wide range of output levels
- "Ramp" or change output levels quickly
- Operate at "near-market" heat rates over operating range

Issues for the Sixth Power Plan:
How much do we need?

- How much capacity will Balancing Authorities need to set aside for within-hour regulation and load following?
  - How much is attributable to load growth?
  - How much is attributable to increased wind generation?
  - Could better wind forecasting reduce this capacity requirement?
  - Could a shortened scheduling window reduce this capacity requirement?

Issues for the Sixth Power Plan:
How much do we have?

- How much capacity for within-hour regulation and load following can be provided from existing resources?
  - Which resources are currently used for within-hour balancing?
  - Are there other existing resources that could be used?
  - Would dynamic scheduling better allocate existing capacity?
  - How do constraints on hydro system operations impact the availability of capacity for within-hour balancing?
  - Can demand-side resources provide capacity for within-hour load following?

Issues for the Sixth Power Plan:
How do we know when to add more?

- Is it necessary to add capacity solely for within-hour balancing or is it more appropriate to consider operating flexibility when adding capacity to meet energy or peak demand requirements?
  - How do the different types of capacity related to one another?
    - Capacity for meeting peak load
    - Capacity for contingency events
    - Capacity for within-hour balancing

Issues for the Sixth Power Plan:
What technologies provide more?

- Which generation technologies are the best candidates for augmenting system capacity for within-hour regulation and load following?
  - Combined-cycle combustion turbines with duct-firing
    - Adding duct-firing to existing CCCT
  - Simple-cycle combustion turbines
    - Frame units (e.g., GE 7F)
    - Aeroderivative units (e.g., LM6000)
    - Hybrid units (e.g., GE LMS100)
  - Internal combustion reciprocating engines (gas-fired)
  - Pumped storage hydro
  - Other storage resources