

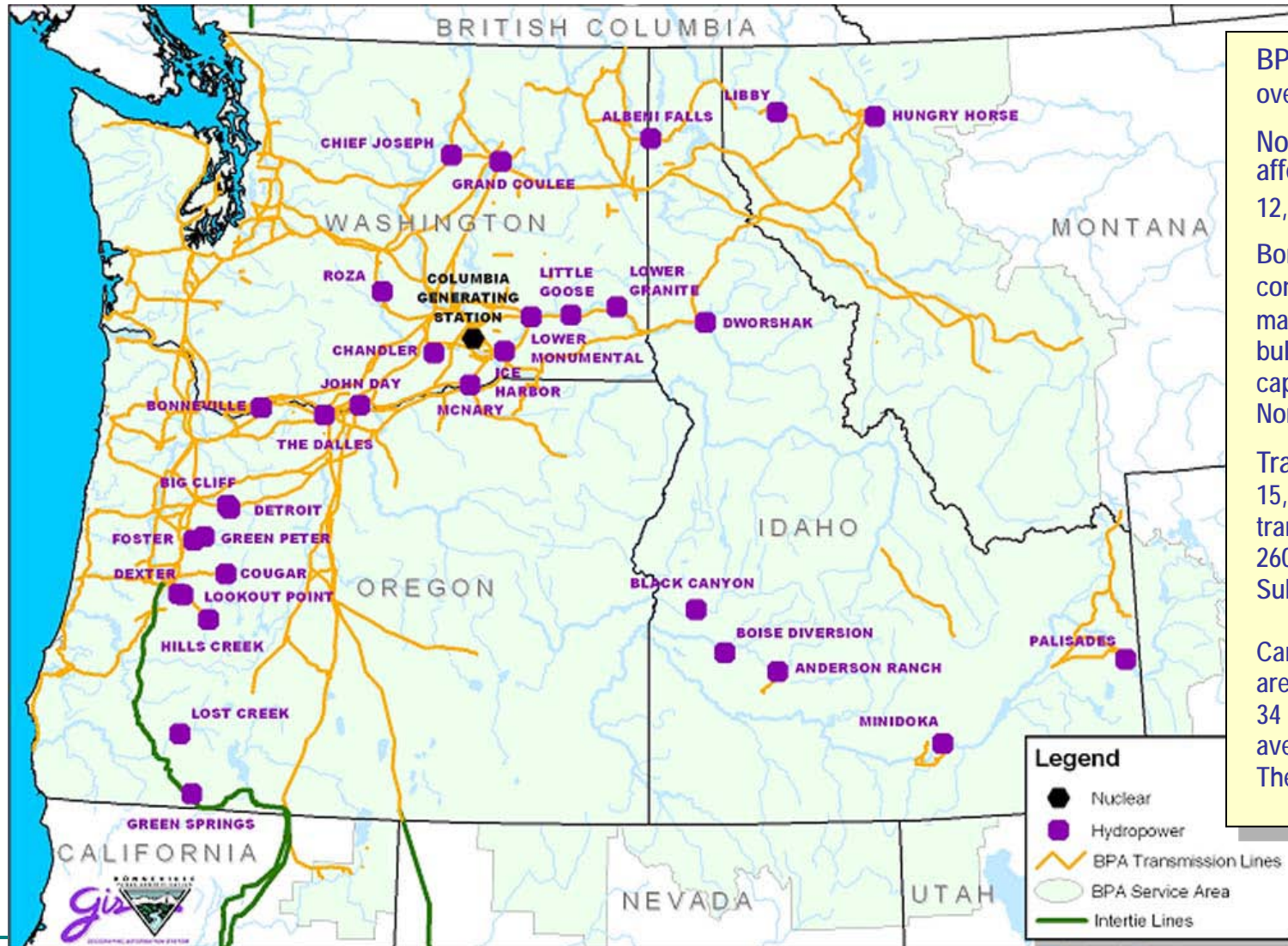
Pumped Storage and Integration of Renewable Resources



**National Hydropower Conference
2010
April 27th, 2010**



Federal Columbia River Power System Generation & Transmission – System Map



BPA's service area:
over 300,000 sq. miles

Northwest population
affected:
12,434,934 people

Bonneville has
constructed and
maintains 75% of the
bulk transmission
capacity in the Pacific
Northwest

Transmission System:
15,191 circuit miles of
transmission line and
260 BPA-owned
Substations

Canada has 15% of basin
area but provides 30% of
34 million acre feet (maf)
average annual flow at
The Dalles



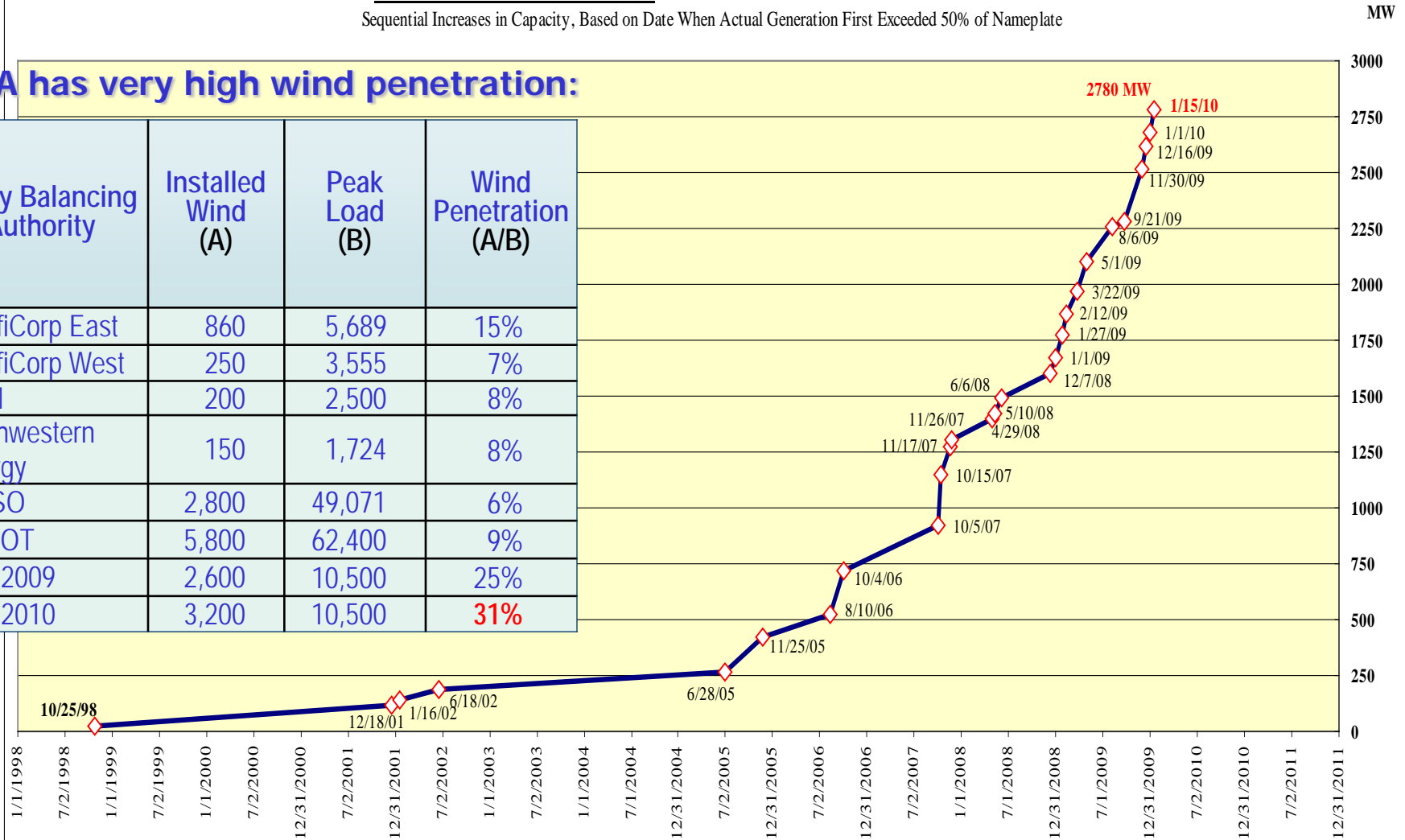
Wind Power is Growing Fast

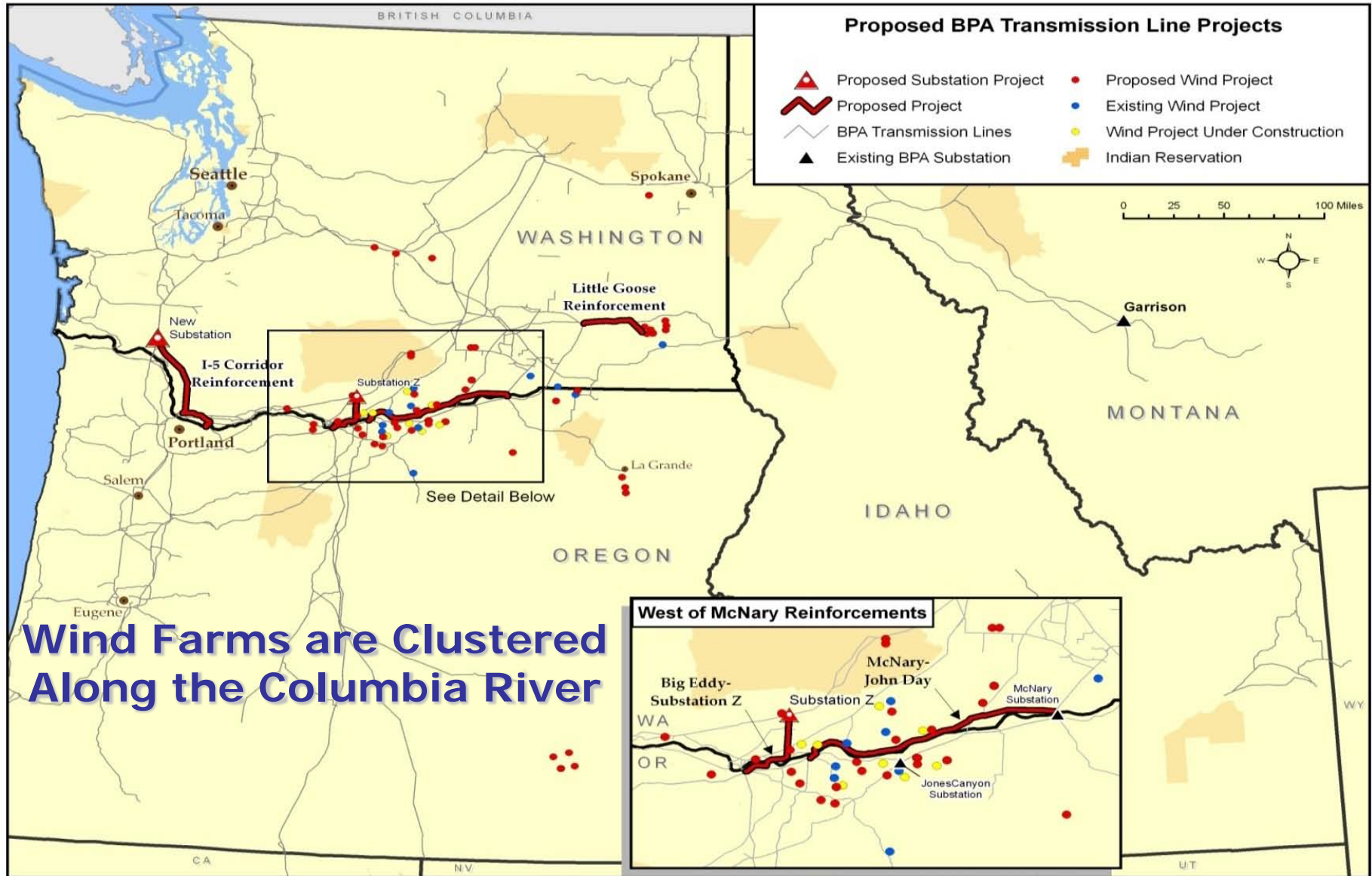
WIND GENERATION CAPACITY IN THE BPA BALANCING AUTHORITY AREA

Sequential Increases in Capacity, Based on Date When Actual Generation First Exceeded 50% of Nameplate

BPA has very high wind penetration:

Utility Balancing Authority	Installed Wind (A)	Peak Load (B)	Wind Penetration (A/B)
PacifiCorp East	860	5,689	15%
PacifiCorp West	250	3,555	7%
PNM	200	2,500	8%
Northwestern Energy	150	1,724	8%
CAISO	2,800	49,071	6%
ERCOT	5,800	62,400	9%
BPA 2009	2,600	10,500	25%
BPA 2010	3,200	10,500	31%

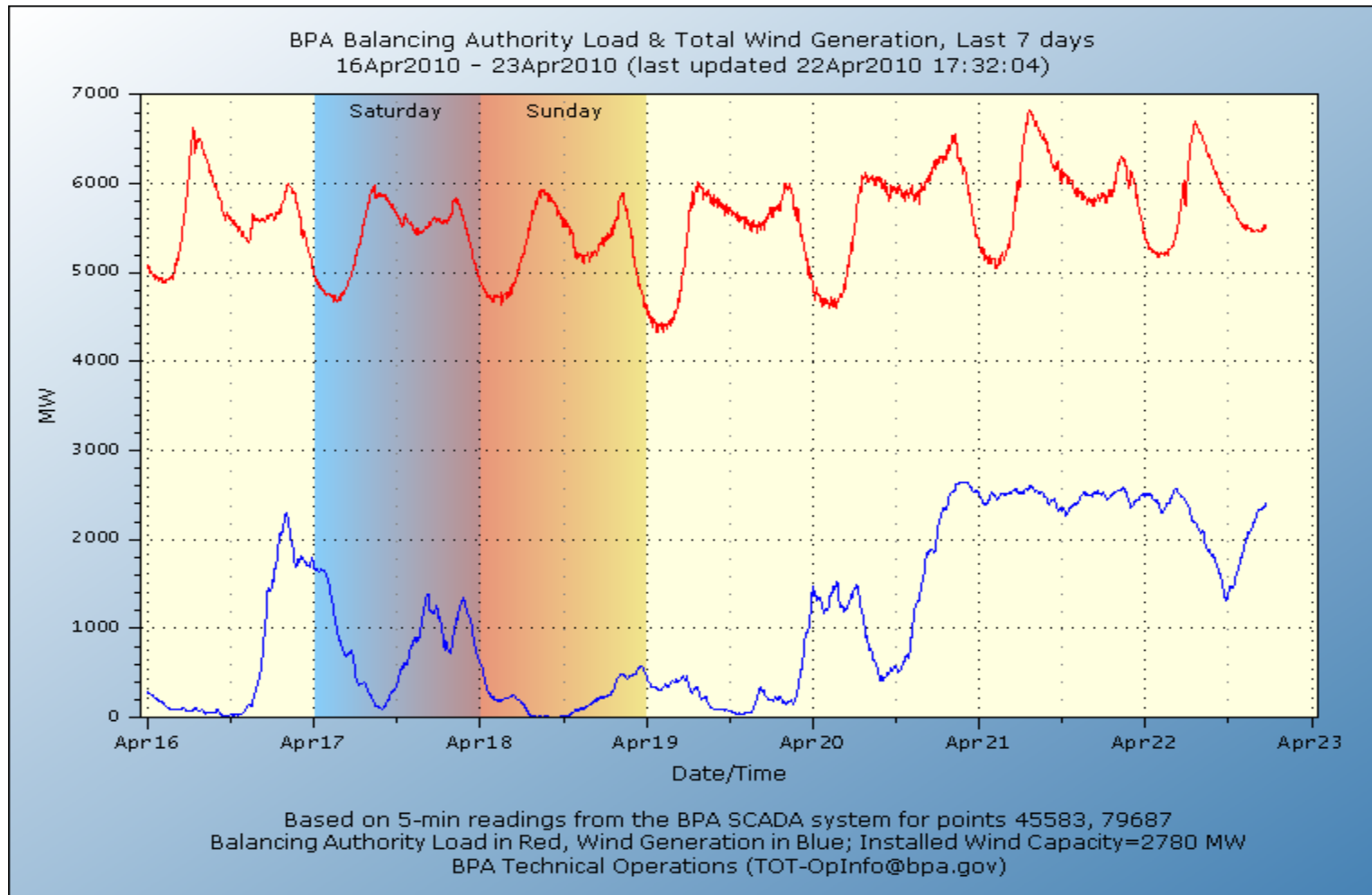




\\sqlp42\gis_data2\work\jake\SimpleWind_Projects_1119.mxd, Map date: 2/20/09



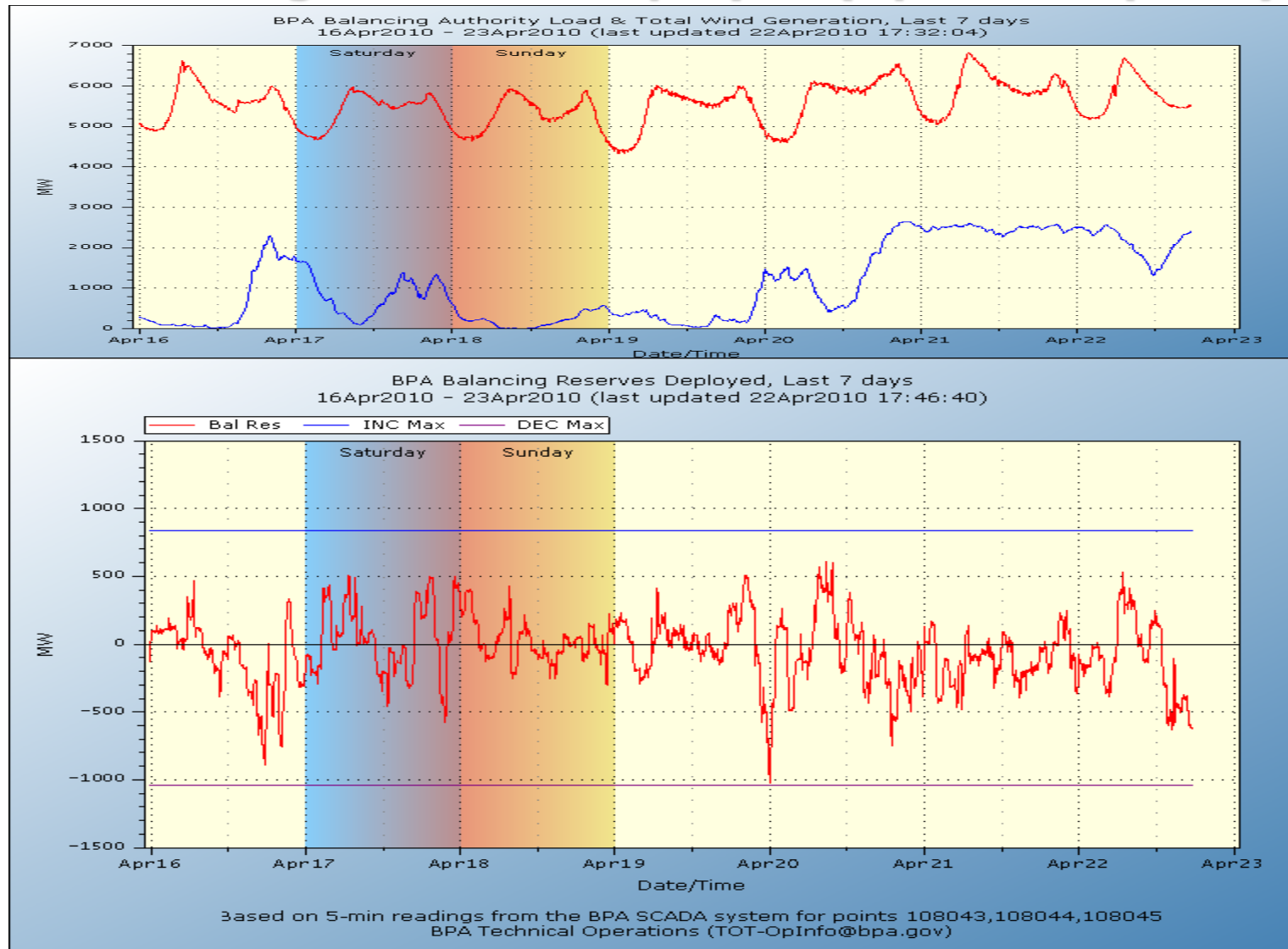
Recent Load and Wind Data (Apr 16 – Apr 23)



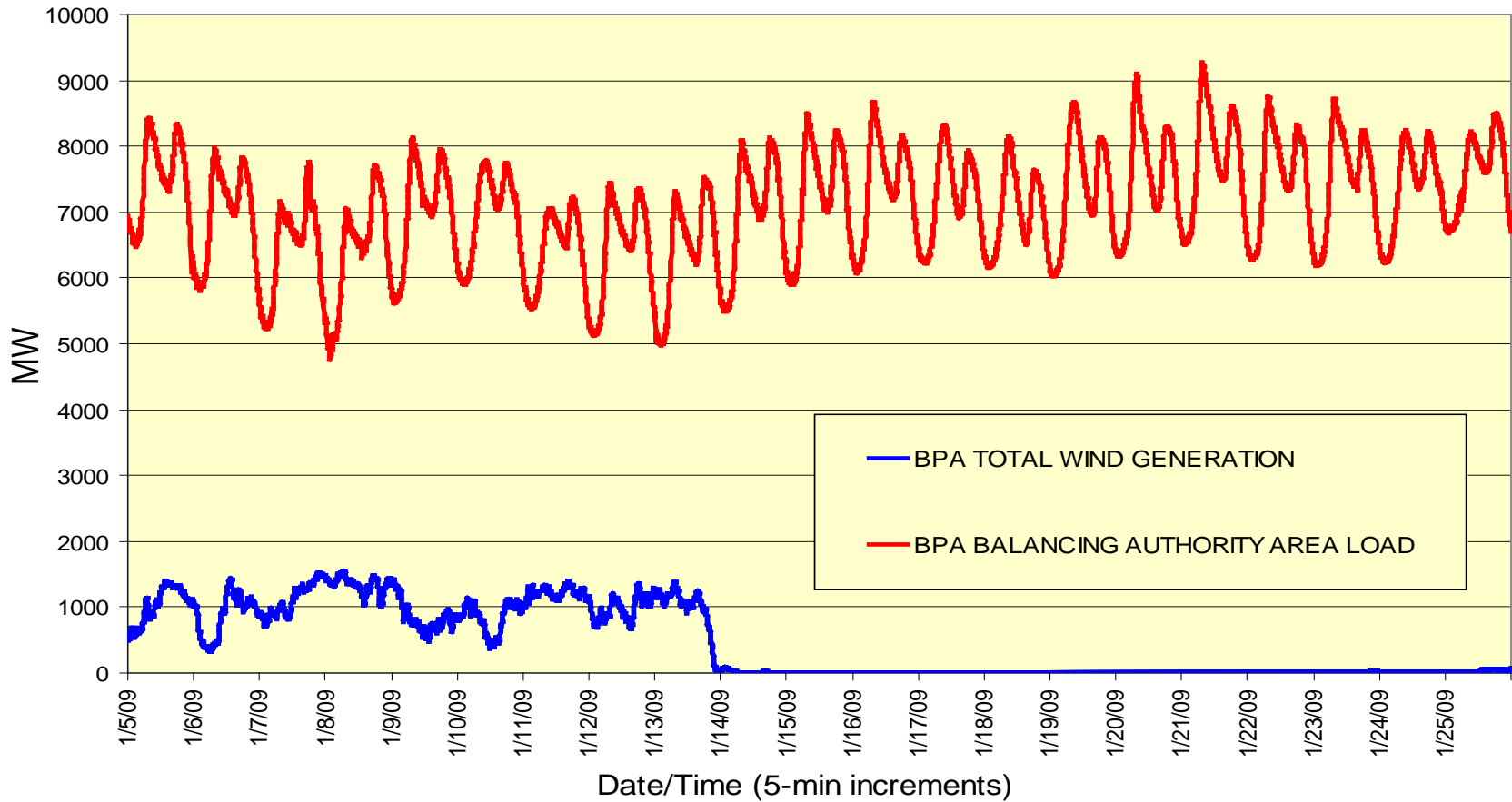
<http://www.transmission.bpa.gov/Business/Operations/Wind/reserves.aspx>



Balancing Reserves Deployed (Apr 16 – Apr 23)



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

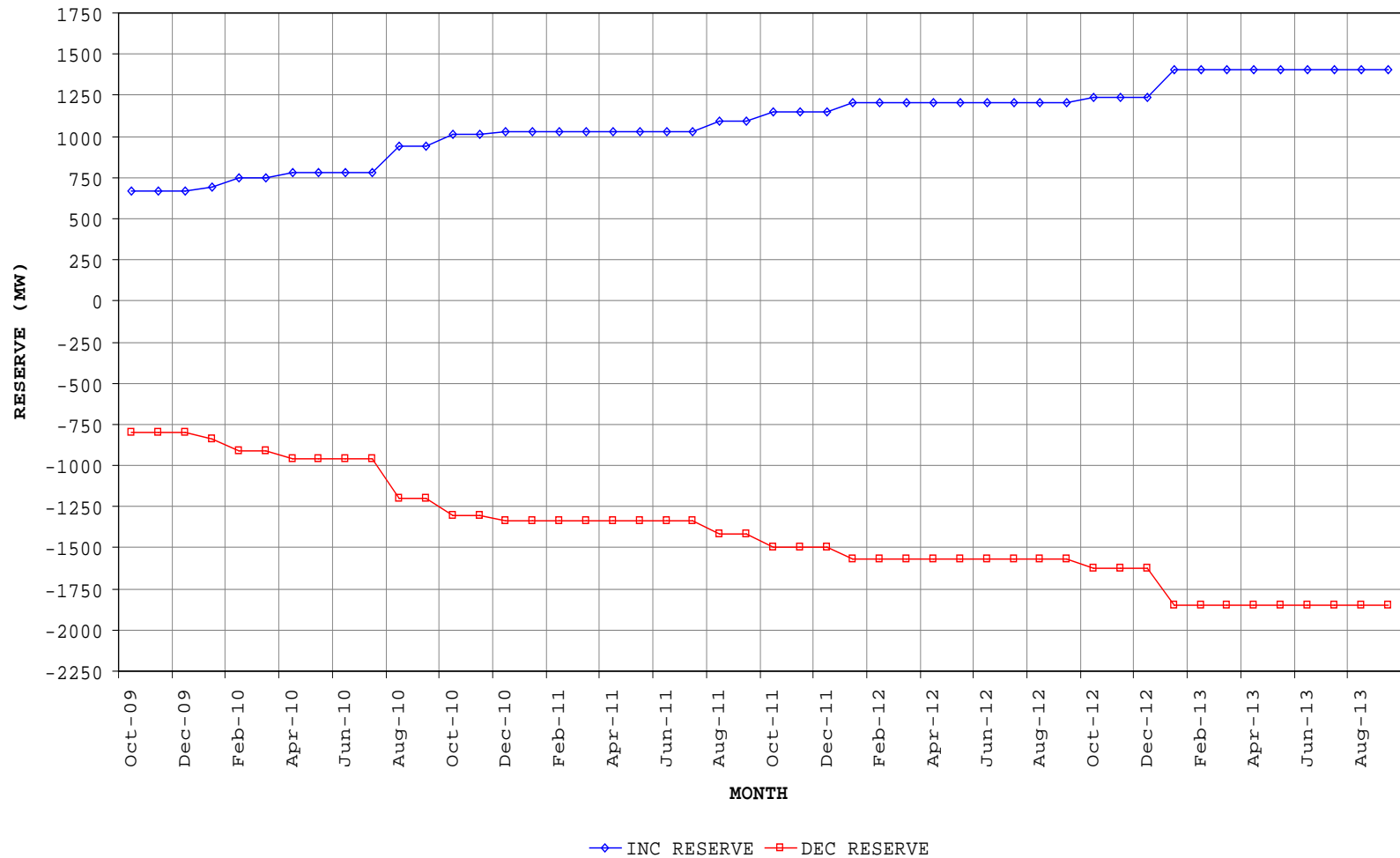


Wind started coming back on Jan 26 and peaked at nearly 1600MW on Jan 29.



Growing Flexibility Demands

EXPECTED RESERVE GROWTH



Long-Term Solutions

- Transmission additions to reach/blend diverse wind projects
- Continued scheduling improvements
- Explore virtual Balancing Area consolidation
- Enhanced storage capability:
 - Batteries
 - Pumped storage
 - Compressed air
 - Flywheels
 - Plug-in electric vehicles
- Conservation/Demand response/Smart Grid applications



Integrating Wind

with

**Pumped
Storage**

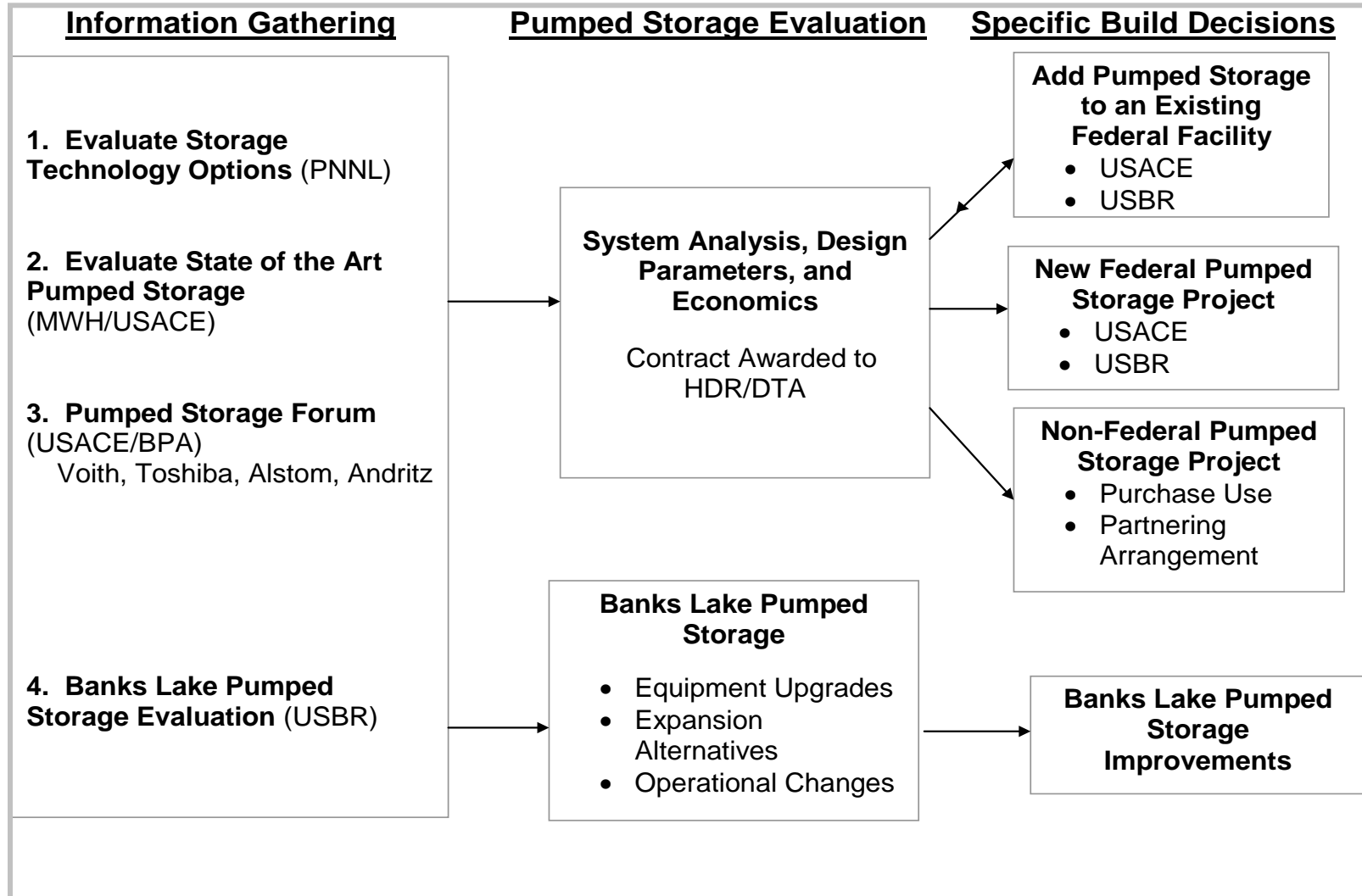


Energy Storage for Support of Wind Integration

- “I want to assure you the Administration places a priority on improving the Nation's capabilities to integrate renewable resources into its electricity supply. I support the full exploration of pumped storage potential in the context of providing necessary intermittent renewable integration services. Pumped storage has unique potential in the Pacific Northwest where a higher percentage of wind generation has already been integrated into the region's transmission system than anywhere else in the Nation.”
 - *U.S. Energy Secretary Steven Chu,*
in a letter to the Governors of Oregon, Washington, Idaho, and Montana; July 10, 2009
- The Northwest Power and Conservation Council draft 6th Power Plan points out that pumped storage is one of the few storage concepts with “bulk” storage potential.
- BPA’s draft Resource Program considers that pumped storage could provide BPA with a unique opportunity to return flexibility to the Federal hydro system.



BPA Pumped Storage Evaluation – Overall Plan



Questions ?



Questions ?

