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December 3, 2008

MEMORANDUM

TO: Council Members

FROM: Terry Morlan

SUBJECT: Renewable Northwest Project on Wind Integration

One of the key actions in the Council's Fifth Power Plan was to analyze the ability of the Northwest power system to integrate the large amount of wind power that was found to be cost-effective. The Wind Integration Forum was formed to address this issue and has been working to resolve these issues.

The Wind Integration Forum started with a threshold question of whether integration of 6,000 megawatts of wind capacity was possible in the Northwest. That question was answered in the affirmative, providing that actions were undertaken to enable fuller use of existing system flexibility by regional balancing authorities and providing that certain transmission reinforcements were implemented on Bonneville's system.

The need for resolution on these issues has been accelerated by the far more rapid development of wind power than envisioned in the Council's plan. An increasing amount of this development is driven by California utilities seeking renewable resources to meet California's renewable portfolio standard. Bonneville and other Northwest balancing authorities are faced with integrating large amounts of wind power quickly. Some see the need to add generation to provide the reserves needed to accommodate intermittent wind energy. Others see significant potential for operational changes that will release the latent wind integration capability of the existing power system. These changes involve new ways of coordinating and sharing transmission. In a region (the Northwest Power Pool) that includes 17 separate balancing authorities such changes are difficult to achieve and, although organizations are working on these changes, may take time to accomplish.

Ken Dragoon and Rachel Shimshak of the Renewable Northwest Project will discuss wind integration and describe their views on the most cost-effective ways to provide needed wind power integration capability. For information about the Renewable Northwest Project see their web site at <http://www.rnp.org/default.html>.

Northwest Wind Integration Progress Report



Rachel Shimshak & Ken Dragoon
Renewable Northwest Project
503-223-4544
www.RNP.org



Renewable Northwest Project (RNP)

Objectives:

Proper siting, advance policies that promote new renewables, expand retail markets.

Geography: OR, WA, ID, MT

Members: Business, non-profit, educational

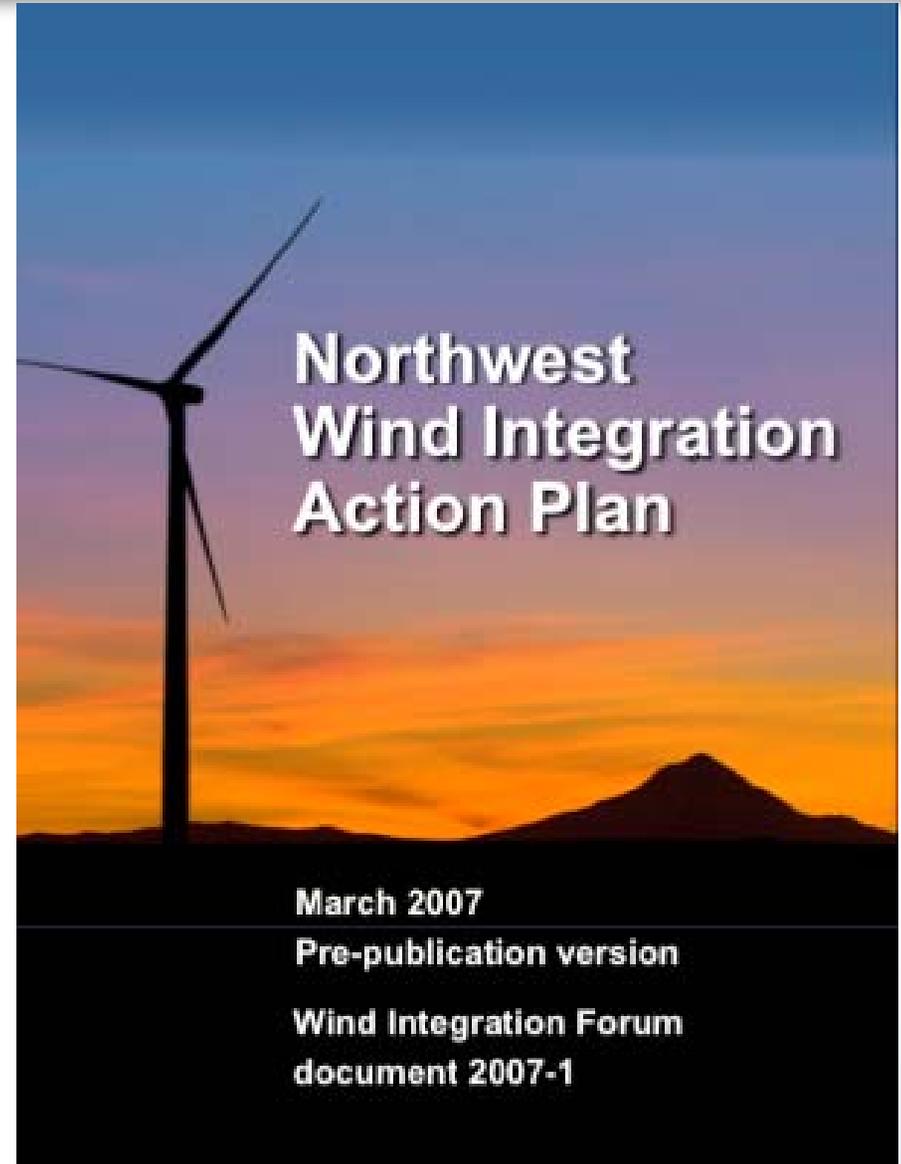


Overview

- Power Council's NW Wind Integration Action Plan.
- Wind industry growth- regional, national, and global.
- Addressing operational issues
 - ◆ Most significant wind issue today- handling surplus power.
 - ◆ Wind power forecasting- state of the art.
 - ◆ Cost mitigation toolkit.
- Ongoing work.

Integrating Wind on NW Power Systems

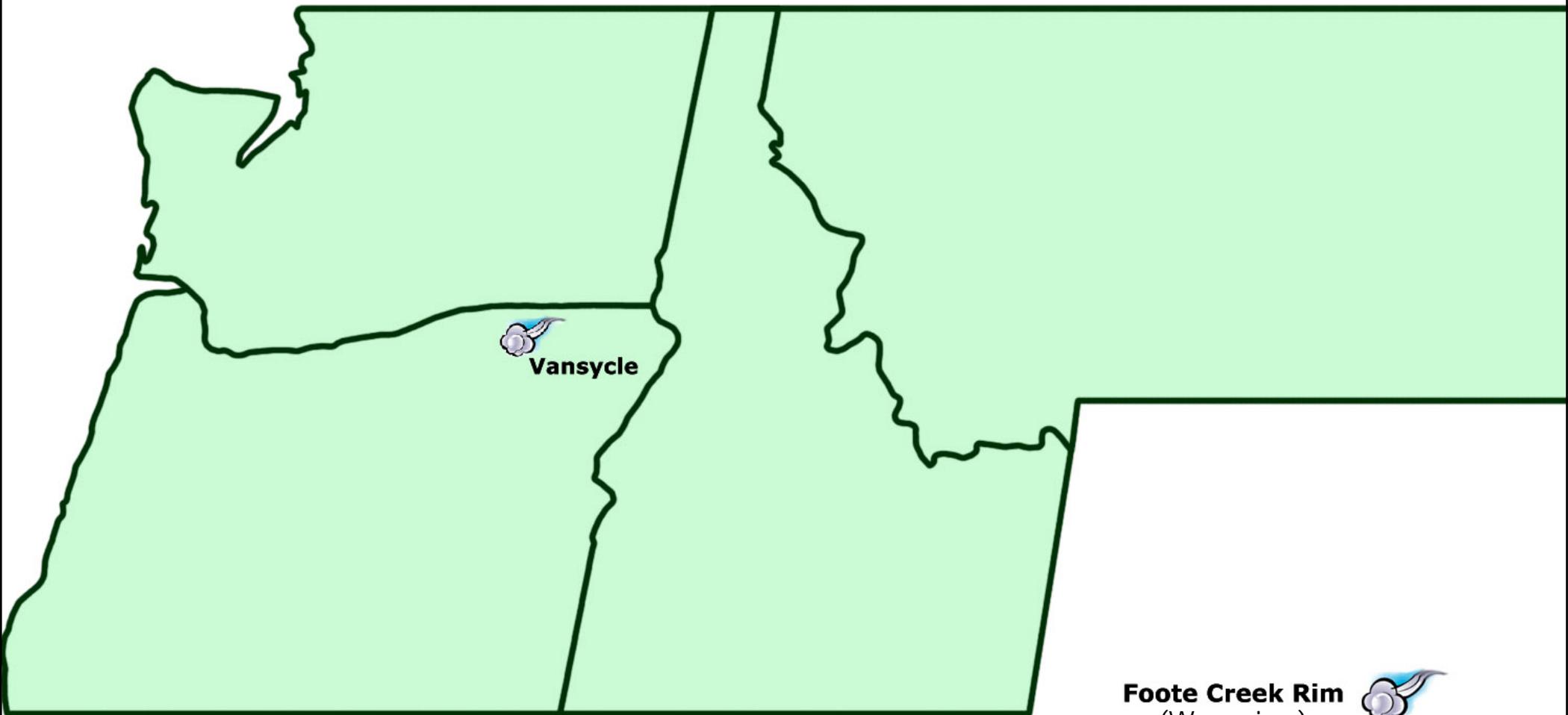
- Regional report addressed whether 6,000 MW of wind can be integrated in NW.
 - ◆ Findings:
 - Yes!
 - 16 Action Items designed to minimize wind integration cost.



Wind Industry Growth

- Economic source of clean energy with no dependence on volatile fuel prices.
- DOE study finds 20% of electric power consumption can be met by wind power.
- Today, wind constitutes just a few percent of Northwest generation.
- Institutional and operational changes will likely be needed to efficiently and effectively accommodate 20% wind.

Renewable Energy Projects in the Northwest 1998

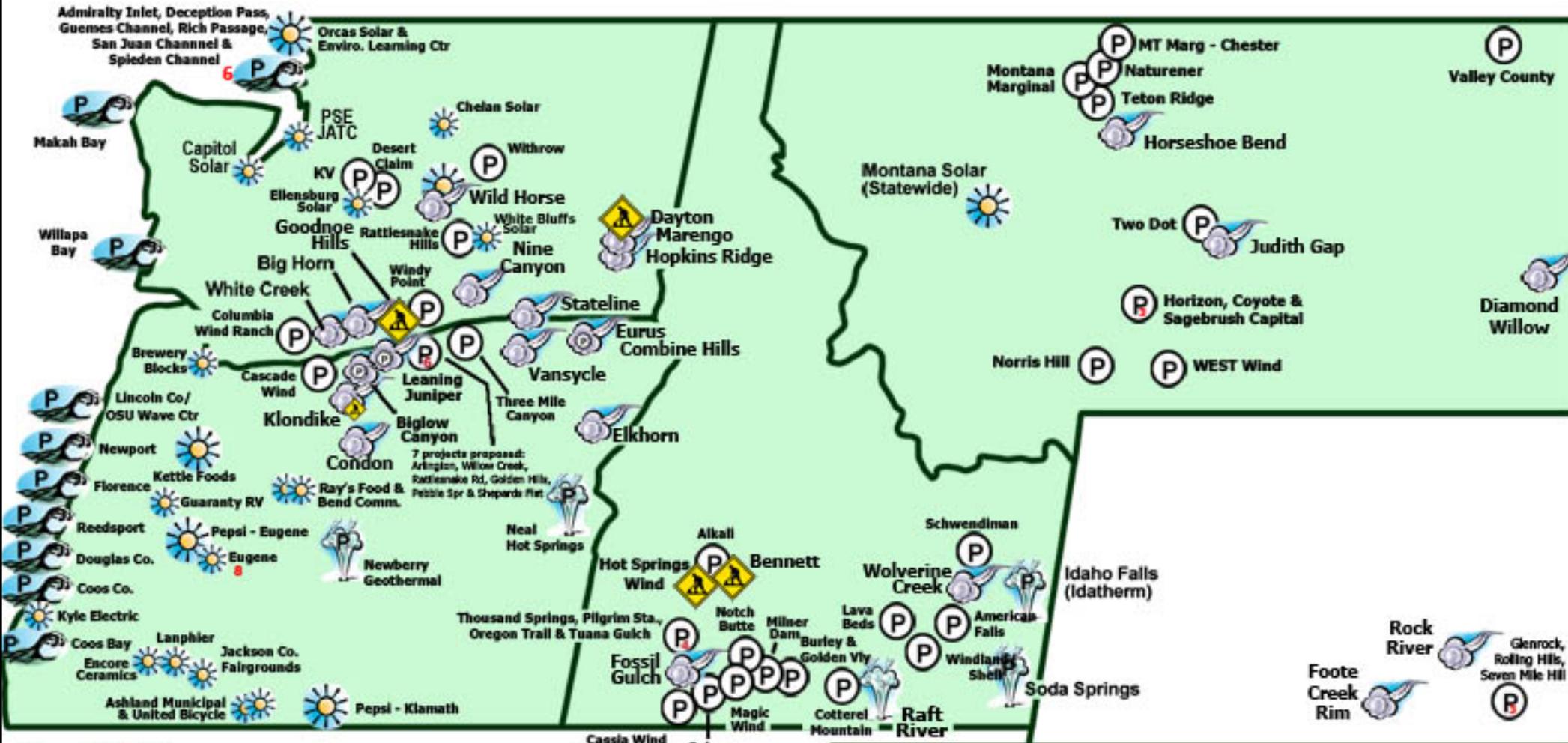


Foote Creek Rim 
(Wyoming)

 **Wind - Operating**

Renewable Energy Projects in the Northwest

April 2008



8 Eugene Solar Projects
 Pacific Coop, AEC,
 West Wind Forest,
 Tamarack, Chase Garden,
 Sweet Life, Mkt of Choice
 & UO Lillis Complex

 Glass Mountain

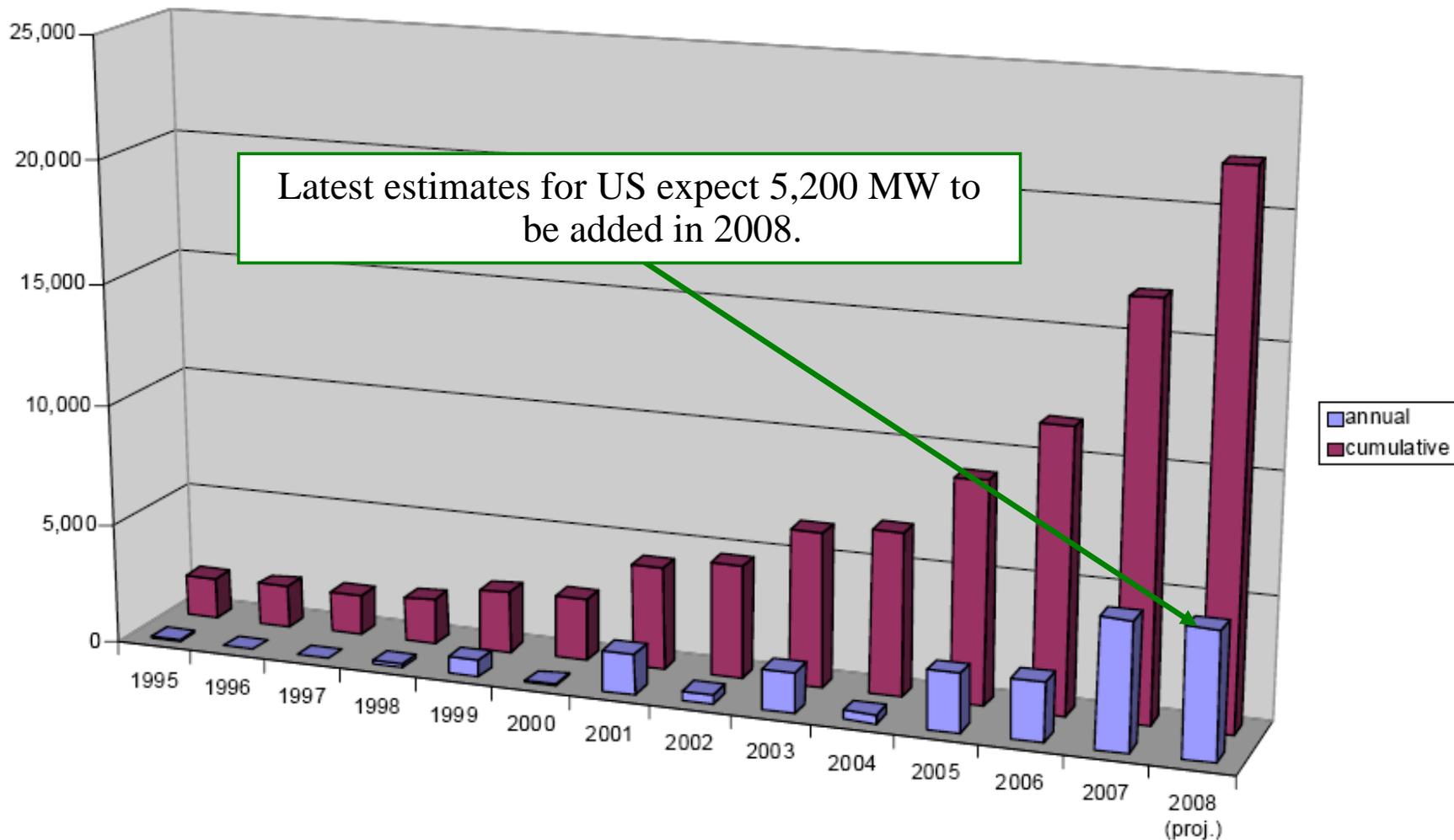
Legend

	Wind - Operating		Geothermal - Operating
	Wind - Construction		Geothermal - Proposed
	Wind - Proposed / Env Review		Solar 20-99 kW
	Wave / Tidal - Proposed		Solar >100 kW

Last Updated 04/2/08

US Wind Increasing 45% in 2008

U.S. Wind Power Capacity, Annual & Cumulative (MW)



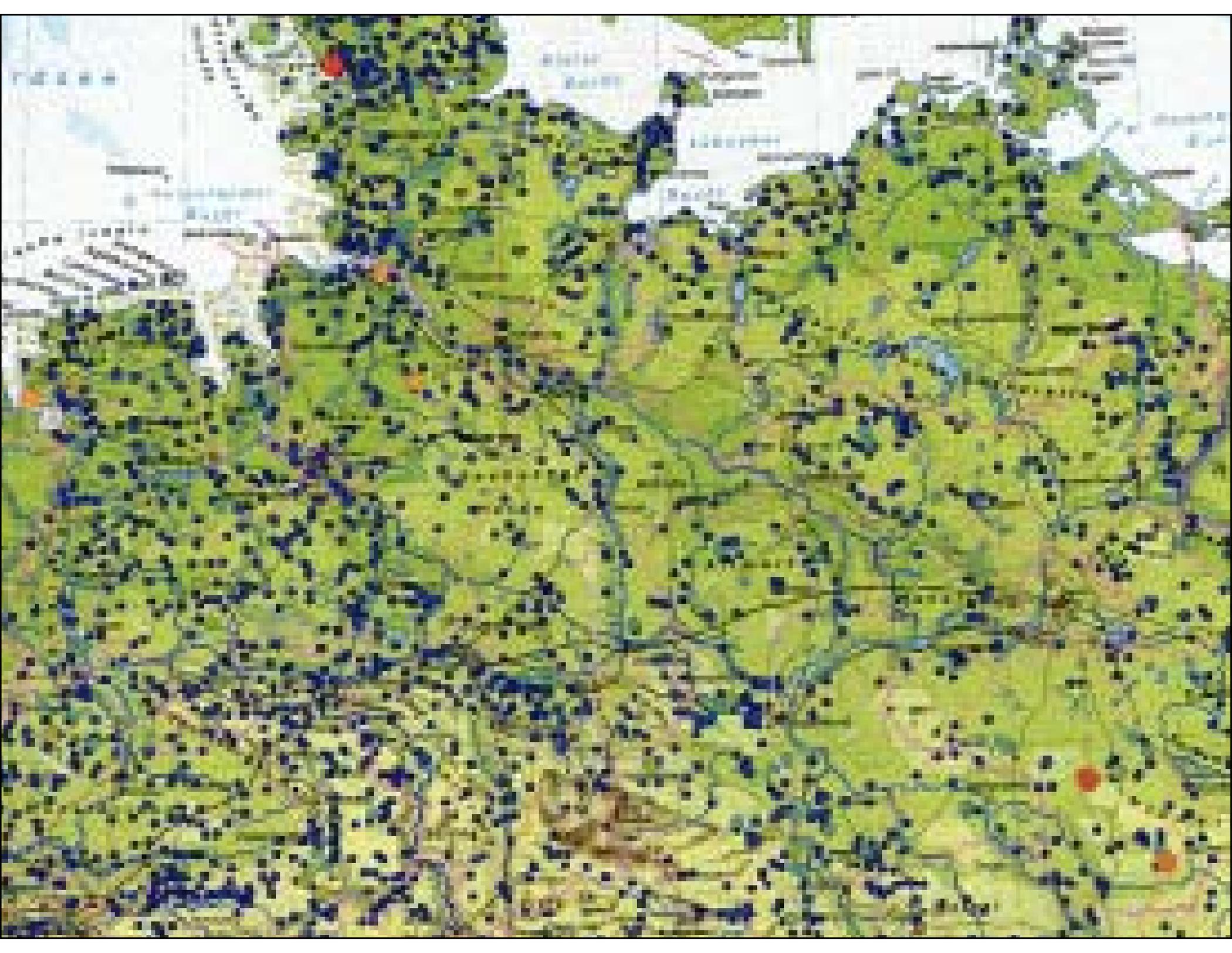
...And Europe is Ahead of US

- Germany is Number One with more than 22,000 MW of wind, serving 7% of German demand.
- Spain has 14,000 MW of wind on a 45,000 MW peak system with a weak (2,600 MW) interconnection, serving 10% of all demand-- going to 20,000 MW by 2010.
- Ireland targets 33% of load to be met by wind power.

Closer to home, the Big Island of Hawaii serves 9% of its energy demand with wind.



German wind projects across the country-- with average capacity factors roughly half that of the US.

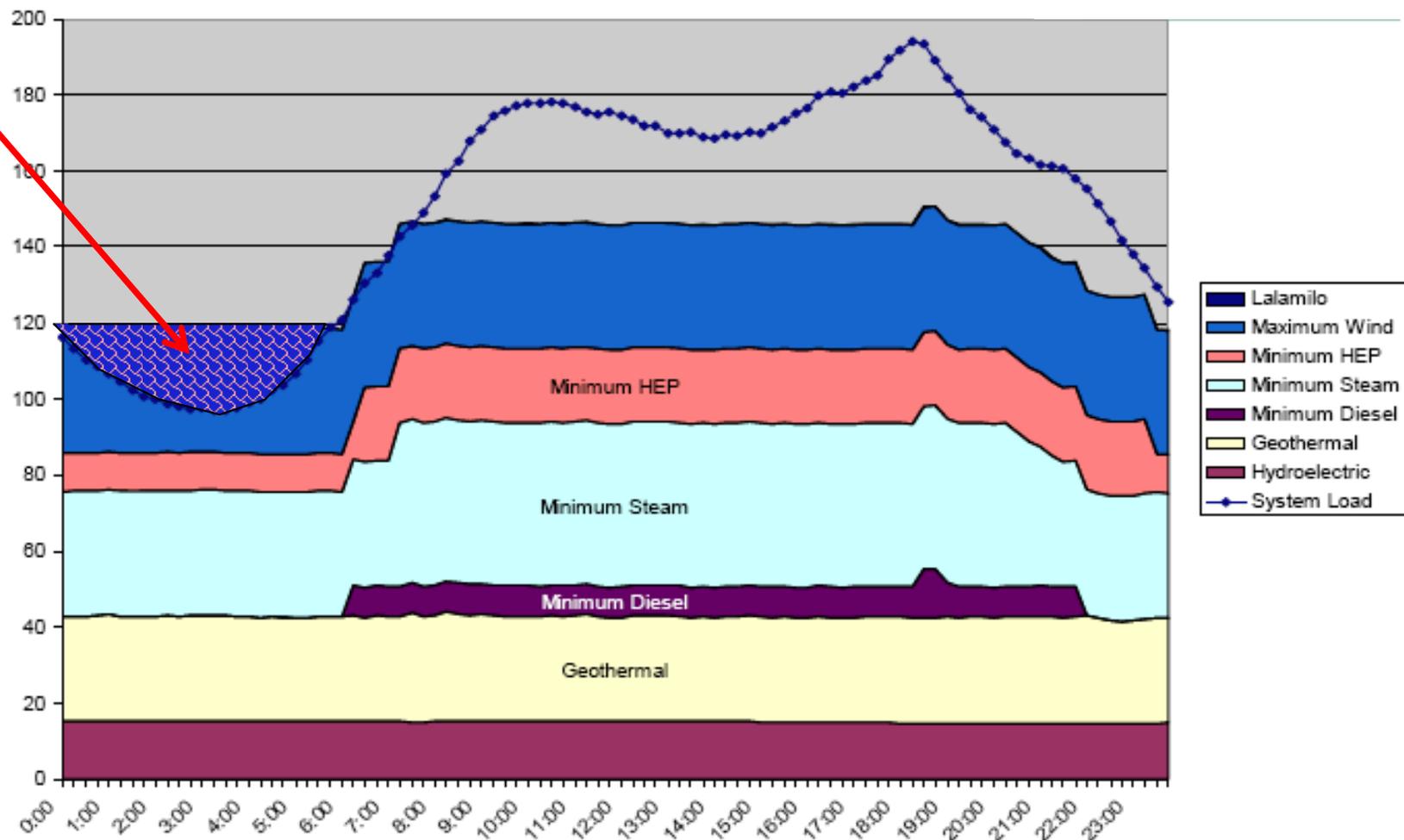


Biggest Wind Issue

- Perhaps commonly thought to be meeting high winter loads during calm days, the biggest operational issue is excess production when wind experiences rapid increases.
 - ◆ Utilities are not counting on wind to meet peak demand.
 - ◆ Primary value proposition is as an energy resource, displacing fossil generation.
 - ◆ Progress being made to share the surpluses on a more regional scale during high wind events.
 - Great opportunity for smart grid, demand response programs.

Biggest Issue is High Wind During Light Load Hours Island of Hawaii Example

High wind during low load hours may exceed system ability to responsibly back down other resources-- spilling the wind may be necessary-- active load management and reserve sharing are other possibilities.



Wind Concerns/Misconceptions

- “Wind is too variable and can’t be predicted.”
 - ◆ **Fact: Wind is somewhat variable, and somewhat predictable.**
 - Variability of wind is similar to variability of loads, and addressed in similar ways by system operators.
 - Wind forecasts are based on weather models that do a pretty good job on temperatures, less well on precipitation. Wind forecasts are more accurate than precipitation, but less accurate than temperature.
- “Wind Needs to be ‘backed up’ by other resources.”
 - ◆ **Facts:**
 - Generation is added to serve load, not other generators. Wind likely brings little to no additional “peaking capability”, but when the wind blows, other resources are displaced with resulting savings in fuel costs and emissions--wind is primarily an energy resource.
 - Most utilities find the biggest challenge with wind is an overabundance of generation when loads are lows.

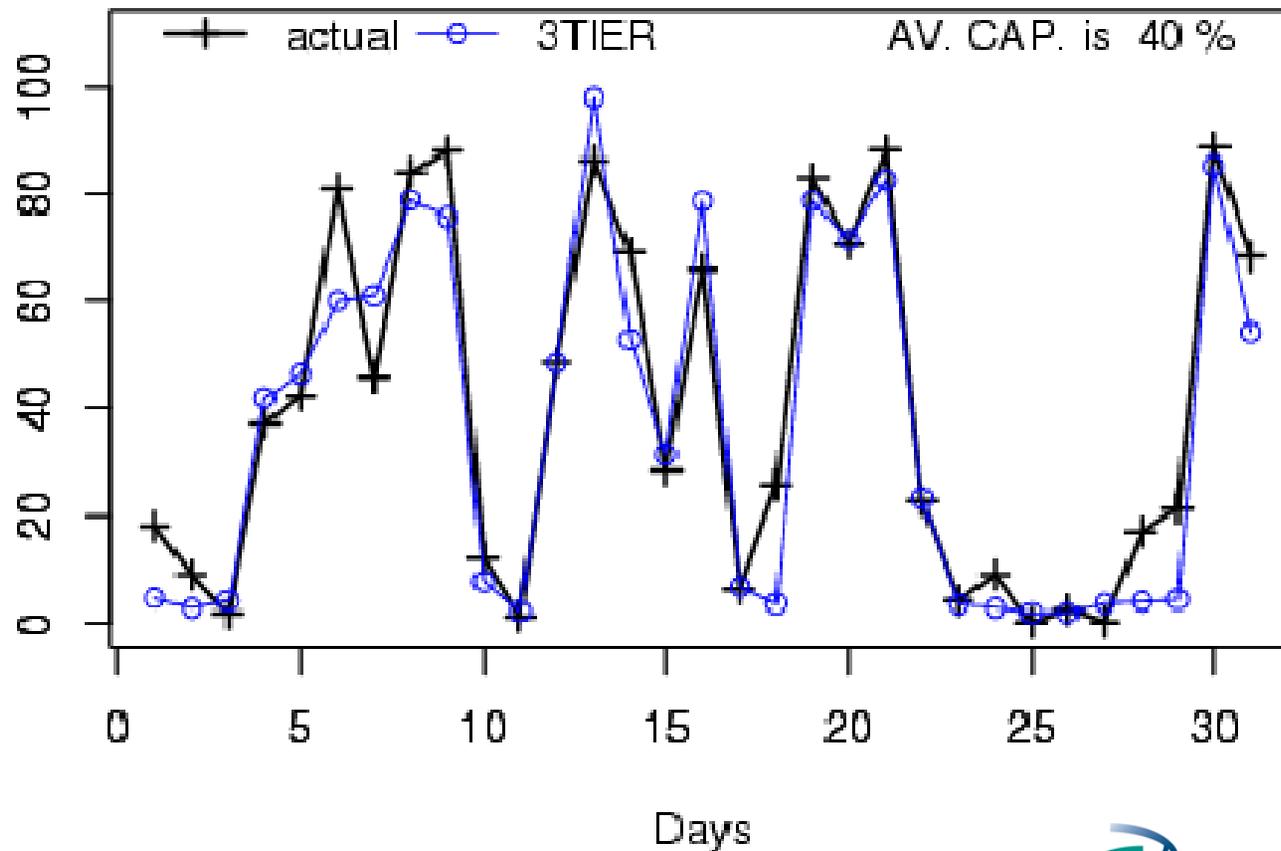
Wind Forecasting

- Common misconception is that wind cannot be forecast.
 - ◆ Forecast tools are improving, and a whole industry has sprung up to provide forecast services based on advanced weather models, and hybrid weather-statistical models.
 - ◆ The best forecast tools will take regional pooling of wind data, and more meteorological data stations.
 - ◆ One of the premier, and rapidly growing wind forecasting services is located in Seattle.
- A significant impediment to better forecasting has been lack of price signals.
 - ◆ The value of schedule accuracy is only now becoming evident.

Wind Can be Forecast

Day Ahead Forecast Example

Actual Day-Ahead Energy Forecast for NW Wind Farm



Improved hour-ahead forecasts are needed, but may require region-wide sharing of wind data.

Operational Challenges

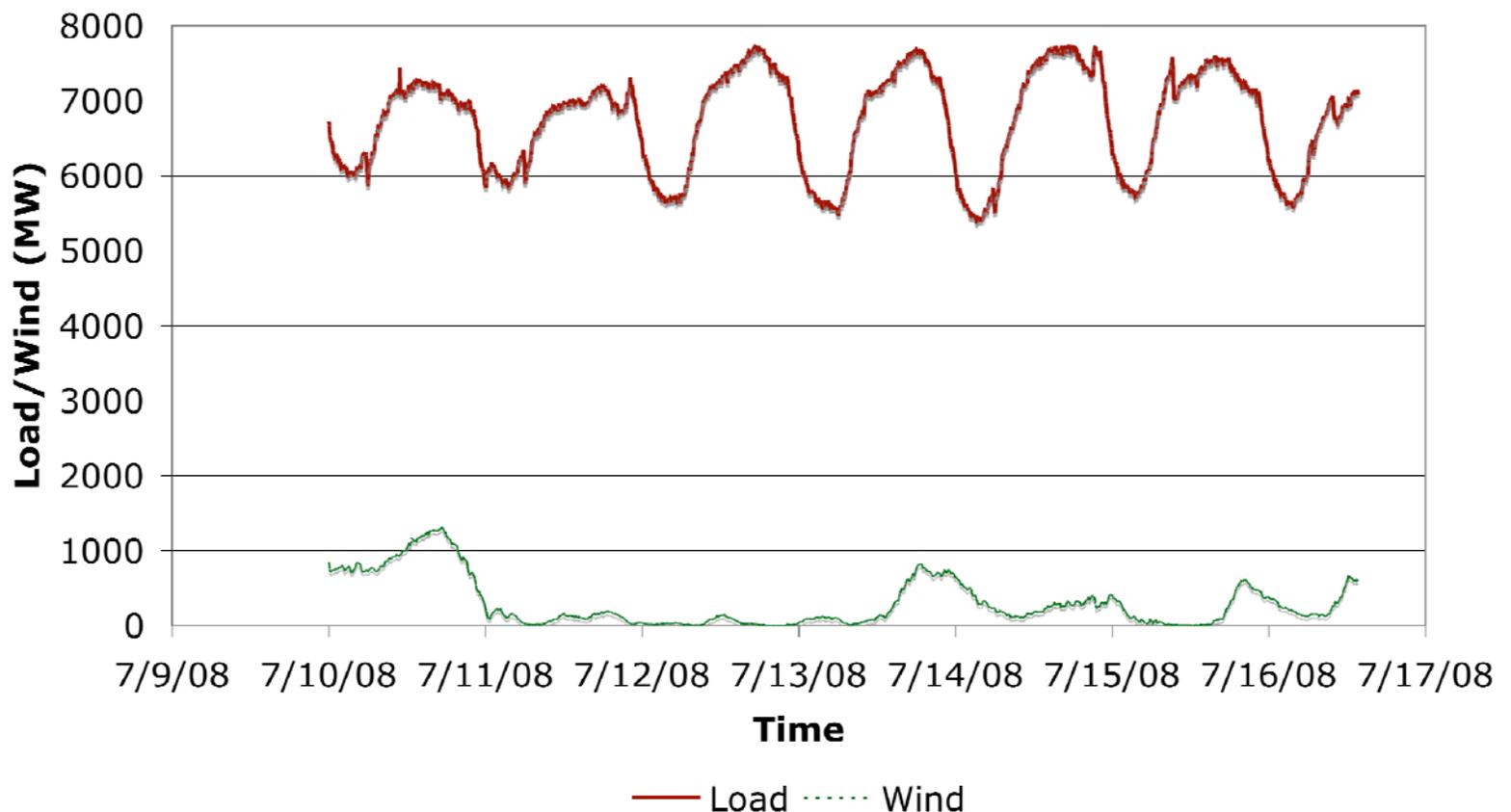
- Northwest wind variability is currently small compared with the dynamic range of demand on most hours.
- Wind variability is accommodated primarily by increasing or decreasing other generation.
 - ◆ In general, existing storage capability of hydro system, gas pipelines and storage fields, and coal piles is sufficient.
- Rapid wind ramp events can be accommodated by better forecasting and limiting wind to schedules when necessary.

Relative Effects of Wind and Load Example

The dynamic range of loads is greater than the wind variability on most hours.

Much of the variability is accommodated by recipients of the wind power, and not BPA.

Recent Week of BPA Load and Wind Generation

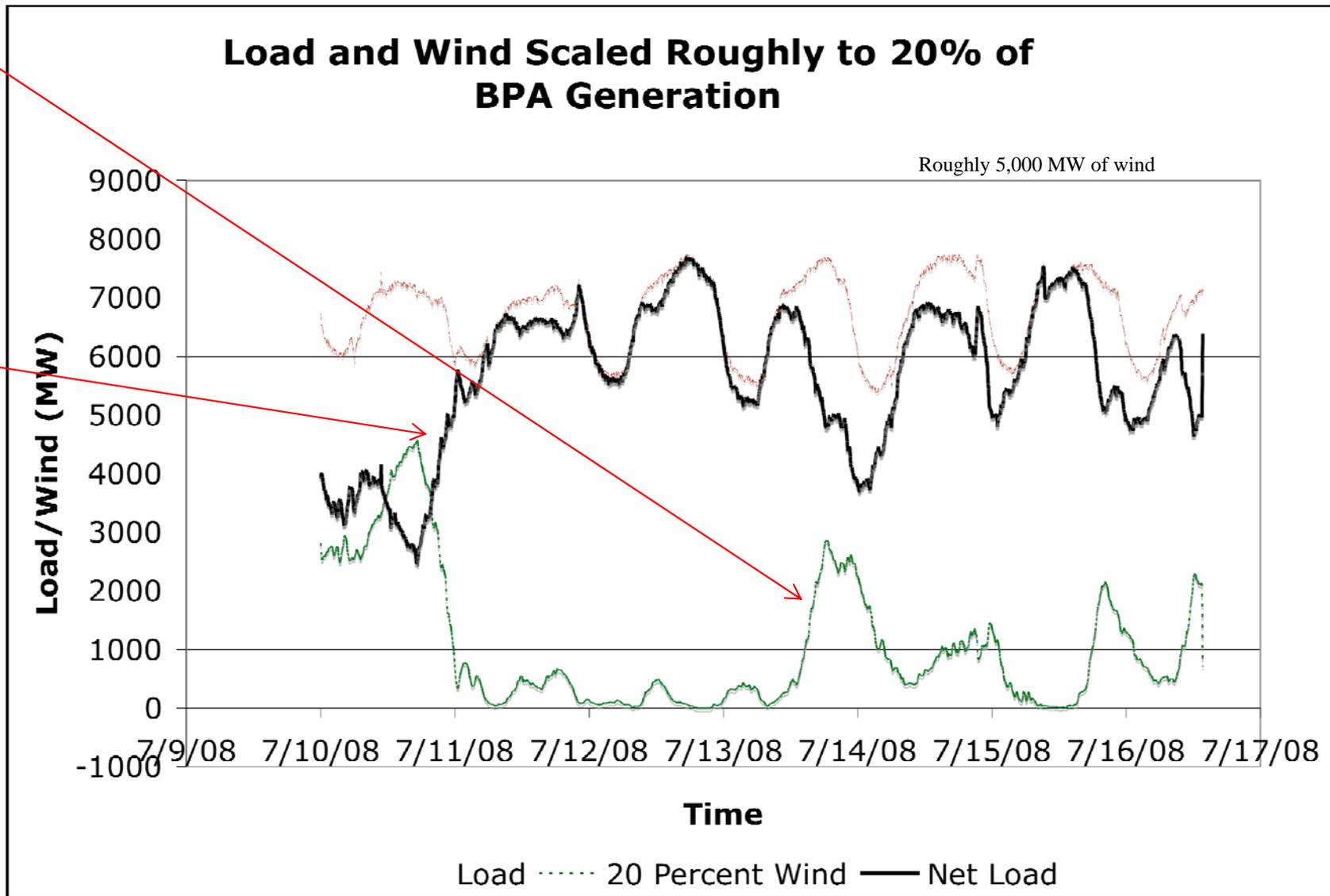


Anecdotal Look at a 20% Wind System

A Recent Week of NW Wind and Load

Same week with
~5,000 MW of
wind serving
equivalent of 20%
of BPA load.

Net load after
subtracting wind
to be served by
balance of the
power system.

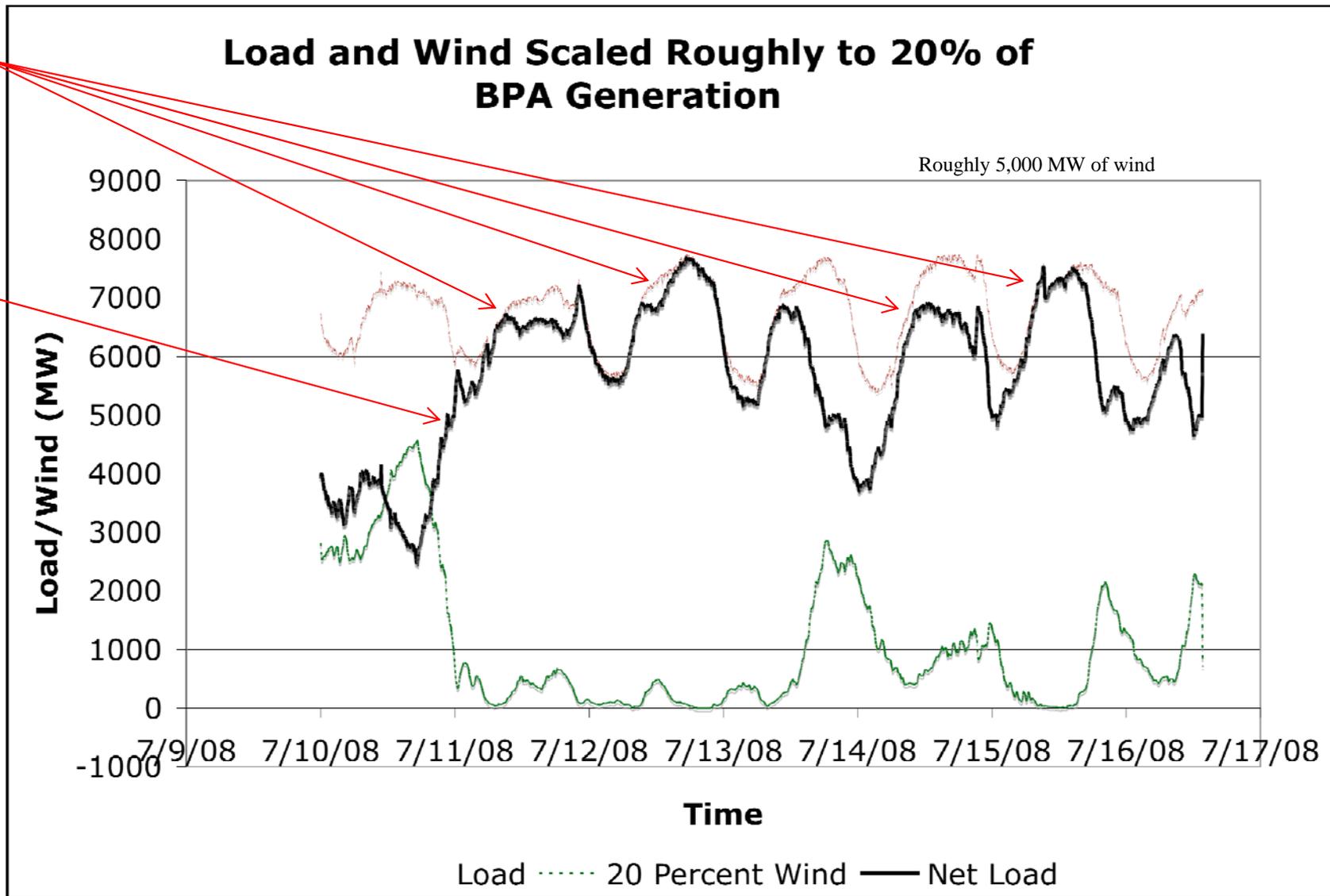


Anecdotal Look at a 20% Wind System

A Recent Week of NW Wind and Load

Net load shape relatively similar to existing shape on most hours.

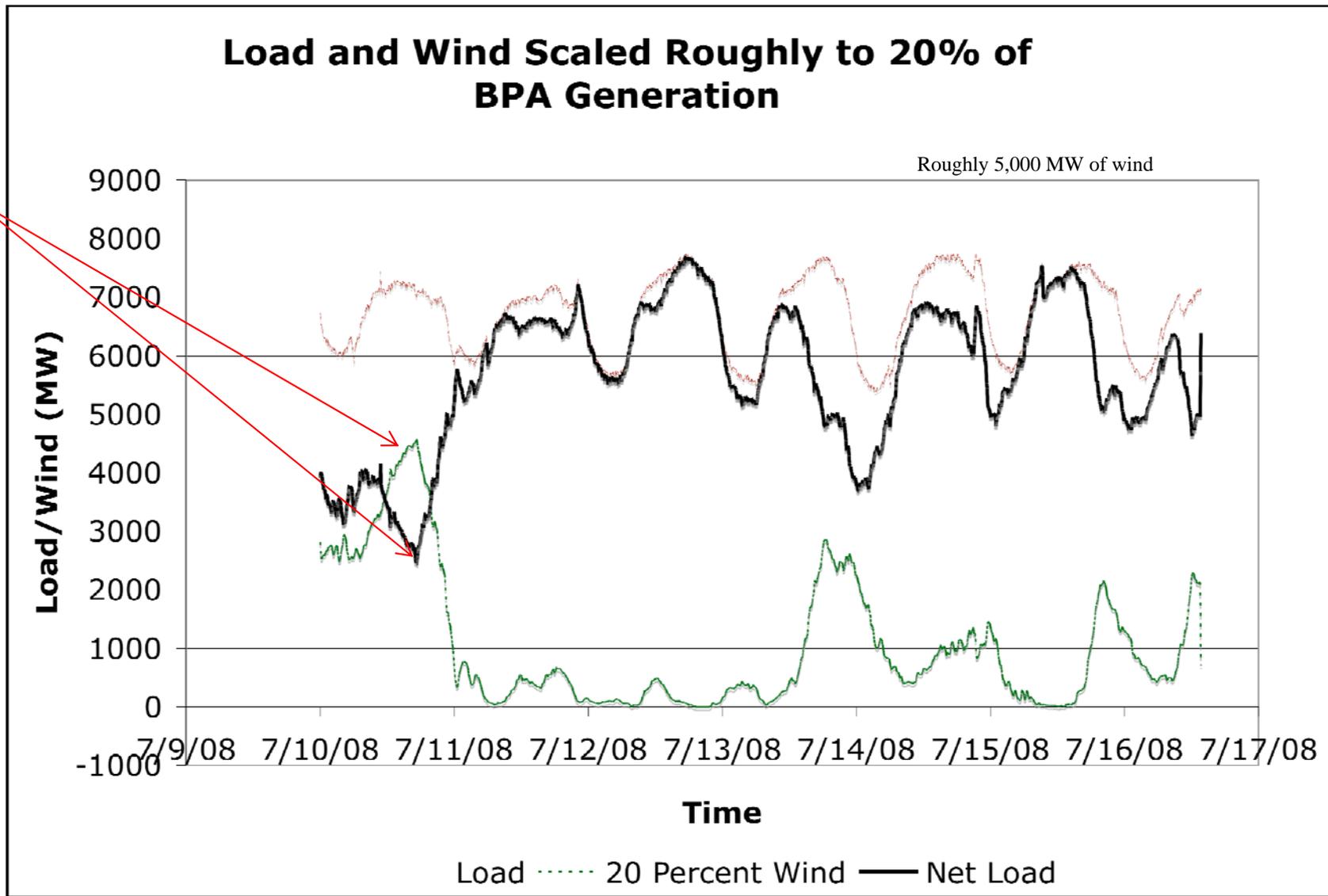
Faster ramp rates may be needed to accommodate rapid changes in wind output due to fast moving weather systems.



Anecdotal Look at a 20% Wind System

A Recent Week of NW Wind and Load

Especially high levels of wind generation may at times require off-system sales, third party dispatchable loads and resources, spilled energy, and better forecast capability.



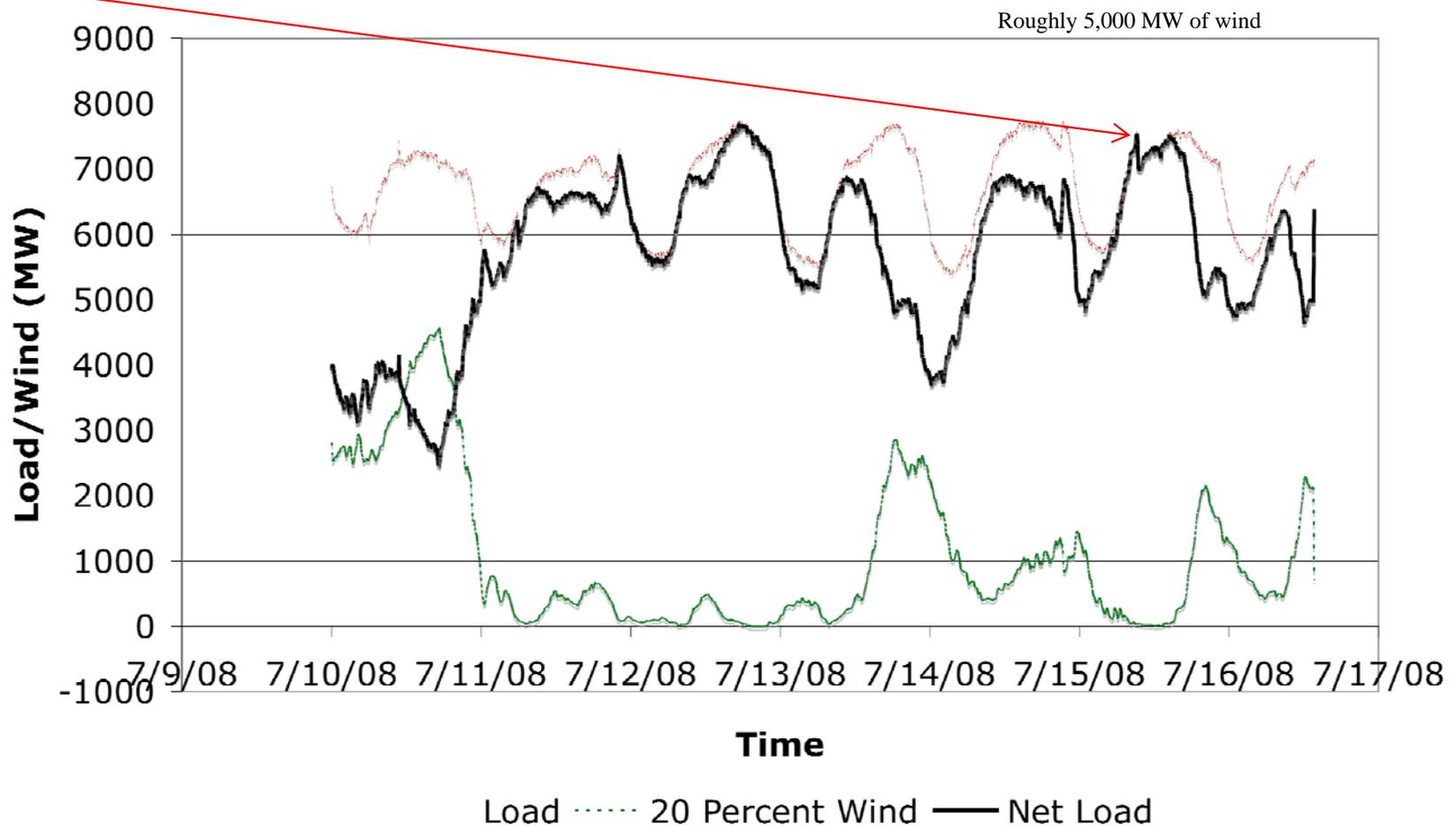
Anecdotal Look at a 20% Wind System

A Recent Week of NW Wind and Load

Additional capacity is not likely to be needed-- net load is no greater than load absent wind.

Generally, wind is expected to be relatively calm during extreme weather events-- resulting in very small impacts to system operations during peak loads.

Load and Wind Scaled Roughly to 20% of BPA Generation



Smart Grid Applications

- Dispatchable loads may be more cost effective way to handle wind variability than with dispatchable generation.
 - May combine with domestic solar hot water applications, or district heating.
- Will likely be needed to efficiently and economically reach the DOE 20% wind study level.

Cost Mitigation- Many Tools

- Wind integration costs can be vastly reduced from current estimates:
 - ◆ Intra-hour power trading
 - WSPP contract development
 - BPA & Grant County PUD)
 - BPA RFI for Third Party Ancillary Services
 - BPA proposal to adjust schedules within operating hours.
 - Reserve Sharing Among Balancing Authorities
 - ACE Diversity Interchange (ADI) Project
 - Joint Initiative proposal for within-hour balancing area trades.
 - ◆ Dispatching wind
 - ◆ Define rapid wind ramp events as contingency events.
 - ◆ Improvements in wind forecasting capability.
 - ◆ Demand response programs.

Help Wanted!

- Wind integration is the topic du jour, but there are many (mostly institutional) solutions being pursued that will greatly reduce the ultimate cost and increase the ability to accommodate wind on the system.
- What is missing is a plan for how the power system we have today evolves to a low carbon, renewable based energy future. The Council has an opportunity in the Sixth Power Plan to lay out a framework for the institutional, economic, and technological means to reach that future.

Other Resources

- *Northwest Wind Integration Action Plan Report*
 - ◆ <http://www.nwcouncil.org/energy/Wind/library/2007-1.htm>
- Utility Wind Integration Group
 - ◆ UWIG works on all aspects of wind integration, www.uwig.org
- *Working with Wind: Integrating Wind into the Power System*
 - ◆ IEEE Power & Energy Magazine, November/December 2007, Vol. 5, Number 6.
- *Wind Power in Power Systems*
 - ◆ Thomas Ackermann, Editor, John Wiley & Sons, Ltd., 2005.

Questions?

Iberdrola Renewables Stateline Wind Project

Photo courtesy Renewable Northwest Project