

Preliminary Assumptions for Wind Technologies

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Today's Discussion

- Current status of wind development in the Pacific Northwest
- Recent trends in wind development and technology
- Open questions regarding regional wind build-out and future potential
- Next Steps
- Brief discussion on offshore wind

Current Status of Wind in PNW

- About 8,700 MW wind installed and operating in the PNW*
 - 13% of region's total installed generating capacity
 - Over 50% of total installed wind capacity is in BPA balancing authority
- ~2,000 MW new wind installed in 2012; not much development since



Mountain Air Wind Farm (138 MW) – Elmore County, ID
(Image courtesy of Terna-Energy)

* Includes PAC WY wind projects and projects serving load outside the region (CA, UT)

Current Installed Wind Projects



Courtesy Council webpage

What Drives Wind Development?

- State Renewable Portfolio Standards (RPS)
- Emission free resource with no fuel costs
- Federal and Regional tax credits and incentives for renewable resources
 - Federal Production Tax Credit (PTC)
 - 2.3 cents/kWh over first 10 years of operation
 - Investment Tax Credit (ITC) alternative
 - 30% towards developer's income tax for qualifying solar, fuel cell and small wind (<100kW); 10% for geothermal, CHP
 - BETC – just Oregon (now expired)

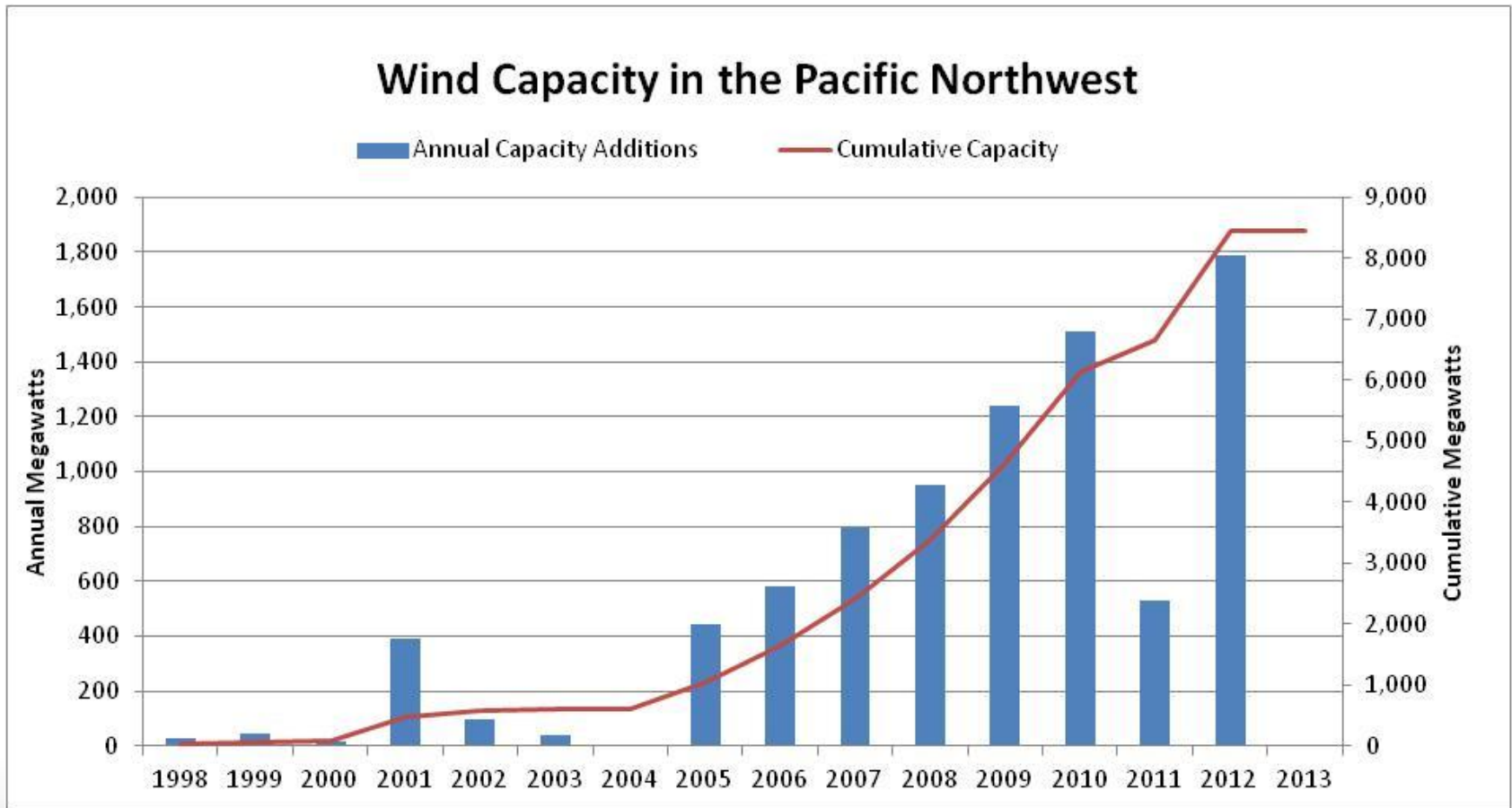
Status of Incentives

- Federal Production Tax credit
 - Expired at the end of 2013; to-date has yet to be extended
 - Projects are eligible if they “started construction” before 1/1/2014
- Investment Tax Credit
 - Expires at the end of 2016 – small wind, fuel cells, CHP
 - To qualify, projects must be placed “in service” prior to 12/31/16
 - Post-2016, credit drops to 10% - solar PV, geothermal

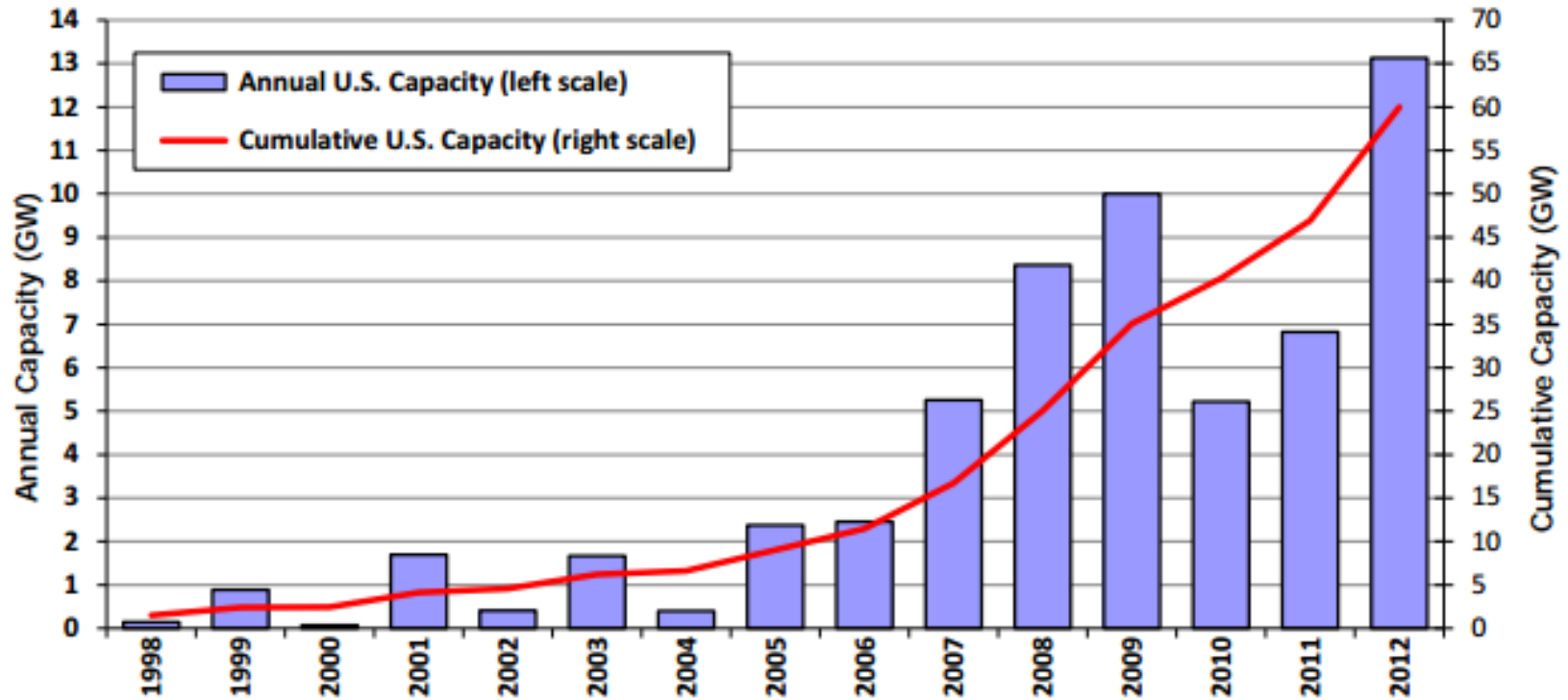
Status of Regional RPS

- Based on Council analysis, region appears to be RPS compliant through 2019/2020 with committed resources, planned REC procurements, and banking provisions
 - This is consistent with the general feedback from utilities
- Wind development in the PNW has slowed down significantly compared to the past decade
 - Little new development in 2013; few wind projects in planning process for next 2-3 years

Annual and Cumulative Wind Capacity in the PNW



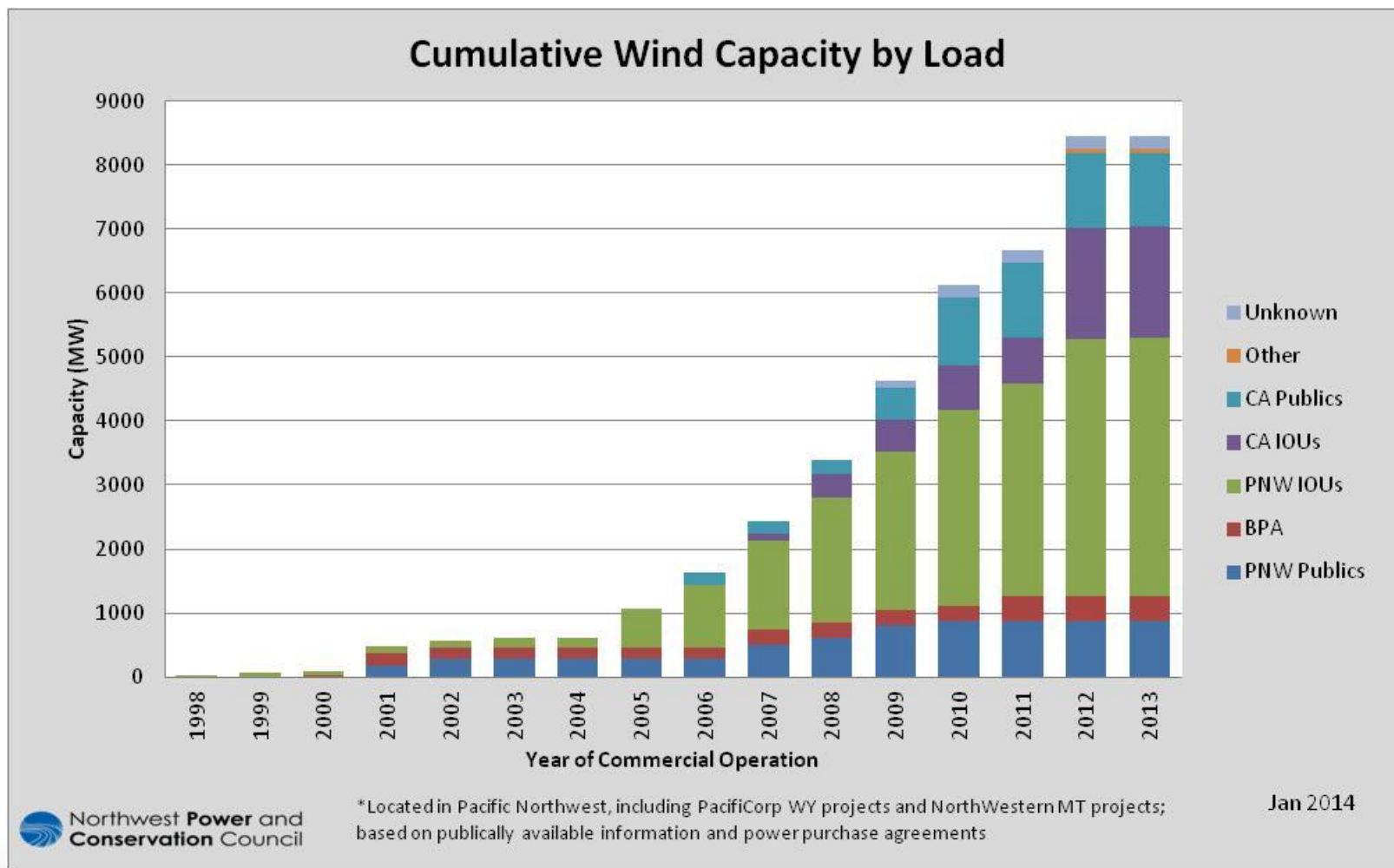
Annual and Cumulative Wind Capacity in the US



Source: AWEA project database

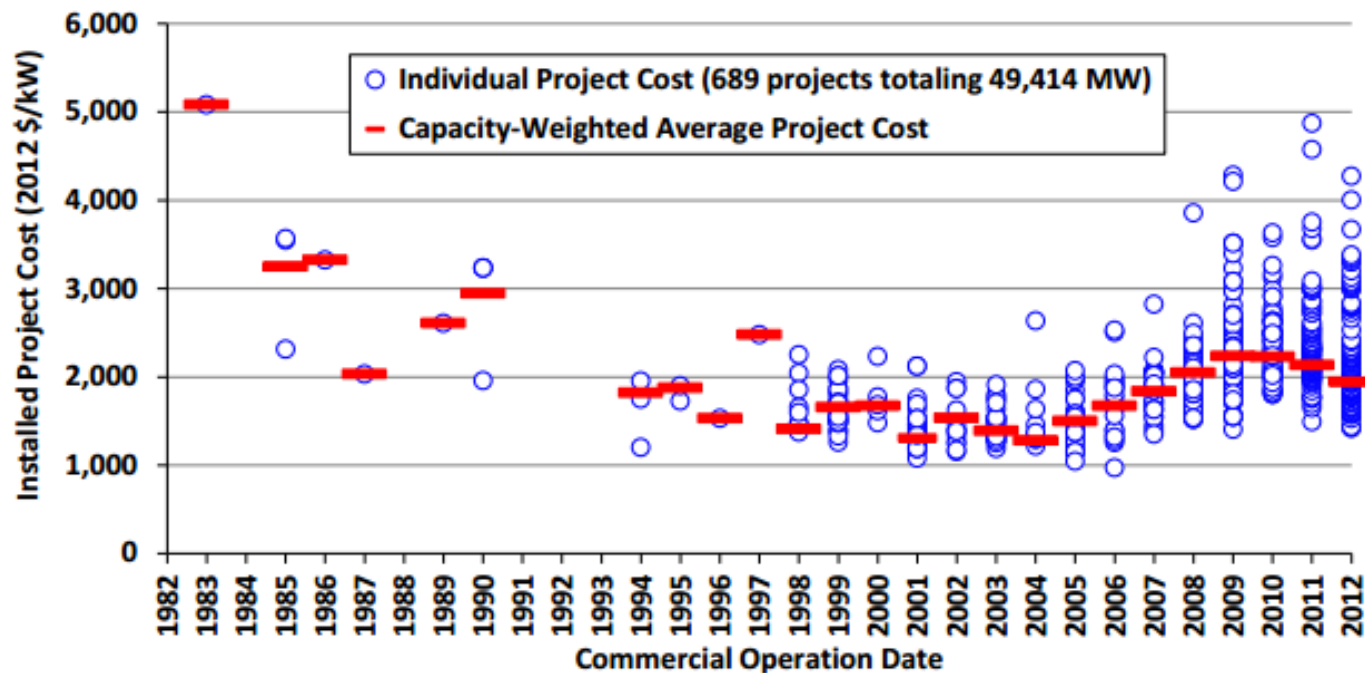
Figure 1. Annual and Cumulative Growth in U.S. Wind Power Capacity

Where is the Wind Going?



Trends – Project Cost

- 1980s – 2000s: significant reduction of capital cost and increase in performance
- 2003 – 2010: increase in capital cost (rising commodity and raw materials prices, increased labor costs, improved manufacturer profitability, turbine upscaling)
- Present – turbine prices and capital costs have declined while performance has improved



Source: Berkeley Lab (some data points suppressed to protect confidentiality)

Technology Trends

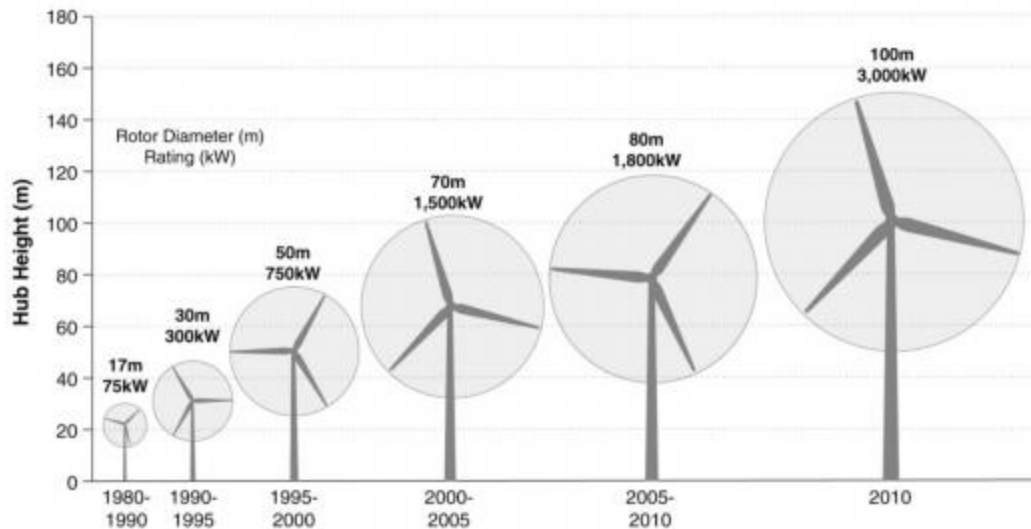


Figure 4. Representative turbine architectures from 1980 to 2010

Source: NREL

- Significant growth of rotor diameter and hub height have contributed to greater turbine nameplate capacity
 - New turbines on the market have 108m rotors
- Increasing capacity factors
 - Allows development of suboptimal wind sites
- Increased control of blades - feathering

Trends in Development

- Development to meet RPS declined significantly in 2013 as states are on track to meet targets until 2019/2020
- Development in the PNW to meet RPS in other states has declined significantly
 - CA SBX1-2 limits imports
- IPP vs. Utility development
 - More utilities procuring own projects; IPPs having more difficulty building projects without power purchase agreements

Vestas installs next generation low wind turbine prototype

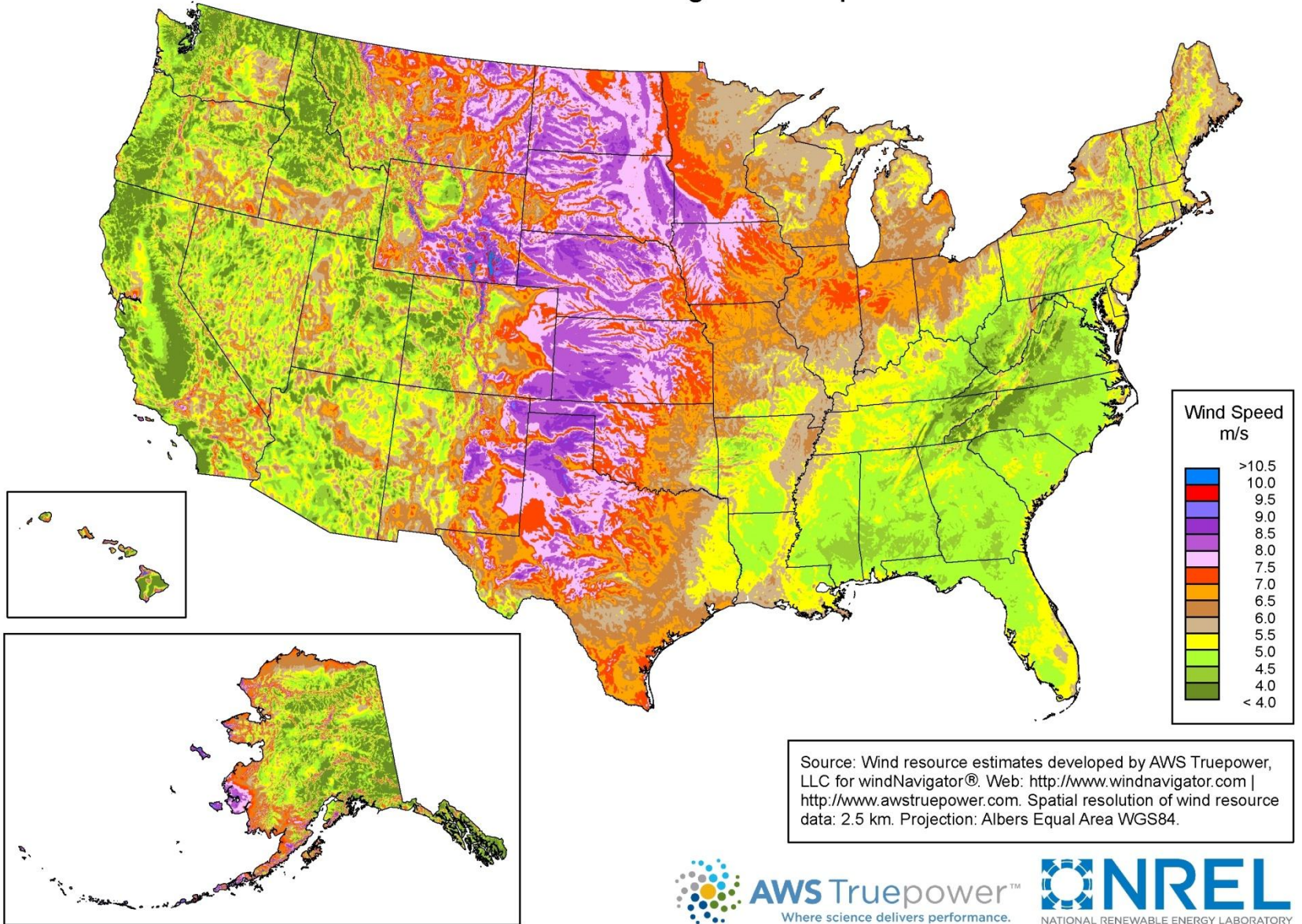
May 08 - ENP Newswire

The first V110-2.0 MW prototype has been successfully installed and commissioned, ready for testing ahead of serial delivery in the fourth quarter of 2014.

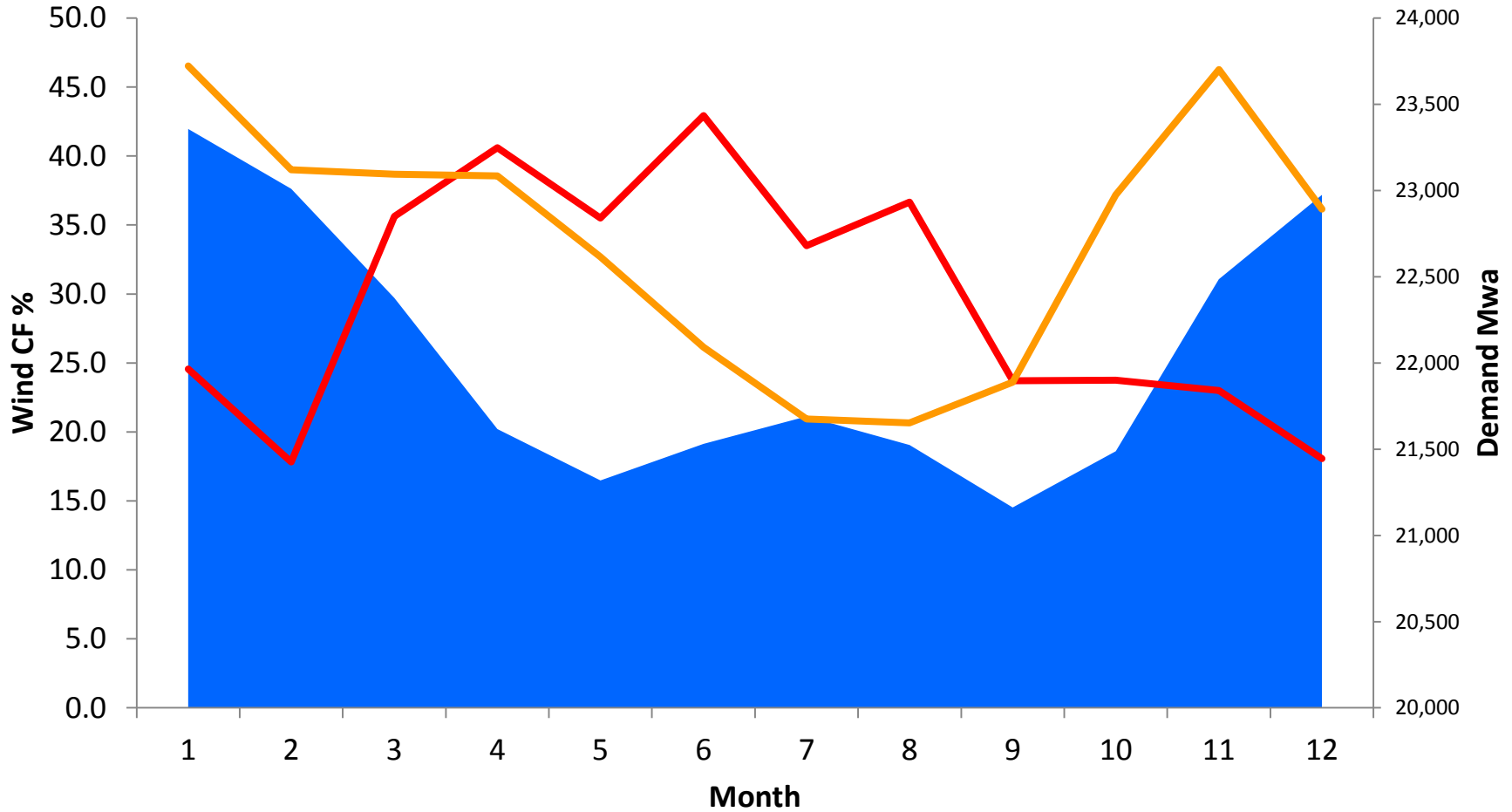
Vestas has installed the first V110-2.0 MW prototype turbine at a test site in Hovsore, on the west coast of Jutland, Denmark . The turbine has produced the first kilowatt hour of electricity and will undergo an extensive test and verification programme to ensure reliability before full scale production commences prior to the first deliveries at the end of the year.

The V110-2.0 MW is built from the proven technology of Vestas' 2 MW platform and features a larger rotor using 55m blades. The turbine is optimised for production on low wind sites, and increases annual energy production by up to 13.6% compared to the V100-1.8 MW on low wind sites.

United States - Annual Average Wind Speed at 80 m



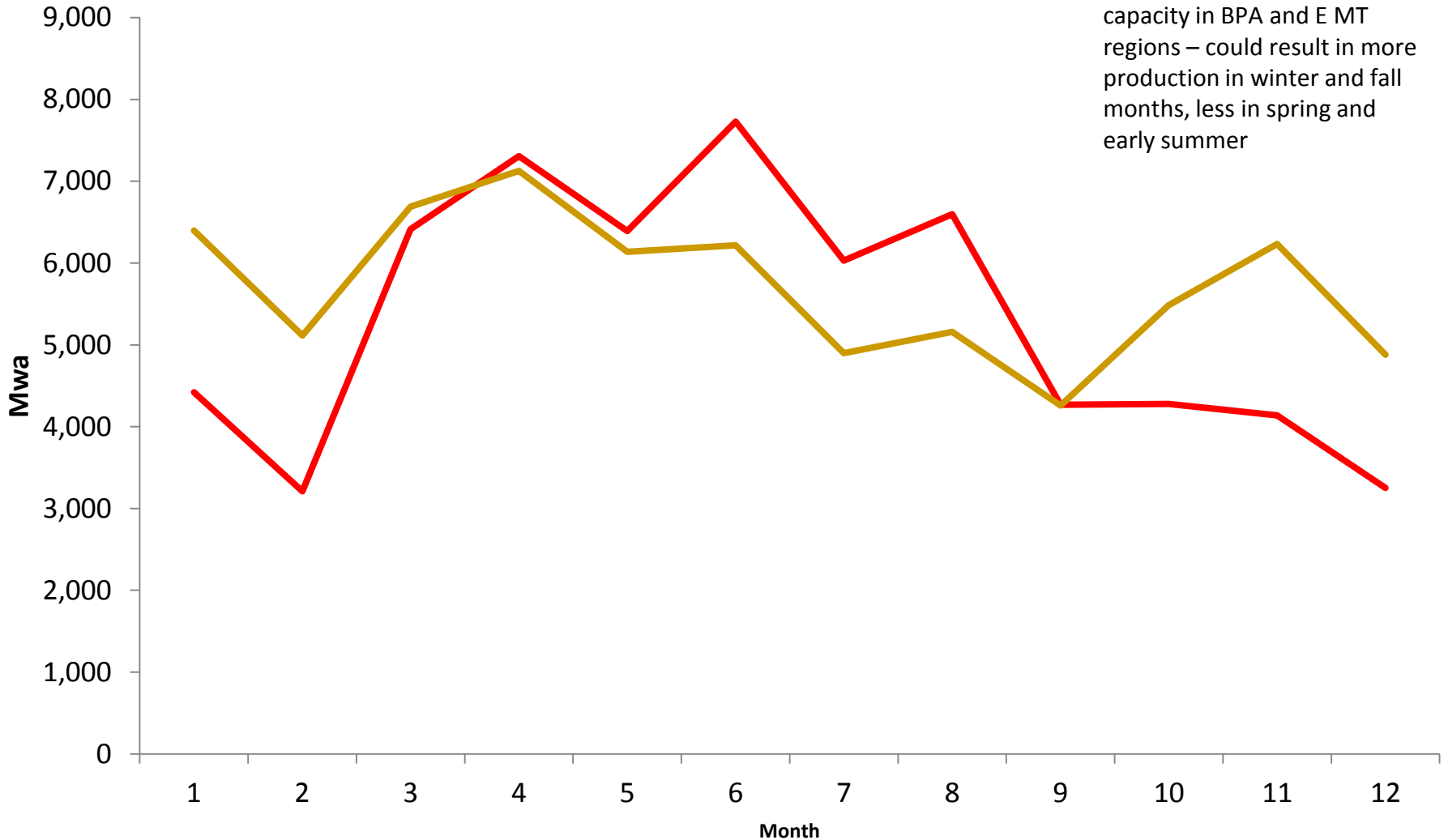
Monthly Regional Wind Capacity Factors and Demand



■ Demand Mwa - 2020 Forecast — Approximate Ave Wind CF - BPA region
— Approximate Ave Wind CF - Montana East

Hypothetical 18k MW of Wind Capacity

By a 50/50 mix of wind capacity in BPA and E MT regions – could result in more production in winter and fall months, less in spring and early summer



— All Capacity in BPA Region — 50% in BPA 50% in MT E

Open Questions

- Does it make sense for the region to continue building the majority of wind power in the Columbia Gorge region? Or would there be diversity benefits from expanding development in other areas with different wind profiles?
 - Montana is ranked 3rd in the US in terms of high wind potential*, but there are constraints
 - Wyoming has strong wind potential
- How does the region coordinate shaping the wind with available transmission?

* According to AWEA

Next Steps

- Transmission estimates and issues
 - Montana and Wyoming wind → PNW load centers
 - Future of coal plants
 - If unit(s) retire, potential use of existing transmission lines
 - Potential transmission expansions
 - West of Garrison - addition of 500 MW transfer capability to existing lines
 - Wyoming
- Preliminary cost estimates and reference plant