BONNEVILLE POWER ADMINISTRATION

backgrounder

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Wind blows stronger in Northwest power system

Wind power is the fastest growing renewable power source in the Pacific Northwest. A dozen wind farms now spin electricity from dryland wheat fields and pastures of eastern Oregon and Washington into the power grid, providing energy for the region and a second source of income to local farmers.

By the end of 2007, the region is expected to have more than 2,000 megawatts of wind turbines on line. Another 2,000 megawatts are in the planning stages. And still more are wind power proposals are expected.

Today, Northwest utilities are working together with regulators, the wind power industry and public interest groups to determine how to cost-effectively incorporate large amounts of variable wind power into the Northwest power system, while sustaining a highly reliable transmission system. BPA and the Northwest Power and Conservation Council are leading this effort.

A decade of fast development

The first commercial wind farm to serve the Northwest was built in Wyoming. In 1999, PacifiCorp and the Eugene Water and Electric Board energized the Foote Creek 1 project. BPA bought 37 percent of the output of this wind farm to sell to its utility customers.

Foote Creek Wind Project.

Demand for green power surged during the West Coast energy crisis of 2000-2001 and is still growing. BPA has purchased a total of 198 megawatts of wind power from several Northwest wind farms under 15 to 25 year contracts to sell to Northwest utilities.

BPA markets wind energy as "green" Environmentally Preferred Power. Premiums from these sales support more renewable energy development. The independent Bonneville Environmental Foundation also markets BPA Renewable Energy Certificates through its Green Tags program. More than 50 Northwest utilities now purchase BPA Environmentally Preferred Power and/or Renewable Energy Certificates.

Building wind into the grid

BPA's biggest role today in the wind power story is integrating new wind farms into the transmission grid. The first commercial wind project in the Columbia River Basin was Portland General Electric's Vansycle Ridge project in Oregon. BPA built a new substation to interconnect the 25-megawatt project with its transmission grid. Power from the wind farm is delivered to the BPA transmission system, which shapes the energy to meet utility needs and delivers it to PGE.

So far, BPA has connected nine wind projects into the Northwest transmission grid. Operating at full capacity, these projects together can produce enough electricity to light up a city the size of Portland, Ore.

Wind integration has become a major element of BPA's transmission construction program. BPA is now working

on five more new substations, plus 230-kilovolt and 500-kV substation yard additions, a line upgrade and a 12-mile, double-circuit 230-kV transmission line, all to integrate additional wind farms now under construction or in the late stages of planning.

Challenges of wind power

Wind is environmentally friendly with no emissions to cause air pollution. The fuel is free. But the wind is also an intermittent and variable source of power. In the Northwest, wind projects average about 20 to 30 percent capacity factor, which means they generate on average less than one-third of their total capacity.

In any power system, loads – the amount of electricity being consumed at any second – must always match generation. Power system operators schedule generation to meet expected loads. They set aside a portion of the generation fleet to follow load swings, regulate system voltage and keep the system in balance. If this balance is not maintained, the lights go out.

Wind generates power when the wind blows, not necessarily when power is needed. The power produced by individual turbines can vary greatly – even minute-to-minute fluctuations can be over 25 percent of a turbine's capacity. Unlike hydroelectric dams, coal plants or other traditional power sources, operators have only limited control of wind project output, including how fast or slowly generation increases or decreases (ramp rate) and maximum output.

These are the special challenges utilities have faced as wind has emerged as a competitive power resource. The Northwest has already solved these challenges for the wind projects now on line. The question now is how best to address these same challenges for large amounts of wind energy in the Northwest.

Dams store some wind energy

The Northwest is fortunate to have a robust hydroelectric system to complement its wind resource. Hydroelectric dams can store energy by holding water in reservoirs when the wind blows and releasing water for hydropower when the wind stops. BPA proved the feasibility of storing wind energy in the hydro system in the 1980s.

As wind farms went commercial, BPA began offering power products to shape and firm wind energy, using the

Wind prospecting has paid off

With all this wind development in progress, it may be surprising to learn that the Northwest does not have the nation's best wind power resource. The Midwest's vast flat prairies claim that advantage.

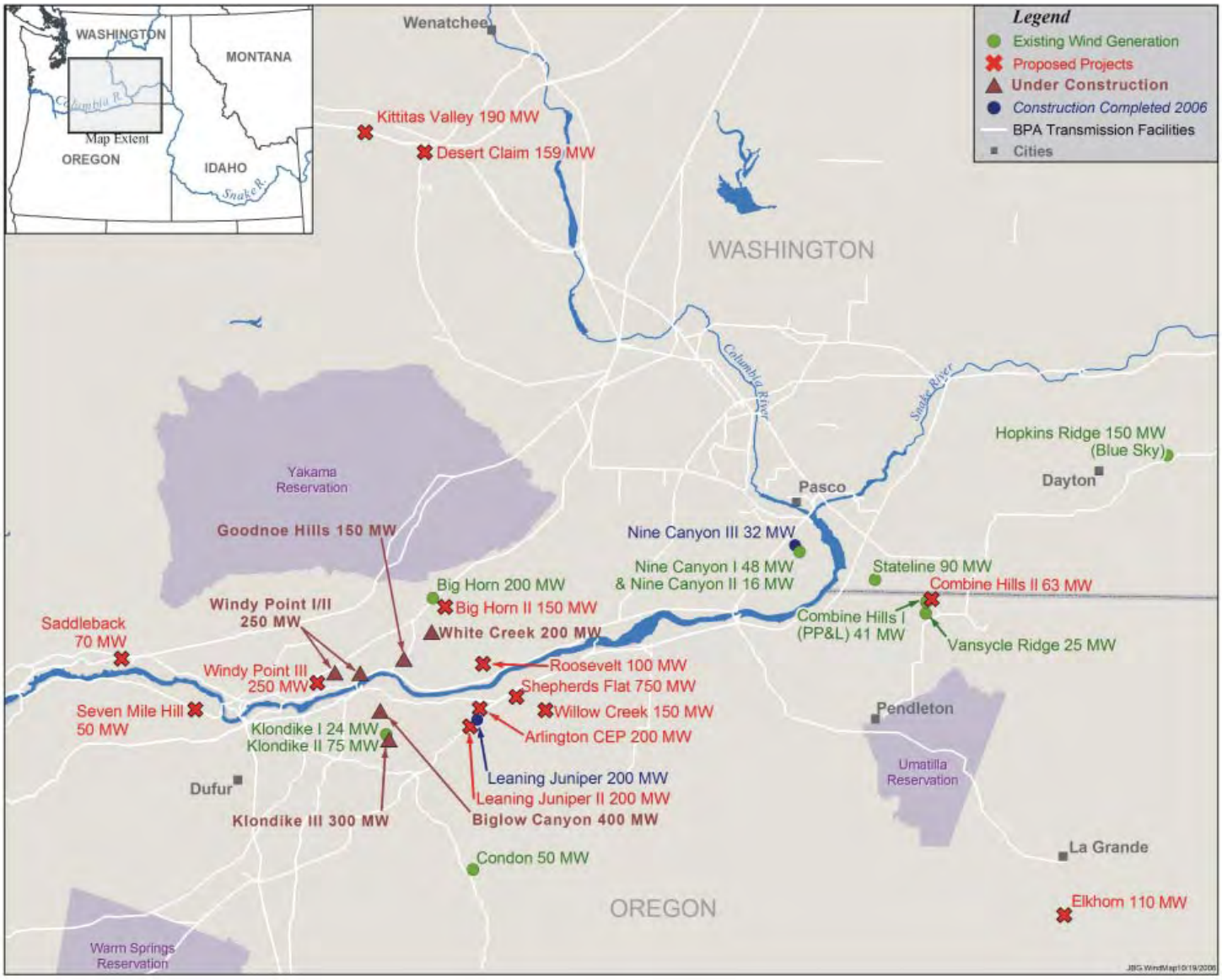
What the Northwest has, in addition to hydropower, is 30 years of research pinpointing where in the region the wind blows best for power production.

BPA started supporting wind power research in the Northwest in 1976, when it began funding collection of wind speed and direction data at Kennewick, Wash., and Cape Blanco, Ore. In the early 1980s, BPA funded instrumentation of many wind-data collection sites throughout the Northwest. BPA funded and still supports Oregon State University's exhaustive Pacific Northwest Wind Data Base.

In 2001, BPA also became a primary sponsor of an interactive wind database held by NW Sustainable Energy for Economic Development (NWSEED). The National Renewable Energy Laboratory (NREL) co-sponsors this effort; many organizations contribute. The system gives easy access to wind resource estimates through an interactive Geographic Information System. It's available at *www.windmaps.org*.

Where are the Northwest's best wind sites? The best places include the Columbia River corridor between Portland and Boardman, Ore., the Ellensburg area in central Washington; the Oregon coast; southern Wyoming; and the Livingston area in southwestern Montana.

Current and proposed wind project interconnections to BPA transmission facilities



hydroelectric system. BPA has sold power storage and shaping services to developers and utilities to let them store wind power in the federal hydro system and shape the delivery of the wind power to increase its value.

As the region develops more wind power, and as additional requirements are placed on the hydro system, there will be less remaining flexibility in the hydro system to serve as a back up resource for additional wind power.

BPA has had to put a hold on future sales of its power products to back wind power. One of the questions under discussion today is how much of these services the hydropower system can provide and at what cost.

Old penalties removed

Balancing unexpected changes in power generation can be quite expensive. Accordingly, BPA, like most transmission operators, imposes a $100 per megawatt-hour penalty on generators that schedule power over the transmission grid and then fail to deliver. In 2002, BPA changed this provision for wind power, recognizing that wind generators can't accurately predict their output consistently. While wind power producers no longer pay a penalty, they still pay BPA for the cost of any power BPA provides to make up the difference between scheduled and actual generation.

New transmission options

Wind developers need adequate space on the transmission grid for their power production at a price both they and the transmission system can afford. Because wind output varies, reserving enough capacity on a transmission path for the full capacity of a wind project can be expensive and leave that capacity unused much of the time. For several years, BPA has been working to develop a new transmission service called "conditional firm" transmission that would allow purchasers to use space on a transmission path except when bumped off for firm power users during extremely high transmission line use.

Another possibility is building new transmission lines – not just to integrate wind farms into the grid, but to expand the grid's capacity to carry more power to distant cities.

The Northwest Wind Integration Action Plan

Northwest utilities have come together to answer these questions in the Northwest Wind Integration Action Plan. The plan seeks strategies to cost-effectively, reliably and quickly add large amounts of wind energy into the Northwest power system.

The Action Plan will address several key questions:

- How much wind power and other intermittent resources can the regional power system currently absorb?
- What additional capacity could be integrated through new and revised policies, operational strategies and market mechanisms?
- What equipment upgrades could further extend wind integration?

The draft Action Plan is being developed by a Technical Work Group of Northwest utility operators, power systems analysts, transmission planners, renewable energy advocates, state energy officials and others. A Policy Steering Committee of leaders of Northwest utilities, regulators and others is overseeing this effort and will be asked to endorse its findings. Technical Work Group membership is open; all meetings are open to the public. A draft Action Plan is expected to be available for public comment in January 2007.

Goodnoe Hills – still a good wind site

In 1979-1987 BPA hosted a large scale wind turbine demonstration project sponsored by the U.S. Department of Energy. The Boeing Corporation built three 2.5 megawatt, 300-foot wind turbines on the Goodnoe Hills in Washington's Klickitat County. This project was discontinued in 1987, but it provided operating experience and helped engineers learn to integrate the output of large wind turbines safely into the power grid. Today, a large-scale wind farm is planned for the Goodnoe Hills.

For more information

Northwest Wind Integration Action Plan:
www.nwcouncil.org/energy/Wind/Default.asp

BPA transmission projects for wind farms:
www.transmission.bpa.gov/PlanProj/Wind/

NREL wind program:
www.nrel.gov/wind/about_wind.html

OSU Northwest wind data base:
http://me.oregonstate.edu/ERRL/pnwdat.html