Chapter 1: Introduction

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PURPOSE OF THE POWER PLAN

The Northwest Power and Conservation Council (Council) was formed by the Northwest states in 1981 in accordance with the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Act). Each state's governor appoints two members to the Council making eight members in total representing Washington, Oregon, Idaho, and Montana. The Council was formed to give the Pacific Northwest states and the region's citizens a say in how growing electricity needs of the region would be provided. The Act charges the Council with creating a power plan for the region. The purpose of the Council's power plan is to ensure an adequate, efficient, economical, and reliable power supply for the Pacific Northwest[1].

The Act also recognized that development of the region's hydropower dams had detrimental effects on migratory fish and wildlife and required the Council to develop a program to mitigate those effects. The fish and wildlife program is an integral part of the Council's power plans.

The Council's power plan and the fish and wildlife program are developed through an open, public process to involve the region's citizens and businesses in decisions about the future of these two interdependent aspects of the Pacific Northwest environment and economy. The Act grants different approaches for these two Council responsibilities. The fish and wildlife program is based on, and defers to, recommendations from fish and wildlife agencies and tribes. However, the power plan is developed through Council analysis, helped by scientific and statistical advisory committees.

The power plan develops a strategy for the region to meet its future electricity needs. The Act recognizes that the demand for electricity is derived from the need for services electricity can provide, such as heat for homes, lights for commercial buildings, or motors for industrial processes. These services are the focus of the power plan. Technologies that allow production of these services more efficiently are the equivalent of generating additional electricity. In fact, the Act designates efficiency improvements as the highest-priority resource for meeting electricity demands and gives it a 10 percent cost advantage. Second priority is renewable

[1] Public Law 96-501, Sec. 2(2).

resources followed by high-efficiency generating technologies and then other generating technologies.[2] Except for efficiency improvements, the priorities of the Act are only tie breakers when alternative resources have equal cost.

The power plan includes a resource strategy to ensure demand for electricity is met by a combination of improved efficiency and generating resources that minimizes the cost of the energy system, including quantifiable environmental costs. Because there are many unknowns in the future, the power plan considers how costs might vary with changing conditions and identifies strategies to reduce the risk of high-cost futures. The action plan identifies specific actions needed in the next five years for the region to achieve the long-term strategy. These actions are the heart of the power plan because they set an agenda for the next several years.

The Act requires that the Council's power plan be reviewed at least every five years. This power plan is the sixth produced by the Council since the Act was passed. In each plan, costs and technologies have changed resulting in subtle changes in the plans. Generating technology cost-effectiveness has shifted away from large coal and nuclear facilities toward shorter-lead-time, more flexible, gas-fired generation. Recently, climate concerns and related state regulations have made renewable generation technologies more attractive.

However, consistently in all of the Council's power plans, efficiency improvement has been the lowest-cost resource. As the Council's ability to assess risk has grown more sophisticated, efficiency also has proven to be the least-risky resource alternative. As a result, in each of the Council's plans energy efficiency has been identified as an important resource for the region. In the Council's first plan, conservation was expected to meet half of the region's 20-year, medium-high load growth to 2002. In successive plans, the amount and share of conservation varied as utility programs or codes and standards captured some of the potential, new technologies became available, and cost-effectiveness levels changed. But the share of expected new energy resources to be provided by efficiency improvements never fell below 25 percent, and has typically been between 30 percent and 40 percent.

Over the years since the Council was formed, conservation has met nearly half of the region's growth in energy-service demand. If the region's energy savings were added back to the regional energy loads, load would have increased by 8,150 average megawatts between 1980 and 2008. During that time the region acquired 3,900 average megawatts of conservation, so that actual loads to be met by electricity generation only increased by 4,250 average megawatts.

In addition to the resource strategy, the Council's power plan addresses significant issues facing the Northwest power system and provides guidance to the region on addressing those issues. The focusing issues have changed with each power plan. The region's power system has gone through many changes over the 28 years of the Council's existence, including changes to the operation of the power system to aid fish and wildlife; electricity industry restructuring; a changing role for the Bonneville Power Administration, the federal power-marketing agency that implements the Council's power plan; and evolving environmental concerns. The Council's power plans have reflected those changing conditions.

A constant focus through all of the Council's power plans has been the significant uncertainty facing the regional power system. In early plans, long resource lead times for coal and nuclear

[2] Public Law 96-501, Sec. 4(e)(1).

plants created risk in the face of highly uncertain load growth. Over time, other risks became a larger part of the problem including fuel prices and availability, industry restructuring, and environmental risks. Although the regional power system has changed in many ways from what was envisioned in the Act, the basic planning guidelines have proven resilient and continue to provide guidance to the region.

MAJOR ISSUES

The regional power system is facing significant changes. The Sixth Power Plan addresses these changes through its resource recommendations and action plan. Some of the most important changes include:

- Growing concern about, and evolving policies to address, climate change
- Increased importance of assessing the capacity of the power system to meet periods of sustained peak electricity needs and provide ancillary services to meet system operation and wind integration requirements
- The changing role of the Bonneville Power Administration in providing resources to meet the growing needs of public utilities
- Emerging technologies and incentives with the potential to change significantly the relationships among electricity producers, utilities, and consumers
- Significant increases in the price of natural gas, oil, and coal supplies

Climate Change

Concerns about climate change have changed the power planning landscape dramatically. Regardless of one's beliefs about the causes of climate change there is a wide consensus among scientists and policy-makers that human-caused greenhouse gas emissions are contributors. These concerns have resulted in a wide variety of polices throughout the world, the nation, and the Pacific Northwest and western states. These policies are affecting the resource choices available for electricity generation both directly through restrictions on certain types of resources, and indirectly through incentive programs to encourage certain types of resources.[3]

An example of these policies is restrictions on new coal-fired power plants. In some cases these restrictions are direct prohibitions against new power plants emitting more than a determined amount of carbon. In others, it is regulatory or public resistance. But in any case, new conventional coal-fired power plants appear unlikely to be an alternative in the Northwest's future.

Renewable portfolio standards in Montana, Oregon, and Washington will require that a substantial portion of utilities' added electricity generation will be from renewable resources. By 2030, the shares of loads that must be met from renewable technologies are: 15 percent in

[3] See Chapter 11 for a discussion of these policies.

Montana, 25 percent in Oregon, and 15 percent (by 2020) in Washington. The timing to reach these levels varies by state. Many other states in the West have similar renewable requirements.

Some policies already are in place. However, that does not mean they will remain unchanged. Policies can be reassessed and refined. Further, the Western Climate Initiative (WCI), an effort of 11 U.S. states and Canadian provinces to address climate issues, has set greenhouse-gas emissions goals and designed a market-oriented cap-and-trade process to facilitate meeting their goals. Participants in the WCI may have individual goals to reduce greenhouse gas emissions. Such initiatives are often accompanied by a host of state policies to help reach the goals. The U.S. has yet to act at the national level on greenhouse gas policies although legislation is being actively considered. The carbon-reduction goals of these policies vary but typically would imply about a 40- percent reduction from 2005 levels of emission by 2030, and an 80 percent reduction from 2005 levels by 2050. The result of all these factors is simply that many future policies that could profoundly affect resource choices remain unknown, creating risks for resource decisions that have to be made now.

Uncertainty about climate policies raises several questions for the Sixth Power Plan. These include:

- What are likely costs of carbon-control policies, and will those costs be known (carbon tax) or unknown (cap-and-trade system)?
- What is the lowest-cost approach to meeting carbon emissions reduction targets, and what are those targets most likely to be?
- What are the costs of renewable resources, and what will be the costs to consumers of meeting renewable portfolio standards?
- How will development of renewable generation affect the operation of the power system and the need for new transmission investments?
- Are there carbon-control policies in other sectors, such as transportation or building construction and maintenance, that will affect the need for electricity?
- Will uncertainty about future carbon policies and their effects on energy costs lead to inadequate investment in electricity supplies?

Providing Capacity and Ancillary Services

Until recently, the Pacific Northwest was able to plan its power system based on average annual energy needs and supplies. The hydroelectric system provided a large share of the regional electricity supply and had the flexibility to provide most of the peaking and shaping (ancillary services) required to match reliably electricity generation to consumption on an annual, seasonal, hourly and sub-hourly time scale.

The hydroelectric system, however, can no longer be assumed to provide all of these services. There are several reasons for this change:

- First, the seasonal patterns of electricity demand in the region are changing as air conditioning use has grown.
- Second, flexibility of the hydroelectric system has been constrained by actions taken to help mitigate for its impacts on fish and wildlife.
- Third, the share of non-hydroelectric generating resources has been growing over the last 40 years and those resources typically do not have the same degree of flexibility as the hydroelectric system.
- Finally, the region has added significant amounts of wind generation, which is a variable resource and adds to the shaping and flexibility requirements of the power system.

Assuring an adequate and reliable power system increasingly requires addressing the peaking and shaping capability of the power system. This power plan, for the first time, addresses these issues.

- What is the capacity of the hydroelectric system to meet peak loads and provide flexibility resources?
- Are there actions that can reduce the need for additional capacity and flexibility?
- What other resources can provide such services and what are their costs?
- What mix of generating resources, energy storage, and demand-side response is most cost-effective for providing needed flexibility?

Bonneville's Role

More than 10 years ago, the Comprehensive Review of the Northwest Energy System recommended that Bonneville should focus on marketing the existing resources of the federal base system to protect its low cost and ensure regional commitment to repaying debt to the U.S. Treasury.[4] One of the review's basic tenets was that utilities would pay the cost of new electricity supplies for growth in their customers' demand beyond that provided through the existing federal base system.

Bonneville adopted its Regional Dialogue Policy in July 2007. Subsequently, Bonneville and its customer utilities signed long-term contracts in 2008 to implement the policy with the intention of protecting the cost-based federal system while providing better incentives for utility resource decisions.

This change will empower many customer-owned utilities to make their own resource decisions. In addition, many of these utilities are now subject to planning requirements and renewable portfolio standards imposed by states in the region.

[4] Comprehensive Review of the Northwest Energy System: Final Report. December 12, 1996.

As a result of these changes, implementation of the Council's plan will become even more diverse. Bonneville's role in developing future power resources for the region likely will be reduced. These changes prompt several questions:

- How will the region implement the Council's power plan?
- Who will be responsible for meeting efficiency goals, and how will achievements be tracked?
- How will small customer-owned utilities develop resources to meet their load growth?

Changing Technologies

The digital revolution has created technologies that could substantially change the way the power system is planned and operated. These technologies offer the possibility for improved control, reliability, and efficiency of power system operations, an enhanced market for energy and ancillary services, and a greater opportunity for consumers and distributed generation to participate in the operation of the power system.

This general area of technology is frequently referred to as the "smart grid." Components of this technology include electric meters at homes and businesses that can be remotely monitored, saving utilities meter-reading costs, but also other sensor technology that can communicate back to the power system on the status of electricity use, the exact location of outages, and the status of the distribution system at all points in a utility's system. This technology provides a foundation for automated demand response when coupled with appropriate price signals, consumer agreements, and end-use equipment controls.

The advancement and deployment of these technologies is likely to significantly change the way in which improved efficiency is acquired. With data on each customer's use at intervals of one hour or less, energy-savings estimates and evaluations of conservation-acquisition alternatives can be more confident. As better information about the value of electricity savings in particular locations and at particular times is made available to consumers, efficiency improvements increasingly will be pursued as a business strategy. Energy service and management companies will be able to offer a business case to consumers that improves the quality and reduces the cost of electricity. This continues a trend of increasing roles for non-utility entities in the acquisition of energy efficiency. This trend has included the creation of the Northwest Energy Efficiency Alliance, the Energy Trust of Oregon, and numerous energy-service companies. Pursuit of efficiency as a profitable business case may be the next stage of energy efficiency acquisition strategies. Technology advancements pose questions for power planners, including:

- How will advancement of smart-grid technologies change the role of utilities and customers?
- What actions are needed to facilitate development of these technologies?
- Are there barriers to expansion of these technologies?

- Will smart-grid technologies and practices improve the reliability and efficiency of the electrical grid, or will diffusion of control create problems for management of the system?

- How will smart-grid technologies facilitate other objectives of energy or climate policy? For example, is it needed to integrate plug-in electric vehicles into the power system?

Growing Cost of Energy

Since the Council was formed in 1981 there have been two major incidents of electricity price increases. The first was just about completed as the Council was created and it was due to large overinvestment in nuclear facilities that turned out to be unneeded. The second large increase occurred in 2000-2001 and was due to underinvestment in electricity generation.

Current expectations are that the region faces a third increase in electricity costs, although perhaps it may occur over a more extended time period. In this case, the increase will be due to increased cost of basic energy supplies, such as oil, natural gas, and coal, increased carbon-emissions controls, and requirements to develop more expensive renewable sources of electricity.

Each historical increase in electricity prices changed the Northwest economy and electricity use. The 1979-1981 increase pushed electricity-intensive industries of the region to marginal producers in world markets. The 2000-2001 increase resulted in the permanent closure of many of these regional industries. From the 10 aluminum plants that were operating in the region when the Act was passed, only three remain in partial operation. In addition, many other energy-intensive industries have closed permanently in the last 10 years. The potential for higher future energy costs raises these questions:

- What additional effects will increasing electricity prices have on the economic structure of the region?

- Are there strategies to reduce the effects of higher prices on the region's consumers of electricity?

- Are there approaches to carbon-emissions reduction that moderate the price increases?

HISTORICAL CONTEXT

The Council's power plan looks 20 years into the region's electricity future. Decisions regarding this future are long-lasting and have important effects on the adequacy, efficiency, reliability, cost, and environmental footprint of the power system. To plan for a future that ensures the region a resilient supply of electricity consistent with long-term growth and environmental sustainability, it is important to understand how the regional electricity market has evolved. Anticipating changes that could take place during a period of 20 years requires investing in a power system that is as adaptable as possible.

This section provides background on trends in electricity demand and supply since the time the Council was created. It looks at changes that have occurred during the past 25 years to provide

important insights into the region's energy future. This section seeks to answer questions: How has the use of electricity grown and changed? What role has improved efficiency played in these trends? How have the sources of electricity generation changed over the years, and how have the institutions and regulations changed?

Electricity Demand

The year 1980, the year the Northwest Power Act was passed, was a watershed for the region. In preceding decades, the region had experienced rapid growth in electricity demand. There was an expectation that this rate of demand growth would continue. During this time, there was little hydroelectric expansion and many planned investments in large-scale coal and nuclear generating plants. The cost of these new generating sources was much higher than existing hydroelectricity. Their development created a huge increase in electricity costs.

Instead of the ever-growing electricity demand experienced before 1980, the region found that demand was indeed responsive to price changes. The region's aluminum plants, which accounted for nearly 20 percent of all regional electricity use, became far less competitive in world markets. But other users of electricity also responded by altering their consumption. Between 1960 and 1980 regional electricity loads grew at 5 percent per year, but in the subsequent 20 years from 1980 to 2000, load growth was only slightly over 1 percent per year. Slowed growth in demand and escalated costs of new power plants combined and forced many of the regional investments in new nuclear facilities to be abandoned. Unfortunately, many of their costs already were incurred and still affect electricity prices today.

In 2000 and 2001, the region experienced a second large electricity price increase. Unlike the 1980 price increase, this one was a result of too little investment in electricity generation, combined with a poor water year and a flawed power-market design in California. This price increase confirmed the demise of most of the region's aluminum smelters and resulted in closure or cutbacks in other energy-intensive industries as well. Regional loads dropped by 16 percent between 1999 and 2001, falling back to levels of the mid-1980s.

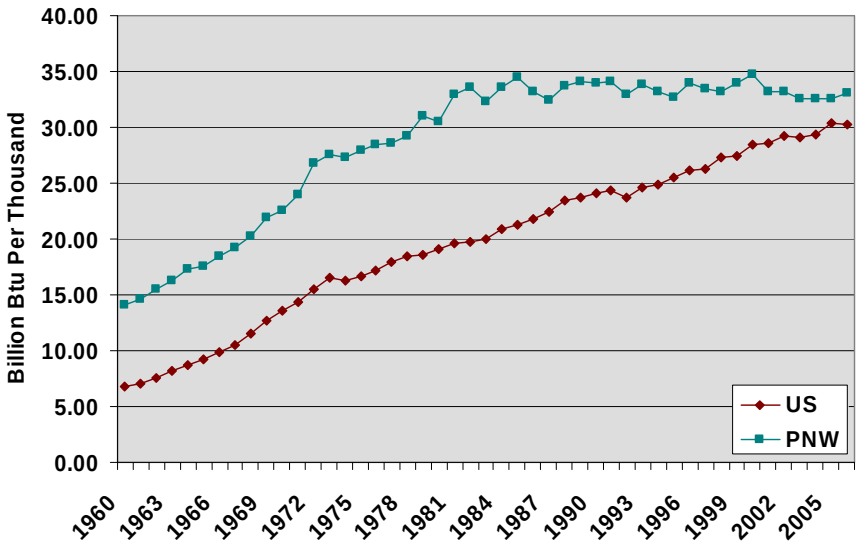
Electricity prices and consumption are often compared to national statistics. Such comparisons help us understand regional long-term trends. The Pacific Northwest economy historically has been both more energy-intensive than the rest of the nation, and more electricity-intensive. However, the regional trends in total energy use per capita, and per dollar of economic production (Gross Domestic Product (GDP) or Gross State Product (GSP)), have been different from the national trends in recent decades. National total energy use per capita flattened following the early 1970s whereas the regional use of energy per capita declined. By 2006, the region's energy use per capita and the nation's were the same. National total energy use per real dollar of GDP has declined since 1977 when the data first were available. However, the Pacific Northwest's energy use per real dollar of GSP declined faster, and has equaled the nation's since 2001.

The Pacific Northwest remains more electricity intensive than the nation. That is, the share of electricity used to meet all energy needs is higher in the Northwest than it is in the rest of the nation. But that gap has narrowed significantly since 1980. Until 1980 the regional share of end-use energy needs met by electricity, compared to other sources such as oil or natural gas, was nearly double the national share. Both the national and regional shares grew between 1960

and 1980. However after 1980, the national electricity share continued to grow, but the regional share remained stable. By 2006, the regional electricity share in total energy consumption by households and business was 20 percent compared to a national share of 17 percent.

The greater electricity intensity of the Pacific Northwest historically was due in large part to the region's electricity-intensive industries drawn here because of low-cost electricity supplies. The loss of some of these industries has significantly reduced the region's electricity demand. Not only has the region's industrial use been electricity-intensive, the region's residential and commercial energy use also historically has been more electricity-intensive than the rest of the nation. The national electrical intensity of these sectors has grown over the last 45 years, but the region's intensity has remained flat since 1980. Figure 1-1 shows that the region's per capita residential and commercial electricity demand has been higher but its rate stable, whereas the nation's demand has been lower but is growing at a steady rate.

Figure 1-1: Residential and Commercial Electricity Use Per Capita: U.S. versus Region

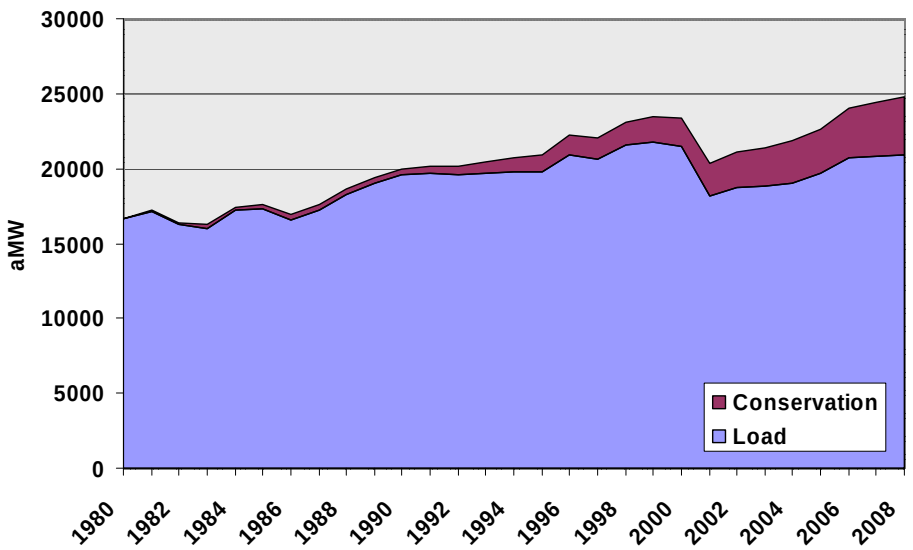


Both regional and national electricity prices have increased over the last 35 years. National prices increased following the oil embargo in 1973, but the region's prices, which were less influenced by changes in oil and natural gas prices, did not escalate rapidly until 1980. During the 1980s and 1990s regional electricity prices remained roughly half of national prices. With the price increases following the Western electricity crisis in 2000-2001, the gap closed some, but as shown in Figure 1-6, the region continues to have significantly lower prices than the nation as a whole.

Although the nation and the region had similar electricity price growth, regional demand per capita stopped growing after 1980 while the nation's continued to grow. What accounts for this difference in response? Part of the explanation is the loss of electricity-intensive industrial sectors. However, the pattern is also evident in the residential and commercial sectors. Part of the pattern can be traced to conversions of space and water heat from electricity to natural gas. Other parts of the country already used natural gas for these services.

Another important factor limiting the region's growth of electricity demand has been its efforts to improve the efficiency of electricity use. Since the Northwest Power Act in 1980, the Pacific Northwest has pursued programs to improve the efficiency of electricity use. By 2008, the region had saved 3,900 average megawatts of electricity as a result of the accumulated effects of Bonneville and utility conservation programs, improved energy codes and appliance-efficiency standards, and market-transformation initiatives. Figure 1-2 shows the effects of these savings over time. These efficiency improvements have met 48 percent of the region's load growth since 1980, and the savings now amount to more than the total electricity use of Idaho and Western Montana combined. Without improved efficiency, the growth of regional electricity use would have been 1.5 percent per year from 1980 to 2008 instead of the 0.8-percent the region experienced during that time.

Figure 1-2: Effects of Conservation on Growth of Demand



The region's historical electricity use has implications for electricity demand forecasts. Because fuel conversions and fewer electricity-intensive industries played an important role in the past stabilization of the electricity intensity of the Pacific Northwest, it may be more difficult to offset growth in the future. Without aggressive conservation efforts, electricity demand may return to growing at the same rate as population and economic activity.

Electricity Generation

A long-term view of electricity generation in the Pacific Northwest reveals a trend of growing diversity of energy sources. In 1960, nearly all electricity was supplied from hydroelectric dams. As Figure 1-3 shows, growth in electric generation needs has been met by other sources, such as coal, nuclear, natural gas, biofuels, and most recently wind power.[5] These resources weren't developed with diversity in mind; they were developed in phases based what was apparently most attractive at the time. Early diversification from hydroelectricity focused on coal and

[5] Figure 1-3 shows average annual energy capability. The hydropower numbers are critical-water, and wind assumes a 30-percent capacity factor.

nuclear generation. In the late 1990s and early 2000s natural gas was favored, and most recently wind has been encouraged by economic incentives and state renewable portfolio standards.

But not all growth in electricity consumption has been met by increased generation capability. Figure 1-3 shows conservation as part of the current mix of electricity generating resources. Conservation is the fourth-largest resource meeting the Northwest's electric energy needs, exceeded only by hydropower, coal, and natural gas.

Figure 1-3: Growing Electricity Resource Diversification in the Pacific Northwest

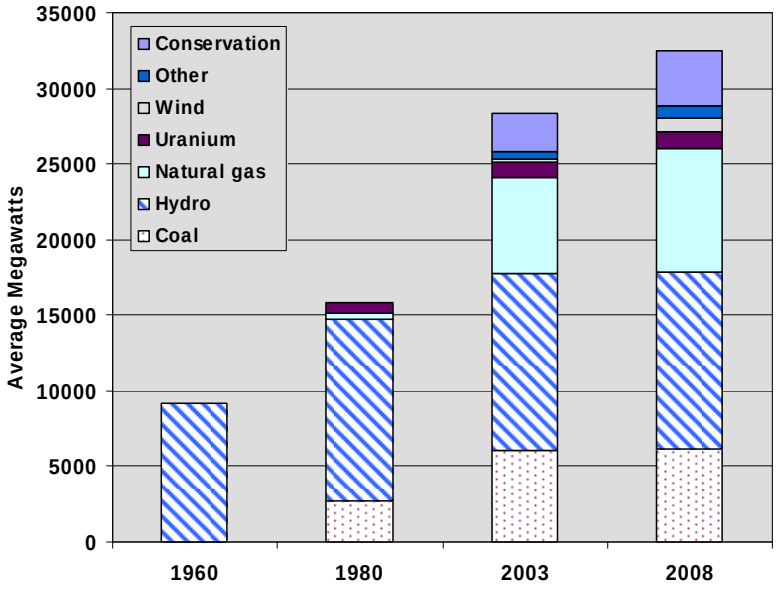
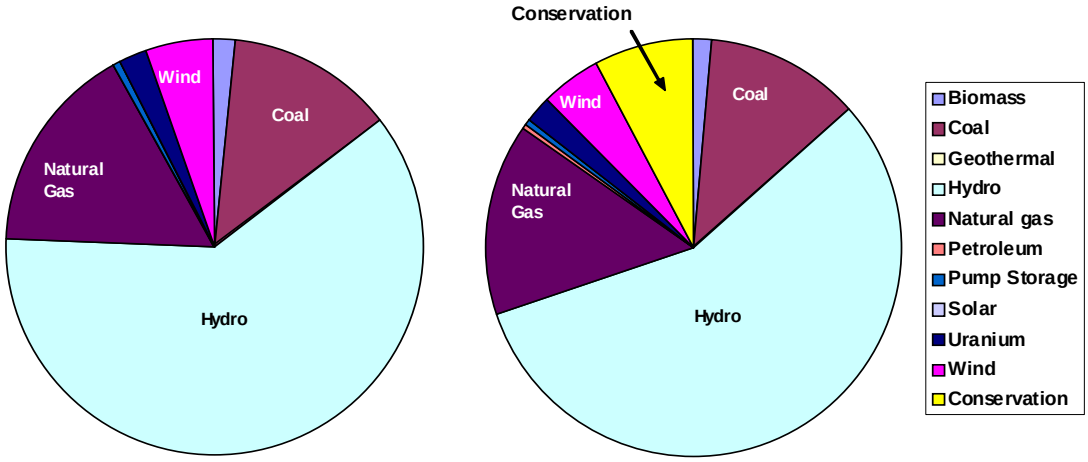


Figure 1-4 shows the mix of electricity capacity in the region.[6] Capacity refers to the ability to produce energy during peak demand hours. Figure 1-3 shows contributions to "energy," which refers to the sources of electricity used to meet average demand over a year typically. Compared to the energy mix, installed capacity shows much higher hydropower and wind shares. The left side of Figure 1-4 shows generation only; the right side includes the effect of conservation on peak loads.

However, hourly capacity as shown in Figure 1-4 can be misleading for the assessment of adequacy of electricity supplies. For example wind is a variable resource and has very little dependable capacity value because its generation cannot be counted on reliably over short periods of time. Likewise, the hydroelectric system's capacity value must be reduced because of its limited ability to sustain energy production over several days of high loads. In both cases, the generation that can be counted on is limited by the fuel supply -- that is, by the wind or, in the case of hydroelectric generation, by available water. In April 2008, the Council adopted a resource adequacy standard, which acts as an early warning system to alert the region when the power supply can no longer reliably supply annual energy or peak capacity needs.

[6] Figure 1-4 shows installed generating capacity of resources. Installed capacity is the maximum amount of energy that could be generated during a peak hour. Dependable capacity is the amount of energy that can be counted on in a peak load hour. In the case of wind generation, dependable capacity is only about 5 percent of the installed capacity shown in Figure 1-4. Conservation has been increased by the system load factor, that is peak energy consumption relative to average annual consumption.

Figure 1-4: Electrical Capacity Resources in the Pacific Northwest

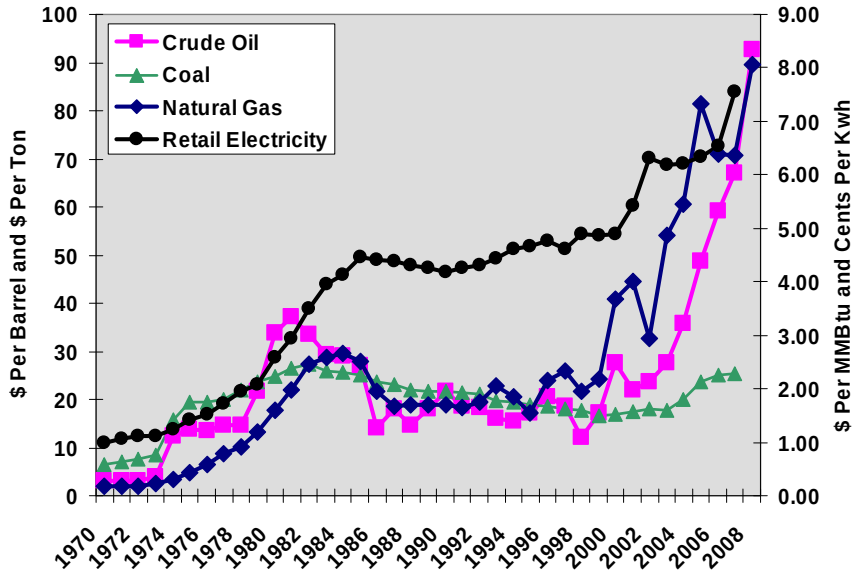


Energy Cost Trends

Energy, like many other commodities, tends to experience price cycles. At the time the Council was developing its first power plan in the early 1980s, energy prices were at a high point. Oil prices were high due to OPEC policies and war in the Middle East. Natural gas prices were high as a result of regulatory policies that impeded development of new supplies. Electricity costs in the Pacific Northwest had just experienced a huge increase due to overbuilding new nuclear generation capacity exacerbated by the high inflation and interest rates of the late 1970s.

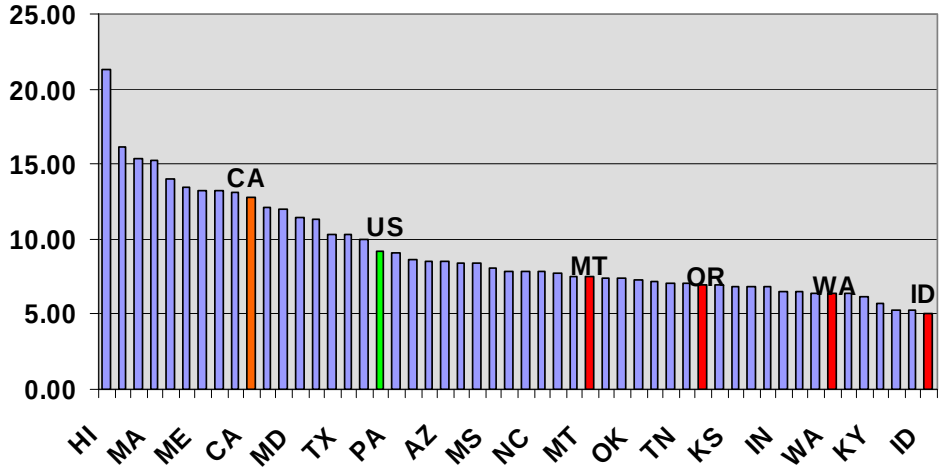
In the mid-1980s fuel prices fell, but retail electricity prices in the region remained high. The new millennium brought another commodity price cycle for oil, natural gas, and coal. For example natural gas prices, which had averaged $2 per million Btu in the 1990s, increased to an average of nearly $6 during the first decade of the new millennium. In addition, fuel prices have become more volatile. The wholesale market price of electricity is more closely linked to cycles in fuel prices than in the past because more of the region's generation is based on natural gas and coal now. Figure 1-5 illustrates these historical trends in fuel and electricity prices.

Figure 1-5: Energy Price Trends



In spite of price increases over the past 30 years, the cost of electricity to Pacific Northwest consumers remains lower than costs to consumers in other parts of the country. In 2007, Idaho was the lowest-price state in the nation, Washington rated seventh-lowest, Oregon was 15th, and Montana 22nd. Taken together, retail electricity prices in the four Northwest states in 2007 were a little more than two-thirds of the national average, and only half of electricity prices in California. Although prices have increased substantially since 1980, the Northwest still enjoys relatively low electricity prices.

Figure 1-6: Average Retail Electricity Prices by State, 2007



An important factor in California's higher electricity prices is the cost of resources for peak demand. California electricity demand is more variable than in the Pacific Northwest. Peak electricity loads in California are about 70-percent higher than average annual electricity use. In comparison, peak loads in the Pacific Northwest are typically 25 percent higher than average

annual electricity use. But more importantly, California uses fuel-based peaking resources to meet its requirements to a much larger extent than in the Pacific Northwest. The capital and fuel costs of these peaking resources must be recovered over very few operating hours a year when they are used to meet these periods of high demand. In the Pacific Northwest, the hydroelectric system provides much of the peaking capacity and ancillary services for the region at very low cost.

The hydropower system's use as a base resource and its inexpensive flexibility together keep Northwest electricity prices low. As the region outgrows the hydropower system's capability to provide peaking and flexibility, other resources will be necessary and the cost of electricity will likely increase. Preservation of the hydropower system's flexibility and capacity is key to keeping Northwest prices low, and also to maintaining a low carbon footprint. Developing cost-effective demand response also can contribute to meeting peak loads and providing flexibility.

A VISION FOR THE SIXTH POWER PLAN

For nearly 30 years, the Council's mission – to assure the region of an adequate, efficient, economical, and reliable power supply, while also protecting, mitigating and enhancing fish and wildlife affected by the Columbia River Basin hydroelectric system – has not changed.

The Northwest's energy environment is complex, and this is a time of profound change. From concerns about the increasing cost of electricity to the effects of greenhouse gases on climate and the operation of the region's hydroelectric and transmission systems to meet peak demand, integrate wind generation, and recover endangered salmon and steelhead, the challenges are many, and they are interrelated.

The Council's Sixth Power Plan recognizes and responds to this new environment. It lays out a strategy for moving toward the power system of the future while maintaining a reliable and affordable system.

How will these challenges be addressed, and what will the energy system of the future look like? The Council's Sixth Power Plan envisions a cleaner and more efficient system for the region, with these attributes:

- Nearly 6,000 average megawatts of achievable energy efficiency that will greatly reduce the Northwest's electricity demand and carbon-dioxide production over the next 20 years.

- Improved operation of the regional power system that will help accommodate diverse and variable-output renewable generation and promote the efficient use and expansion of the regional transmission system.

- Conventional coal plants that will operate with effective carbon-reducing technologies or be displaced by resources that emit less or no carbon.

- Smart grid and other technologies that will make the energy system more efficient and decentralized, maintaining its reliability and safety, and potentially transforming power system operations. It will facilitate instant notification and location of outages, provide

flexibility and energy storage, and help integrate variable-output wind power and plug-in hybrid cars into the regional power system.

- A hydroelectric system whose capability is preserved and improved in order to provide low-cost power for the region, providing both flexibility to help integrate wind and other variable-output resources and improved conditions for salmon and steelhead.

- A regional power system that does its part through the above actions to achieve the carbon-reduction goals that have been adopted by three of the four states in the Pacific Northwest.

- Access by Pacific Northwest citizens to better information about their electricity supply so that they can participate in the formation and implementation of important regional policies.

Today, the road to this vision means addressing many new questions. The Sixth Power Plan is a map to that future.