

factsheet

March 2009

How BPA supports wind power in the Pacific Northwest



Much of the Northwest's wind power is located east of the Columbia River Gorge.

The Northwest wind power boom is continuing, and much of this growth is occurring in the heart of the Bonneville Power Administration system. The agency now has more than 2,000 megawatts of wind connected in its balancing authority and expects that more than 6,000 megawatts of wind could be attached to its system by 2013. This fact sheet reviews what BPA is doing to enable and support this growth.

This is an exciting time to be working in an electric utility, particularly in a large transmission utility like BPA with a significant renewable energy resource base.

We in the Pacific Northwest are advantaged by a federal hydro system that is a major source of carbon-free, renewable electricity. This system is now being called upon to support the growth of another source of carbon-free, renewable electricity – wind energy. One of the most important challenges in meeting the nation's carbon-reduction goals is to integrate large amounts of intermittent, carbon-free renewable resources such as wind power into the transmission grid.

BPA's transmission system is a major component of the Western Interconnection, which extends from Mexico to Canada and supports long-distance transfer of electricity. This grid is carrying increasing amounts of wind power.

BPA is working intensively with the region on three aspects of the challenge of integrating large amounts of wind power in the transmission grid:

- **Building** (and financing) transmission to physically interconnect remote renewable resources to metropolitan areas.
- **Revamping** the way BPA operates its system to allow the grid to work reliably with large amounts of variable generation.
- **Creating** new wind power-friendly business practices and institutional arrangements with other utilities across the Western Interconnection.

BPA has made great strides on the first challenge. We have interconnected 19 wind projects into our



transmission grid. We have built five substations and six tap lines to do so, with more in the works. We have devised new ways to transmit more wind power and other resources over existing transmission capacity, and are beginning to build new transmission lines primarily to serve still more wind projects.

We are implementing new operational protocols to allow us to continue to maintain reliable transmission operation as wind power continues its fast growth on the BPA grid for the next few years.

The next challenge is, if anything, more complex, because it involves creating new regional institutional structures among many parties. We are working with other parties throughout the region to develop more sophisticated and effective operational techniques and institutional arrangements for wind power for the long term.

The work that's being done today to manage variable wind power will also help BPA and other utilities across the nation manage solar, wave and other renewable power sources whose output is controlled by Mother Nature, as those resources also come on line in large quantities.

Getting wind energy to market

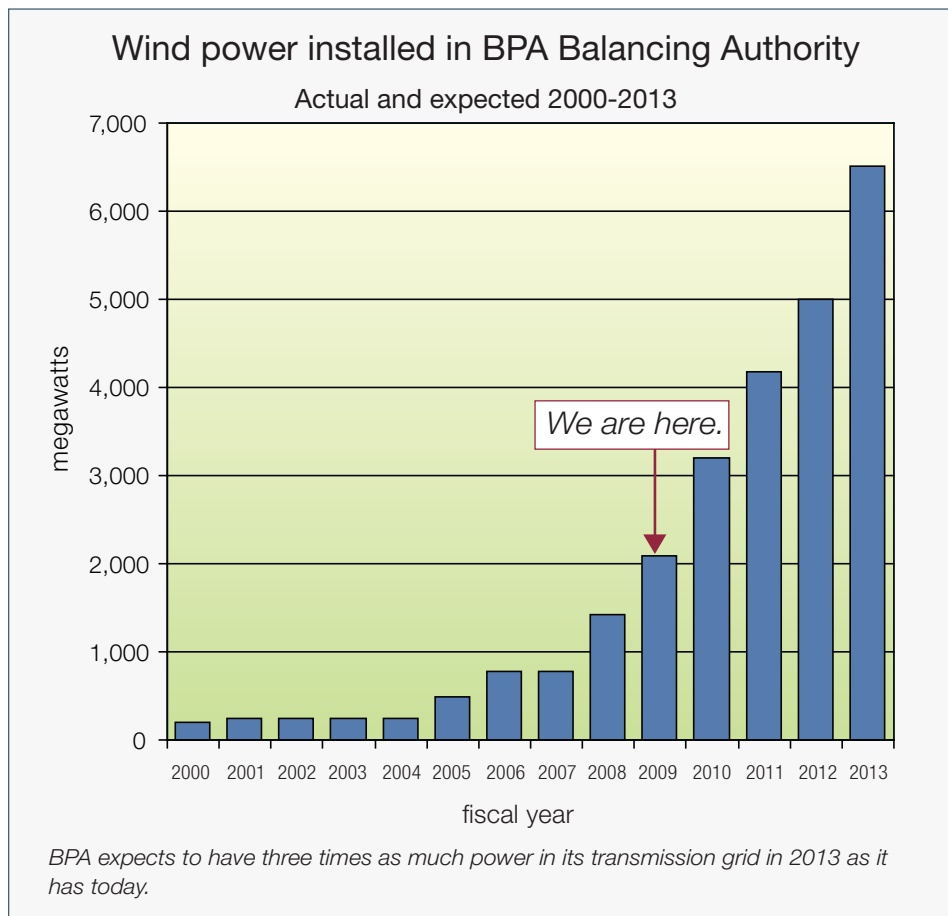
Beyond building short transmission tap lines and substations to connect new wind projects to its transmission grid, BPA has developed three innovative new mechanisms to increase available transmission capacity, so that more wind projects can get their wind power to market. These include:

New transmission service without new construction

Last year BPA conducted a first-of-its-kind Network Open Season to sort out a complicated

queue of service requests from customers seeking access to BPA's transmission system. The Network Open Season obtained financial commitments and signed service agreements that allowed BPA to conduct system engineering studies to determine what service could be provided from the existing capacity of the transmission system, as well as what service required new infrastructure.

We found that we could provide service for 1,780 megawatts of new service without major construction, simply by withdrawing from the queue those not ready to commit to taking service. Of the more



than 6,000 megawatts of new power projects that requested service through the Network Open Season, more than 4,700 megawatts are wind power projects.

*We have devised
new ways to transmit
more wind power.*

Greater use of existing transmission capacity

In March 2009, BPA began offering Conditional Firm transmission service to another 1,200 megawatts of new service requests. Conditional Firm service provides transmission with the potential for a small amount of interruption if transmission becomes congested. This product has appeal for some of our customers, particularly wind generators.

BPA helped develop the concept of Conditional Firm service earlier in this decade and the idea has been picked up nation-wide. We expect to make additional offers of Conditional Firm service on an interim basis in the future.

New transmission construction financed

After completing system engineering studies that allowed greater use of existing transmission capacity, we conducted financial analysis of the construction costs for the remaining service requests we evaluated in the Network Open Season. We are preparing to offer transmission service with four new transmission lines and one system upgrade for 3,700 megawatts, almost 2,800 of which will come from renewable, non-carbon-emitting generation.

Three of these projects are about to undergo environmental analyses; but one is shovel-ready, the environmental review having been completed in 2002. That project is a 500-kilovolt transmission



line from McNary Dam to John Day Dam along the Columbia River in Washington and Oregon.

With the assurance of additional borrowing authority with the Treasury that Congress has just provided, BPA is confident it can move forward with these projects. The agency has announced construction of the 79-mile, McNary-John Day line that will deliver more than 700 megawatts of wind energy across BPA's transmission system.

Integrating wind with traditional power sources

Like other utilities across the country, BPA views wind primarily as a source of energy rather than a source of power capacity to meet peak power loads. The primary value of wind energy lies in its ability to displace fossil fuel consumption, reduce carbon emissions and limit exposure to volatile natural gas

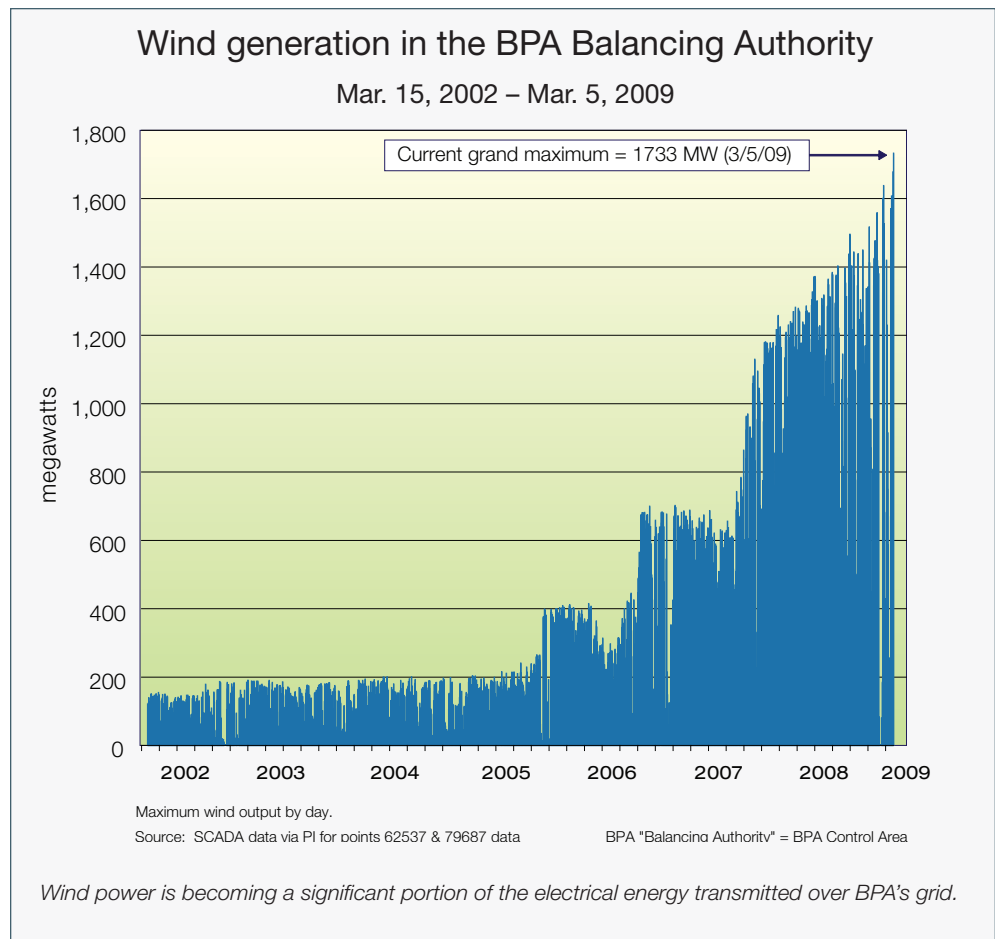
prices. BPA is working internally and with other utilities to match up the different operating characteristics of variable wind energy with those of traditional resources.

The natural variability “and uncertainty of wind energy increases the demand for balancing reserves. This increased demand for balancing reserves requires changes in system operations, with corresponding integration costs and consequences for balancing resource availability. BPA, along with wind developers and operators, is exploring many innovative approaches to reliably integrating wind into the grid. While much has been accomplished, a great deal of work remains to be done, and we are moving quickly to do it.

Implementing the Northwest Wind Integration Action Plan

In 2007, BPA and the Northwest Power and Conservation Council completed an Action Plan that confirmed that adding 6,000 megawatts of wind generation in the Northwest by 2020 is technically feasible. The unexpected speed of wind’s actual development has put a priority on resolving the technical issues the Council and BPA identified to realize this goal.

In the two years since completion of the Northwest Wind Integration Action Plan, BPA and other



entities in the region together have made considerable progress on 10 of the 16 Action Plan items, including the Network Open Season, Conditional Firm Transmission Service and financing new transmission construction for wind and other new resources.

Creating new techniques: the Wind Integration Team

In 2008, under a transmission rate agreement with its customers, BPA launched a Wind Integration Team to tackle the grid operation, business practice and institutional arrangements needed to make the most of the wind resource.

Since September 2008, BPA’s Wind Integration Team has been working closely with its customers

and the wind community to establish new operating procedures within BPA's control area. The work we already have completed will allow the wind fleet to continue its rapid growth in our balancing authority area while long-term technical improvements are realized.

At the end of February, BPA established a new work plan to complete the remaining integration team tasks.

Remaining work largely involves creating new institutional and commercial approaches.

The challenge now is to develop more sophisticated tools to manage large amounts of wind power effectively in the transmission grid. Because the wind resource is growing so rapidly, these technical improvements are needed quickly, and BPA has moved budgets from other areas to increase staffing dedicated to this effort.

This isn't quite rocket science, but it's close

There's a great deal of highly technical work to be done. (Advanced electrical engineers with an interest in supporting renewable energy, please take note.)

The solutions involve changing the way the "largest machine in the world" works. That machine is the Western Interconnection – the deeply linked, interdependent electrical power grid of the Western United States, Alberta, British Columbia and small portions of Mexico.

Engineers test their ideas, computer models and operating protocols thoroughly before putting them

on line, because the interconnected grid must be kept running constantly at a frequency of 60 cycles per second. Introducing new mechanisms that are not fully tested could cause violations of grid reliability rules, leading to millions of dollars in fines or, at worst, blackouts. BPA currently is working on 10 research and development projects dedicated to wind integration.

Remaining work largely involves creating new institutional and commercial approaches with other utilities and government entities and cannot be achieved solely by BPA. We are working closely with other utilities, the wind community and other interested parties to realize these regional opportunities.

Our comprehensive Wind Integration Team work plan is focused on five critical areas:

- 1. New operating procedures:** BPA has announced new operating protocols that it will implement by October 2009. These

Key terms

Balancing Authority: A balancing authority is an entity that is responsible for maintaining a constant balance between power load and power generation in a geographic area. It is usually a utility or other transmission provider such as a regional transmission organization. There are 14 balancing authorities in the Pacific Northwest. BPA's balancing authority area includes primarily rural portions of Oregon and Washington, plus small portions of northern Idaho and northwest Montana.

Balancing Reserves: Generation held available to be ready to use if needed to maintain the balance between power load and power generation as loads fluctuate and/or as real-time generation differs from scheduled generation.

protocols will assure grid reliability while the wind fleet in BPA's balancing authority area continues its fast growth. BPA is now installing the necessary operating and control equipment for these procedures.

2. Tools for transmission dispatchers:

Dispatchers in transmission control rooms traditionally schedule generation by the hour. Automatic generation controls on major power plants, such as Grand Coulee Dam, follow the moment-to-moment vagaries of power loads.

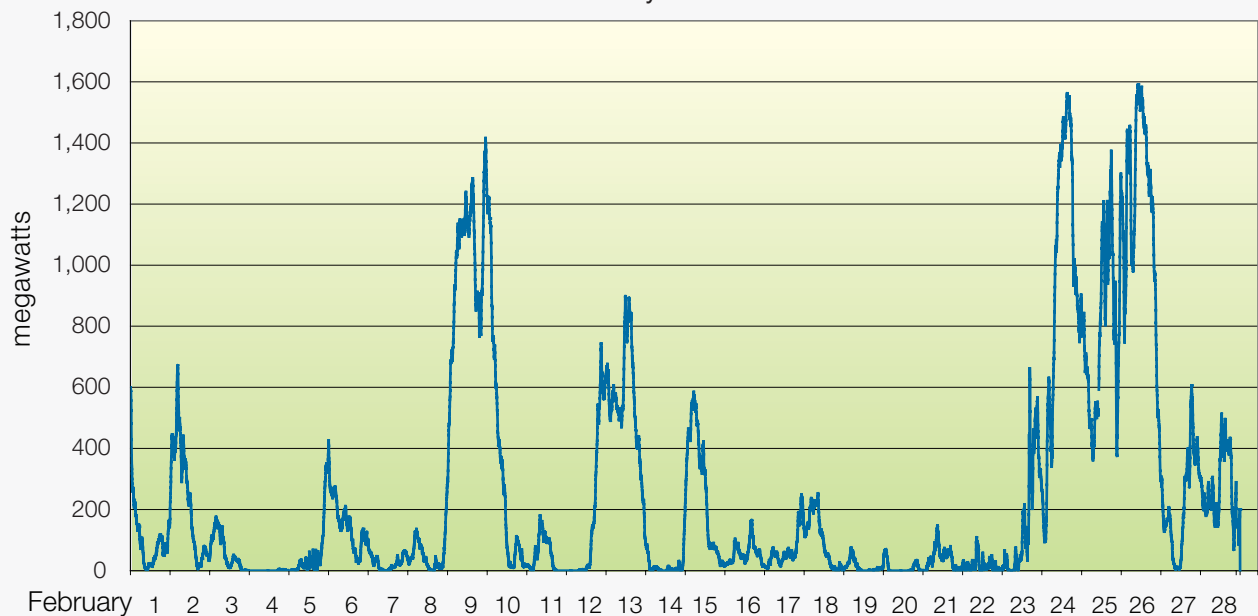
Now, with fast changes in wind power output added into the mix, dispatchers need better

tools to see how much power wind projects are generating minute-to-minute, so they can effectively move to changing generation schedules within each hour.

BPA is working with the Pacific Northwest National Laboratory to develop these dispatchers' resources. For example, this summer, BPA and PNNL will install 16 new wind monitoring sites in a research and development project to improve hour-ahead wind forecasts. This, in turn, will help improve the accuracy of wind generation forecasting and scheduling.

Wind generation in the BPA Balancing Authority

February 2009



Source: Plot based on 5-min data via SCADA/PI for Pt. 79687; Stated Monthly Max based on full 2-sec resolution data.

Wind power in BPA's balancing authority area tends to ramp up or down quickly and often unexpectedly. System operators are inventing new techniques to maintain the necessary constant balance of power loads and generation levels while managing large variations in wind output. Some solutions have already been put in practice; others are on the way.

3. **Sub-hourly transmission scheduling:**

Utilities throughout the Western Interconnection are working on ways to change power supply schedules within an hour, so that within-hour variations in the wind can be matched to within-hour changes in the operation of other resources and, perhaps, to changes in loads.

BPA is working to develop within-hour transmission scheduling as part of a Joint Initiative with other utilities and utility organizations in the Western United States. This initiative is being led by three regional transmission planning groups: ColumbiaGrid, the Northern Tier Transmission Group and WestConnect.

Dispatchers need better tools.

4. Dynamic scheduling: Also in conjunction with the Joint Initiative, BPA and other utilities are developing new power dispatch protocols and scheduling systems and tools so that wind farms physically located in BPA's transmission balancing authority can be electronically controlled and supported by other utilities' balancing authorities. For example, a utility receiving wind energy from BPA's grid into its own grid could supply the balancing resources for that energy. This concept, which is already possible on a limited scale, may be feasible more broadly and with more frequent changes through development of remote sensors and controls similar to those of emerging Smart Grid technologies.



5. Third-party supply: BPA issued a Request for Information in 2008 seeking information about third-party supplies of within-hour services to support variable wind power. The results were encouraging, but they also made it clear that dynamic scheduling will be a necessary prerequisite, especially to use third-party supplies located in other utilities' balancing areas. BPA therefore expects to launch a pilot project on third-party supply in 2010.

The future's blowing in fast

In the last decade, wind power has grown from commercial infancy to a significant energy source for the Pacific Northwest. In the next half-decade, it's expected to become a major energy source. BPA has been and will continue to be a primary facilitator of this new addition to the Northwest's renewable energy base.

To follow the work of BPA's Wind Integration Team or participate in its efforts, go to www.bpa.gov/corporate/About_BPA/wind/index.cfm, contact Eric King at evking@bpa.gov, or call BPA at 1-800- 622-4519.

