

Wind Integration Issues

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Grant County
PUBLIC UTILITY DISTRICT
Excellence in Service and Leadership



Who is Grant County PUD

Consumer Owned Electric Utility

- 44,836 Metered Accounts
- Significant Industrial and Agricultural Load
- Peak Load 623 MW

Dedicated Resources

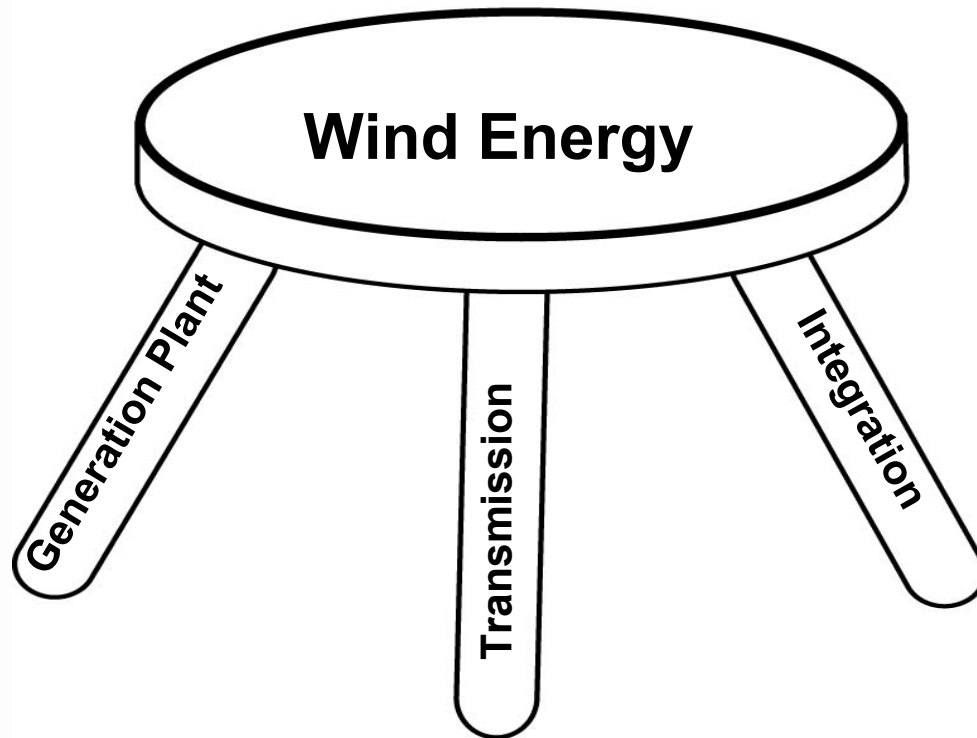
- Priest Rapids Dam – 955.5 MW – Multiple Purchasers
- Wanapum Dam – 1038 MW – Multiple Purchasers
- Potholes East Canal Project – 6.5 MW
- Quincy Chute Project – 9.4 MW
- Nine Canyon Wind Project – 12 MW

Today's Purpose

To examine some core issues related to the integration of wind energy into the power grid that are of specific interest to developers and operators of hydro generation plants.



The Three Necessary Legs of Wind Energy



Players in Wind Energy

- Interconnection Providers
- Transmission Providers
- Host Balancing Authorities
- Equipment Manufacturers
- Developers/Owners of Gen
- Purchasers of Energy
- Integration Service Providers
- Transmission Planning Entities
- Land Owners of Gen Sites
- Affected Land Owners
- Affected Transmission Systems
- Other Affected Parties





Grant PUD and Wind Generation

- Purchaser of busbar wind over contractual transmission
- Early provider of shaping and storage services
- Provider of physical interconnection for wind energy
- Provider of dynamic capacity services to Balancing Authorities that do not have sufficient variable generation to deal with wind generation
- Purchaser of test energy and early commercial energy

What is Wind Integration?

- Wind integration refers to the use of generation and transmission resources to enable the raw output of the wind facility to be used and useful to the overall power system.
- There is not an exact definition.
- Can mean different things in different contexts.
- Involves various transmission and generation issues.



Integration Services

Today's Focus

- Wind integration is the least understood leg of the stool.
 - Most people understand in general the variable nature of wind energy.
 - The actual issues this creates in operating a power system are much less understood.
 - If you are going to own or integrate a wind generation facility, you need to be informed on this issue.
 - The specifics of how you deal with this issue will vary based on the system you interconnect with.

Ancillary Services

- Ancillary Services - Those services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the transmission service provider's transmission system in accordance with good utility practice.



Wind Integration and Ancillary Services

Traditionally – The amount of generation required to provide ancillary services has been relatively small compared to the amount of power being moved.

This is not the case with wind generation.

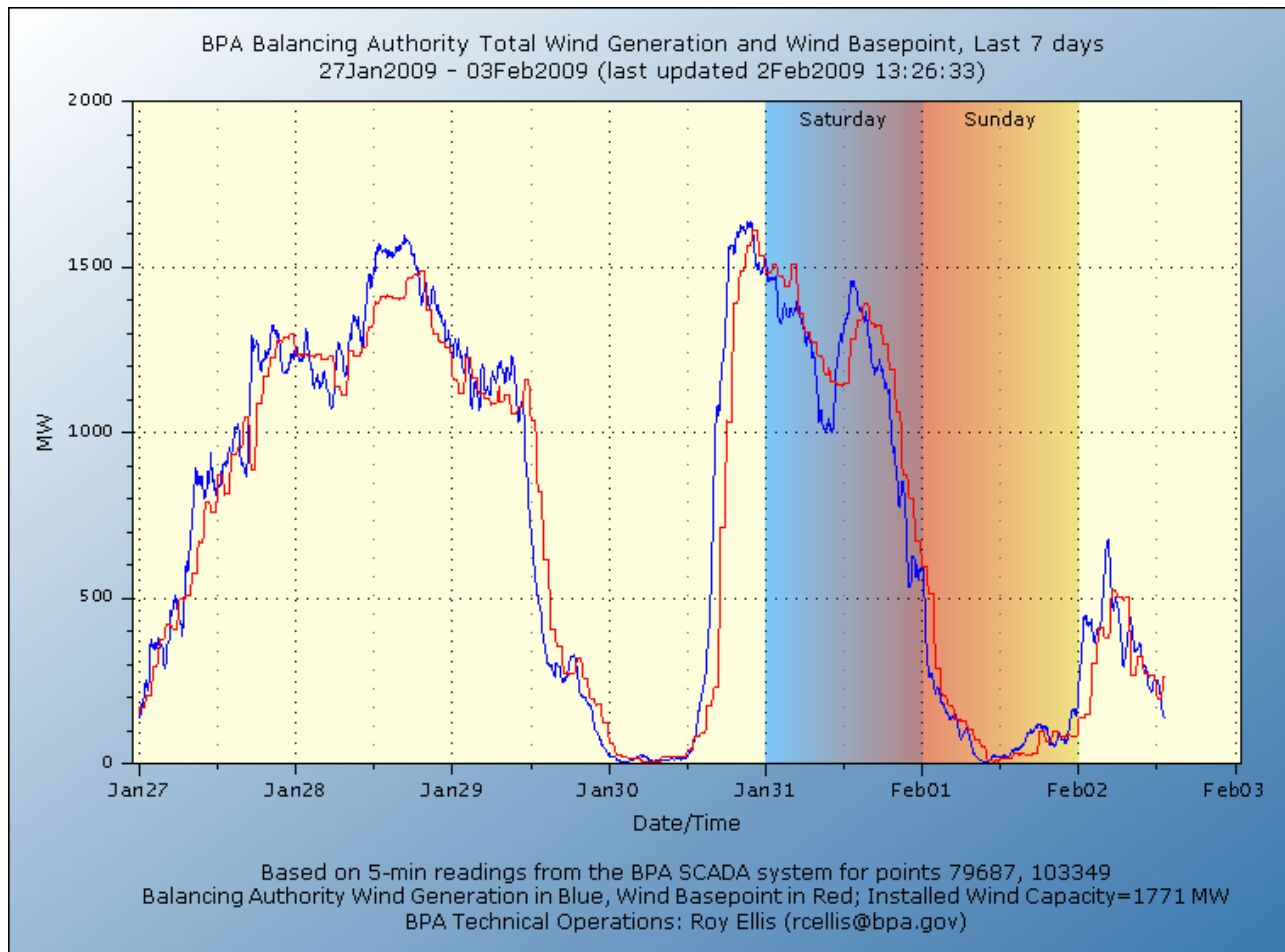


References to European Wind Integration

If you seek information on wind integration, you will find references to the European wind integration experience:

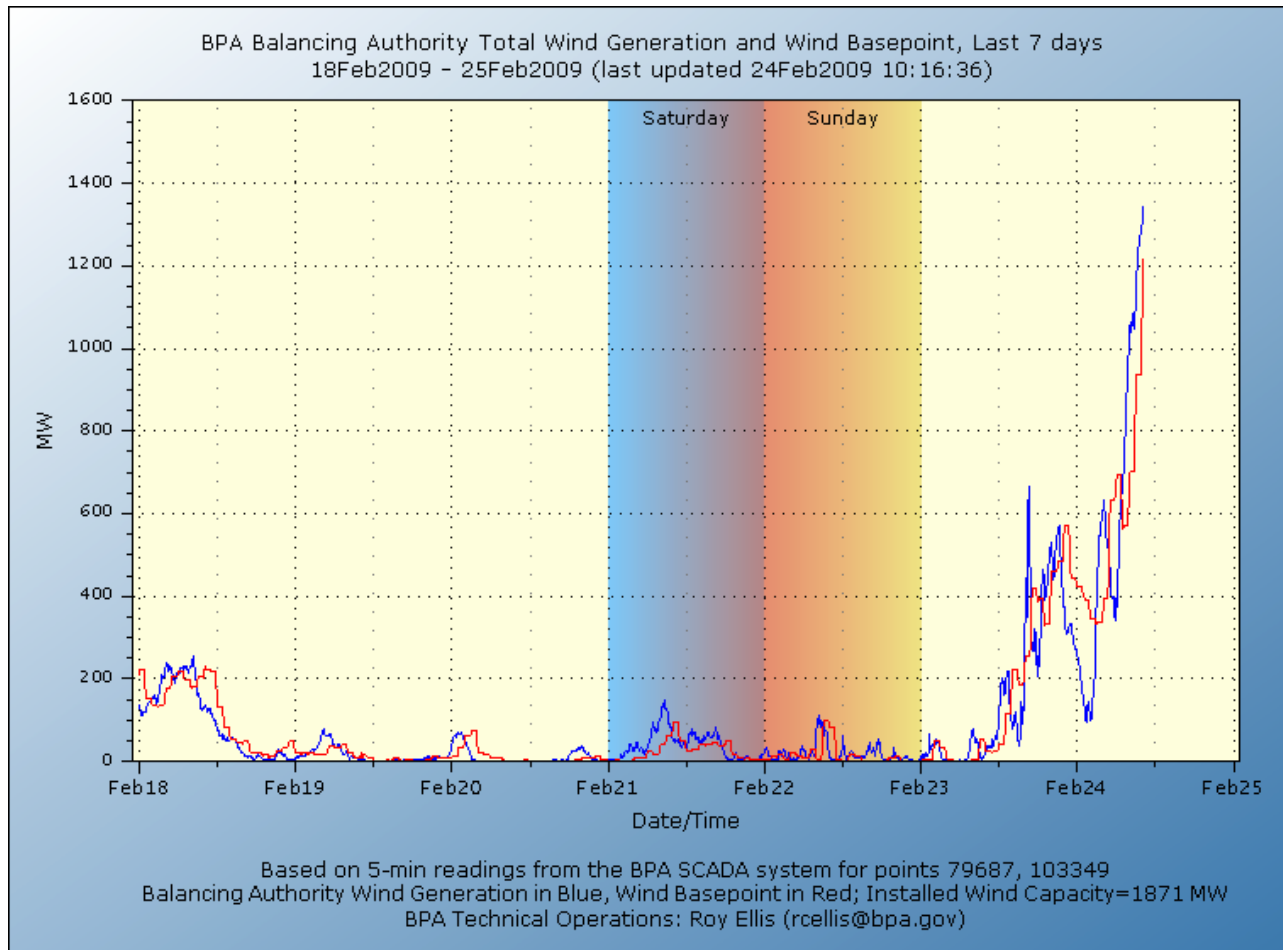
- Europe has approached the building of Wind Generation very different than the US
- “Wind Power Carpet”
- Decreases the integration burden
- The US will not likely move in this direction for several reasons
 - Geography
 - Economic Structure of Ownership
 - Electrical Infrastructure
- As an example: What is seen as a significant integration event in Denmark is a daily occurrence in the Northwest.

BPA BA Wind Generation Jan 27, 2009 – Feb 3, 2009



BPA BA Wind Generation

Feb 18, 2009 – Feb 25, 2009

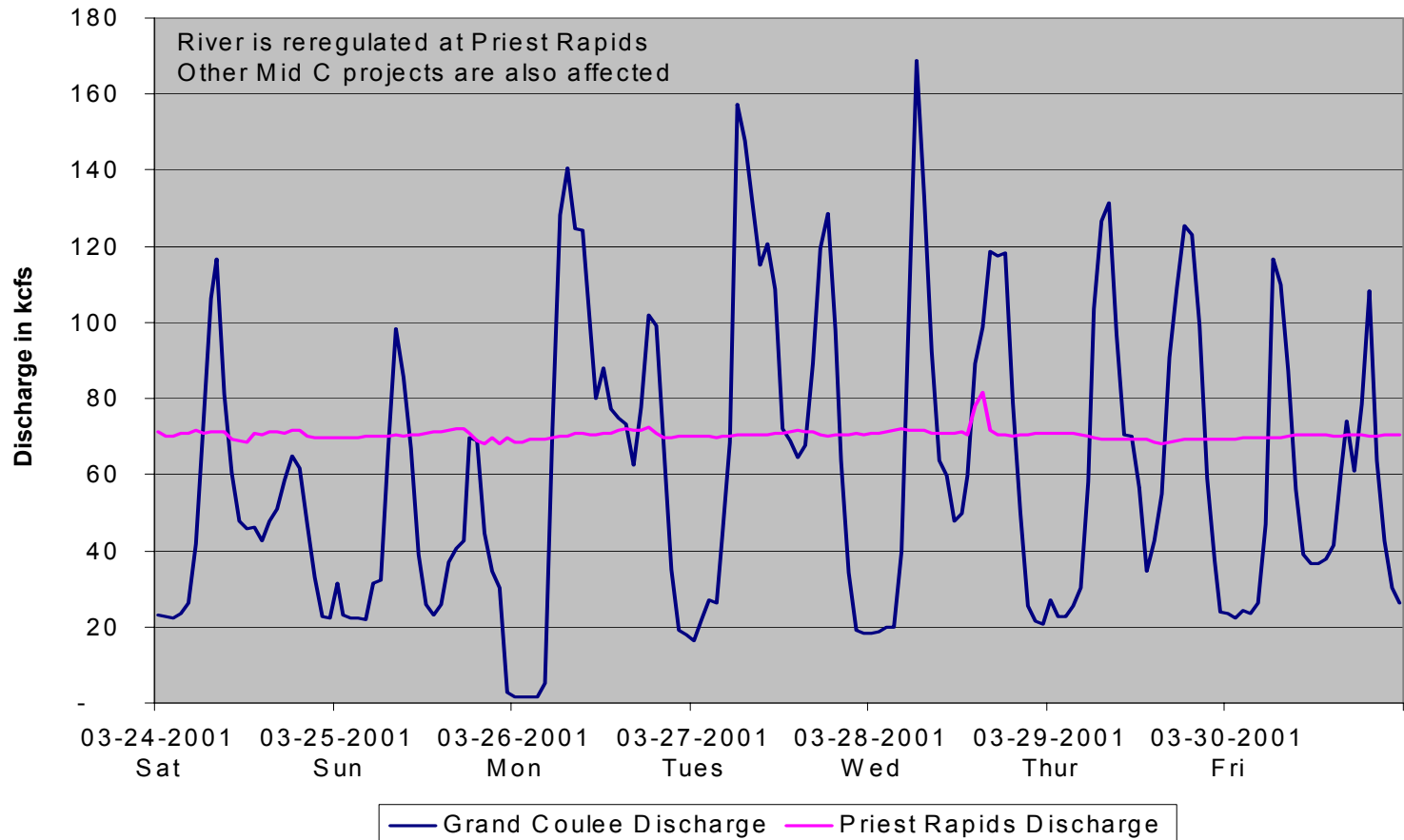


Hydro Power for Wind Integration

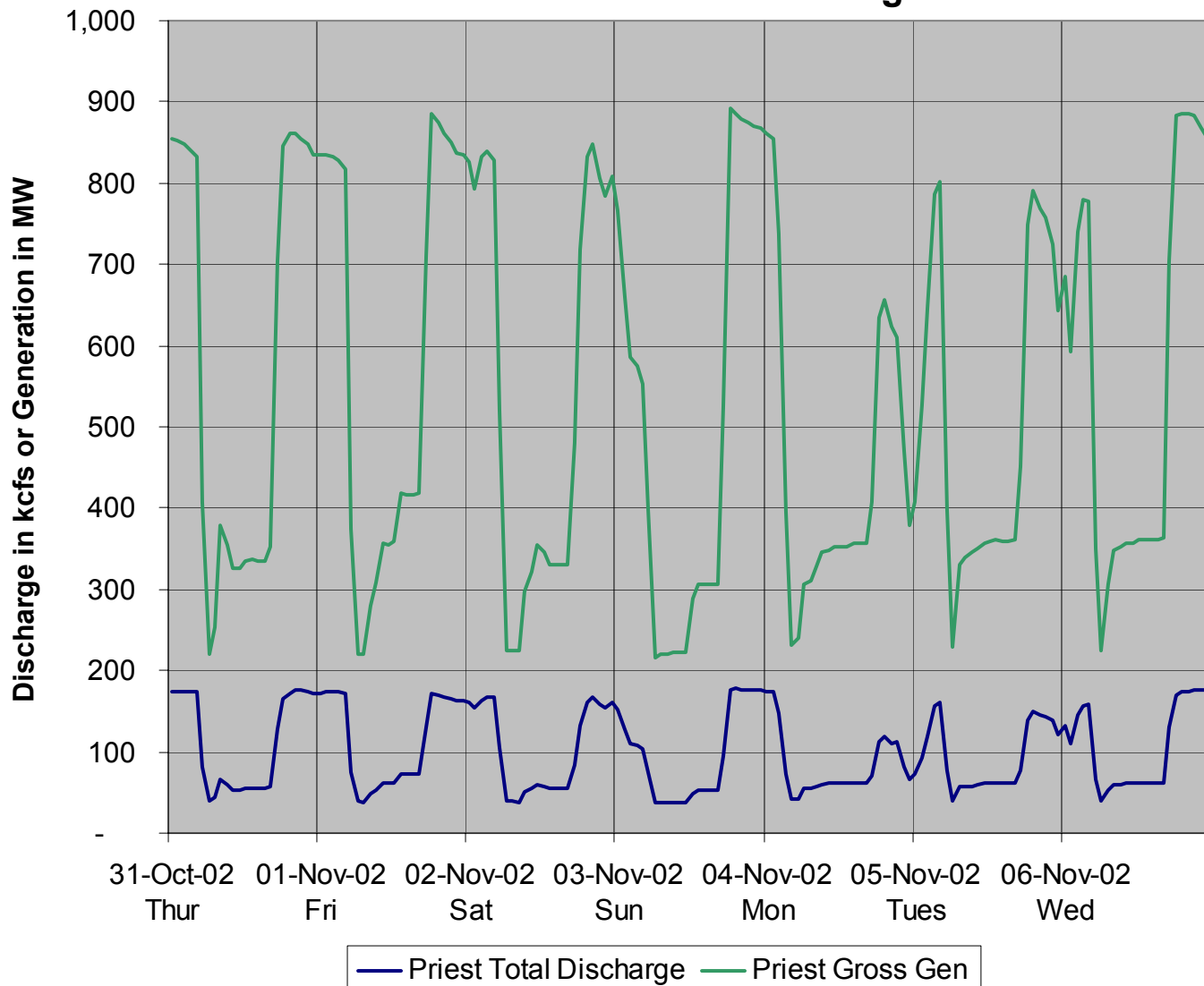
- Just a few years ago, it was common to hear references to the ideal nature of hydro power to use in wind integration.
- Not that simple.
- Limited flexibility of hydropower in the NW is already stretched.
- There are many factors that govern allowable discharges of hydro projects in the NW.
- In order to have variable generation output of a hydro project, you must have variable flow discharge.



Grand Coulee and Priest Rapids Total Discharge Minimum Protection Flow of 70 kcfs at Priest Rapids



Priest Rapids Discharge and Generation Reverse Load Factoring



Flexibility of Hydro

Varies by Project

Sometimes a small amount of very flexible generation when compared to the rated capacity of a project.

Extreme Example of Misinformation

“Its called shaping – when the wind blows, the regions dams can be shut down. When the wind stops blowing, the dams can be switched back on.”

The News Tribune, 4/3/06. “States wind farm frenzy picks up its pace”

Major Cost Drivers for Hydro-Wind Integration

- Costs driven primarily by need to secure additional flexibility over multiple timescales.
- Costs are a strong function of wind penetration rates relative to size of integrating Balancing Area (or integrating resource).
- Geographic diversity is an important cost burden reducer.
- The overall level of flexibility in the relevant power system is important to costs experienced.
- Access to robust markets for flexibility products, Balancing Area services and Storage & Shaping products is important.

Cost Issues for Hydro-Wind Integration

- A very important point is that wind integration issues are very dependent on non-(hydro) plant specific variables.
- While incremental wear & tear is occurring, primary cost results from suboptimal operation of hydro project.

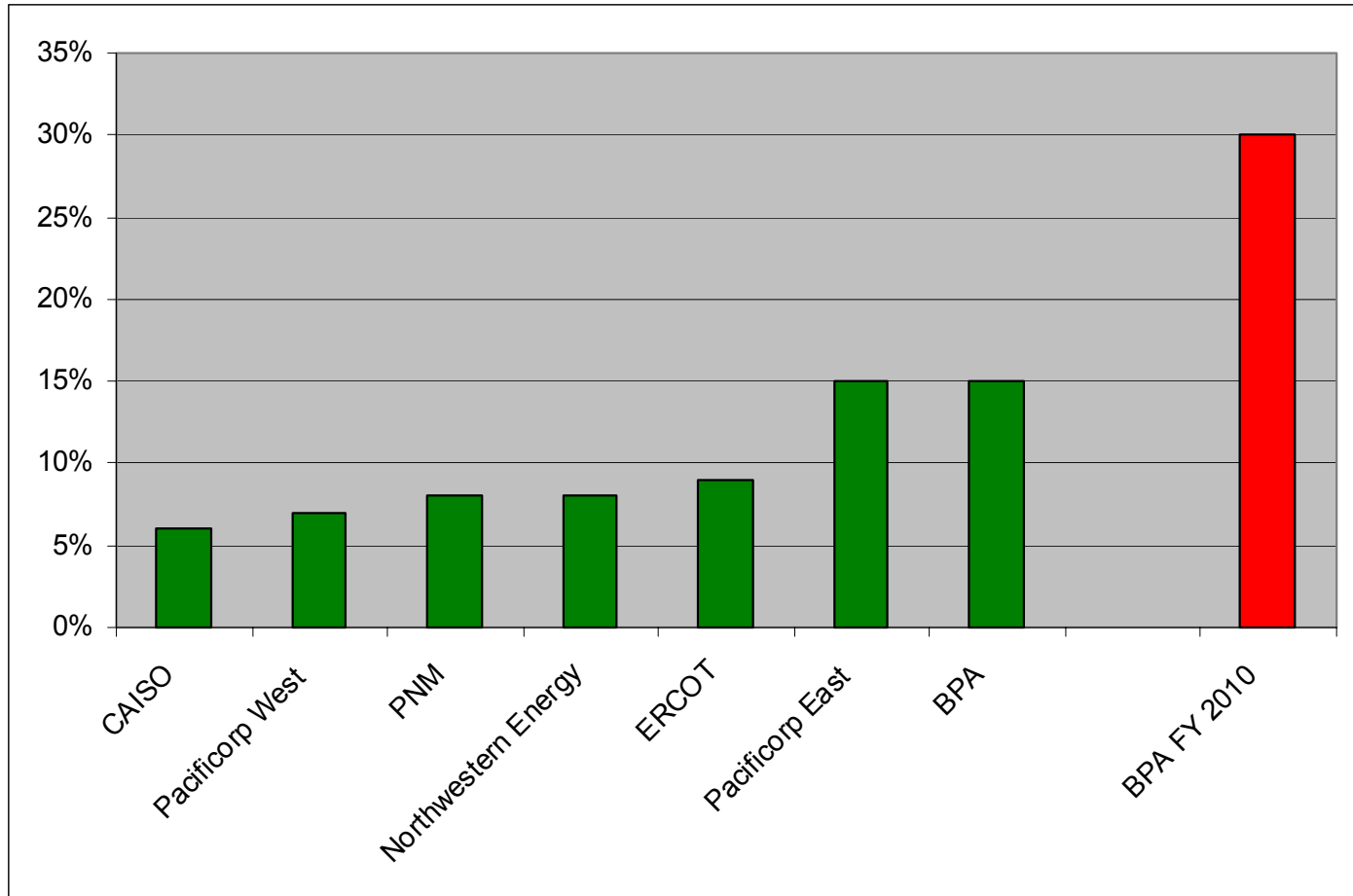
Cost Issues for Hydro-Wind Integration

- Costs are very dependent on on- / off- peak price spread and absolute market price.
- Integration should be thought of as a supply curve and there exists a very important “least upper bound”
 - the full cost of the cheapest new resource able to provide the service.

Where Are We Headed With Wind Integration

- Different regions of the US will have different approaches due to the regional wind profile, resources available in the region to accomplish wind integration, and the regional structure of the transmission providers.
- In the longer term, we may strengthen the interties between regions with a national transmission grid.
- **BPA is the current leader in the NW dealing with this issue**
 - High Priority
 - Serious Work
 - Variety of Opposition
 - Know they must do something to facilitate continued development

Proportion of Installed Wind Generation Capacity to Peak Load Selected Balancing Authorities



Source: Balancing Act: BPA grid responds to huge influx of wind power, BPA, November 2008

Are There Precedents to Follow?

- Penetration rates are moving targets – even for current penetration.
- There is a not precedent at this time for BPA to follow.
- BPA is with the leaders of the curve in penetration in the US and is facing tremendous demand for future growth.
- RFPs have been conducted in the region to acquire specific services with limited response.
- BPA has conducted an RFI but has not released the results.



Current BPA Approach in Rate Case

Within Hour Integration

- Determine an amount of reserve capacity to set aside based on a forecast accuracy assumption.
- Establish a method to determine when the set aside capacity has been consumed.
- Use schedule cuts and generation reductions when the set aside capacity has been exceeded.



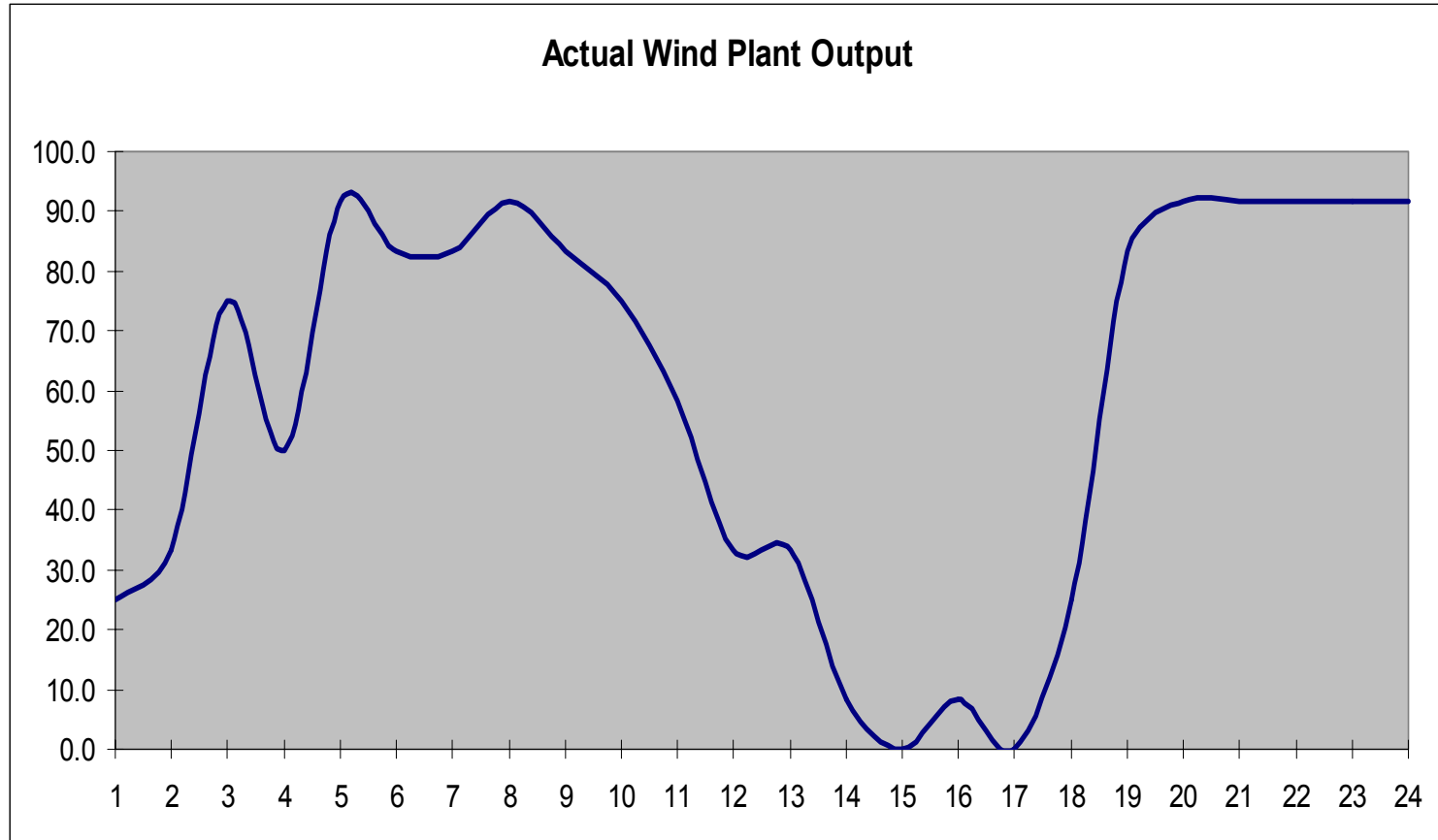
Current Price Range

BPA Rate Case Discussions

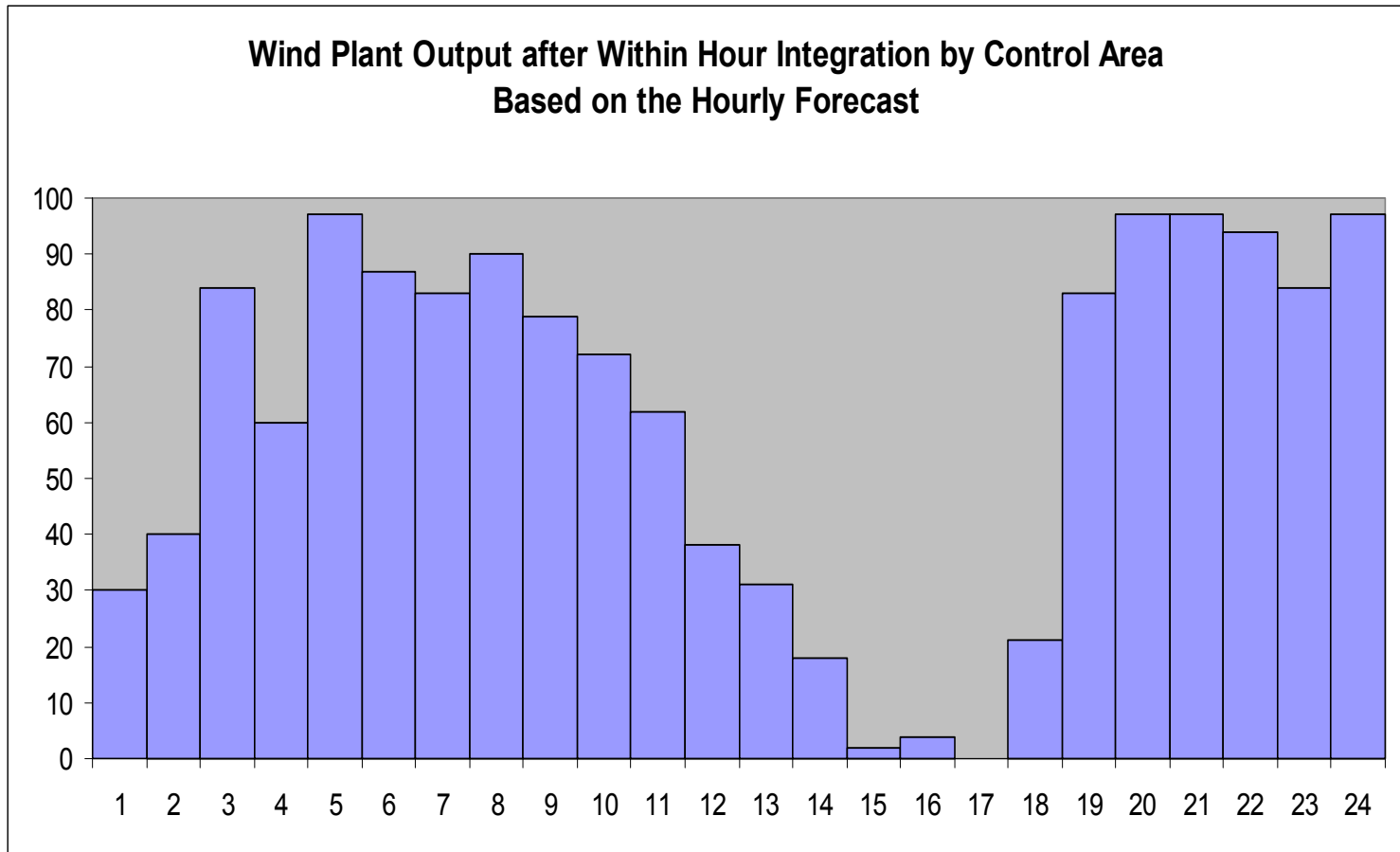
- Moving Target - The current range of costs for this service is likely:
 - Based on Installed Wind Capacity
 - \$1.37/kW month to \$2.73/kW month
 - Based on Energy – Approximate
 - \$6.2/MWh to \$12.5/MWh
- These are pretty good prices, lets take a look at what you are getting.



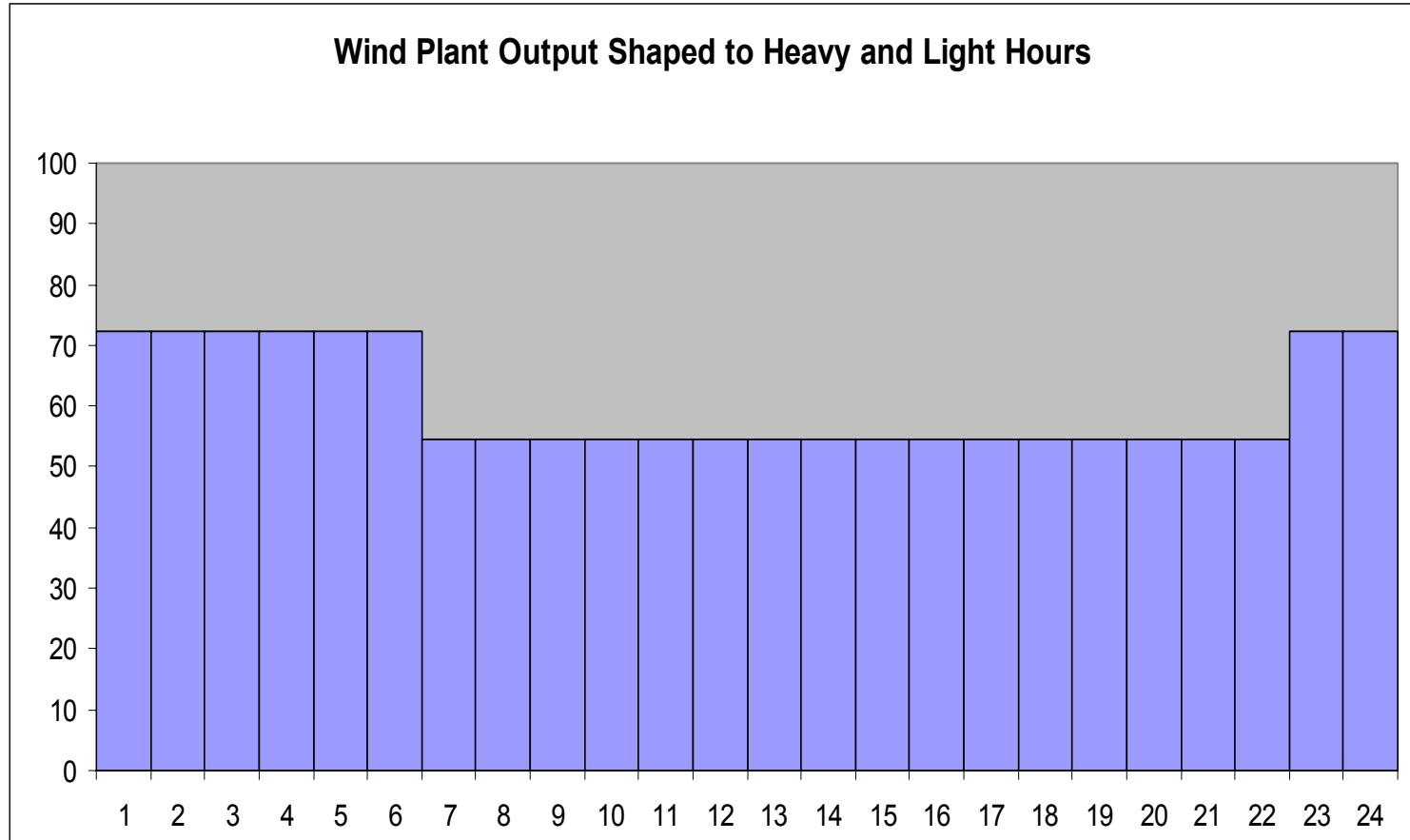
Actual Generation Supplied to BPA



What BPA Supplies in Return for the Wind Int Charge



Example Additional Service Often Sought After



Alternatives to Purchasing BPA Within Hour Integration

- Dynamic Schedule within NW on firm transmission.
 - Work out integration with another Balancing Authority.
- Possible increase in Dynamic Schedules out of the region in the future.
- Possibly Self Supply of within hour integration.
 - Not yet known exactly how this would work and if any parties will offer the service at a better price than BPA.



Major Current Northwest Efforts Regarding Integration

- Joint Initiative: NTTG, Columbia Grid, Westconnect along with individual members of these organizations:
 - Enable Dynamic Scheduling to a greater degree than now
 - Standardize within hour transmission schedules for the participants
 - ITAP: Intra-hour Transaction Accelerator Platform
- WIT – Wind Integration Team at BPA:
 - BPA formed a team of highly qualified individuals to specifically work on the wind integration effort
 - Shows a serious commitment by BPA
 - Work aimed at developing and implementing solutions
- WIST – Wind Integration Study Team- NTTG and Columbia Grid:
 - Transmission Planning with Specific emphasis on issues related to increasing the use of dynamic schedules
 - New Effort

Takeaways

- There is much more to wind integration than what we spoke about today.
- Wind integration is a complex topic.
- Can mean many things – and issues vary by region.
- It is important to be familiar on a first hand basis with wind integration issues specific to your area if you are going to be involved with the raw output of a wind generation facility.
- Wind integration has costs that are sometimes specifically charged by service providers and you need to be aware of what you are specifically receiving and what you are not receiving for these charges.

