

# Sixth Power Plan Overview

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## SUMMARY

The Pacific Northwest power system is faced with huge uncertainties about the direction and form of climate change policy, future fuel prices, salmon recovery actions, economic growth, and integration of rapidly growing amounts of variable wind generation. And yet the focus of the Council’s Power Plan is clear, especially with regard to the important near-term actions.

The Council’s Power Plan addresses the risks that these uncertainties and others pose for the region’s electricity future and seeks an electrical resource strategy that minimizes the expected cost of the regional power system over the next 20 years. Across hundreds of possible futures considered in the development of the Sixth Power Plan, one conclusion was constant; the most cost-effective and least risky resource for the region is improved efficiency of electricity use.

In each of its power plans, the Council has found substantial amounts of conservation to be cheaper and more sustainable than many forms of additional electric-generating capability. In this Sixth Power Plan, because of higher costs of alternative generation sources, rapidly developing technology, and heightened concerns about global climate change, conservation holds an even larger potential for the region.

The Plan finds enough conservation to be available and cost-effective to meet the load growth of the region for the next 20 years. If developed aggressively, this conservation, combined with the region’s past successful development of energy efficiency could constitute the future equivalent of the regional hydroelectric system; a river of energy efficiency that will complement and protect the regional heritage of a clean and affordable power supply.

Aggressive pursuit of this conservation in the near-term is the primary focus of actions for the next five years. Combined with investments in renewable generation as required by state renewable portfolio standards, this holds the potential for delaying investments in more expensive and uncertain forms of electricity supply until the direction and form of future environmental legislation becomes clearer, and availability of alternative low-carbon technologies has matured in both technology and cost.

At the same time, the region cannot stand still in maintaining and improving the reliability of its power system. Investments in additional transmission capability and improved operational agreements are important for the region, both to access growing site-based renewable energy and to better integrate it into the power system. The Council expects that there are small-scale

resources available at the local level in the form of cogeneration or renewable energy opportunities. The Plan encourages investment in these resources when cost effective.

The Power Plan also recognizes that meeting capacity needs and providing the flexibility reserves necessary to successfully integrate growing variable generation sources may require shorter-term investments in generation resources to provide reliable electricity supplies in specific utility balancing areas. In addition, individual utilities have varying degrees of access to electricity markets and varying resource needs. The Plan is not a plan for every individual utility in the region, but rather is intended to provide guidance on the types of resources that should be considered and their priority of development.

The near-term actions recommended in the Council's Sixth Power Plan are important, but the region cannot neglect the consideration of longer-term needs. The Plan encourages research on, and exploration of, advanced technologies for the long-term development of the power system. Advancing technologies that facilitate consumers' participation in their own efficiency improvements and their provision of capacity and flexibility services to the power system offer great potential for a transformed power system that is more diverse in its supplies and more efficient in its operation. Such "smart grid" development may facilitate the deployment of plug-in electric hybrid vehicles that work in concert with the power system to improve the use of available generating capacity and help reduce carbon emissions in the transportation sector. This is a long-term process that will require many years to reach its full potential, but the region can facilitate progress through research, development, and demonstration of the technologies.

Along with a smarter grid, other technologies may be able to provide power when it is needed with low cost, low risk, and low emissions. In the future we may find greater value in power generated by geothermal resources, ocean waves, tides, gasified coal with carbon sequestration, or currently unknown technologies. New methods to store electric power, such as pumped storage or advanced battery technologies may enhance the value of existing generators like wind. Given the uncertainties of the future, the region should not concentrate on any one potential future solution to its power supply, and should diversify its exploration of potential sources of future energy generation and conservation.

## **FUTURE REGIONAL ELECTRICITY NEEDS**

The Pacific Northwest is expected to develop and expand over the next 20 years. Regional population is likely to increase from 12.7 million in 2007 to 16.3 million by 2030. This 3.6 million increase compares to a 3.8 million increase between 1985 and 2007. The population growth will be focused on older age categories as the baby boom generation reaches retirement age. While the total regional population is projected to increase by 28 percent, the population over age 65 is expected to nearly double. Such a large shift in the age distribution of the population will change consumption patterns and electricity uses. Some possible effects could include increased health care, more retirement and elder care facilities, more leisure activities and travel, and smaller size homes.

The cost of energy (natural gas, oil, electricity) is expected to be significantly higher than during the 1980s and 1990s. Although these prices have decreased significantly since the summer of 2008, current price levels, especially natural gas, are depressed by the effects of the recession. The production of nonconventional natural gas supplies has increased dramatically in the last

few years, encouraged by higher prices. The technology to retrieve these supplies cost-effectively has only developed recently and this has made expectations for adequate future supplies more certain. Nevertheless, the cost of finding and producing these supplies is higher than for conventional supplies, which increases the estimated future price trend for natural gas.

Carbon emissions taxes or cap-and-trade policies are likely to further raise these energy costs. Some of the planning scenarios used to develop this Plan include a wide range of possible carbon mitigation costs from \$0 to \$100 per ton. The expected average prices in this range start at zero and increase over time to \$47 per ton of CO<sub>2</sub> emissions by 2030. Carbon costs can have a significant impact on electricity costs and prices to consumers. While higher prices reduce demand, they also bring forward new sources of supply and efficiency, and make more efficiency measures cost-effective.

Electricity use before accounting for new conservation is expected to grow by about 5,500 average megawatts by 2030, growing at about 273 average megawatts, or 1.3 percent, per year. Residential and commercial sector electricity use account for much of the growth in demand. Contributing to the growth in the residential sector is an anticipated increase in air conditioning and consumer electronics. Also, summer peak electricity use is expected to grow more rapidly than annual energy. All of this growth in energy demand must be met by a combination of existing resources, more efficient use of electricity, and new generation. An important change for the Sixth Power Plan is that electricity needs in the future can no longer be adequately addressed by evaluating only average annual energy requirements. In the future resource needs must also consider capacity to meet peak loads and the flexibility to provide within-hour load following and regulation. The requirements for within-hour flexibility reserves have been increased by the growing amount of variable wind generation located in the region.

## CONSERVATION POTENTIAL

The Council's Power Plan includes a detailed analysis of efficiency potential in hundreds of applications. The achievable technical potential of efficiency improvements increased from the Fifth Power Plan levels due to advancing technology, reduced cost, development of estimates in new areas such as efficiency in electricity distribution systems, consumer electronics, and street, parking and exterior building lighting. The estimated achievable potential conservation is nearly 6,000 average megawatts for measures costing under \$100 per megawatt-hour. Over 4,000 average megawatts is available at a cost of less than \$40 per megawatt-hour. These increased opportunities excluded savings from efficiencies that have already been secured through building codes, appliance efficiency standards, and utility programs. However, the amount of achievable technical conservation that is found to be cost-effective still has increased significantly because avoided costs have doubled and carbon cost risk is several times higher than in the Fifth Power Plan.

The Plan shows that a substantial amount of the growth in demand for electricity could be met by conservation. Portfolio model analysis shows that over 5,800 average megawatts of conservation are cost-effective in the draft plan, double the amount in the Council's Fifth Power Plan. The amount that can be achieved is constrained by the commercial availability of technologies, limits on the annual development rate considered possible, and an ultimate penetration rate limit of 85 percent. However, the amount of conservation that was found to be cost-effective changed very little in response to changing assumptions about carbon costs and policies. In general, failure to

achieve the conservation included in the plan will increase both the cost and risk of the power system.

## **GENERATION ALTERNATIVES**

The Council analyzed a large number of alternative generating technologies. Each of these technologies is compared in terms of risk characteristics and cost with other generating technologies, efficiency improvements, and demand response. In addition, resource contributions need to be considered in terms of their energy, capacity, and flexibility characteristics.

Generating technologies that are technologically mature, meet restrictions on new plant emissions, and are cost-effective are limited in the short to intermediate term. Wind remains the primary large scale cost-effective renewable generation source in the near term, and natural gas-fired generation is also feasible and cost-effective. New coal-fired generation is difficult to site and permit, and prohibited in many states by new plant emissions standards. There are likely some small-scale dispersed renewable generation alternatives that are local and site specific. Cost-effective development of these is encouraged even though the Council currently lacks enough information to include them explicitly in the Plan. Longer-term alternatives that may develop include carbon separation and sequestration, maturing renewable technologies, advanced nuclear generation, demand response, smart grid, and storage technologies to help provide flexibility reserves. When CO<sub>2</sub> costs are added to the direct cost of generating alternatives, the cost of most generating resource alternatives range between \$75 and \$105 (levelized 2006\$) per megawatt-hour.

## **RESOURCE STRATEGY**

In addition to efficiency improvements, new renewable generation (primarily wind) is required to meet renewable portfolio standards in Washington, Oregon, and Montana. Analysis shows that meeting RPS requirements uses most of the readily accessible wind potential (5,300 MW) in the region. In addition to the wind, some geothermal resources enter the plan. However, the amount of geothermal potential is considered quite limited. Given risk of some form of carbon pricing strategy in the future, additional renewable generation is cost effective. Natural gas-fired generation is optioned toward the middle of the planning period. It is attractive for energy and capacity needs and provides an ability to displace coal plants in futures with high carbon costs, or assumed coal plant closures. Both combined-cycle turbines and simple-cycle turbines are included in most scenarios. Although these natural gas plants are optioned in the plan, they are not optioned until after the 5-year action plan period, and although the options protect against the risk of uncertain future conditions, they are not actually constructed in many of the simulated futures during the entire 20 year period.

Due to slower growth of electricity demand, the large conservation potential, and required RPS resources, there is no apparent need for these other generating resources in the Plan's first five years from a regional planning perspective. The Council recognizes that individual utilities' needs and access to market resources will vary. Some utilities will need additional resources in the next few years even if they acquire all conservation available to their service territory and meet their renewable portfolio standards.

During the last 10 years of the Power Plan the non-conservation resource priorities become less clear. Given current climate change policies and concerns, new coal without carbon sequestration is unlikely, and any significant reduction in carbon will require reduced operations of existing coal plants. Alternatives beyond more reliance on natural gas are typically unproven commercial technologies or alternatives that require significant new transmission investments. Long-term generating resources considered include wind developed outside the region and imported on new transmission lines, advanced nuclear, use of gasified coal with carbon sequestration, and development of relatively unproven renewable resources, or ones that are currently too expensive. Natural gas is used in the Plan to meet long-term needs, but the Council recognizes that other alternatives are likely to become available over time.

## **CLIMATE CHANGE POLICY**

The focus of climate policy especially for the power generation sector will be on carbon dioxide emissions. Nationwide, carbon dioxide accounts for 85 percent of greenhouse gas emissions. Nationally, about 38 percent of carbon dioxide emissions are emitted from electricity generation, but for the Pacific Northwest the power generation share is only 23 percent because of the hydroelectric system. Analysis by others has shown that substantial and inexpensive reductions in carbon emissions can come from more efficient buildings and vehicles. More expensive reductions can come from substituting non- or reduced-carbon electricity generation such as renewable resources and nuclear, or from sequestering carbon.

Reductions in carbon emissions can be encouraged through various policy approaches including, regulatory mandates (e.g. RPS or emission standards), emissions cap-and-trade systems, emissions taxation, and efficiency improvement programs. State policy responses within the region to climate change concerns have focused on renewable energy standards and new generation emission limits. National and regional proposals have focused on cap-and-trade systems, although none have been adopted successfully nationally or in the region. Although carbon taxes are easier to implement than cap-and-trade systems, none have been proposed. The Council's Sixth Power Plan reflects the likely, but uncertain, costs of potential carbon pricing policies by assuming a possible range of carbon costs between \$0 and \$100 per ton. The average of these uncertain future costs increases over time and reaches about \$47 per ton by 2030. These potential costs play an important role in the proposed resource portfolio, with the exception of the conservation resource, which remains a key component regardless of climate change policy assumptions.

The key findings from the Council's analysis of climate change policies include the following:

- Without any carbon control policies, including existing ones, carbon emissions from the Northwest Power System would continue to grow to 5 percent over 2005 levels by 2030.
- Without additional carbon pricing policies, current policies would stabilize carbon emissions from the Northwest power system.
- Assuming higher carbon prices, the Sixth Plan resource strategy has the potential to reduce regional power system carbon emissions to below 1990 levels, or 30 percent below 2005 levels adjusted for normal hydro conditions.

- Significant reductions of carbon emissions from the Northwest's power system require reduced reliance on coal, which currently emits over 85 percent of the carbon dioxide from the regional power system. A carefully coordinated retirement and replacement of coal-fired generation with conservation, renewable generation, and lower-carbon-emission resources could reduce carbon emissions to 35 percent of 1990 levels.
- To the extent that public policy raises the cost of carbon, we can expect an increase in a typical consumer's electric bill and a decrease in carbon emissions, especially when the carbon price begins to exceed \$40 per ton. A variety of different scenarios are considered in Chapter 9.
- Protecting the capability of the existing regional hydroelectric generation through conservation and preservation of its generating capability keeps costs and carbon emissions down. In scenarios where the capability of existing resources are reduced, whether hydroelectric or coal, the energy and capacity are largely replaced with gas-fired generation.

## **CAPACITY, FLEXIBILITY, AND WIND INTEGRATION**

Reliable operation of a power system requires minute to minute matching of electricity generation to varying electricity demands. In the Pacific Northwest, resource planners have been able to focus mostly on annual average energy requirements, leaving the minute to minute balancing problem to system operators. This was because the hydroelectric system historically had sufficient peaking capacity and flexibility to provide the needed operations as long as there was sufficient energy capability. This is changing for several reasons; growing regional electricity needs are reducing the share of hydroelectricity in total demand, peak loads have grown faster than annual energy, the capacity and flexibility of the hydro system has been reduced over time for fish operations, and growing amounts of variable wind generation have added to the balancing requirements of the system.

As a result, planners must now consider potential resources in terms of their energy, capacity, and flexibility contributions. The rapid growth of wind generation, which has little capacity value and increases the need for flexibility reserves, means that meeting growing peak loads and flexibility reserves will require adding these capabilities to the power system. Changes can be made to the operation of the power and transmission system that will reduce flexibility reserve needs. These operational changes are expected to be lower cost than adding peaking generation, demand response, or flexibility storage, and can be implemented more quickly.

## **FISH AND WILDLIFE PROGRAM AND THE POWER PLAN**

The Fish and Wildlife Program is part of the Council's Power Plan. It is intended to guide Bonneville's efforts to mitigate for the adverse effect on fish and wildlife that resulted from construction and operation of the Columbia River hydroelectric system. One of the roles of power plan is to help assure reliable implementation of fish and wildlife operations. The power system, guided by the power plan, has done this in the past and will continue to do this in the future. It has done so by acquiring conservation and generating resources to make up for 1,170 average megawatts of lost hydroelectric generation stemming from actions to aid fish migration, by developing resource adequacy standards, and by implementing strategies to minimize power

system emergencies and events that might compromise fish operations. Power system adaptations have taken place in such a way not only to accommodate fish operations but also to leave the power system adequate and reliable.

In addition to operational changes, the direct cost and capital costs of fish and wildlife programs have been recovered through Bonneville revenues, resulting in higher electricity prices. Bonneville estimates that replacing lost hydropower capability and funding direct fish and wildlife program expenditures has increased its costs from \$750 to \$900 million per year. This amount represents approximately 20 percent of Bonneville's annual net revenue requirement. The power system is less economical as a result of fish and wildlife program costs, but still economical in a broad affordability sense.

The future presents a host of uncertain changes that are sure to pose challenges for the successful integration of power system and fish and wildlife needs. These include possible new fish and wildlife requirements, increasing wind generation and other variable renewable integration needs that could require more flexibility in power system operations, conflicts between climate change policies and fish and wildlife operations, possible changes to the water supply from climate change that might make it more difficult to deliver flows for fish and meet power needs, and possible revisions to Columbia River Treaty operations to match 21st century power, flood control, and fish needs.

To address current operations and prepare for these additional challenges, the Council has adopted a Regional Adequacy Standard to help ensure that events like the 2000-01 energy crisis, in which fish operations were affected, do not happen again. In addition, the Wind Integration Forum is addressing issues with integration of wind into the power system. Large swings in wind output have sometimes adversely affected hydropower and fish operations. Addressing adequacy and flexibility issues in the Sixth Power Plan will both improve electricity reliability and help insure reliable fish operations.