Chapter 3: Electricity Demand Forecast

SUMMARY OF KEY FINDINGS

The Pacific Northwest consumed 19,000 average megawatts or 166 million megawatt-hours of electricity in 2007. That demand is expected to grow to 25,000 average megawatts by 2030 in the Council's medium forecast. Between 2007 and 2030, demand is expected to increase by a total of 6,500 average megawatts, growing on average by 270 average megawatts, or 1.2 percent, per year. This forecast has been influenced by expected higher electricity prices that reflect a rapid rise in fuel prices and emerging carbon emission penalties. At the same time, the impact of cost-effective efficiency improvements identified in the Sixth Power Plan should help to meet that demand growth.

This increase is driven primarily by significant growth in two areas: home electronics and elder-care facilities. Demand for home electronics--a new component to the Council's residential sector--is expected to double in the next 20 years. In the commercial sector, the elder-care segment is increasing as the population ages, resulting in their surge. While the industrial sector is growing at a relatively slow pace, custom data centers (Google, etc.) are a relatively new end-use that has been seeing significant growth as well.

The Northwest has always been a winter-peaking power system. However, due to growing summer load, mostly because of the increased use of air conditioning, the difference between winter- and summer- peak load is expected to shrink over time. Assuming normal weather conditions, winter-peak demand in the Sixth Power Plan is projected to grow from about 34,000 megawatts in 2010 to around 42,000 megawatts by 2030, an average annual growth rate of 1 percent. Summer-peak demand is forecast to grow from 28,000 megawatts in 2010 to 39,000 megawatts by 2030, an annual growth rate of 1.4 percent. By the end of the planning period, the gap between summer-peak load and winter-peak load has narrowed.

The projected growth of demand is comparable to the actual growth rate experienced during the 1990s. When new cost-effective conservation is subtracted, the need for additional generation will be quite small compared to past experience. However, summer supply needs will likely increase as summer-peak demand continues to grow. In addition, the growing share of variable wind generation may change the types of generation needed to meet demand. There is likely to be an increased need for resources that can provide reliable capacity to meet high load conditions and that can operate flexibly to accommodate variable, but non-CO2 emitting, wind energy.

INTRODUCTION

The 2001 energy crisis in the West refocused the region on long-term demand forecasting. There has been a renewed interest and concern about generating capacity and flexibility as well. To deal with these issues, the Council replaced its end-use forecasting models with a new end-use forecasting and policy analysis tool and, working with Bonneville, adapted it to the regional power system and the Council's planning requirements. The new demand forecasting system is based on the Energy 2020 model and generates forecasts for electricity, natural gas, and other fuel.

The Energy 2020 model is an integrated end-use forecasting model. The Council will use the demand module of Energy 2020 to forecast annual energy and peak loads for electricity as well as other fuels. The model has been used extensively by several utilities, and within the region the Bonneville Power Administration uses a version of it.

Three electricity demand forecasts were developed in the Sixth Power Plan. Each scenario corresponds to an underlying set of economic drivers, discussed in Chapter 2 and Appendix B. The high and low range of the load forecasts are not explicitly used in the development of the Power Plan, but rather are used as loose guidelines for the regional portfolio model when creating the 750 alternative load forecasts. These demand scenarios reflect an estimate of the impact of the current recession.

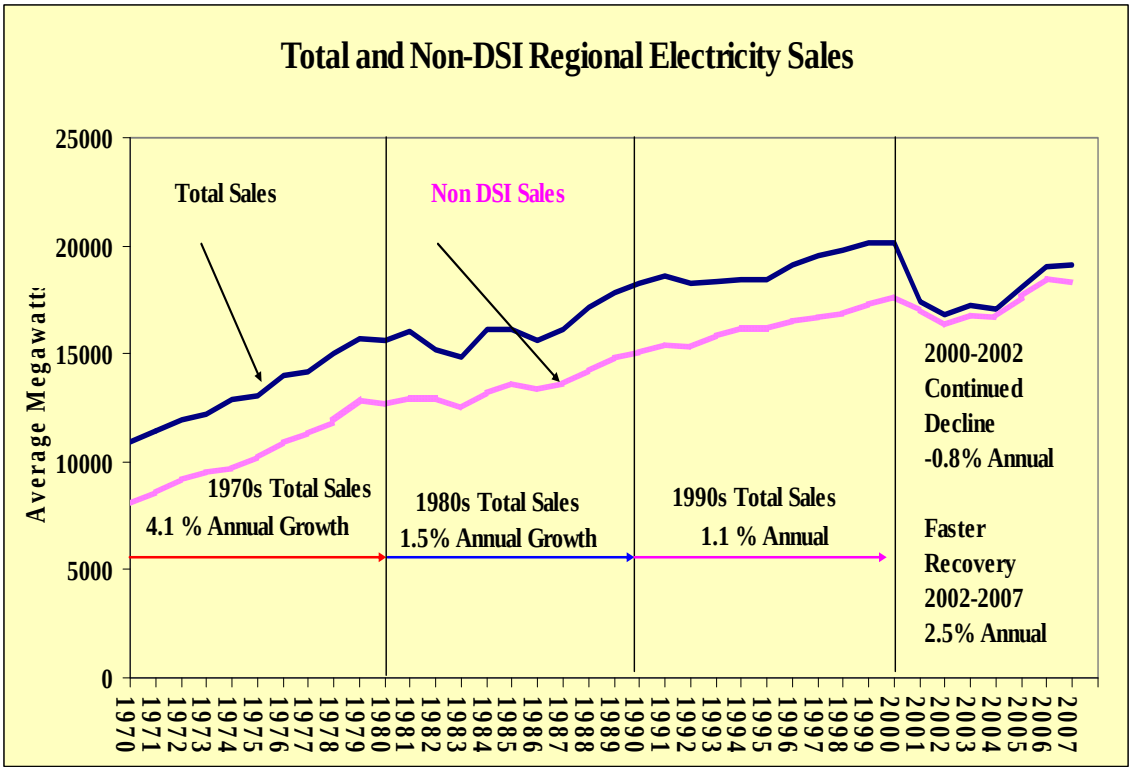
Historic Demand Growth

It has been 26 years since the Council's first Power Plan in 1983. In the decade prior to the Northwest Power Act, regional demand was growing at 4.1 percent per year and the non-direct service industry (DSI) load was growing at an annual rate of 5.2 percent. Back in 1970, regional demand was about 11,000 average megawatts. In the decade between 1970 and 1980, it grew by about 4,700 average megawatts. During the 1980s, demand growth slowed significantly, falling to about 1.5 percent per year and load increased by about 2,300 average megawatts. In the 1990s, another 2,000 average megawatts were added to regional demand, making growth in the last decade of the 20th century only about 1.1 percent per year. The energy crisis of 2000-2001 increased electricity prices dramatically. As a result, regional demand decreased by 3,700 average megawatts between 2000 and 2001, eliminating much of the growth since 1980. The bulk of this decline was in the region's aluminum industry and other energy-intensive industries. Since 2002, however, regional demand has begun to recover, growing at an annual rate of 2.5 percent. This growth has been driven by increases in commercial and residential sector demand. Nevertheless, demand remains well below levels of the late 1990s. Table 3-1 and Figure 3-1 illustrate regional electricity demand from 1970-2007.

Table 3-1: Historical Growth Rate of Regional Electricity Sales

Annual Growth	Total Sales	Non DSI
1970-1979	4.1%	5.2%
1980-1989	1.5%	1.7%
1990-1999	1.1%	1.5%
2000-2007	-0.8%	0.5%
2002-2007	2.5%	2.2%

Figure 3-1: Total and Non-DSI Regional Electricity Sales (MWa)



The dramatic decrease in demand after the Power Act was not due to a slowdown in economic growth in the region. The region added more population and more jobs between 1980 and 2000 than it did between 1960 and 1980. The decrease was the result of a shift in the regional economy as the number of energy-intensive industries declined, largely because of the dramatic increase in electricity prices that followed the region's over-investment in nuclear generation in the 1970s and increased investment in conservation. As shown in Table 3-2, electricity intensity in terms of use per capita increased between 1980 and 1990, but has been declining since 1990.

Table 3-2: Changing Electricity Intensity of the Regional Economy

Year	Non-DSI Electricity Use Per Capita (MWa / Thousand Persons)
1980	1.64
1990	1.71
2000	1.61
2006	1.51

The upswing in demand since 2002 has been mainly due to growth in residential and commercial sector sales. By the end of 2007, the residential sector had added about 888 average megawatts and the commercial sector had added 285 average megawatts, whereas the industrial sector saw a reduction of 337 average megawatts.

Sixth Power Plan Demand Forecast

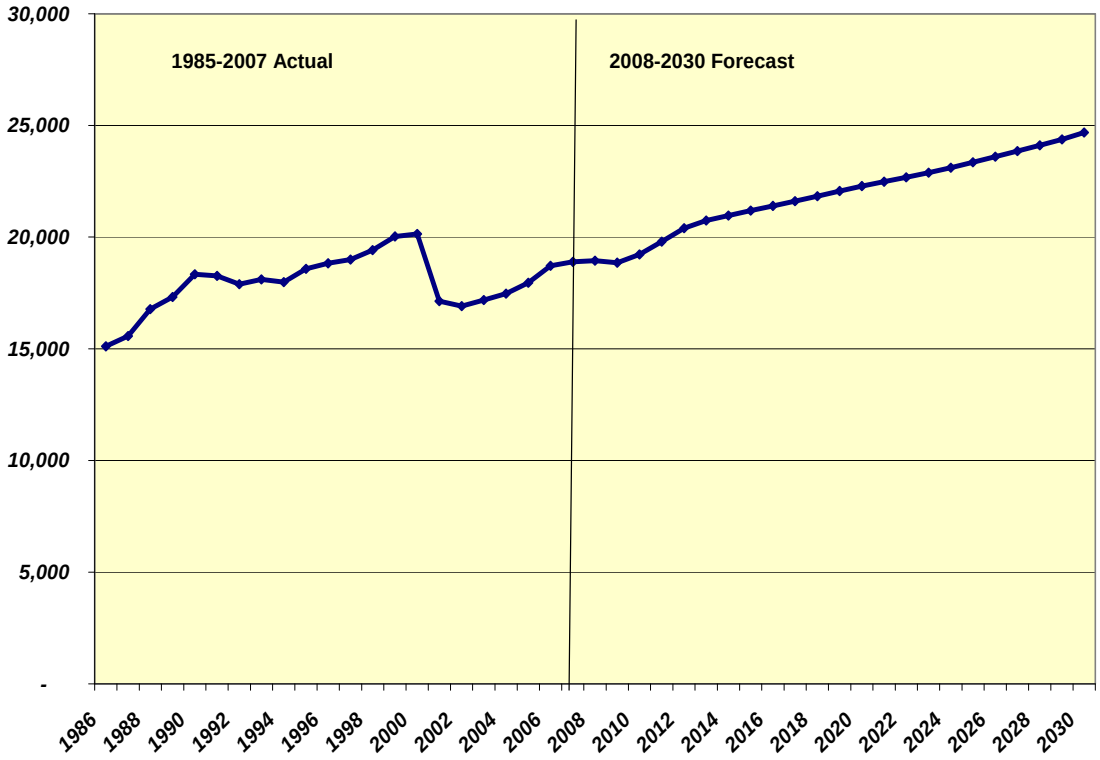
Demand is forecast to grow from about 19,000 average megawatts in 2007 to 25,000 average megawatts by 2030 in the medium case forecast. The average annual rate of growth in this

forecast is about 1.2 percent. This level of growth does not take into account reductions in energy from new conservation resources. To the extent conservation is used to meet demand growth, the forecast will decrease. This growth rate is similar to the Council's Fifth Power Plan forecast, which projected growth of 1.4 percent per year from 2000 to 2025.

Assuming normal weather conditions, the winter-peak demand for power is projected to grow from about 34,000 megawatts in 2010 to around 42,000 megawatts by 2030 at an average annual growth rate of 1 percent. Summer-peak demand is projected to grow from 28,000 megawatts in 2010 to 39,000 megawatts by 2030, an annual growth rate of 1.4 percent.

The medium demand forecast means that the region's electricity needs would grow by about 6,000 average megawatts by 2030, absent any conservation, an average annual increase of 260 average megawatts. Most of the growth is from increased electricity use by the residential and commercial sectors, with slower growth in the industrial sector, especially for energy-intensive industries. Higher electricity and natural gas prices have fundamentally shifted the energy intensity of industries in the region. As a result of the 2000-01 energy crisis and mild recession of 2002, the region lost about 3,500 average megawatts of industrial demand, which it has not regained. The region is projected to surpass the 2000 level of demand by 2013. However, the depth of 2008-9 recession may prolong this recovery. Figure 3-2 illustrates the demand forecast for the medium case. Table 3-3 shows the sectoral demand forecast for selected years.

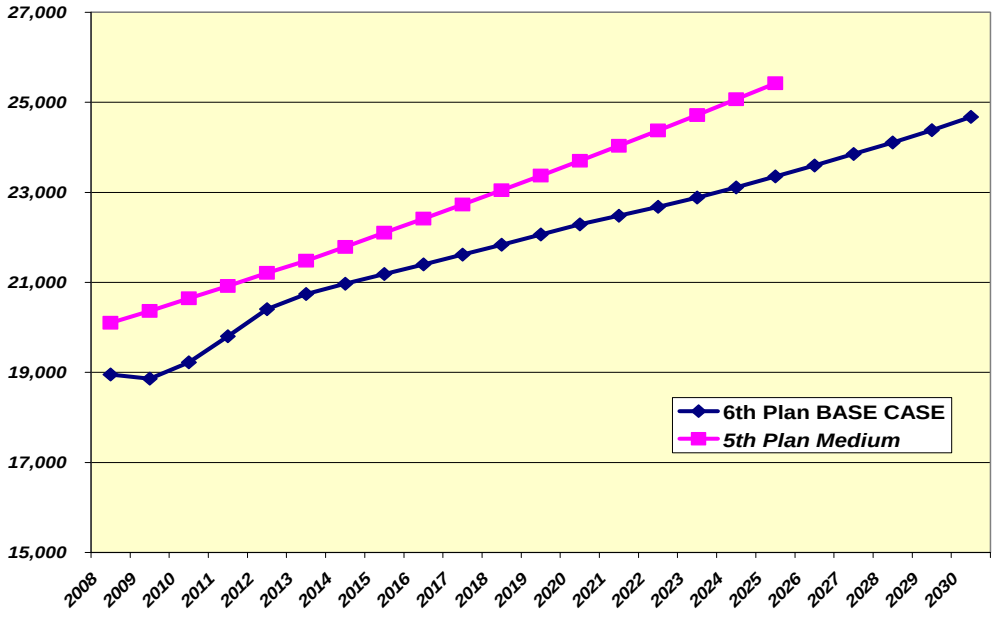
Figure 3-2: Sixth Plan Medium Demand Forecast (MWa)



Comparing the Fifth Power Plan projections with actual consumption, regional demand was in the range of the plan's medium to medium-high forecast. The Sixth Power Plan forecasts are

lower than the Fifth Power Plan as illustrated in Figure 3-3. By 2025, the two forecasts differ by about 2,000 average megawatts.

Figure 3-3: Sixth Plan Demand Forecast Comparison to Fifth Plan (MWa)



Sectoral Demand

The draft Sixth Power Plan forecasts demand to grow at an average annual rate of 1.3 percent in the 2010 through 2030 period. The residential sector is expected to grow at 1.3 percent per year which, on average, translates to about 100 megawatts each year. Increased growth in the residential sector is from a substantial increase in demand for home electronics, categorized as information, communication, and entertainment (ICE,) and the increased use of air conditioning.

Table 3-3 shows the actual 2007 demand for electricity and the forecast for selected years, as well as the corresponding annual growth rates. These demand forecasts do not include any new conservation initiatives.

Table 3-3: Medium Case Sector Forecast of Annual Energy Demand (MWa)

	Actual 2007	2010	2020	2030	Growth Rate 2010-2020	Growth Rate 2020-2030	Growth Rate 2010-2030
Residential	7,432	7,554	8,452	9,765	1.1%	1.5%	1.3%
Commercial	6,106	6,537	8,201	8,767	2.3%	0.7%	1.5%
Industrial Non-DSI	3,725	3,648	3,952	4,277	0.8%	0.8%	0.8%
DSI	764	693	818	818	1.7%	0.0%	0.8%
Irrigation	802	728	781	958	0.7%	2.1%	1.4%
Transportation	64	65	83	94	2.5%	1.3%	1.9%
Total	18,893	19,224	22,288	24,678	1.5%	1.0%	1.3%

Commercial sector electricity consumption is forecast to grow by 1.5 percent per year between 2010 and 2030. During this period, commercial sector demand is expected to increase from

6,500 average megawatts to 8,800 average megawatts. This increase is higher than the 1.2 percent per year that was forecast in the Fifth Power Plan. Compared to the Fifth Power Plan's forecast of commercial electricity use, the Sixth Power Plan cases have been adjusted upward to reflect the fact that there has been a tendency to under-forecast commercial demand. The forecast for 2025 is about 1,600 average megawatts higher than the 2025 medium forecast in the Fifth Power Plan. On average, this sector adds about 120 average megawatts per year.

Industrial electricity demand is difficult to forecast with much confidence. Unlike the residential and commercial sectors, where energy use is predominately for buildings, and therefore reasonably uniform and easily related to household growth and employment, industrial electricity use is extremely varied. Also, industrial electricity use tends to be concentrated in relatively few, very large users instead of spread among many relatively uniform users.

In the last plan, Bonneville's direct service industries were treated separately because this assortment of plants (mainly aluminum smelters) accounted for nearly 40 percent of industrial electricity use. In addition, the future of these plants was highly uncertain. Large users in a few industrial sectors such as pulp and paper, food processing, chemicals, primary metals other than aluminum, and lumber and wood products dominate the remainder of the industrial sector's electricity use. Many of these sectors have declined or are experiencing slow growth. These traditional, resource-based industries are becoming less important to regional electricity demand, while new industries, such as semiconductor manufacturing, are growing faster.

Industrial (non-direct service industries) consumption is forecast to grow at 0.8 percent annually. Electricity consumption in this sector is forecast to grow from 3,700 average megawatts in 2007 to 4,300 in 2030. One segment of the industrial sector that has experienced significant growth is that of custom data centers. Although these businesses do not manufacture a tangible product, they are typically classified as industrial customers because of the amount of electricity they use. The Council's estimates show that there are currently about 300 average megawatts of connected load for these businesses. Demand from this sector is forecast to increase by about 7 percent per year. However, considering existing opportunities to improve the energy efficiency of custom data centers, it was assumed that demand from these centers will grow about 3 percent per year.

Demand Forecast Range

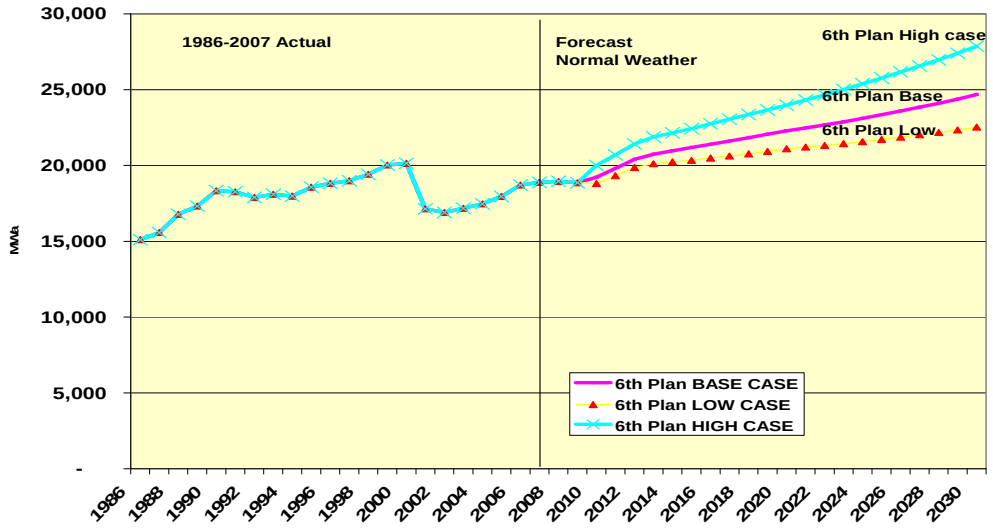
Uncertainty about economic and demographic variables, along with uncertainty about fuel prices, adds to uncertainty about demand. To evaluate the impact of these economic and fuel price uncertainties in the Sixth Power Plan, two alternative demand forecasts were produced. To forecast demand under each scenario, the appropriate economic and fuel projections were used. Table 2-1, presented in Chapter 2, shows a range of values for key economic assumptions used for each scenario. The resulting range in the demand forecast is shown in Table 3-4 and Figure 3-4, and is compared to the Fifth Power Plan in Figure 3-5.

Two alternative scenarios were developed for the Sixth Power Plan. The most likely range of demand growth (between the low and high forecasts) is between 0.9 and 1.7 percent per year. Figure 3-4 summarizes the forecast range. In all three scenarios demand growth in the first 10 years of the forecast is faster than the second 10 years, reflecting a recovery from the current recession in the 2010-2020 period followed by a return to the long term growth trend from 2020-2030.

Table 3-4: Sixth Plan Electricity Demand Forecast Range (MWa)[1]

	Actual 2007	2010	2020	2030	Growth Rate 2010-2020	Growth Rate 2020-2030	Growth Rate 2010-2030
Low	18,893	18,815	21,103	22,538	1.2%	0.7%	0.9%
Medium	18,893	19,224	22,288	24,678	1.5%	1.0%	1.3%
High	18,893	20,006	23,982	27,876	1.8%	1.5%	1.7%

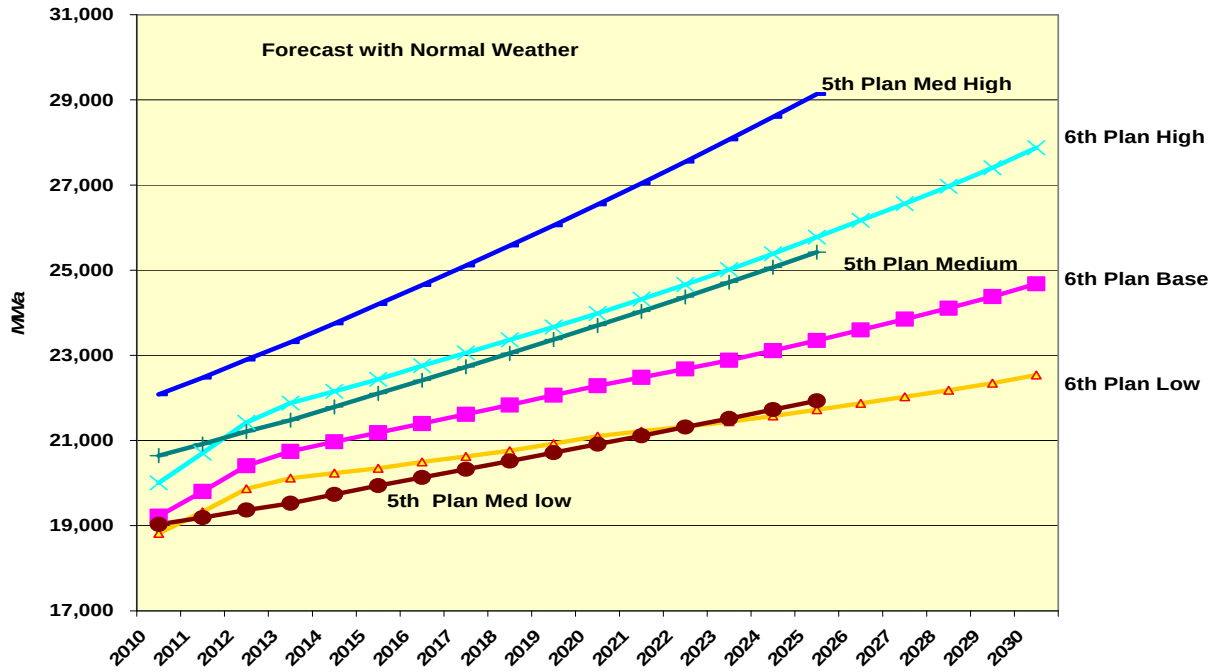
Figure 3-4: Historical Sixth Plan Sales Forecast



A comparison of the range of forecasts in the Fifth and Sixth Power Plans shows that the range is narrower in the Sixth Power Plan. As indicated in Figure 3-5, the medium cases for the two plans are very close. The low case in the Sixth Power Plan is comparable to the medium-low case of the Fifth Power Plan. The Sixth Power Plan medium case is about 2,000 average megawatts lower than the medium case in the Fifth Power Plan. The high case in the Sixth Power Plan is also lower than the medium-high case in the Fifth Power Plan. The main reason for this smaller difference between the high and low case in the Sixth Plan is the narrower range in the economic drivers. The low to high range in the Fifth Plan was intended to cover 95 percent of future demand growth possibilities. The Sixth Power Plan's low to high range is based on Global Insight's range of forecasts, which stays closer to its most likely forecast. The Sixth Plan's low to high range is more comparable to the medium-low to medium-high range in previous Council plans, and both are considered reasonably likely to occur. However, additional uncertainty is addressed in the Regional Portfolio Model (RPM).

[1] Sales figures are electricity use by consumers and exclude transmission and distribution losses.

Figure 3-5: Comparison of Fifth and Sixth Plan Demand Forecasts (MWa)



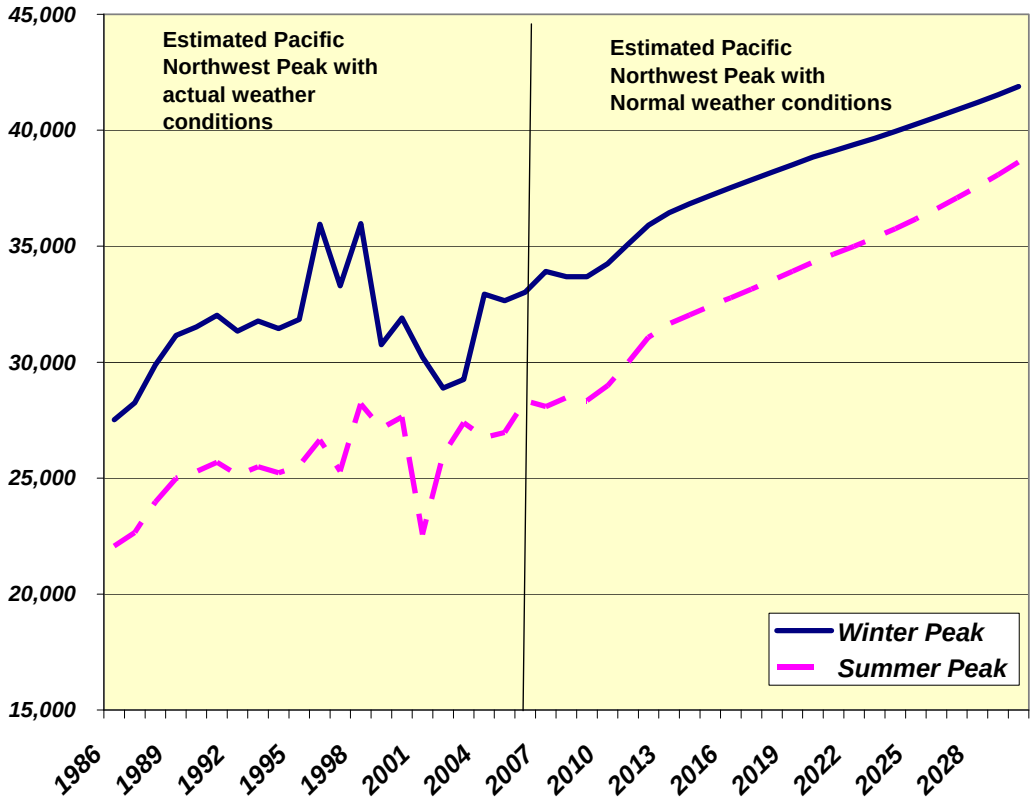
LOAD FORECAST AND PEAK LOAD

Peak Load

The Council's new long-term demand forecasting system forecasts annual sales, as well as monthly energy and peak load. The Council often refers to electricity sales to consumers as demand, following the Northwest Power Act's definition. The difference between sales and load is transmission and distribution losses on power lines. Regional peak load is determined from the end-use level for each sector. The regional peak load for power, which has typically occurred in winter, is expected to grow from about 34,000 megawatts in 2010 to around 42,000 megawatts by 2030 at an average annual growth rate of 1.0 percent. Assuming normal historical temperatures, the region is expected to remain a winter-peaking system, although summer peaks are expected to grow faster than winter peaks, significantly narrowing the gap between summer-peak load and winter-peak load.

The forecast for regional peak load assumes normal weather conditions. There are no assumptions regarding temperature changes incorporated in the Sixth Power Plan's load forecast at this time. Sensitivities will be conducted to help assess the potential effects of climate change on electricity use (See Appendix L). Figure 3-6 shows estimated actual peak load for 1985-2007, as well as the forecasts for 2008-2030. Note that load growth looks very steep due to the graph's smaller scale.

Figure 3-6: Historical and Forecast Regional Peak Load (MW)



Load Forecast Range

Figure 3-7 shows forecast winter and summer month peak load under the three alternative cases. Assuming the high-growth scenario, regional summer-peak load is expected to grow from about 28,000 megawatts in 2007 to about 43,000 megawatts by 2030. Between 2010 and 2030, the growth rate in summer-peak load is 1.8 percent per year, about 0.1 percent higher than the growth rate in the high case average annual demand. The growth rate of winter-peak load in the high case is lower than the growth in average annual energy demand. Assuming normal weather, the region is forecast to remain a winter peaking system. However, the difference between winter and summer peak loads shrinks overtime.

Figure 3-7: Total Summer and Winter Peak Load Forecast Range (MW)

	Actual 2007	2010	2020	2030	Growth Rate 2010-2020	Growth Rate 2020-2030	Growth Rate 2010-2030
Low - Winter	33,908	33,795	37,109	39,060	0.9%	0.5%	0.7%
Low - Summer	28,084	28,229	32,462	35,357	1.4%	0.9%	1.1%
Medium - Winter	33,908	34,243	38,842	41,885	1.3%	0.8%	1.0%
Medium - Summer	28,084	28,976	34,313	38,630	1.7%	1.2%	1.4%
High - Winter	33,908	35,416	41,481	46,552	1.6%	1.2%	1.4%
High - Summer	28,084	30,232	36,876	43,413	2.0%	1.7%	1.8%

In the low case, summer-peak load is expected to grow from 28,000 megawatts in 2007 to 35,000 megawatts in 2030. Winter-peak load grows from 34,000 in 2007 to 39,000 in 2030. Other patterns between summer and winter peaks are similar to the other cases. Winter peaks grow more slowly than average energy load, and summer peaks grow faster.

Plug-in Hybrid Electric Vehicles

A study of the potential impacts of plug-in hybrid electric vehicles (PHEVs) assumed a range of penetration of these cars into the market, with the result that regional electricity use increases by 100 to 550 average megawatts. The power system's emissions of greenhouse gasses increases slightly as a result of PHEVs, but that effect is more than offset by the decrease in emissions by vehicles. The estimated effects on electricity bills and rates were small; these estimates "conservative" since they did not include an estimate of the reduction in cost of gasoline purchases due to PHEVs.