Electricity Use in the Pacific Northwest

Utility Historical Sales by Sector 1990 & Preceding Years

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ELECTRICITY USE IN THE PACIFIC NORTHWEST

UTILITY HISTORICAL SALES BY SECTOR

1990 & PRECEDING YEARS

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SUMMARY

This Electricity Use in the Pacific Northwest report officially releases the compilation of regional 1990 retail customer sector sales data by the Bonneville Power Administration. The report is intended to enable detailed examination of annual regional electricity consumption. It also provides observations based on statistics covering the 1983-1990 time period, and gives statistics covering the time period 1970-1990.

The electricity use report is the only information source that provides data obtained from each utility in the region based on the amount of electricity they sell annually to four sectors. Data is provided on each retail customer sector and also on the customers Bonneville serves directly:

- * Residential
- * Commercial
- * Industrial
- * Direct-service industrial
- * Irrigation

Other reports on electricity use typically examine electricity consumption trends by all utilities or by utility groups such as private and public utilities, and do not include sector breakdowns.

This report should be useful to utility practitioners who need to understand how much electricity is being used at the sector level or for what purposes. It lends dimension to the more highly aggregated descriptions of electricity use to help the reader begin to describe the underlying reasons for those observations. For example, this document should enable the reader to describe why non-temperature adjusted total electricity sales experienced only 1.3 percent growth in 1989-1990 by observing how electricity was used by each retail customer sector.

The data in this report are compiled and presented annually by the End-Use Research Section in the Bonneville Power Administration to assist the agency in its various planning responsibilities ranging from conservation and generation planning to transmission planning. The data specifically supports forecasting activities, rate development, conservation and market assessments, and conservation and market program development and delivery. All of these activities require a detailed look at electricity use.

The electricity use report offers extensive graphic and tabular data on electricity consumption in all sectors for the years 1983-1990 and 1970-1990. Many views of the data are presented for users of the report, providing the opportunity to look at sector consumption from three perspectives:

- * The region
- * Utility groups
- * States in the region

In addition, explanations are provided for the information illustrated in all the graphs, and observations are made about sector electricity use trends and reasons discussed for those trends. Special graphs show annual heating degree days for 1983-1990, shares of commercial business type by floor area and number of buildings, aluminum sales and prices for 1983-1990, public and private utility average rates for 1983-1990, and number of retail customers and their average annual energy use.

Key Observations

- *1990 firm sales in the region totaled 17,437 aMW, a 1.3 percent increase from 1989 (1.1 percent when temperature adjusted)*
- *1990 residential firm sales totaled 33.5 percent of the region's total firm sales; commercial firm sales totaled 22.9 percent; industrial firm sales (including DSIs) totaled 39.0 percent; and irrigation firm sales (including USBR) totaled 3.9 percent*
- *From 1983-1990 firm sales in the region averaged an annual increase of 459 megawatts, or 3.0 percent; the average annual increase when temperature adjusted was 441 megawatts, or 2.8 percent*
- *From 1983-1990 firm sales average growth in residential sales was unadjusted 1.8 percent (adjusted, 1.7 percent); in commercial sales, unadjusted 4.1 percent (3.7 percent adjusted); in industrial sales (including DSIs), 3.3 percent; and in irrigation sales (including USBR), 3.9 percent*

- *For 1983-1990 the average retail rates for the residential, commercial, industrial, and irrigation customers of public utilities increased by approximately 3.5 percent annually*
- *In 1990 the average residential customer used 1.58 kilowatts (13,800 kilowatthours) of electricity*
- *Oregon saw the greatest percentage growth in electricity firm sales from 1989 to 1990, 3.3 percent, and the highest annual average megawatt change in usage, 155 aMW*

ACKNOWLEDGEMENTS This report was made possible by the efforts of many people in different offices within the Bonneville Power Administration. Special thanks go to the staff of the End-Use Research Section, Power Forecasting Branch, Rate Design Section, Bonneville's Industry Initiative for Science and Math Education (IISME) Program, and the Writer/Editor Pool.

ADDITIONAL COPIES Requests for additional copies of this publication (DOE/BP-1661) and comments regarding the data presented should be directed to:

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Also direct any requests for additional data summaries that would be useful, such as individual utility breakdown of electricity use by sector, to Mary Lange. The data provided in the appendix is available on diskette.

EVALUATION FORM The End-Use Research Section would like to know how you use the Electricity Use Report, and how we can improve it. An evaluation form has been provided for your use at the end of the report. Thank you for your help.

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Bonneville Power Administration Service Area Boundaries

The Pacific Northwest (also referred to as the region) includes the states of Oregon, Washington and Idaho, the portion of Montana west of the Continental Divide, and the portions of Nevada, Utah and Wyoming that lie within the Columbia River drainage basin; and any rural electric cooperative not in the geographical area described above but served by BPA on the effective date of the Pacific Northwest Electric Power Planning and Conservation Act (December 1980).

CHAPTER 1

INTRODUCTION

This report releases the annual compilation by the Bonneville Power Administration of electricity consumption statistics for the Pacific Northwest. The statistics are coupled with observations and discussions of what appears to underlie the consumption trends found in the data. Also provided are descriptions of the regional pattern of consumption: where the growth is occurring and in which retail customer sectors.

In this report, the Pacific Northwest (also referred to as the region) corresponds to Bonneville's service area: the states of Oregon, Washington, and Idaho, the portion of Montana west of the Continental Divide, and the portions of Nevada, Utah, and Wyoming that lie within the Columbia River drainage basin; and any rural electric cooperative not in the geographical area described above but served by BPA on the effective date of the Pacific Northwest Electric Power Planning and Conservation Act (December 1980). The report emphasizes electricity use in Oregon, Washington, Idaho, and western Montana. (See Bonneville service area boundary map on opposite page.)

UTILITY GROUPS

Across the Pacific Northwest nearly 140 utilities supply electricity to consumers who use it in homes, businesses, and industry, and on farms and ranches. In reporting utility sales, the utilities are divided into three groups: private utilities (also called investor-owned utilities), public generating utilities, and public non-generating utilities. Generating utilities are typically distinguished by their capacity to generate electricity (even though some non-generating utilities have small amounts of their own generation to serve customers). All the utilities that Bonneville considers generating utilities are members of the Northwest Power Pool.

**1990 REGIONAL
SALES SUMMARY**

The utilities in the region and Bonneville served more than 4.2 million retail electricity customers as of 1990. Table 1 shows the number and type of utilities in the region, their energy sales, and the number of retail customers they serve as well as the number of federal agencies and industries directly served by Bonneville.

Table 1

Pacific Northwest Regional Sales By Utility Groups & BPA Direct Service 1990			
Type	Number in Region	Firm Sales (aMW)*	Number of Consumers
Utilities			
Public			
Generating	9	3,670	836,931
Non-Generating	120	3,052	886,198
Private	8	8,058	2,519,369
Subtotal	137	14,780	4,242,498
BPA Direct-Service Customers			
Direct-Service			
Industries	17	2,465	17
Federal Agencies	21	192	50
Subtotal	38	2,657	67
Total	175	17,437	4,242,565

* Numbers are not temperature adjusted (See pp. 39 & 47 for residential and commercial temperature adjusted information).

**HOW TO USE
THE INFORMATION
PROVIDED**

The information provided in this report allows tracking of past electricity sales in each sector by different utility groups and in the states of the region. Such tracking can reveal correlations between sales and customer groups in different areas of the region that may have important policy and planning implications.

Knowledge of how segments of the population are using electricity can help in planning and designing programs to reach those segments. Knowledge of past sales to different electricity market segments can also help in the assessment of opportunities to conserve electricity and in the design of programs for conservation.

Information about electricity use and especially observations about growth trends assist Bonneville in planning to meet its customers' power needs, plan and develop conservation programs, and provide customer service. Lately this information has grown even more important as the estimate of the level of the region's power surplus has changed and planning procedures, such as transmission planning, have become more refined. Data about the levels of electricity consumption by sector and numbers of retail customers are important ingredients in helping Bonneville continue to satisfy diverse electricity needs in the future.

**WHAT'S IN
THE REPORT**

This report, designed to use as a reference, provides a variety of different views of electricity consumption in the Pacific Northwest. Graphics summaries are provided from six view points:

- * Sales in the region as a whole
- * Public and private utility sales, and average retail rates
- * Sector sales and retail rates
- * Bonneville direct sales to industries and federal agencies
- * Number of retail customers served and average energy use per customer by sector, and by state
- * Distribution of sales and average retail rates by state

Key observations at the beginning of each chapter summarize important observations. A glossary is included with definitions of terms as they are used in the report. Electricity use statistics for the years 1970-1990 appear in the appendix.

DATA SOURCES

The sector data is compiled mostly from unaudited Financial and Operating reports prepared annually by each utility in the region. This data is based on the amount of electricity sold to each utility's customers.

The sales history of all utilities is examined, regardless of whether the utility receives power from its own generation, transfers from other utilities, or from the federal power system.

EUR VS. MLC

Two Bonneville reports produced by its Office of Energy Resources look at current and historical rates of growth. This Electricity Use Report (EUR) focuses on the amount of electricity delivered or sold to the ultimate consumer (sales). The Monthly Load Comparison (MLC) report focuses on the amount of electricity generated or the amount delivered to the utility (load).

The sales growth numbers in the two reports do not correspond exactly. There are three reasons for the discrepancies.

First, the sources of data for the two reports differ. The Electricity Use Report focuses on electricity use by sector based on data from electricity bills sent to retail customers by utilities. The MLC focus is on electricity use by utility grouping and is based largely on wholesale electricity bills sent to utilities and direct-service customers by Bonneville. These electricity bills are the best source of quickly available data for immediately ascertaining electricity use trends. Sector level electricity use is not available for preparation of these bills and is not used in the MLC.

Second, the two sources of information represent two distinctly different summaries of consumption. The electricity use report illustrates what has been delivered to the customer's door; the MLC represents what has been delivered to or in some cases generated by utilities to meet customer needs.

The differences between the two summaries represent distribution losses -- losses that occur when electricity is delivered over utility distribution lines to the customer's door. These losses vary with weather, outages, and intensity of use (line loading) and can result in the two data sets yielding different growth rates.

Third, each report is based on data summarized over different time periods. The electricity use report presents sales information based on a billing year for each individual customer in the region. Since utilities generally stagger the reading of meters throughout each month, the reported billing year sales for each customer seldom corresponds to calendar year consumption. Specifically, a colder or warmer than average December will cause the residential and commercial sector sales to show smaller or larger growth. Staggered meter reading was a factor in 1990 when the western side of the region experienced a cold snap in late December. As a result, the EUR shows an average growth rate of 1.25 percent from 1989 to 1990. The MLC, on the other hand, is based on data that does not entail individual meter readings for each customer and therefore is more closely aligned to true calendar months and years. The 1989-1990 average growth rate for the MLC was 2.19 percent.

The different data sources used in each report usually result in only small discrepancies between the growth rates derived from each. These discrepancies are not critical since the numbers in the electricity use report are not offered as absolute but rather as indicators. The numbers indicate relative sector shares; relative sales activity by different utility groups (private, generating public, non-generating public) in the region and by Bonneville in its direct- service sales; and perhaps most importantly, the distribution of sales within the region. Sector breakdowns make it easier to observe and explain trends in different electricity market segments.

**GROWTH AT
A GLANCE**

For quick reference, Table 2 below shows average annual firm sales growth in the Pacific Northwest, from 1989 to 1990 and from 1983 through 1990. Table 3, on the next page, gives primary factors affecting sales growth.

Table 2

Region Average Annual Firm Sales Growth*				
By Sector	1989-1990 (aMW)	1989-90 (Percent Growth Rate)	1983-1990 (aMW)	1983-1990 (Percent Growth Rate)
Residential	34	0.6%	97	1.8%
Commercial	135	3.5%	140	4.1%
Industrial	92	2.3%	112	3.0%
DSI (Firm)	-66	-2.6%	86	4.1%
Irrigation	32	5.5%	21	4.0%
Total Sales	216	1.3%	459	3.0%

* Based on actual observed data (not temperature adjusted). For temperature adjusted data see Table 6 (1989-1990) on page 21, and Table 8 and Figure 4 (1983-1990) on page 27.

Table 3

Primary Factors Affecting Sales Growth	
Residential	<ul style="list-style-type: none"> - regional economy - weather - population - energy conservation - relative fuel prices - electricity prices
Commercial	<ul style="list-style-type: none"> - regional economy - weather - service sector growth - amenity level - use of electronic equipment - energy conservation - electricity prices
Industrial	<ul style="list-style-type: none"> - regional economy - energy conservation - electricity prices
Direct-Service Industrial	<ul style="list-style-type: none"> - energy conservation/modernization - economy/aluminum prices
Irrigation	<ul style="list-style-type: none"> - regional economy - energy conservation - amount of rainfall - price of farm products - electricity prices

**WEATHER AND
TEMPERATURE
ADJUSTMENT**

One of the primary factors affecting sales -- Weather -- has significant impacts specifically in the residential and commercial sectors. (Weather refers to outdoor temperatures in this report.) Electricity use in homes and businesses would typically be lower in a mild year than in a year that had harsher temperatures.

If temperatures fluctuate from cold to mild year to year, observations about longer term electricity use trends are difficult if not impossible to develop. It is therefore important when looking at electricity use across several years to take weather into consideration. This is typically done by adjusting annual electricity use to remove the effects of temperature extremes and reflect common temperatures.

The temperature adjustments in this document are based on methods that use approximations of the actual impacts of temperatures on electricity use, and are subject to refinement as other data and methods are developed. These methods can be reviewed upon request.

The National Oceanic and Atmospheric Administration provides the temperature information. Temperature readings from 23 weather stations throughout the region are collected and averaged for adjusting the private utilities' electricity sales. For adjusting the generating public utilities' electricity sales, readings are collected from 8 weather stations (Everett, Wenatchee, Newport, Ephrata, Seattle, Puyallup, Longview, and Eugene); and for the non-generating utilities, readings are collected from 9 weather stations (Astoria, Redmond, Salem, Spokane, Richland, Seattle, Boise, Pocatello, and Missoula).

Over the 1983-1990 time period, the region experienced six years of warmer and two years of colder than normal weather (shown in Figure 1). These observations are based on heating degree days*, a convenient way of summarizing annual temperatures.

The development of the temperature adjustment for the commercial sector differs somewhat from that of the residential sector. The difference arises because of the large influence that air conditioning has in the commercial sector. Temperature adjustment for commercial sales takes into account air conditioning use during two hotter than normal summers in 1984 and 1985.

Figure 1

* Note: Heating degree days are the average degrees in a given year it takes to bring the daily temperature to an interior temperature of 65 degrees.

**THE RATE DESIGN
PROCESS**

The price consumers pay for electricity has a primary influence on electricity consumption in the long run. For this reason, the rate design process of utilities is explained at length in this year's report.

It should be noted that in order to have one common rate measurement by which to compare the rates of different sectors and utilities, revenue received per kilowatthour sold is used to determine an "average rate" (more accurately called "average revenue"). Revenues are received through customer, demand, and horsepower charges as well as energy charges. An average rate is calculated by dividing the revenues by the kilowatthours sold during the same time period. Average retail rates are used throughout this report.

**REVENUE
REQUIREMENT**

Co-ops, municipal, and other publicly owned utilities generally design rates to recover their revenue requirements, or costs they expect to incur over the period in which their rates are in effect.

For most of the publicly owned utilities that Bonneville serves, purchased power costs are the largest single expense item. Other items included in the utility's revenue requirement are transmission expense, distribution expense, administrative and general expense, depreciation expense, interest on long-term debt, and customer accounts expense.

Utility costs have a number of components. These include whether a utility generates its own power needs or purchases them; type of generation at its disposal; type of fuel used (if it has thermal generation); age and size of the utility system; its method of financing; its rate of growth; and its standards for system reliability.

**COST OF
SERVICE**

Once they have established their revenue requirements, utilities generally follow a cost-of-service approach in setting their rates.

Costs are functionalized, or distributed, between production, transmission, distribution, and customer expense. They then classify costs between demand and energy-related costs based on commonly accepted ratemaking methodologies. Then, they relate costs to time periods, such as winter and summer seasons. Finally, utilities allocate costs to different customer classes based on relative use of energy, capacity, and other services. Once allocated, the costs provide a fairly accurate indication of what it costs to serve each class of customer.

UNCERTAINTY

In designing its rates, a utility faces a number of uncertainties with respect to the adequacy of its rates. One major uncertainty is weather. Because most utilities establish rates based on forecasted cost and load information, events may unfold in ways that cause the rates to either over- or under-recover its revenue requirement. When a utility assumes a normalized weather condition during its rate period, a period of abnormally warm weather during the winter may cause sales of electricity to decrease, resulting in under-recovery. Conversely, an abnormally cold period during the winter may cause a dramatic increase in sales, resulting in over-recovery.

Cost overruns or underruns, another source of uncertainty, are usually a result of a utility experiencing an unforeseeable circumstance. Utilities therefore tend to build into their revenue requirement a slight margin to cover contingencies, and to minimize the effects of uncertainty on their financial positions.

*CUSTOMER
SECTORS*

Residential, commercial, and industrial are the three primary utility customer sectors, or rate classes. In addition, most rural and a few urban utilities have an irrigation sector. Other miscellaneous sectors, such as street lighting, are small.

Customers are separated into sectors, or classes, based on shared similarities of their load on the utility, and on the nature of service provided. Customer power requirements can differ with respect to the size of the load, time of use (daily or seasonal), duration of use, the relationship between peak and average use (load factor), end use, and other features that affect both the cost of service and design of the rate.

*FACTORS THAT
AFFECT RATES*Size of Load

Large loads are generally less costly to serve than smaller loads. Billing expenses per kilowatthour sold are lower, and power system components are used more efficiently when constantly loaded. Industrial loads tend to be large, stable loads, and therefore rates for sales to industrial customers tend to be lower than rates applicable to smaller customers.

Time of Use

In the Pacific Northwest there is heavier demand for electricity in the winter than in the summer. Utilities that set higher winter rates reflect this seasonal usage pattern.

Rates that vary according to the time of day (diurnal rates) are not common for residential and commercial customers in the region because metering requirements to implement such rates are not yet economical. The intent of implementing time-of-use rates is to send a pricing signal to users during peak use periods that may discourage load growth at those times and lessen the need for expansion of the system.

As loads grow, the size of the power system must be expanded to accommodate customers during the peak use periods. The need to expand the power system subjects the utility to additional expenses, and it is equitable to design rates to recover those additional expenses from users that contribute to a utility's peak load burden.

Load Factor

Load factor is the relationship between peak usage and energy usage over a period of time, usually a billing cycle. Customers whose loads are fairly constant, and have little fluctuation over a billing cycle are said to have a high load factor; customers whose loads have greater fluctuations over a billing cycle are said to have a low load factor.

Load factor is a major determinant in grouping customers into classes. Industrial customers tend to have high load factors because their loads tend to fluctuate less over time. This type of load is less costly to serve because generation and transmission resources can be used more efficiently as a result of constant loading. On the other hand, residential customers have a lower load factor relative to industrial customers.

In order to serve a low load factor customer, a utility has to build resources to meet the peak demand placed on its system. But because the average use of a low load factor load is much lower than the peaking capability of the resources, the utility has excess capacity for a large portion of the billing cycle. The lower the load factor, the greater is the utility's excess resource capacity, and therefore the costlier it is to serve such a load.

Commercial loads generally have slightly higher load factors than residential loads, but lower load factors than industrial loads. Irrigation loads have a high load factor over the irrigating season (April through October), but a lower load factor over an entire year. However, irrigation loads, because they occur during the summer season, which is the off-peak season for other loads, tend to improve the efficient use of the overall power system.

Cost-Related Factors

Rate design includes three cost-related considerations:

Customer charges Costs are allocated to a customer sector based on the number of customers in the sector, and are recovered through fixed monthly customer, or "service", charges.

Demand charges Costs are allocated based on demand or peak load placed on the system by the customer class. These costs are recovered through a charge per kilowatt of maximum demand during a billing period. This type of charge can only be applied to customers (and customer sectors) with installed demand recording meters. For customers and customer classes where such metering equipment is not installed, costs are recovered entirely through energy charges. A horsepower charge may be used in lieu of a demand charge for irrigation or drainage pumping, since pumps are not usually demand metered, have specific power ratings and are either on or off. A horsepower charge is based on the horsepower rating of pumps.

Energy charges Costs are allocated based on energy use, and are recovered through an energy charge per kilowatthour used during the billing period.

Non-Cost-Related Factors

Non-cost-related factors that influence rate design include utility board or city council preferences, goals of the local community, a desire to encourage conservation, competition of alternative heating fuels, rates of neighboring utilities, and a desire to give preferential rates to certain customers (such as 'lifeline' rates for people on low fixed incomes).

Note: For information about historical BPA rates, see Wholesale Power Rate Projections 1990-2011 and Historical Wholesale Power Rates 1940-1989 (DOE/BP-1529; November 1990).

CHAPTER 2

1990: THE YEAR IN REVIEW

Key Observations

- *Private utilities showed the largest share of sales in all sectors in 1990*
- *Industrial sector sales (including DSIs) were greater than sales to any other sector*
- *Public utility customers paid less, on the average, for electricity than did private utility customers*

REGIONAL SALES

The summary information in table 4 is for those who wish to concentrate on electricity use for only 1990. The table shows the relative magnitude of electricity use for the whole region, for each sector by utility group, and for directly served customers.

A look at 1990 electricity sales by sector shows that regional industries (including DSIs) consumed the most electricity: the 7,588 aMW sold to industrial users by Bonneville and the region's retail utilities made up 42 percent of all electricity sales in the region. Residential consumers used 5,836 aMW, or 32 percent of the electricity sold during 1990. The commercial sector used 4,001 aMW (22 percent of total sales), and irrigators used 614 aMW (3 percent of total sales).

Table 4

Regional Sales By Utility Groups & BPA Direct-Service 1990		
Type	aMW*	Percent of Regional Total
<u>Public</u>		
Residential	2,614	14.3
Commercial	1,648	9.0
Industrial -		
Industrial Firm	2,024	11.1
Industrial Non-Firm	6	**
Industrial Colockum***	153	0.8
Irrigation	283	1.6
Subtotal	6,728	36.8
<u>Private</u>		
Residential	3,222	17.7
Commercial	2,353	13.0
Industrial -		
Industrial Firm	2,152	11.8
Industrial Non-Firm	142	0.8
Irrigation	331	1.8
Subtotal	8,200	45.1
<u>Directly Served Customers</u>		
Direct-Service Industrial		
Firm	2,465	13.5
Non-Firm	646	3.5
Federal Agency/ US Bureau of Reclamation	192	1.1
Subtotal	3,303	18.1
Regional Total	18,231	100.0

* Numbers are not temperature adjusted. (See pp. 39 & 47 for residential and commercial temperature adjusted information.)

** Less than 1/10 of a percent.

*** Colockum is a subsidiary company owned by ALCOA. (See glossary for a more detailed definition.)

**AVERAGE RETAIL
RATES**

Table 5 provides a summary of the 1990 regional average retail rates for public and private utility groups. Large loads are generally less costly to serve than smaller loads. Billing expenses per kilowatthour sold is lower, and power system components are used more efficiently when constantly loaded. Industrial loads tend to be large, stable loads, and therefore rates for sales to industrial customers tend to be lower than rates applicable to smaller customers.

Table 5

Regional Average Retail Rates By Public and Private Utility Groups 1990	
Sector	Cents/kWh
Residential	
Public	4.02
Private	5.02
Commercial	
Public	3.50
Private	5.02
Industrial	
Public	2.54
Private	3.38
Irrigation	
Public	2.98
Private	3.72

CHAPTER 3

1989-1990: CHANGES

Key Observations

- *Regional electricity usage grew only 1.3%, unadjusted, from 1989 to 1990; 1.1%, temperature adjusted*
- *Commercial and industrial sectors showed the highest annual average megawatt change, with industrial the highest for public utilities, and commercial the highest for private utilities*
- *Little change in average retail rates took place from 1989 to 1990*

The 1989-1990 sales summary narrative and graphics are for those interested in a quick assessment of regional changes in electricity use from 1989 to 1990. Information is provided specifically for the region as a whole, utility groups, and each sector.

From 1989 to 1990, electricity use in the region increased by 216 average megawatts, or 1.3 percent unadjusted for temperature. Residential sector energy use grew by 0.6 percent and commercial sector use by 3.5 percent. Use in the industrial sector rose 2.3 percent, while irrigation sector use dropped 5.5 percent.

Temperature adjustment of sales is done to separate changes in use due to weather from changes in use due to any other factors, such as changes in use by existing customers or a change in the number of customers. After temperature adjustment, residential sales increased to 0.7 percent growth and commercial dropped to 2.7 percent growth. No temperature adjustment is made for the industrial sector since only a very small amount of its energy usage is affected by temperature. Temperature adjustment procedures for the irrigation sector are still under development. (Weather and Temperature adjustment are discussed on pages 9 and 10.)

Table 6 shows the regional firm sales growth, both actual and temperature adjusted, in average megawatts and percentages from 1989 to 1990. The commercial and industrial sectors experienced the most significant growth in average megawatts, while the irrigation sector had the largest percentage increase.

Table 6

Regional Firm Sales 1989-1990						
Sector	Firm Sales (aMW)		aMW Changes		Percent Change	
	1989	1990	Unadj	Adj*	Unadj	Adj*
Residential	5,802	5,836	34	43	0.6 %	0.7 %
Commercial**	3,866	4,001	135	102	3.5 %	2.7 %
Industrial	4,084	4,176	92	92	2.3 %	2.3 %
DSI	2,531	2,465	-66	-66	-2.6 %	-2.6 %
Irrigation	582	614	32	32	5.5 %	5.5 %
Total***	17,221	17,437	216	192	1.3 %	1.1 %

* Temperature adjusted, residential & commercial sectors only.

** Commercial includes street lighting & public facilities.

*** Total includes Colockum and federal agencies/USBR.

Figure 2 shows actual and temperature adjusted growth in electricity use in the region, by public and by private utilities. The temperature adjusted growth rates appear in parentheses for the residential and commercial sectors, and for total growth.

Figure 2

Figure 3, on the next page, shows actual electricity use growth in the region, by generating and by non-generating public utilities.

Figure 3

Table 7 shows the 1989 and 1990 average retail rates of the region by sector for the public and private utility groups and their percent change.

Table 7

Average Annual Retail Rate Changes Public/Private 1989-1990			
Sector	1989 Cents/kWh	1990 Cents/kWh	Percent Change
Residential			
Public	3.96	4.02	1.5%
Private	5.04	5.02	-0.4%
Commercial			
Public	3.47	3.50	0.9%
Private	5.00	5.02	0.4%
Industrial			
Public	2.57	2.54	-1.2%
Private	3.34	3.38	1.2%
Irrigation			
Public	2.87	2.98	3.8%
Private	3.70	3.72	0.5%

Chapter 4

1983-1990 TRENDS

Key Observations

- *Regional average annual growth rate was 3.0% unadjusted (increase of 459 aMW) and 2.8% temperature adjusted (441 aMW increase)*
- *Residential was the slowest growing sector in percentage terms, both unadjusted and temperature adjusted*
- *Commercial saw the most average temperature adjusted growth*
- *Average retail rates for public utilities' residential, commercial, and industrial sectors increased by approximately 3.5 percent annually*

A detailed picture of trends in regional and utility group electricity consumption for the period 1983-1990 places 1990 Pacific Northwest electricity use in context with several years of history. (For a look at total growth in energy consumption over a much wider range in time, 1970-1990, see the Appendix.)

The post-1982 period was chosen as the focus for observing trends since in 1983 Rural Electrification Administration utilities changed the way they classify commercial and industrial customers. A focus beginning with 1983 eliminates the difficulty of merging data from before and after the change in classifications.

Discussions included to give a complete picture of electricity use:

- * Distribution of consumption in the region and by utility group
- * Electricity use by sector
 - Residential
 - Commercial
 - Industrial
 - Industrial sales by retail utilities
 - Bonneville direct-service industrial sales
 - Irrigation

Various tables and figures illustrate the impacts on the region, on public and private utilities, and on the residential and commercial sectors of adjusting for departures from normal weather. (For further information on how adjusted and unadjusted figures are derived, see Weather and Temperature adjustment on pages 9 and 10.)

By use of graphics and narrative, each sector discussion covers four areas:

- * Composition of the sector
- * Observations on recent trends
- * Geographical distribution of electricity use
- * Factors affecting consumption

In the industrial sector discussion, the industries served directly by Bonneville are looked at separately from industries served by retail utilities. Because the aluminum company portion of direct-service industries (DSIs) uses a large amount of electricity, the seven-year sales summary for DSIs is split into aluminum and non-aluminum companies. Total DSIs are further broken down into firm and nonfirm sales. A graph tracks aluminum sales and prices for 1983 to 1990.

DISTRIBUTION OF ELECTRICITY CONSUMPTION

The region overall experienced a fairly moderate rate of growth of electricity sales over the 1983-1990 period, with growth accelerating from 1987 to 1989. After accounting for weather influenced fluctuations, the largest contributor to regional electricity sales growth during the 1983-1990 period was increased use of existing capacity by direct-service industries' aluminum smelters.

Over the period 1983-1990, the residential sector averaged the slowest percentage growth of all sectors (both unadjusted and temperature adjusted). However, in 1988 and 1989, residential use increased at a faster rate than the 1987-1988 and 1988-1989 regional average.

Table 8 shows the 1983-1990 regional firm sales growth in average megawatts and by percentages for each sector and for the region as a whole. For the residential and commercial sectors, temperature adjusted changes are also shown.

Table 8

Regional Firm Sales 1983-1990						
Sector	Firm Sales (aMW)		aMW Changes		Percent Change	
	1983	1990	Unadj	Adj*	Unadj	Adj*
Residential	5,156	5,836	97	94	1.8%	1.7%
Commercial**	3,020	4,001	140	126	4.1%	3.7%
Industrial	3,390	4,176	112	112	3.0%	3.0%
DSI	1,860	2,465	86	86	4.1%	4.1%
Irrigation	467	614	21	21	4.0%	4.0%
Total***	14,226	17,437	459	441	3.0%	2.8%

* Temperature adjusted, residential & commercial sectors only.

** Commercial includes street lighting & public facilities.

*** Total includes Colockum and federal agencies/USBR.

Figure 4 shows public and private utility sales growth rates (actual and temperature adjusted) by sector and makes it possible to determine relative changes over the time period 1983-1990. The temperature adjusted growth rates appear in parentheses for the residential and commercial sectors. No temperature adjustments were made for the industrial sector since only a small amount of its energy usage is affected by temperature. Temperature adjustment procedures for the irrigation sector are under development.

Figure 5, shows actual growth rates. This makes possible a comparison for generating and non-generating public utilities.

Figure 4

Figure 5

Weather is a major factor affecting sales to the residential and commercial sectors. Comparison of temperature adjusted annual residential and commercial sales with non-temperature adjusted (actual observed) sales gives a picture of how much annual sales changes are due to fluctuations resulting from weather and how much changes are due to other factors that affect usage.

Figure 6 provides a picture of changes in electricity use by sector for the region. Rapid electricity rate increases during the early 1980s, energy conservation, and a growing regional economy were important factors in electricity sales to all sectors. Additional factors in sales were: population increase and relative fuel prices in the residential sector; service sector growth, increased amenity levels, and increased use of electronic equipment in the commercial sector; and weather, price of farm products, and new irrigating methods in the irrigation sector.

As figure 6 shows, electricity use in the irrigation sector fluctuates greatly. Even going back to the 1970s, this characteristic is evident. Electricity sales to irrigators in 1970 were 263 average megawatts (aMW) while in 1975, sales were at 424 aMW, an average annual increase of 12.7 percent. 1978 sales of 495 aMW grew to 603 aMW, in 1979. In the base year used in this report, 1983, the irrigation sector used only 467 aMW.

The average annual growth rate in irrigation sales during 1979-1983 was -6.2 percent, and during 1979-1990, only .2 percent. The long term trend in irrigation sales, from 1970-1990, shows an average annual increase of 4.3 percent, which is close to the 1983-1990 increase of 4.0 percent. Because of irregular and large changes in irrigation electricity usage, it is difficult to forecast or analyze the irrigation sector's electricity usage.

Figure 6

(Avg MW)	1983	1984	1985	1986	1987	1988	1989	1990
Residential: Temp Adj	5,205	5,372	5,387	5,430	5,396	5,582	5,819	5,862
Residential: Actuals	5,156	5,458	5,661	5,369	5,271	5,540	5,802	5,836
Commercial: Temp Adj	3,042	3,177	3,204	3,418	3,544	3,660	3,821	3,923
Commercial: Actuals	3,020	3,235	3,407	3,425	3,537	3,686	3,866	4,001
Industrial (excludes DSIs)	3,390	3,520	3,570	3,640	3,768	3,896	4,084	4,170
Irrigation	467	475	556	523	555	585	582	614

**SUMMARY OF
AVERAGE
RETAIL RATES**

There are 120 non-generating public utilities that purchase most of their electric power from Bonneville. The rates that non-generating public utilities charge their retail consumers for electric power are influenced to a large extent by the rates that Bonneville charges the utilities for power at the wholesale level. All of these utilities are entitled to purchase power from Bonneville at the Priority Firm power rate.

Bonneville's Priority Firm rate averaged 1.80 cents per kilowatthour from October 1, 1982 through October 31, 1983. From November 1, 1983 through June 30, 1985, the Priority Firm rate averaged 2.27 cents per kilowatthour. The Priority Firm rate averaged 2.26 cents per kilowatthour from October 1, 1987 through the end of 1990.

The percentage change in Bonneville's wholesale power rate does not translate directly into an equal percentage change in retail utility rates. For example, if the wholesale power rate were to increase by 10 percent, it would be reasonable to expect a smaller percentage increase at the retail level. For non-generating public utilities who buy all of their electric power from Bonneville, generally the purchased power costs represent from one-half to two-thirds of a retail utility's total revenue requirement. The effect of a change in Bonneville's Priority Firm rate is smaller for public utilities that generate some of their own power.

Changes in retail electricity rates can have an effect on electricity consumption. Any such change is said to be the effect of price elasticity. When electric rates increase dramatically over a short period of time, consumers may use less electricity to avoid rapidly escalating power bills. The relationship between price changes and changes in consumption of electricity in the Pacific Northwest is not very strong: a small increase in price has little effect on consumption. It can be concluded that electricity prices are relatively inelastic in the region in the short run.

Figure 7 provides a picture of changes in average retail rates by sector for the region.

Figure 7

**1983-1990 TRENDS
BY SECTOR**

During the 1983-1990 period, retail rates for residential, commercial, and industrial customers of public utilities increased by approximately 25 percent, or an average yearly increase of about 3.5 percent. Rates for irrigation customers increased by slightly less than 10 percent, or an average yearly increase of 1.1 percent, over the same period.

Table 9 shows the average annual change in retail rates for the 1983-1990 period by sector for the public and private utility groups.

Table 9

Average Annual Change in Retail Rates 1983-1990		
Sector	Cents/kWh	%Change
Residential		
Public	0.12	3.3 %
Private	0.18	4.1 %
Commercial		
Public	0.11	3.5 %
Private	0.11	2.4 %
Industrial		
Public	0.08	3.5 %
Private	0.07	2.1 %
Irrigation		
Public	0.03	1.1 %
Private	0.06	1.8 %

**RESIDENTIAL
SECTOR**

In 1990, 33.5 percent of total regional firm sales were made to 3,696,163 residential customers. During the period 1983-1990, residential sector firm sales in the region grew at an average annual rate of only 1.8 percent compared to the region's firm sales average annual growth rate of 3.0 percent (neither rate temperature adjusted).

Residential retail customers are concentrated west of the Cascades. While the residential sector encompasses all residential, farm, apartment, and seasonal dwellings urban areas accounted for about 81 percent of regional residential sales in 1990. Electric energy is used in homes for such end uses as space heating, water heating, cooking, and lighting. Over half of all electric energy used in homes is for space heating and water heating; most of the rest is used for refrigeration, freezing, cooking, and lighting. Table 10 presents electric energy use shares by end use.

Table 10

Shares of Residential Use By End Use 1990	
End Use Category	Percent Share
Space heat	28.6
Water heat	23.0
Refrigeration	11.2
Cooking	6.0
Lighting	4.9
Air conditioning	1.2
Freezers	3.4
Miscellaneous	21.7
Total	100.0

The numbers in Table 10 are estimated shares rather than directly metered shares. The estimates are from the Joint 1991 Long Term Forecast.* These shares are intended as an illustration of how electricity is used in homes.

* Note: The 1991 Long Term Forecast was a joint effort of Bonneville Power Administration and the Northwest Power Planning Council.

In addition to how electricity is used, residential sales are also categorized by one of three housing types: Single Family (1-4 units), Multifamily (more than 4 units), and Manufactured Housing. Table 11 shows the relative share of each housing type in 1990. The estimates in Table 11, as in Table 10, are from the Joint 1991 Long Term Forecast.

Table 11

Shares of Total Residential Firm Sales by Type of Home 1990	
Residence Type	Percent Share
Single Family	74
Multifamily	16
Manufactured	10
Total	100

RECENT TRENDS

While total regional firm sales (not adjusted for temperature) have continued to grow at a moderate rate since 1983 -- averaging 3.0 percent annually -- the residential sector has shown a more modest growth rate of 1.8 percent annual average for the same period. When the data is temperature adjusted, the average yearly residential growth rate for 1983-1990 is 1.7 percent and the region's is 2.8 percent. On a percentage basis, residential sector electricity sales have been growing more slowly than sales to any of the other sectors.

Adjustment for Temperature Effects

Outdoor temperatures have a significant impact on residential sales, since almost 30 percent of residential electricity use is for space heating. In a mild year, residential sales will be noticeably lower than in a year with a harsh winter, all other use factors being equal. Because temperature effects vary from year to year without a systematic pattern and can mask other longer term trends that may affect residential electricity sales, it is useful to adjust sales to reflect a "typical", or normal, weather year in order to remove the effects of temperature extremes.

Over the 1983-1990 time period, the region experienced six years of warmer than normal and two years colder than normal weather, as measured by annual Heating Degree Days. (See Weather and Temperature Adjustment on pages 9 and 10.)

Table 12 shows actual observed (non-temperature adjusted) residential and total regional firm electricity sales--percentage growth and average megawatt (aMW) gain--contrasted with temperature-adjusted sales for 1989-1990 and 1983-1990. (See page 37, figure 8, for actual aMW figures.)

Table 12

Residential Sector and Regional Firm Sales Growth Unadjusted & Temperature Adjusted				
	Residential Sector		Regional Total*	
	1989-1990	1983-1990	1989-1990	1983-1990
Growth Rate (%)				
Unadjusted	0.6%	1.8%	1.3%	3.0%
Adjusted	0.7%	1.7%	1.1%	2.8%
Average Annual Growth (aMW)				
Unadjusted	34	97	216	459
Adjusted	43	94	192	441

* Regional total = all sectors, including residential.

Residential sales over the 1983-1990 period, adjusted for temperature effects, grew at an average annual rate of 1.7 percent while the number of households grew at an average annual rate of 2.1 percent. Adjusted electricity sales to the residential sector grew at a much slower rate than total regional sales (1.7 percent vs. 2.8 percent).

The slower growth of residential sales compared to number of households can be attributed to two primary factors:

- * The effect of energy prices on fuel choice
- * Increased energy efficiency of homes and appliances

Effect of Energy Prices

The factors affecting electricity consumption in a home include weather, the number and type of appliances, occupant behavior, and the efficiency of the home. However, perhaps the largest single determinant of residential electricity consumption is the type of fuel used for space heating and water heating.

Fuel choice for space and water heating in *new* homes depends primarily on the relative prices of the various heating systems and fuels. Because the price of electricity relative to competing fuels (principally natural gas) has been increasing over the last seven years, some utilities are experiencing a shift away from electric space and/or water heat in new single-family homes. This trend is more pronounced in areas served by private utilities, where the difference in price between electricity and natural gas is greater.

Rising relative electricity prices have also had an impact on fuel choice in *existing* homes, including more wood heat use and switching from electric to natural gas water heaters. The early 1980s saw both sharp increases in electricity prices and an economic recession in the region. During this time, use of wood heat rose sharply in single-family homes with electric space heating, presumably because consumers attempted to lower their electricity bills.

More recently, growth in use of wood heat has slowed, likely due to stabilizing electricity prices and improved household incomes associated with economic recovery. Some other recent contributing factors may be environmental issues and safety, wood and wood stove cost, and personal effort issues associated with wood use.

In contrast to new single-family homes, the percentage of new multifamily units using electric space heating equipment over the last seven years has remained relatively constant, at 90 to 95 percent. One contributing factor to this constancy is that multifamily units are smaller than single-family homes and generally have common walls, thus annual heating bills are relatively lower.

Another factor is that natural gas heat generally costs more to install in multifamily units than does electric heat. Given lower multifamily heating requirements, this additional initial cost takes longer to recover in operating cost savings than in single-family homes. There is therefore less incentive to move toward other fuels for heating.

Yet another factor contributing to the relatively high percentage of new multifamily units with electric space heat is that owners of multifamily units who decide on equipment types are not the actual consumers of electricity. As a result they do not face the electric bills associated with heating but rather seek to minimize the initial capital cost of installing the heating equipment, and therefore install comparatively inexpensive electric baseboard heating systems.

Energy Efficiency of Homes and Appliances

Significant energy efficiency gains have occurred in both new and existing houses since the early 1980s, contributing to the low rate of growth in residential electricity sales.

Adoption of more stringent state building codes and promotion of the Model Conservation Standards (MCS) through the Super Good Cents and Northwest Energy codes (formerly Early Adopters) programs have improved new home efficiencies. Rankings of appliances by their efficiencies has also helped to increase the efficiency of the region's appliance stock by assisting consumers to make better informed purchasing decisions.

*TRENDS BY
UTILITY GROUP*

Figure 8 shows residential firm sales by utility group over the past eight years in average megawatts. In the same figure, public utility sales are also broken down into sales by generating and non-generating utilities. (Temperature adjusted data are provided in the table following the graph).

Figure 8

Temperature Adjusted

	1983	1984	1985	1986	1987	1988	1989	1990
Public	2,261	2,339	2,367	2,414	2,392	2,483	2,620	2,628
Private	2,944	3,033	3,020	3,016	3,004	3,099	3,199	3,234

Non-temperature Adjusted

	1983	1984	1985	1986	1987	1988	1989	1990
Public	2,237	2,383	2,514	2,379	2,327	2,462	2,601	2,614
Gen	1,089	1,153	1,218	1,168	1,132	1,196	1,246	1,250
Non-Gen	1,148	1,230	1,296	1,211	1,195	1,266	1,355	1,364
Private	2,919	3,075	3,147	2,990	2,944	3,078	3,201	3,222

The relative shares of residential sector electricity sales by public and by private utilities have changed little over the past eight years. The seven-year average annual residential sales growth rate for the two groups is 1.4 percent for private and 2.3 percent for public utilities.

*AVERAGE
RETAIL RATES*

The residential sector tends to be more expensive to serve than other sectors for several reasons. First, the residential sector is made up of a large number of small users who have wider variations in energy use during the day and during the year than do users in other sectors. The relatively low load factor of the residential sector results in higher average rates.

Second, residential customers expect highly reliable electricity service; utilities must be prepared to serve those customers' needs at all times. And third, distribution costs tend to be higher for the residential sector, especially in rural areas where customers are spread far apart and the terrain is rough.

Utility expenses of serving residential customers can be mitigated to a certain extent by measures aimed at assisting the residential sector. Two such Bonneville measures are the residential and small farm power exchange (Residential Exchange) and the Low Density Discount.

Table 13 provides the region's residential sector average retail rates for the public and private utility groups for the years 1983-1990. Table 14 shows the residential sector's average cents/kWh change for the period 1989-1990 and the period 1983-1990, and also provides percent change for each time period.

Table 13

Regional Average Retail Rates -- Residential Sector 1983-1990								
(Cents/kWh)	1983	1984	1985	1986	1987	1988	1989	1990
Residential								
Public	3.20	3.50	3.59	3.66	3.76	3.86	3.96	4.02
Private	3.79	4.36	4.73	4.89	5.18	5.15	5.04	5.02

Table 14

Average Annual Changes in Retail Rates Residential				
Residential	Cents/kWh Change 1989-1990	% Change	Annual Average Change 1983-1990	Annual Average %Change
Public	0.06	1.5 %	0.12	3.3 %
Private	-0.02	-0.4 %	0.18	4.1 %

**COMMERCIAL
SECTOR**

In 1990, 23 percent of the region's total firm sales were made to the commercial sector, a share little changed since 1983. During the period 1983-1990, commercial sector sales in the Pacific Northwest grew at an average annual rate of 4.1 percent (unadjusted for temperature). However, when longer term changes in the commercial sector's share of total regional sales are examined, beginning with 16 percent in 1970, a steady upward movement in this sector can be observed.

The distribution of the region's commercial consumers is similar to the distribution of the region's population. Commercial consumers are concentrated west of the Cascades, in the most populous areas of the region.

More commercial activity in 1990 occurred in the state of Washington than in all other states in the region combined. More than half of the region's commercial sales, most of the commercial seven-year growth, and almost two-thirds of the commercial floorspace were in Washington state.

The commercial sector includes a very diverse group of consumers, both in terms of the types of buildings occupied and the types of activities conducted.

For example, auto repair shops, office buildings, fast food restaurants, and bowling alleys are all included in the commercial sector. This sector also includes electricity used for street lighting and electricity used in churches and government buildings.

The primary driver of energy use in the commercial sector is business activity (primary economic activity) since it determines the type of electrical equipment installed in the building space. For example, the largest load in restaurants is for cooking and other food preparation equipment, while in groceries the largest loads are for refrigeration units.

Because business activity so strongly influences equipment use, building types, categorized according to business activity, are used to characterize the commercial sector.

Table 15 lists building types in the commercial sector, and gives the share of total commercial firm sales for each business type for 1988. The office and dry goods retail business types account for the largest share of sales in the commercial sector, together making up about 47 percent of regional firm sales to commercial consumers. These shares are not directly measured but are estimates from the Joint 1991 Long Term Forecast prepared by Bonneville Power Administration and the Northwest Power Planning Council.

Table 15

Shares of Commercial Sector Firm Electricity Sales By Type of Building 1990	
Business Type	Percent Share
Office	28.9
Dry Goods Retail	17.9
Grocery	9.7
School	7.5
Restaurant	5.3
Health	4.9
Warehouse	4.8
College	3.3
Hotel/Motel	3.0
Miscellaneous	14.7
Total	100.0

RECENT TRENDS

The commercial sector has grown significantly in recent years. During the period 1983-1990, sales grew at an average annual rate of 4.1 percent unadjusted for temperature effects and 3.7 percent when adjusted. During this period, the commercial sector averaged larger average megawatt increases per year than any of the other sectors-- 140 aMW per year unadjusted; 126 aMW when adjusted.

Adjustment for Temperature Effects

Heating, ventilating, and air conditioning (HVAC) account for one-third to one-half of typical electricity use in certain types of commercial buildings -- most notably in offices and dry goods retail shops, which represent 50 percent of total commercial electricity use. In these buildings, outdoor temperature can have a significant effect on electricity use.

Temperature effects vary from year to year without a systematic pattern and can mask other long-term trends that may affect commercial electricity sales, such as acquisitions of energy intensive equipment or efficiency gains from new building codes. It is therefore useful to adjust actual sales to reflect a normal, or "typical", weather year to remove effects of unusually hot or cold temperatures.

Over the 1983-1990 period, the region experienced six years of warmer than normal weather and two years colder than normal, as measured by annual Heating Degree Days. (See Weather and Temperature Adjustment on pages 9 and 10.)

Table 16 shows actual observed (unadjusted) commercial and total regional firm electricity sales -- percentage growth and aMW gain -- contrasted with temperature-adjusted sales growth for 1989-1990 and 1983-1990. (See page 45, Figure 9, for actual aMW figures.)

Table 16

Commercial Sector and Regional Firm Sales Growth Unadjusted & Temperature Adjusted				
	Commercial Sector		Regional Total*	
	1989-1990	1983-1990	1989-1990	1983-1990
Growth Rate (%)				
Unadjusted	3.5%	4.1%	1.3%	3.0%
Adjusted	2.7%	3.7%	1.1%	2.8%
Average Annual Growth (aMW)				
Unadjusted	135	140	216	459
Adjusted	102	126	192	441

* Regional total = all sectors, including commercial.

During the unusually mild winters over the 1983-1990 time period, the commercial sector required less electricity for heating than normal. This decrease was partially offset by excessive cooling loads resulting from unusually warm summers. When commercial sales are temperature-adjusted so that both the dampening effect of the mild winters and the exaggerating effect of the hotter than normal summers are removed, the resulting adjusted growth is somewhat lower than actual growth.

Commercial sales grew at a temperature adjusted rate of 3.7 percent annually over the past eight years, exceeding the regional growth rate of 2.8 percent. Commercial sector growth after taking into account the influence of weather is primarily due to three factors:

- * Service sector growth
- * Increased amenity levels
- * Increased use of electronic equipment

Service Sector Growth

The rapid growth in electricity sales in the commercial sector is primarily driven by an increase in the number of commercial buildings in the region. This growth reflects a national trend toward expansion in the service sector (rather than the manufacturing sector) of the economy. About half of the commercial buildings constructed in the region since 1980 have been office buildings, underscoring the dramatic growth in service sector activities.

Increased Amenity Levels and Use of Electronic Equipment

Electricity sales in commercial sector buildings have continued to grow despite energy efficiency improvements. These improvements in new and existing commercial buildings have largely focused on the heating, ventilating, and air conditioning (HVAC) systems, overhead lighting, and refrigeration (in grocery stores). While consumption has been reduced, the reduction seems to be counterbalanced by two recent trends.

First, tenants in newer commercial buildings are showing preferences for increased amenity levels in their space. For example, many new (and, increasingly, older) buildings show higher levels of comfort or service. Increased service can mean more hours of operating, greater temperature and humidity control, or more attractive display lighting. Services are most commonly seen in offices, schools, retail establishments, and various buildings in the other, or miscellaneous, category.

Second, electronic equipment such as computers, printers, and facsimile machines continues to proliferate in all business types. This is nowhere more evident than in offices. For example, it is still expected that by 1995 microcomputers, which were virtually nonexistent in 1983, will be on one in three office employees' desks. The continuing rapid growth in electronic equipment is causing electricity use to increase significantly in virtually all business types.

*TRENDS BY
UTILITY GROUP*

The relative shares of commercial sector electricity sales by public and by private utilities have changed very little in the past eight years. Private utilities made 59 percent of sales to the commercial sector each year. The average annual sales growth rate barely differs for the two groups: 4.2 for public and 4.1 percent for private utilities.

The relative shares of commercial sector electricity sales for generating and for non-generating public utilities also have remained constant over the past eight years: about 42 percent for non-generating and 58 percent for generating public utilities.

Figure 9 shows commercial firm sales by utility group over the past eight years, in aMW. Public utility sales are also broken down into sales by generating and by non-generating utilities. (Temperature adjusted data are provided in the table following the graph.)

Figure 9

Temperature Adjusted

	1983	1984	1985	1986	1987	1988	1989	1990
Public	1,249	1,323	1,328	1,411	1,450	1,515	1,584	1,619
Private	1,793	1,854	1,876	2,001	2,094	2,145	2,237	2,304

Non-Temperature Adjusted

	1983	1984	1985	1986	1987	1988	1989	1990
Public	1,240	1,344	1,415	1,410	1,442	1,521	1,598	1,648
Gen	722	770	816	820	840	877	920	954
Non-Gen	518	574	599	590	602	644	678	694
Private	1,780	1,891	1,992	2,015	2,095	2,165	2,268	2,353

**SECTOR
CHARACTERISTICS**

In the mid-1980s, the region had 1.87 billion square feet of commercial floorspace distributed over approximately 235,000 buildings. While many of the buildings are small -- the average size in the mid-1980s was about 8,000 square feet -- a proportionately small number of large buildings contain a sizable amount of floorspace.

Figure 10 shows that three commercial business types (office, dry goods retail, and miscellaneous) make up more than half of the region's floorspace and more than 60 percent of the total number of buildings in the commercial sector.

Figure 10

Data Source: Pacific Northwest Non-Residential Survey (PNNonRES)
Documentation, Phase I and II Descriptive Data Analysis Report (June, 1991).

Miscellaneous

The largest proportion of both buildings and floor area in the commercial sector falls into a category labeled "miscellaneous". A variety of business activities fall under this category, such as post offices, gas stations, laundries, and photo labs. Because this category is so diverse, a detailed description of it is not included in this report.

Office

The office is the second largest business type in the commercial sector, accounting for about 304 million square feet of commercial electricity sales in the mid-1980s. The office business type includes (but is not limited to) banks, insurance, legal, and real estate offices, health care offices and government offices. About 60 percent of the region's office floor area is contained in the largest 20 percent of the region's office buildings, and these buildings are located mainly in urban areas.

About half of all commercial construction between 1980 and 1986 was office buildings. Typically, these office buildings are both larger and more efficient in terms of energy use for HVAC and lighting than buildings built before 1980. However, rapidly growing computer and other miscellaneous loads have tended to offset energy efficiency improvements to varying degrees.

Despite the continuing construction trend toward larger office buildings, most are still small. Of the region's office buildings, 59 percent have less than 5,000 square feet of floorspace.

Based on metered data collected through Bonneville's End-Use Load and Consumer Assessment Program, now called Residential End-Use Metering Program (REMP), it has been observed that HVAC is the largest end use of electricity in office buildings, accounting for about 50 percent of typical building consumption. Lighting uses another 41 percent, and miscellaneous loads use the remainder.

Dry Goods Retail

Dry goods retail businesses accounted for 285 million square feet of floorspace in 42,800 buildings in 1986, and 19 percent of commercial electricity sales in 1988 (15 percent in 1986). This business type includes department stores, hardware stores, clothing stores, car dealerships, and other retail trade.

Most dry goods retail establishments are small: two-thirds have less than 5,000 square feet of floorspace. However, while only 6 percent are larger than 20,000 square feet, they account for 42 percent of the region's dry goods retail floorspace.

Based on REMP data, it has been observed that in dry goods retail businesses half to two-thirds of the total electricity consumed annually goes for indoor lighting. Another 25 to 45 percent of annual consumption goes for HVAC equipment and the remainder is used for various other end uses.

AVERAGE RETAIL RATES

Commercial enterprises tend to be less energy-intensive than industries, have lower load factors, and have higher distribution costs. However, electric utilities may face more competition in the commercial sector than in any other from different fuel sources for commercial heating, and commercial rates may reflect a desire by the utility to be competitive. Further, commercial sales may be a substantial part of a utility's total sales, especially in areas without large industries, and utilities will strive to set rates to keep their customer base.

Table 17 provides the region's commercial sector average retail rates for the public and private utility groups for the years 1983-1990. Table 18 shows the commercial sector's average cents/kWh change for the period 1989-1990 and the period 1983-1990, and also provides percent change.

Table 17

Regional Average Retail Rates -- Commercial Sector 1983-1990								
(Cents/kWh)	1983	1984	1985	1986	1987	1988	1989	1990
Commercial								
Public	2.75	3.02	3.15	3.19	3.25	3.33	3.47	3.50
Private	4.24	4.89	5.03	5.11	5.22	5.05	5.00	5.02

Table 18

Average Annual Changes in Retail Rates Commercial				
Commercial	Cents/kWh Change 1989-1990	% Change	Annual Average Change 1983-1990	Annual Average % Change
Public	0.03	0.9%	0.11	3.5%
Private	0.02	0.4%	0.11	2.4%

**INDUSTRIAL
SECTOR**

A large and growing part of the Pacific Northwest's electricity sales are to the industrial sector (including DSIs). In 1990, 39 percent of total regional firm sales were made to this sector. Total sector firm sales grew from 5,250 aMW in 1983 to 6,641 aMW in 1990, an average annual increase of 3.4 percent. This increase is higher than the regional average, but lower than the 8.5 percent increase from 1988 to 1989, mostly due to DSI loads reaching full capacity in 1989. The increase from 1989 to 1990 was only 26 aMW, or 0.4 percent.

The industrial sector has two major groupings: retail customers served by all of the region's utilities and customers served directly by Bonneville (direct-service industries, or DSIs). Retail utility sales and DSI sales are discussed separately.

**RETAIL
UTILITIES**

Sales to industries by the region's retail utilities (excluding DSIs) were 24 percent of the region's total firm sales in 1990. During 1983-1990, sales to the industries served by the region's utilities grew at an average annual rate of 3.0 percent.

Sales to industry by utilities grew the fastest in the state of Washington during the 1983-1990 period due to the opening of new mines. Industrial sales in Washington grew at an average annual rate of 3.7 percent, or an average of 61 aMW per year. The percentage of 1990 industrial sales attributable to Washington was large (50 percent) relative to electricity sales in the states of Oregon (30 percent), Idaho (15 percent), and western Montana (5 percent).

Electricity use in the industrial sector (excluding DSIs) is concentrated in five sub-sectors: pulp and paper, chemicals, lumber and wood products, primary metals (excluding aluminum), and food processing. These sub-sectors account for nearly 80 percent of utility sales to industries. Table 19, based on Bonneville's 1990 estimates, shows the types of industries and their relative shares of industrial firm sales.

Table 19

Shares of Industrial Sector Firm Electricity Sales* By Type of Industry 1990	
Industry Type	Percent Share
Pulp and Paper	33
Chemicals	16
Lumber & Wood Products	12
Primary Metals	11
Food Processing	7
Other	21
Total	100

* Excludes sales made directly by BPA to industries (DSIs).

Recent Trends

Regional utility industrial sales (excluding DSIs) grew at an average annual rate of 3.0 percent during the period 1983-1990. This growth largely reflects an expanding regional economy despite rising electricity prices. Electricity price increases during this period were estimated to have little effect on industrial electricity consumption basically because electricity prices increased only slightly faster than the inflation rate.

Table 20 shows the growth in firm electricity sales to retail utility industrial customers (unadjusted) relative to regional total firm electricity sales (unadjusted) during the periods 1988-1990 and 1983-1990. Sales from 1989 to 1990 grew at a faster rate than regional total sales grew. In contrast, industrial sector sales growth paralleled growth in regional total sales in the period 1983-1990.

Table 20

Industrial Sector Firm Sales Growth and Regional Firm Sales Growth				
	Industrial Sector*		Regional Total**	
	1989-1990	1983-1990	1989-1990	1983-199
Annual Average Growth Rate (%)	2.3%	3.0%	1.3%	3.0%
Annual Average Growth (aMW)	92	112	216	459

* Excludes sales made directly by BPA to industries (DSIs).

** Regional total = all sectors, including industrial.

Trends By Utility Group

Figure 11 shows industrial electricity firm sales by utility group (excluding DSIs). Public utility sales are further broken down into sales by generating and by non-generating utilities.

Figure 11

	1983	1984	1985	1986	1987	1988	1989	1990
Public	1,587	1,662	1,720	1,767	1,788	1,840	1,934	2,024
Gen	1,001	1,051	1,083	1,127	1,139	1,169	1,199	1,256
Non-Gen	586	611	637	640	649	671	735	768
Private	1,803	1,858	1,850	1,873	1,980	2,056	2,150	2,152

Excludes DSIs and Colockum.

Electricity sales by utility group show that the sales by public utilities to the industrial sector grew faster than sales by private utilities during the 1983-1990 period. Industrial sector electricity sales by public utilities increased at 3.5 percent per year, while sales by private utilities increased 2.6 percent per year.

Subsector Characteristics

Events in the five major industrial subsectors served by retail utilities in the Pacific Northwest help to explain the trends in industrial sales during the 1983-1990 period. These events are described under each subsector.

Pulp and Paper

The major industry served by retail utilities in the region, pulp and paper, accounted for 33 percent of total industrial sales in 1990. Within the pulp and paper industry, electricity is mainly used in the preparation of wood chips or blocks prior to and during the pulping process, which involves cleaning, washing and sizing of the wood chips, and grinding and refining of the wood chips if mechanical processes are used. Electricity is also used in the "dewatering of pulp" as it is transformed into paper, and in the numerous motors that convey the wood pulp and paper through the various processing stages.

Actual electricity and fuel consumption statistics are compiled and reported annually for the Pacific Northwest Region by the American Paper Institute. These statistics show that electricity consumption by the pulp and paper industry in 1988 (data not available for 1989 or 1990) was only 3.6 percent above what the industry consumed in 1983. This stands in stark contrast to pulp and paper production tonnage, which increased by 20.4 percent during this period. It also contrasts with recent trends in the industry which include the increasing use of mechanical pulping processes as a replacement for more conventional chemical pulping processes and is several times more electrically intensive per ton of pulp.

The foregoing facts suggest that electricity consumption should be increasing by more than just 3 or 4 percent. The relatively flat electricity consumption during 1983-1988 may be explained by the fact that the pulp and paper industry has great potential for generating its own electricity. Investigation of this trend is continuing.

Chemicals

The chemicals industry in the Pacific Northwest, which accounted for 16 percent of industrial electricity sales by retail utilities in 1990, showed slight growth during the 1983-1990 period. Electricity sales to this industry are largely affected by the production of chlorine, caustic soda (chloralkali) and sodium chlorate, and the production of elemental phosphorus.

Nationally, chloralkali production levels remained relatively flat during the 1983-1990 period. But because U.S. plant capacity decreased during this period, Pacific Northwest plants realized some growth.

Elemental phosphorus production levels in the U.S. during the 1983-1990 period gradually decreased from a high reached in 1984. The Northwest phosphorus plants followed suit. As a result, electricity sales to phosphorus plants slowly declined.

Lumber and Wood Products

The lumber and wood products industry, which accounted for about 12 percent of industrial sales by retail utilities in 1990, performed strongly during the 1983-1990 period. Electricity in lumber and wood product production is primarily used for cutting, trimming, milling, and planing of raw timber into finished wood products such as lumber, and plywood and other structural panel board.

The lumber and wood products industry recovered tremendously from the lows it experienced during 1981-1982. Lumber production rose by 25 percent, and plywood and structural panel board production rose by 17 percent during the period 1983-1988. During the period 1983-1990, lumber production rose by only 18 percent. Similarly, plywood showed an increase of only 6 percent during the same period. These production levels came close to or surpassed levels achieved in 1977 when the industry achieved pre-recession highs.

Although the market for new housing is not as strong as it was in 1977, the industry continues to profit from the strong repair and remodeling market.

During 1989, the potential listing of the Northern Spotted Owl as a threatened species under the Endangered Species Act became a heated issue, with suits filed by environmental groups halting sales of old-growth timber on U.S. Forest Service and Bureau of Land Management forest lands. Preliminary data indicates that in spite of the injunctions halting timber sales, lumber and panelboard production declined by only a small amount in 1989, due to the fact that mills still had access to timber inventory from previous sales. Projections by the US Forest Service indicate a 30 percent reduction from the 1988 peak harvest by 1995. Twenty-five percent of the reduction is attributed to adjustments to protect spotted owls. The remainder results from revised estimates of sustainable harvest, other ecologic considerations, and market conditions unfavorable to Pacific Northwest manufacturers.

Primary Metals

About 11 percent of all utility industry sales are made to firms producing raw steel or castings made of iron or steel. The region's steel production rose sharply over the last seven years, recovering fully from a 1983 recession induced low. It is estimated that raw steel production increased 70 to 90 percent between 1983 and 1990. The recovery in steel and other non-aluminum metals is calculated to have added between 100 aMW and 200 aMW to total utility electricity sales.

Food Processing

The food processing industry accounted for 7 percent of industrial sales in 1989. The industry includes a wide range of activities from milk processing to production of frozen french fries. Within food processing industries, electricity is used in four basic processes: refrigeration, cooking, drying, and heating liquids.

The demand for output from the regional food processing industry is comprised of processing of all foods for regional consumption and processing of fruits and berries, vegetables, and potatoes.

Potato processing increased by 44 percent during the 1983-1990 period, while canned fruits, berries, and vegetables increased by 36 percent. Food processing of other types is primarily for regional consumption and is assumed to follow population.

Average Retail Rate

Industrial customers tend to be the least costly sector to serve. Industries often have the ability to use electricity at a higher load factor than other sectors, especially if the industry operates 24 hours a day. Industries can consume power at higher voltages than other sectors, which requires fewer transformers. Distribution cost per kilowatthour used is lower for industries since a few customers consume large amounts of electricity. Utility and community political and economic policies often play an important role in industrial electricity rates. For example, in order to attract industries and jobs to the area, rate incentives may be offered to new or expanding industries.

Table 21 shows the region's industrial sector (excluding DSIs) average retail rates for the public and private utility groups for the years 1983-1990. Table 22 shows the industrial sector's average cents/kWh change from 1989 to 1990 and for 1983-1990, and shows their average annual percent of change.

Table 21

Regional Average Retail Rates -- Industrial Sector 1983-1990								
(Cents/kWh)	1983	1984	1985	1986	1987	1988	1989	1990
Industrial								
Public	2.00	2.22	2.27	2.31	2.36	2.47	2.57	2.54
Private	2.92	3.31	3.49	3.44	3.33	3.22	3.34	3.38

Table 22

Average Annual Changes in Retail Rates Industrial				
Industrial	Cents/kWh Change 1989-1990	% Change	Annual Average Change 1983-1990	Annual Average % Change
Public	-0.03	-1.2%	0.08	3.5%
Private	0.04	1.2%	0.07	2.1%

*DIRECT-SERVICE
INDUSTRIAL*

The direct-service industries (DSIs) account for a large share of Bonneville's power sales--17 percent of total sales and 14 percent of the region's firm sales in 1990. Given the large size of the DSIs, any change in their loads can significantly affect Bonneville and the region. During the time period 1983-1990, total DSI sales in the region grew at an annual rate of 4.1 percent.

The DSIs are 17 industrial firms served directly by Bonneville rather than by retail utilities. Most of these firms use electric-intensive production processes. Eight of the firms produce aluminum. Table 23 lists all the DSI firms by what they produce.

Table 23

Direct-Service Industrial Customers			
Aluminum	Chemicals	Primary Metal	Pulp & Paper
Reynolds Metals	Pennwalt	Oregon Metal.	Port Townsend
Kaiser Aluminum	Pacific Carbide*	ACPC	
Columbia Falls	Georgia Pacific	Nickel Joint Vent. **	
Intalco Aluminum	Carborundum*	Gilmore Steel*	
ALCOA			
Columbia Aluminum			
VANALCO			
NW Aluminum			

* Companies under contract with BPA, but not presently operating.

** Reopened June 1989 (previously under the name of Hanna Nickel).

Over the last eight years, sales to the DSIs have been volatile, their loads varying with economic events. As the economy improved and as Bonneville developed means to reduce their load fluctuations, DSI firm sales grew more, on a percentage basis, than sales to any other sector. Table 24 illustrates DSI percentage load growth and growth in average megawatts from 1989-1990 as well as the eight year period, 1983-1990.

Table 24

Direct-Service Industrial Firm and Non-Firm Sales and Regional Firm Sales Growth				
	Direct-Service Industrial		Regional Total*	
	1989-1990	1983-1990	1989-1990	1983-1990
Annual Average Growth Rate (%)				
Total	3.0%	4.0%		
Firm	-2.6%	4.1%	1.3%	3.0%
Non-Firm	31.8	3.4%		
Annual Average Growth (aMW)				
Total	90	106		
Firm	-66	80	216	459
Non-Firm	156	19		

* Regional total = all sectors, including direct-service industrial.

Figure 12 shows firm and non-firm sales in average megawatts to direct-service industries during the period 1983-1990.

Figure 12

	1983	1984	1985	1986	1987	1988	1989	1990
Total	2,370	2,945	2,454	2,210	2,477	2,971	3,021	3,111
Firm	1,860	2,458	2,068	1,885	2,065	2,435	2,531	2,465
NFirm	510	487	386	325	412	536	490	646

Recent Trends

DSI load growth is due not to additional facilities, but to increased use of existing production facilities. As of December 1990, plants were operating at 100 percent of capacity.

During the past seven years, DSI loads grew an average of 4 percent per year or 86 aMW. The significance of this change in DSI loads is illustrated by the fact that 86 aMW is more than what the customers of Springfield (Oregon) Utility Board use in a year.

Aluminum Companies

The aluminum companies, the largest part of the DSI group, accounted for about 91 percent of DSI load in 1990. Table 25 lists the companies and shows their shares of the load.

Table 25

Aluminum Direct-Service Industry Companies' Share of Total and Firm DSI Load in 1990				
Company	Percent Share of Total	aMW	Percent Share of Firm	aMW
Reynolds Metals	21%	665	21%	510
Kaiser Aluminum	18%	546	18%	443
Intalco Aluminum	14%	450	14%	347
Columbia Falls	11%	338	11%	266
ALCOA	6%	176	6%	154
Columbia Aluminum	9%	279	9%	217
VANALCO	7%	228	7%	175
NW Aluminum	5%	163	5%	128

Between 1983 and 1990, aluminum total loads varied from 2,005 aMW in 1986 to 2,845 aMW in 1990. This period corresponds to the time during which the aluminum industry faced especially volatile prices for their product. During this period there were long periods when aluminum prices were below the operating costs of several plants, affecting their production levels and therefore their electricity use. Figure 13 shows aluminum prices and DSI electricity sales.

Figure 13

Aluminum loads were relatively low at the start of 1983. In 1984, demand for aluminum increased to record levels and regional smelter loads rose, increasing to almost full capacity. Even though demand for aluminum was strong, high production levels resulted in a buildup of inventories. At the end of 1984 the industry again experienced sharply reduced demand for its product and consequently less need for electricity. The depression of prices lasted nearly three years and caused three plants to close, with consequent large cutbacks in production and employment.

Bonneville, the DSIs, and other interested groups worked together to restore the competitive position of the region's aluminum companies. This effort resulted in two programs:

- * **Variable Rate:** This specially designed power rate, established in 1986, varies with the price of aluminum, resulting in lower electricity (production) costs during periods of poor market conditions and higher electricity costs during periods of good market conditions.
- * **Conservation/Modernization (Con/Mod):** This incentive program encourages more efficient production processes in aluminum smelting.

By 1987, Bonneville had implemented the Variable Rate and the Con/Mod program, helping to enable the restart of the three previously closed smelters. In contrast, some of the higher cost plants in other parts of the United States and the world had closed. Then, the recovering demand for aluminum, supply constraints, low inventories, and higher prices brought regional aluminum smelter loads to 98 percent of capacity by 1988, and full capacity in 1990.

The results of the two Bonneville programs for the aluminum industry have been striking. Together, the region's aluminum companies saved about 100 aMW in the Con/Mod program by 1990. The Variable Rate has been credited with enabling Bonneville to collect \$230 million more revenue by 1990 due to the higher aluminum prices.

Non-Aluminum Companies

The non-aluminum companies, the smallest part of the DSI group, accounted for only 8.6 percent of the 1990 DSI load. Table 26 lists the direct-service non-aluminum companies and shows their shares of the DSI load in 1990.

Table 26

Non-Aluminum Direct-Service Industrial Companies' Share of Total and Firm DSI Load in 1990				
Company	Percent Share of Total	aMW	Percent Share of Firm	aMW
Penwalt	2.00	68	2.00	60
Nickel Joint Venture	2.00	67	2.00	53
Trentwood	2.00	52	2.00	42
ALCOA	1.00	33	1.00	31
Georgia Pacific	1.00	21	1.00	19
Port Townsend	0.40	11	0.40	9
Oregon Metallurgical	0.30	10	0.30	8
Reynold Cable	0.10	3	0.10	2
ACPC	0.03	1	0.04	1
Gilmore Steel*	0.00	0	0.00	0
Pacific Carbide	0.00	0	0.00	0
Carborundum	0.00	0	0.00	0

* Majority of load served by private utility.

Like their aluminum counterparts, the loads of the non-aluminum DSIs have fluctuated with economic conditions. During 1986-1988, weak demand for their products and high costs of production led two plants to close, hurting regional employment. While the 100 aMW loss due to these closures did not greatly affect total DSI loads, Bonneville worked with non-aluminum DSIs to help stabilize their loads.

Several industrial conservation programs sponsored by Bonneville offer financial incentives to firms proposing to install various electric energy conservation measures. Non-aluminum DSI companies have been eligible to take part in these programs. A few companies have taken advantage of them, with resulting energy savings and lower production costs, increasing their competitiveness with respect to producers in other regions of the United States and the world.

Hanna Nickel was the largest of the non-aluminum DSIs to shut down operations in the 1983-1988 time period. Low nickel metal prices in 1986 and 1987 caused the shutdown despite discounted electric rates and an attempt to install new technology to cut operating costs. By the end of 1988, nickel prices had rebounded to new highs and the smelter reopened under new management in June 1989 as Nickel Joint Venture.

**IRRIGATION
SECTOR**

Utility sales in 1990 in the Pacific Northwest to the irrigation sector accounted for 3.5 percent of total regional firm sales. During the period 1983-1990 sales to the irrigation sector grew at an average annual rate of 4.0 percent. The irrigation sector's electricity usage fluctuates more than any other sector's, ranging from an annual average decrease of -6.2 percent (1979-1983) to an annual average increase of 16.6 percent (1975-1977). Of the 8.2 million irrigated acres in the region, 56 percent are sprinkler irrigated with underground water from aquifers or with surface water from canals and rivers.

Most of the region's irrigation takes place in the arid lands east of the Cascade Mountains in central and eastern Washington, in north central Oregon, and in southern Idaho. Most irrigation energy sales are made during the crop-growing season from April to October, with peak sales in July or August.

The state of Idaho accounted for 48 percent of the 1990 irrigation sales. Washington followed with 33 percent. Oregon accounted for 17 percent and western Montana 2 percent. Over the years there has been very little fluctuation in the state shares of total regional irrigation electricity use.

RECENT TRENDS

Irrigation electricity sales have fluctuated greatly throughout history. Sales in this sector in 1983 were the lowest since the mid-1970s, while in 1988, 1989, and 1990, respectively, the fourth, fifth, and highest sales in history largely reflect a drought.

Even going back to the 1970s, growth trends in the irrigation sector have fluctuated greatly. Electricity sales in 1970 were 263 aMW; in 1975, irrigation sales were at 424 aMW (an annual average increase of 12.7 percent). Irrigation sales jumped to 603 aMW in 1979, growing from 495 aMW in 1978. The annual average growth rate from 1979-1983 (1983 being the base year used in this report), was -6.2 percent, and from 1979-1990, only .2 percent annual growth. The long trend irrigation sales, from 1970-1990, shows an annual average increase of 4.3 percent, which is close to the 1983-1990 increase of 4.0 percent. Because of these great fluctuations in irrigation electricity usages, it is difficult to forecast or analyze the irrigation sector's electricity usage.

Table 27 shows irrigation sector growth in firm electricity sales--percentage growth and average megawatt (aMW) gain--relative to regional total growth for 1989-1990 and during the period 1983-1990.

Table 27

Irrigation Sector Firm Sales Growth and Regional Firm Sales Growth				
	Irrigation Sector		Regional Total*	
	1989-1990	1983-1990	1989-1990	1983-1990
Average Annual Growth Rate (%)	5.5%	4.0%	1.3%	3.0%
Average Annual Growth (aMW)	32	21	216	459

* Regional total = all sectors, including irrigation

Several offsetting factors shape irrigation sales year to year and in the long run:

- * Planted sprinkled crop acreage
- * Weather
- * Prices of farm produce
- * Energy conservation

Acreage and Weather

The two major factors in yearly changes in irrigation sales are sprinkled crop acres and weather. Many crops grown in the arid eastern area of the Pacific Northwest require irrigation. An increase in sprinkled acres or drought conditions boost irrigation sales. Drought conditions in 1988-1990 increased irrigation sales.

Farm Prices

An economic slump in the farm economy during the late 1970s continuing through 1984 had some dampening effect on irrigation sales. This economic slump occurred as reduced exports of farm products and a slowing national economy resulted in lowered crop prices and in the build-up of surpluses of some crops. The farm economy slump has reversed in recent years. Real net farm income was higher in 1989 than any year since 1975 (1990 statistics not available).

Conservation

Nearly all irrigators now practice some kind of conservation. Several measures to conserve irrigation water and electricity have become available over the past few years. The most feasible and accepted measure has been to reduce water pressure in center pivot irrigation systems.

Since 1982, incentives to increase the energy efficiency of their systems have been offered to irrigators in the Northwest through various programs, including several Bonneville programs. Conservation has contributed to flattening the long-term trend in irrigation sales. Farmers are irrigating more prudently, responding to daily or weekly rainfall and temperature.

TRENDS BY UTILITY GROUP

Figure 14 shows irrigation firm sales by utility group over the past eight years, including public generating and non-generating utility sales.

Figure 14

	1983	1984	1985	1986	1987	1988	1989	1990
Public	215	224	259	244	256	263	266	283
Gen	43	43	52	50	53	56	55	57
Non-Gen	172	181	207	194	203	207	211	226
Private	252	251	297	279	299	322	316	331

Irrigation excludes reservoir pumping.

Irrigation sector sales by private utilities in the region roughly paralleled growth with the region's public utilities. Private utility irrigation sales experienced a 4.8 percent growth rate from 1989 to 1990 and an average annual growth rate of 4.0 percent during the period 1983-1990. Public utility irrigation sales grew 6.4 percent from 1989 to 1990 and showed an average annual growth rate of 4.0 percent during 1983-1990. Public utility megawatt increases for irrigation were 17 aMW from 1989 to 1990 and 10 aMW during 1983-1990; private utility changes were 15 aMW from 1989 to 1990 and an average of 11 aMW during 1983-1990.

*AVERAGE
RETAIL RATES*

The irrigation sector is unique in its consumption and load characteristics. Electricity used to pump water for irrigation is used almost entirely in the summer, when electricity rates in the Northwest are generally lower than in the winter. High usage in the summer results in high load factors during those months. (In early spring months, irrigation load factors and energy use are low.)

In addition, since 1981 Bonneville has provided a Low Density Discount (LDD) that applies to most rural public utility and co-op customers and lowers their cost of purchased power. Also, since mid-1985 Bonneville has provided a discount for any electricity purchased from Bonneville that is used for irrigation or drainage pumping. This discount must be passed through in its entirety to irrigators. Finally, Bonneville's residential and small farm exchange program may lower irrigation rates for participating irrigation utilities.

Table 28 provides the region's irrigation sector average retail rates for the public and private utility groups for years 1983-1990. Table 29 shows the irrigation sector's average cents/kWh change from 1989 to 1990 and for 1983-1990, and shows their average annual percent of change.

Table 28

Regional Average Retail Rates -- Irrigation Sector 1983-1990								
(Cents/kWh)	1983	1984	1985	1986	1987	1988	1989	1990
Irrigation								
Public	2.76	2.92	2.78	2.77	2.75	2.83	2.87	2.98
Private	3.28	3.40	3.54	3.62	3.78	3.81	3.70	3.72

Table 29

Average Annual Changes in Retail Rates Irrigation				
Irrigation	Cents/kWh Change		Annual Average Change	
	1989-1990	% Change	1983-1990	Annual Average % Change
Public	0.11	3.8%	0.03	1.1%
Private	0.02	0.5%	0.06	1.8%

Chapter 5

NUMBER OF RETAIL CUSTOMERS AND AVERAGE ENERGY USE 1990 & 1983-1990

Key Observations

- *In 1990, the region had 4,242,447 public and private utility retail customers in the residential, commercial, industrial, and irrigation sectors*
- *In 1990, the average residential customer in the region used 1.6 average kilowatts of electricity, or 13,800 kilowatthours*
- *In 1990, 53.0% of all retail customers were in the state of Washington*
- *Average electricity usage by residential customers dropped in 1986 and 1987 due primarily to warmer than usual winters. 1984 and 1985 were colder than normal years*

Looking at trends in the numbers of retail customers and the average energy use per customer by sector can be important in helping Bonneville satisfy diverse electricity needs in the future.

Tracking average electricity usage trends in the residential sector is relatively easy because the major factor of change is weather. The average electricity usage per customer figures in the commercial and industrial sectors are less simple.

The greatest factor in average use change in the commercial and industrial sectors is the number of small companies starting business: although a small business uses far less electricity than a large business, the small and the large business are each counted as one customer. The effect of increased numbers of small businesses on average electricity use in a sector is evident in the state of Washington.

Average kilowatt use for the industrial sector in Washington dropped from 378 average kilowatts in 1988 to 345 in 1990. Change in average use for irrigation customers is due primarily to the amount of rainfall and the size of the farm.

1990 RETAIL CUSTOMERS AND AVERAGE USE

Table 30 gives the number of retail customers for public and private utilities by sector and the average kilowatt use per customer for 1990. Street lighting has been removed from the commercial sector since the small amount of electricity each street light uses would distort the commercial sector picture. In 1990 the 7,807 street lights reported used a total of only 53 average megawatts of electricity.

Table 30

Number of Retail Customers and Average Use 1990			
Sector	Retail Customers	Avg Annual kW Use Per Customer	Avg Annual kWh Use Per Customer
Residential			
Total	3,696,163	1.6	13,800
Public	1,509,909	1.7	15,200
Private	2,186,254	1.5	12,900
Commercial*			
Total	470,961	8.4	73,400
Public	177,667	9.1	80,100
Private	293,294	7.9	69,400
Industrial			
Total	12,101	345.1	3,023,000
Public	3,576	566.0	4,958,100
Private	8,525	252.4	2,211,300
Irrigation			
Total	55,463	11.1	97,000
Public	27,946	10.1	88,700
Private	27,519	12.0	105,400
Total	4,242,499	3.5	30,500

* Commercial excludes street lighting.

**RETAIL CUSTOMER
TRENDS**

Table 31 provides the average number of retail customers by sector for the time period 1983-1990.

Table 31

Average Number of Retail Customers by Sector 1983-1990								
	1983	1984	1985	1986	1987	1988	1989	1990
Residential	3,279,721	3,325,487	3,367,836	3,422,084	3,480,816	3,544,206	3,611,891	3,696,163
Commercial	398,455	407,776	417,306	432,621	438,374	448,507	458,606	470,961
Street Lighting	5,733	6,298	6,608	6,923	7,238	7,302	7,562	7,807
Industrial	9,788	9,624	9,373	9,509	9,925	10,306	11,468	12,101
Irrigation	52,724	53,366	54,316	53,045	53,587	53,311	54,162	55,465
Total	3,746,421	3,802,551	3,855,439	3,924,182	3,989,940	4,063,632	4,143,689	4,242,497

**AVERAGE
ENERGY USE
TRENDS**

Figure 15 presents in both graphic and tabular form the 1983-1990 trend of average kilowatt use per customer. The Pacific Northwest experienced colder than normal weather in 1984 and 1985, and warmer than normal weather in 1983 and 1986-1990. This weather fluctuation can be seen in average use in both the residential and commercial sectors. The data has not been temperature adjusted. (For information on adjustment see Weather and Temperature Adjustment on pages 9 and 10.)

Figure 15

(kW)	1983	1984	1985	1986	1987	1988	1989	1990
Residential	1.57	1.64	1.68	1.57	1.51	1.56	1.61	1.58
Commercial*	7.43	7.76	8.02	7.78	7.93	8.08	8.30	8.37
Industrial	346.37	365.75	380.91	382.73	379.66	378.00	356.14	345.05
Irrigation	8.86	8.90	10.24	9.87	10.35	10.98	10.79	11.07

* Commercial excludes street lighting.

Note: Average kilowatts can be converted to kilowatthours by multiplying the average kilowatts by the number of hours in a year (8,784 hours in a leap year; 8,760 hours in all other years).

The decline in average industrial usage in 1989 was in part due to a large number of small industries opening in the Puget Sound Area. Drought conditions beginning in 1988 increased irrigation sales, while greater than average rainfall lowered irrigation sales in 1986.

**1990 RETAIL
CUSTOMERS AND
AVERAGE USE
BY STATE**

Table 32 reports the 1990 data by state. The state of Washington served 53 percent of the region's retail customers. Oregon followed with 32 percent, Idaho served 12 percent, and western Montana served 3 percent. Oregon data includes customers of Surprise Valley Electric, whose headquarters is in California; Idaho data includes customers of Wells Rural Electric whose headquarters is in Nevada and customers of Lower Valley P&L whose headquarters is in Wyoming. (See Chapter 6 for electricity sales by state.)

Table 32

Number of Retail Customers and Average Use by State 1990

Washington		
Sector	Retail Customers	Avg KW Use Per Customer
Residential		
Total	1,991,544	3.3
Public	1,093,508	1.8
Private	898,036	1.5
Commercial		
Total	228,405	18.7
Public	122,661	9.9
Private	105,744	8.7
Industrial		
Total	7,086	704.3
Public	2,646	577.7
Private	4,440	126.6
Irrigation		
Total	17,633	19.8
Public	14,044	12.4
Private	3,589	7.4

Oregon		
Sector	Retail Customers	Avg KW Use Per Customer
Residential		
Total	1,171,725	3.2
Public	298,309	1.7
Private	873,416	1.4
Commercial		
Total	161,676	16.0
Public	38,923	7.8
Private	122,753	8.1
Industrial		
Total	2,684	1,089.8
Public	587	669.3
Private	2,097	420.5
Irrigation		
Total	17,784	12.3
Public	8,252	7.9
Private	9,532	4.4

Oregon includes sales for Surprise Valley Electric in CA.

Idaho		
Sector	Retail Customers	Avg KW Use Per Customer
Residential		
Total	419,142	3.2
Public	86,405	1.6
Private	332,737	1.6
Commercial		
Total	63,195	12.5
Public	12,537	6.3
Private	50,658	6.2
Industrial		
Total	1,639	697.0
Public	318	299.1
Private	1,321	397.9
Irrigation		
Total	17,060	29.7
Public	3,596	10.4
Private	13,464	19.3

Idaho includes sales from Wells Rural Electric in NV & Lower Valley P&L in WY.

Montana		
Sector	Retail Customers	Avg KW Use Per Customer
Residential		
Total	113,752	2.5
Public	31,687	1.4
Private	82,065	1.1
Commercial		
Total	17,685	10.7
Public	3,546	4.9
Private	14,139	5.9
Industrial		
Total	82,090	269.4
Public	25	268.3
Private	82,065	1.1
Irrigation		
Total	2,988	5.7
Public	2,054	3.3
Private	934	2.4

**RETAIL CUSTOMER
TRENDS BY STATE**

Table 33 provides the average number of retail customers by sector for each state for the time period 1983-1990.

Table 33

Average Number of Retail Customers by State 1983-1990								
Residential	1983	1984	1985	1986	1987	1988	1989	1990
WA	1,704,907	1,737,860	1,771,501	1,810,694	1,850,179	1,893,003	1,937,905	1,991,544
OR	1,084,045	1,088,812	1,091,589	1,101,214	1,117,000	1,132,892	1,149,936	1,171,725
ID	385,434	391,451	393,864	400,408	403,005	406,651	411,411	419,142
MT	105,335	107,364	108,882	109,768	110,632	111,660	112,639	113,752
Subtotal	3,279,721	3,325,487	3,367,836	3,422,084	3,480,816	3,544,206	3,611,891	3,696,163
Commercial	1983	1984	1985	1986	1987	1988	1989	1990
WA	189,475	194,091	199,267	204,928	210,621	216,069	222,131	228,405
OR	139,597	142,561	145,413	153,255	152,020	155,100	157,691	161,676
ID	54,051	55,355	56,699	57,995	58,913	60,213	61,439	63,195
MT	15,332	15,769	15,927	16,443	16,820	17,125	17,345	17,685
Subtotal	398,455	407,776	417,306	432,621	438,374	448,507	458,606	470,961
Street Lightin	1983	1984	1985	1986	1987	1988	1989	1990
WA	3,701	3,761	3,828	4,066	4,171	4,217	4,307	4,409
OR	1,189	1,651	1,664	1,685	1,682	1,693	1,768	1,863
ID	387	414	418	424	601	592	589	595
MT	456	472	698	748	784	800	898	940
Subtotal	5,733	6,298	6,608	6,923	7,238	7,302	7,562	7,807
Industrial	1983	1984	1985	1986	1987	1988	1989	1990
WA	5,607	5,477	5,283	5,315	5,448	5,847	6,630	7,086
OR	1,863	1,825	1,826	1,875	2,117	2,397	2,676	2,684
ID	1,738	1,743	1,690	1,741	1,789	1,465	1,492	1,639
MT	580	579	574	578	571	597	670	692
Subtotal	9,788	9,624	9,373	9,509	9,925	10,306	11,468	12,101
Irrigation	1983	1984	1985	1986	1987	1988	1989	1990
WA	17,869	17,794	18,089	17,655	17,629	17,563	17,662	17,633
OR	16,835	17,482	17,847	16,969	17,355	17,076	17,154	17,784
ID	14,960	15,020	15,308	15,372	15,616	15,757	16,387	17,060
MT	3,060	3,070	3,072	3,049	2,987	2,915	2,959	2,988
Subtotal	52,724	53,366	54,316	53,045	53,587	53,311	54,162	55,465
Totals	1983	1984	1985	1986	1987	1988	1989	1990
WA	1,921,559	1,958,983	1,997,968	2,042,658	2,088,048	2,136,699	2,188,635	2,249,077
OR	1,243,529	1,252,331	1,258,339	1,274,998	1,290,174	1,309,158	1,329,225	1,355,732
ID	456,570	463,983	469,979	475,940	479,924	484,678	491,318	501,631
MT	124,763	127,254	129,153	130,586	131,794	133,097	134,511	136,057
Total	3,746,421	3,802,551	3,855,439	3,924,182	3,989,940	4,063,632	4,143,689	4,242,497

**AVERAGE ENERGY
USE TRENDS
BY STATE**

Table 34 and Figure 16 present the 1983-1990 trend of average kilowatt use per customer by state for each of the four main sectors. The irrigation sector shows the greatest fluctuation between states. This is primarily due to differences in the size of farms, types of crops, and amount of rainfall.

Table 34

Average Energy Use by State 1983-1990								
Residential	1983	1984	1985	1986	1987	1988	1989	1990
WA	1.69	1.75	1.79	1.67	1.60	1.64	1.68	1.64
OR	1.42	1.49	1.52	1.43	1.41	1.46	1.50	1.51
ID	1.61	1.73	1.74	1.61	1.54	1.60	1.66	1.60
MT	1.18	1.21	1.17	1.14	1.13	1.14	1.20	1.17
Commercial	1983	1984	1985	1986	1987	1988	1989	1990
WA	8.39	8.80	9.15	8.92	8.99	9.13	9.34	9.38
OR	7.10	7.37	7.55	7.26	7.59	7.67	7.94	8.07
ID	5.59	5.84	5.97	5.79	5.74	6.08	6.21	6.25
MT	5.04	5.40	5.65	5.38	5.44	5.54	5.69	5.67
Industrial	1983	1984	1985	1986	1987	1988	1989	1990
WA	288.93	310.80	332.13	342.42	341.95	331.40	302.15	295.03
OR	562.47	591.35	607.20	594.97	548.39	496.67	462.05	474.90
ID	327.32	339.15	335.25	310.79	310.83	400.10	432.57	378.70
MT	264.62	254.49	244.47	281.66	329.55	303.64	297.19	273.91
Irrigation	1983	1984	1985	1986	1987	1988	1989	1990
WA	8.87	9.23	10.41	10.10	10.67	10.81	10.75	11.37
OR	5.20	5.37	5.97	5.90	6.04	5.85	6.06	6.03
ID	14.22	13.87	16.38	15.30	16.19	18.11	17.05	17.43
MT	2.70	2.92	3.53	3.19	2.94	3.55	2.96	3.01

Note: Average kilowatts can be converted to kilowatthours by multiplying the average kilowatts by the number of hours in a year (8,784 hours in a leap year; 8,760 hours in all other years).

Figure 16

Chapter 6

ELECTRICITY SALES BY STATE

Key Observations

- *Washington accounted for 56% of the region's 1990 firm sales*
- *At 3.3%, Oregon saw the greatest percentage growth in electricity sales from 1989 to 1990*
- *Oregon showed the highest annual average megawatt change in usage, 155 aMW, from 1989 to 1990*
- *In 1990, Idaho farmers used almost half of the electricity sold for irrigation in the region*
- *A comparison of 1983-1990 growth trends for the three primary Pacific Northwest states shows Washington with the highest average yearly growth in energy sales (283 aMW)*

Electricity use graphics and tables are presented to give a picture of each state's electricity use growth in recent years, its growth in relation to growth in other states, and also sector contributions to the overall state picture. State summaries give a picture of major factors contributing to 1983-1990 consumption trends.

When using the data in this chapter, it is useful to keep in mind two things:

- * Sales made by a public utility are included in the state where its headquarters is located even though areas served by some public utilities cross state boundaries. For example, the headquarters of Clearwater Power Company is in Idaho but the utility serves customers in Washington as well as Idaho. These sales in other states are typically a small percentage of the total sales made by public utilities within any given state.
- * All average megawatts in this chapter are from actual observed sales (sales not adjusted for temperature).

1990 FIRM SALES

Table 35 shows the 1990 firm energy sales for each state by sector and the average megawatt consumption by utility groups: public and private.

Table 35

Firm Sales by State 1990						
Avg MW	Residential	Commercial*	Industrial	DSI	Irrigation	Total
Washington						
Total	3,267	2,174	2,091	1,760	201	9,493
Public	1,917	1,239	1,529		174	4,859
Private	1,350	935	562		27	2,874
Oregon						
Total	1,764	1,321	1,275	439	107	4,906
Public	513	307	393		65	1,278
Private	1,251	1,014	882		42	3,189
Idaho						
Total	672	398	621	0	297	1,988
Public	139	79	95		37	350
Private	533	319	526		260	1,638
Montana						
Total	133	101	190	266	9	699
Public	46	17	7		7	77
Private	87	84	183		2	356
Region						
Total	5,836	3,994	4,177	2,465	614	17,086
Public	2,615	1,642	2,024		283	6,564
Private	3,221	2,352	2,153		331	8,057

* Commercial includes street lighting & public facilities.

**1990 AVERAGE
RETAIL RATES**

Table 36 shows the 1990 average retail rates for each state by sector by utility group: public and private.

Table 36

Average Retail Rates by State 1990				
Cents/kWh	Residential	Commercial	Industrial	Irrigation
Washington				
Public	3.80	3.26	2.39	2.43
Private	5.22	5.13	3.49	3.98
Oregon				
Public	4.42	3.93	2.95	3.66
Private	4.86	5.04	3.73	2.80
Idaho				
Public	5.10	4.87	2.82	3.96
Private	4.86	4.70	2.69	3.85
Montana				
Public	5.41	4.61	4.93	4.49
Private	5.29	4.82	3.34	3.53

Figure 17

Following Figure 17 is a summary for each state which includes narrative, a table, and a figure. Each narrative gives the state's population ranking in the region and a sketch of its economic base. The figure for each state (Figures 18-21) compares total firm sales for each sector for each year, 1983-1990.

Table 37 on page 90 compares each state's average yearly growth for the years 1983-1990 with the region's, both in percentage and average megawatts.

**WASHINGTON
SUMMARY
1983-1990**

Of the four states in the Pacific Northwest, Washington is the most populous, 4,800,900 in 1990. A large part of the population is concentrated around Puget Sound, in an area that also has a large share of the region's big commercial buildings.

Washington state's economy depends upon diverse activities including lumber and wood products, manufacturing, mining, fishing, tourism, and aerospace. In aerospace, Boeing employment grew from 57,000 to 104,000, almost an 80 percent increase, for the time period 1983-1990.

Figure 18

(aMW)	1983	1984	1985	1986	1987	1988	1989	1990
RES	2,878	3,035	3,175	3,028	2,953	3,109	3,259	3,267
COM	1,621	1,737	1,850	1,856	1,922	2,003	2,107	2,174
IND	1,620	1,702	1,755	1,820	1,863	1,938	2,004	2,091
DSI	1,235	1,588	1,591	1,441	1,477	1,789	1,842	1,760
IRRG	159	164	188	179	188	189	190	201
TOTAL	7,513	8,226	6,859	8,324	8,403	9,028	9,402	9,493

Commercial includes street lighting & public facilities.

**OREGON
SUMMARY
1983-1990**

Oregon is the second most populous state in the region: 2,899,500 in 1990. Oregon's largest industry -- logging/lumber/plywood -- grew gradually during the 1983-1989 period. The impact of the Northern Spotted Owl issue in the region has become a major concern in Oregon's timber industry. Employment in the industry began its drop in early 1990. Diversified manufacturing, especially inland, is strong, along with transportation equipment (shipyards, truck factories), primary metals, electrical equipment, fabricated metals, and construction. Other economic activities include fishing, tourism, and recreation.

Oregon's direct-service industries were hit hard at the end of 1984 when the demand for aluminum fell sharply. Oregon's Northwest Aluminum plant was hit the hardest. The depression of prices lasted nearly three years.

Figure 19

(aMW)	1983	1984	1985	1986	1987	1988	1989	1990
RES	1,539	1,619	1,664	1,570	1,571	1,653	1,727	1,764
COM	1,008	1,069	1,115	1,130	1,171	1,207	1,269	1,321
IND	1,048	1,079	1,109	1,116	1,161	1,191	1,236	1,275
DSI	477	619	216	180	314	373	415	439
IRRG	87	94	106	101	104	100	104	107
TOTAL	4,159	4,480	4,210	4,097	4,321	4,524	4,751	4,906

Commercial includes street lighting & public facilities.

IDAHO SUMMARY 1983-1990

Idaho is the third most populous state in the Northwest: 1,031,600 in 1990. Idaho's economy began to turn around in 1988 after two years of decline. Employment was spurred by a sharp rise in manufacturing, primarily in electronics. Mining, a small component of Idaho's work force, is a basic industry that supports many other activities. Mining made a comeback in 1988 after a three-year slide. Idaho's two largest manufacturing sectors -- lumber/plywood and food processing -- also helped improve Idaho's economy in 1988. Rich in farm land, Idaho represented 48.4 percent of the region's irrigation sales of electricity in 1990.

Figure 20

(aMW)	1983	1984	1985	1986	1987	1988	1989	1990
RES	621	676	689	646	621	650	681	672
COM	306	327	342	340	342	370	385	398
IND	569	591	566	541	556	586	646	621
DSI	0	0	0	0	0	0	0	0
IRRG	213	209	250	235	253	285	280	297
TOTAL	1,709	1,803	1,847	1,762	1,772	1,891	1,992	1,988

Commercial includes street lighting and public facilities

**WESTERN
MONTANA
SUMMARY
1983-1990**

Only Montana west of the Continental Divide is included in Bonneville's service region. This small portion of Montana, primarily rural, prospers from its outdoor recreation. Employment rose in 1988 after a four-year slide, largely due to an increase in mining production. Firm load at Columbia Falls Aluminum (a DSI) increased from 143 aMW in 1983 to 266 aMW in 1990.

Figure 21

(aMW)	1983	1984	1985	1986	1987	1988	1989	1990
RES	117	128	134	126	124	127	135	133
COM	79	87	91	90	93	97	100	101
IND	153	147	141	162	188	181	200	190
DSI	148	251	261	264	274	273	274	266
IRRG	8	9	11	9	8	11	9	9
TOTAL	505	622	638	651	687	689	718	699

Commercial includes street lighting & public facilities.

Table 37

Average Annual Firm Sales Growth by State And Regional Firm Sales Growth 1983-1990										
	Washington		Oregon		Idaho		W. Montana		Regional	
Sector	Average Annual Growth Rate(%)	Average Annual Growth (aMW)	Average Annual Growth Rate(%)	Average Annual Growth (aMW)	Average Annual Growth Rate(%)	Average Annual Growth (aMW)	Average Annual Growth Rate(%)	Average Annual Growth (aMW)	Average Annual Growth Rate(%)	Average Annual Growth (aMW)
Residential	1.8	56	2.0	32	1.1	7	1.9	2	1.8	97
Commercial*	4.3	79	3.9	45	3.8	13	3.6	3	4.1	140
Industrial	3.7	67	2.8	32	1.3	7	3.1	5	3.0	112
DSI	5.2	75	-1.2	-5	--	--	8.7	17	4.1	86
Irrigation	3.4	6	3.0	3	4.9	12	1.7	<0.5	4.0	21
Total	3.4	283	2.4	107	2.2	40	4.8	28	3.0**	459

* Commercial includes street lighting & public facilities.

** Includes Colockum, USBR irrigation & federal agencies.

**AVERAGE RETAIL
BY STATE**

Table 38 shows the average rates for each of the four states in the RATES region. Further information about rates can be found in The Rate Design Process, beginning on page 10.

Table 38

Average Retail Rates by Sector 1983-1990 (Cents per KWh)									
Residential Sector Publics					Residential Sector Privates				
Year	ID	MT*	OR	WA	Year	ID	MT*	OR	WA
1983	4.09	4.70	3.67	2.98	1983	3.84	3.93	3.93	3.64
1984	4.40	4.93	3.93	3.29	1984	4.02	3.93	4.41	4.49
1985	4.59	5.00	3.96	3.39	1985	4.38	4.35	4.90	4.76
1986	4.69	5.03	4.02	3.46	1986	4.44	4.83	5.01	4.97
1987	4.81	5.16	4.13	3.55	1987	4.60	5.58	5.46	5.14
1988	4.92	5.31	4.23	3.65	1988	4.73	5.55	5.28	5.17
1989	4.86	5.28	4.34	3.75	1989	4.83	5.32	4.96	5.18
1990	5.10	5.41	4.42	3.80	1990	4.86	5.29	4.86	5.22
Commercial Sector Publics					Commercial Sector Privates				
Year	ID	MT*	OR	WA	Year	ID	MT*	OR	WA
1983	4.14	4.47	3.27	2.52	1983	4.29	3.81	4.60	3.84
1984	4.47	4.41	3.54	2.78	1984	4.37	3.63	5.46	4.55
1985	4.50	4.47	3.61	2.93	1985	4.85	3.99	5.56	4.62
1986	4.55	4.61	3.59	3.00	1986	4.83	4.40	5.49	4.85
1987	4.60	4.71	3.65	3.05	1987	4.80	4.87	5.63	4.96
1988	4.77	4.83	3.71	3.12	1988	4.64	4.89	5.28	4.97
1989	4.75	4.83	3.83	3.26	1989	4.72	4.86	5.13	4.98
1990	4.87	4.61	3.93	3.26	1990	4.70	4.82	5.04	5.13
Industrial Sector Publics					Industrial Sector Privates				
Year	ID	MT*	OR	WA	Year	ID	MT*	OR	WA
1983	3.25	4.04	2.36	1.84	1983	2.30	2.17	3.79	2.56
1984	2.95	4.57	2.72	2.01	1984	2.43	2.43	4.36	3.01
1985	2.93	4.58	2.65	2.10	1985	2.66	2.96	4.49	3.03
1986	3.06	4.52	2.68	2.13	1986	2.60	3.08	4.30	3.17
1987	3.19	4.60	2.72	2.17	1987	2.48	3.36	4.07	3.18
1988	3.08	4.79	2.90	2.27	1988	2.46	3.35	3.79	3.21
1989	3.07	4.74	2.97	2.42	1989	2.65	3.37	3.80	3.31
1990	2.82	4.93	2.95	2.39	1990	2.69	3.34	3.73	3.49
Irrigation Sector Publics					Irrigation Sector Privates				
Year	ID	MT*	OR	WA	Year	ID	MT*	OR	WA
1983	3.74	4.24	3.31	2.30	1983	3.33	3.60	2.98	3.32
1984	4.12	4.09	3.58	2.38	1984	3.38	3.90	3.19	3.88
1985	3.97	3.86	3.39	2.26	1985	3.55	3.12	3.26	3.96
1986	3.87	3.89	3.36	2.26	1986	3.65	3.37	3.23	4.08
1987	3.66	3.89	3.36	2.26	1987	3.67	3.65	3.70	4.90
1988	3.78	4.16	3.47	2.32	1988	3.76	3.68	3.48	4.83
1989	3.77	4.38	3.47	2.36	1989	3.79	3.54	3.09	4.00
1990	3.96	4.49	3.66	2.43	1990	3.85	3.53	2.80	3.98

* Western Montana.

GLOSSARY

amenity	The quality of being pleasant or comfortable.
average annual growth rate	<p>A measure of growth that takes into account the compounding of growth that takes place over time. Similar to compound interest paid on a savings account.</p> <p>The formula is:</p> $\left(\frac{PV}{HV} \right)^{1/n} - 1$ <p style="text-align: right;"> where PV = present value HV = historical value n = term (number of years) </p>
average megawatt	<p>One average megawatt (aMW) equals one million average watts and is a measure of energy. On an annual basis, the total megawatt hours measured in one year is divided by the number of hours in a year-- 8,784 hours in a leap year; 8,760 hours in all other years.</p> <p>For example, one medium-size coal-fired plant producing 2,190,000 megawatthours per year would produce 250 average megawatts.</p>
average rate	A rate calculated by dividing the revenues by the kilowatthours sold during the same time period. Also known as average revenue .
average use per customer	A measure of the average kilowatts used by the average customer in a given energy use category (sector). It is derived by dividing total average kilowatt (aKW) sales by the total number of customers for the same time period.
Bonneville customer	A utility that buys electric power from Bonneville and industries Bonneville serves directly. <i>See also</i> Directly Served Customers.
Colockum	A subsidiary company owned by Aluminum Company of America (ALCOA). Colockum generates its own hydro electricity and buys additional electricity from Chelan County Public Utility District. All electricity bought or produced by Colockum goes to ALCOA's potlines #4 and #5.

commercial sector	<p>A group of customers consisting generally of trade and service activities. The commercial sector includes business activities which do not involve manufacturing or extraction. This sector has a variety of building types, such as offices, schools, retail stores, warehouses, hotels, and hospitals. Street lighting accounts are classified as commercial.</p> <p>Housing projects normally consist mainly of residential accounts with some small commercial support services. However, a utility might sell power on a single meter to the entire project at a commercial rate.</p>
cooperative	<p>A private, normally nonprofit corporation operating within state laws, but essentially self-regulating. Each cooperative is a preference customer of Bonneville and is controlled by a board of directors, elected from its membership.</p>
demand	<p>In a public utility context, the rate at which electricity is delivered to or by a system over any designated period, expressed in kilowatts or megawatts, or in kilovoltamperes or megavoltamperes.</p>
direct-service industry	<p>An industrial firm that buys electricity directly from Bonneville. These firms operate electric-intensive plants in the Pacific Northwest producing aluminum, other primary metals, chemicals, or pulp and paper products.</p>
directly served customers	<p>The direct service industries and also federal agencies that buy electricity directly from Bonneville for their own use.</p>
dry goods	<p>A firm that sells merchandise to individuals and households. Dry goods retail firms include all retail trade establishments except those engaged mainly in selling food and drink, such as grocery stores and restaurants.</p>
end use	<p>An electricity use category such as heating, cooling, and ventilation, hot water, or lights and conveniences.</p>
federal agencies	<p>In the Pacific Northwest, the U.S. Bureau of Reclamation (USBR); Bureau of Mines in Oregon; Fairchild Air Force Base; U.S. Navy Bases (Puget Sound Naval Yard, Jim Creek, and Bangor); and Department of Energy, Richland - Midway. Federal agencies buy most of their electricity directly from Bonneville; they generate electricity for their remaining load.</p>

firm electricity	Electricity whose availability is assured to the customer to meet all or any agreed upon part of the customer's load requirement over a defined period.
generating utility	<p>A utility that owns generating facilities that meet all or most of its customers' demand for electricity. Even so, some generating utilities buy electricity for a greater percentage of their total loads than do some non-generating utilities. Generating utilities are members of the Northwest Power Pool.</p> <p>Pacific Northwest generating utilities include these public utilities: Eugene Water & Electric, Seattle City Light, Tacoma City Light, Chelan County Public Utility District (PUD), Cowlitz County PUD, Douglas County PUD, Grant County PUD, Pend Oreille County PUD, and Snohomish County PUD.</p>
heating degree days	The average degrees in a given year it takes to bring the daily temperature to an interior temperature of 65 degrees.
horsepower charge	A charge by utilities based on the horsepower ratings of pumps, in place of a demand charge where pumps are not demand metered.
industrial sector	<p>A group of customers that includes manufacturing operations that process a product (including lumbering and wood products) or assemble units into a complete article, as well as extractive activities such as mining and quarrying.</p> <p>Large commercial accounts such as single-metered shopping centers sometimes are included in industrial accounts such as Large Power, Large Commercial, or Small Industrial, even though they are not related to manufacturing a product.</p> <p>Quite often, utilities distinguish between the industrial and commercial sectors by the size of the load. For example, in 1983 the Rural Electrification Authority utilities changed the way they define commercial and industrial customers. Before 1983, customers who used 50 kilovoltamperes (KVA) or more were classified as industrial. Starting in 1983, the commercial group was enlarged to include customers who use up to 1,000 KVA.</p>
investor-owned utility	<i>See private utility</i>

irrigation sector	A group of customers who require electricity for such uses as pumping, spraying crops, and stock pumps used for pasturage. Domestic water pumping is often included as irrigation if no distinction is made on utility rate schedules between residential and irrigation pumping or if the reported data are mixed.
kilovolt (kv)	One kilovolt equals 1,000 volts.
kilowatt (kW)	One kilowatt equals 1,000 watts.
kilowatt hour (kWh)	One kilowatt hour equals one kilowatt (= 1,000 watts) of electricity supplied to or taken from an electric circuit for one hour.
load	The amount of electric power or energy delivered or required at any specified point or points on a system. Load originates mainly at the energy-consuming equipment of customers, such as heaters, air conditioners, lights, and motors.
load factor	The relationship between peak usage and energy usage over a specified period of time, usually a billing cycle, expressed as a ratio of average load to peak load. Customers whose loads are fairly constant, and have little fluctuation over a billing cycle are said to have a high load factor; customers whose loads have greater fluctuations over a billing cycle are said to have a low load factor.
low density discount (LDD)	A Low Density Discount (LDD) was implemented in accordance with the Pacific Northwest Power Act to reduce adverse impacts on retail rates of utilities with low system densities, and to assist rural customers who have high costs due to low system density, difficult terrain, remote service areas, and/or other factors. All customers purchasing priority firm power are currently eligible for the 3, 5, or 7 percent discount, provided they meet the LDD eligibility criteria established by BPA.
megawatt (MW)	One megawatt equals one million watts.
nonfirm electricity	Electricity supplied or available under an arrangement that does not guarantee a continuous availability of that electricity.

non-generating utility	A public utility that has little or no generating facilities. Most Pacific Northwest non-generating public utilities rely on Bonneville to meet all or most of their load. A few have the capability to generate electricity or purchase electricity from sources other than Bonneville.
Northwest Power Pool	A group formed in 1941 to achieve maximum electrical production through coordination of river flows and to help coordinate electricity operations.
preference customer	Public bodies, including utility districts, and cooperative with priority access to federal firm electricity.
private utility	A utility that sells electricity, is owned and by stockholders, and is regulated by state commission. Also known as an investor-owned utility.
public facility/ public authority	Commercial buildings owned by the public. Examples are schools, churches, public libraries, and government buildings.
public utility	A utility that sells electricity to and is owned and regulated by its consumers.
public utility district	A separate unit of government established by voters. The Washington public utility districts and Oregon people's utility districts hold preference customer status in buying power from Bonneville.
residential exchange	The arrangement, based on Section 5(c) of the Pacific Northwest Power Act, whereby Pacific Northwest utilities sell BPA an amount of power equal to their residential and small farm load, in exchange for less-expensive Federal electric power, and pass on the cost benefits to their residential and small farm consumers in the form of lower retail rates to those customers.
residential sector	A group of customers in residential, farm, apartment, and seasonal dwellings who use electricity for such purposes as space and water heating, cooking, and lighting. Electricity uses can include security lighting and swimming pool heating. The residential sector has some overlap with the commercial sector because some businesses are housed in homes.

retail customer	In this report, an entity that buys electricity from a Pacific Northwest utility.
sales	The amount of electricity sold to retail or directly served customers. <i>See also</i> Directly Served Customers, Retail Customers
sector	A large group of energy users whose members have similar types of uses for electricity. Sectors include residential, commercial, industrial, and irrigation.
temperature adjustment	A way of taking into account changes in electricity use due to weather. The adjustment of electricity sales for temperature effects on electricity use for heating is based on heating degree days determined by the National Weather Service.
utility group	One of the collections of utilities served by Bonneville, grouped according to whether they are publicly or privately owned. Publics are further grouped according to whether they are generating or non-generating utilities.
variable rate	The power rate, adjustable monthly based on the average market price of aluminum, that Bonneville offered to its direct-service aluminum smelter customers in August 1986 for ten-year contracts.
voltampere	An electrical unit of power equivalent to electromotive force (volts) times amount of electric current (amperes).
Washington Public Power Supply System (WPPSS)	A municipal corporation and joint operation agency in Washington state composed of representatives of public utility districts and municipal utilities. Based on power purchase contracts of its members or other utilities, WPPSS can acquire, construct, and operate plants and facilities for the generation or transmission of electric power.
watt	An electrical unit of power or rate of doing work. A watt is analogous to horsepower or footpounds per minute of mechanical power. One horsepower is equivalent to about 746 watts.

APPENDIX:

A LOOK AT THE PAST, 1970-1990: SALES BY SECTOR AND BY UTILITY GROUP

This appendix provides a table showing regional sales by sector and utility group for the time period 1970-1990. Two growth rate tables take a quick look at the region's total average yearly growth for the time periods 1970-1990, 1975-1990, 1980-1989, 1985-1990, 1989-1990, and four-year spans beginning with 1970-1974 and ending with 1985-1989.

Several things to keep in mind when reviewing the data:

- * Sales are as observed. For example, when CP National's retail customers were transferred to Oregon Trail in October 1988, a shift occurred in sales from private utility to public utility.
- * No data is adjusted for temperature.
- * The decline in non-firm electricity sales to the direct-service industries after 1981 partly reflect contractual changes brought about by the Pacific Northwest Power Act of 1980.
- * In 1983, the Rural Electrification Authority cooperative utilities changed the way they define commercial and industrial customers. Before 1983, customers who used 50 kilovoltamperes or more were classified as industrial. Starting in 1983, the commercial group was enlarged to include customers who use up to 1,000 kilovoltamperes.
- * The difference between loads and sales is discussed in the segment Electricity Use Report vs. Monthly Load Comparison, on pages 5 and 6 of this report.

The statistics contained in this appendix are available on diskette and may be obtained by calling Mary Lange at Bonneville Power Administration, (503) 230-5858.

Table 39

Growth Rate Table (Average Yearly Growth) Percent					
Firm Sales	1970-1990	1975-1990	1980-1990	1985-1990	1989-1990
Public	3.4	3.0	1.6	1.9	4.5
Private	3.1	2.5	1.7	2.2	4.1
DSI	0.7	0.4	0.2	5.0	3.4
Fed Ag/USBR	0.6	2.3	1.4	-0.9	-3.1
TOTAL	2.7	2.3	1.4	2.4	4.1

Table 40

Growth Rate Table (Average Yearly Growth) Percent				
Firm Sales	1970-1974	1975-1979	1980-1984	1985-1989
Public	4.7	5.4	1.4	1.9
Private	4.9	3.9	1.4	2.2
DSI	1.4	0.9	-3.6	5.0
Fed Ag/USBR	-4.3	4.1	2.5	-0.9
TOTAL	4.0	3.9	0.7	2.4

Electricity Use in the Pacific Northwest

PACIFIC NORTHWEST REGION										
SUMMARY HISTORICAL SALES AND LOAD DATA										
	Total Sales in Pacific Northwest Region, 1970 - 1990						(Average Megawatts)			
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Residential	3328	3643	3848	3970	4070	4429	4636	4809	5090	5524
Commercial *	1662	1815	1962	2049	2024	2242	2356	2441	2606	2809
Industrial non-DSI	2479	2490	2712	2773	2857	2712	3052	3159	3243	3455
Industrial Colockum	154	158	161	156	170	174	174	177	180	183
Industrial DSI	2217	2071	2019	2226	2434	2371	2375	2421	2440	2469
Irrigation	263	268	303	361	417	424	467	576	495	603
USBR irrigation	55	55	55	55	55	55	55	59	55	64
Federal Agencies	114	84	80	76	75	81	84	92	95	108
TOTAL FIRM SALES	10272	10584	11140	11666	12102	12488	13199	13734	14204	15215
Firm losses **	673	693	730	764	793	818	865	900	930	997
TOTAL FIRM LOAD	10945	11277	11870	12430	12895	13306	14064	14634	15134	16212
Ind. non-DSI nonfirm	68	67	71	99	73	105	87	94	99	110
Ind. DSI nonfirm	616	740	719	490	726	471	688	379	731	347
TOTAL NONFIRM SALES	684	807	790	589	799	576	775	473	830	457
Nonfirm losses **	16	19	19	14	19	14	19	11	20	11
TOTAL NONFIRM LOAD	700	826	809	603	818	590	794	484	850	468
TOTAL REGION SALES	10956	11391	11930	12255	12901	13064	13974	14207	15034	15672
TOTAL REGION LOAD	11646	12104	12679	13033	13713	13896	14857	15118	15984	16680

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Residential	5461	5311	5533	5156	5458	5661	5369	5271	5540	5802	5836
Commercial *	2774	2839	2925	2966	3182	3357	3374	3485	3634	3813	3948
Street lighting	62	67	58	54	53	50	51	52	52	53	53
Industrial non-DSI	3462	3664	3469	3390	3520	3570	3640	3768	3896	4084	4176
Industrial Colockum	181	178	173	160	167	159	143	164	173	171	153
Industrial DSI	2484	2448	1993	1860	2458	2068	1885	2065	2435	2531	2465
Irrigation	522	589	541	467	475	556	523	555	585	582	614
USBR irrigation	60	61	51	54	56	58	60	64	64	58	67
Federal Agencies	106	108	115	119	128	137	127	127	130	127	125
TOTAL FIRM SALES	15112	15265	14858	14226	15497	15616	15172	15551	16509	17221	17437
Firm losses **	1063	1061	1045	1123	1043	1176	950	1093	1073	1139	1316
TOTAL FIRM LOAD	16175	16326	15903	15349	16540	16792	16122	16644	17582	18360	18753
Ind. non-DSI nonfirm	113	112	97	134	142	120	134	148	142	148	148
Ind. DSI nonfirm	340	663	257	510	487	386	325	412	536	490	646
TOTAL NONFIRM SALES	453	775	354	644	629	506	459	560	678	638	794
Nonfirm losses **	11	19	8	15	15	12	11	13	16	15	19
TOTAL NONFIRM LOAD	464	794	362	659	644	518	470	573	694	653	813
TOTAL REGION SALES	15565	16040	15212	14870	16126	16122	15631	16111	17187	17859	18231
TOTAL REGION LOAD	16639	17120	16265	16008	17184	17310	16592	17217	18276	19013	19566

* Includes street lighting from 1970 thru 1979.

** Distribution losses, excluding federal transmission losses (6.66% firm from 1970-1979, difference between loads and sales from 1980-1990; 2.40% nonfirm from 1970-1990).

Electricity Use in the Pacific Northwest

Total Public Sales in Pacific Northwest Region, 1970 - 1990 (Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Residential	1509	1653	1738	1776	1812	1979	2084	2163	2297	2480	
Commercial *	695	759	818	836	828	910	977	994	1066	1146	
Industrial non-DSI **	998	971	1036	1079	1118	1111	1305	1397	1447	1568	
Industrial Colockum	154	158	161	156	170	174	174	177	180	183	
Irrigation	99	99	112	146	163	178	216	259	227	268	
TOTAL FIRM SALES	3455	3640	3865	3993	4091	4352	4756	4990	5217	5645	
Industrial nonfirm	.	.	.	.	.	.	.	.	.	.	
TOTAL PUBLIC SALES	3455	3640	3865	3993	4091	4352	4756	4990	5217	5645	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Residential	2474	2390	2449	2237	2383	2514	2379	2327	2462	2601	2614
Commercial *	1138	1139	1174	1217	1321	1394	1388	1419	1498	1575	1624
Street lighting	28	30	27	23	23	21	22	23	23	23	24
Industrial non-DSI **	1602	1748	1698	1587	1662	1720	1767	1788	1840	1934	2024
Industrial Colockum	181	178	173	160	167	159	143	164	173	171	153
Irrigation	239	264	251	215	224	259	244	256	263	266	283
TOTAL FIRM SALES	5662	5749	5772	5439	5780	6067	5943	5977	6259	6570	6722
Industrial nonfirm	3	2	0	48	48	31	21	3	1	2	6
TOTAL PUBLIC SALES	5665	5751	5772	5487	5828	6098	5964	5980	6260	6572	6728

Total Private Sales in Pacific Northwest Region, 1970 - 1990 (Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Residential	1819	1990	2110	2194	2258	2450	2552	2646	2793	3044	
Commercial *	967	1056	1144	1213	1196	1332	1379	1447	1540	1663	
Industrial non-DSI	1481	1519	1676	1694	1739	1601	1747	1762	1796	1887	
Irrigation	164	169	191	215	254	246	251	317	268	335	
TOTAL FIRM SALES	4431	4734	5121	5316	5447	5629	5929	6172	6397	6929	
Industrial nonfirm	68	67	71	99	73	105	87	94	99	110	
TOTAL IOU SALES	4499	4801	5192	5415	5520	5734	6016	6266	6496	7039	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Residential	2987	2921	3084	2919	3075	3147	2990	2944	3078	3201	3222
Commercial *	1636	1700	1751	1749	1861	1963	1986	2066	2136	2238	2324
Street lighting	34	37	31	31	30	29	29	29	29	30	29
Industrial non-DSI	1860	1916	1771	1803	1858	1850	1873	1980	2056	2150	2152
Irrigation	283	325	290	252	251	297	279	299	322	316	331
TOTAL FIRM SALES	6800	6899	6927	6754	7075	7286	7157	7318	7621	7935	8058
Industrial nonfirm	110	110	97	86	94	89	113	145	141	146	142
TOTAL IOU SALES	6910	7009	7024	6840	7169	7375	7270	7463	7762	8081	8200

* Includes street lighting from 1970 thru 1979.

** Includes Industrial nonfirm form 1970 thru 1982.

Electricity Use in the Pacific Northwest

BPA Sales to Directly Served Customers, 1970 - 1990 (Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Industrial DSI's	2217	2071	2019	2226	2434	2371	2375	2421	2440	2469	
USBR irrigation	55	55	55	55	55	55	55	59	55	64	
Federal Agencies	114	84	80	76	75	81	84	92	95	108	
TOTAL FIRM SALES	2386	2210	2154	2357	2564	2507	2514	2572	2590	2641	
Industrial DSI Nonfirm	616	740	719	490	726	471	688	379	731	347	
TOTAL BPA DIRECT SALES	3002	2950	2873	2847	3290	2978	3202	2951	3321	2988	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Industrial DSI's	2484	2448	1993	1860	2458	2068	1885	2065	2435	2531	2465
USBR irrigation	60	61	51	54	56	58	60	64	64	58	67
Federal Agencies	106	108	115	119	128	137	127	127	130	127	125
TOTAL FIRM SALES	2650	2617	2159	2033	2642	2263	2072	2256	2629	2716	2657
Industrial DSI Nonfirm	340	663	257	510	487	386	325	412	536	490	646
TOTAL BPA DIRECT SALES	2990	3280	2416	2543	3129	2649	2397	2668	3165	3206	2303

Electricity Use in the Pacific Northwest

Non-Generating Public Sales in Pacific Northwest Region, 1970 - 1990 (Average Megawatts)										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Residential	665	746	808	844	879	976	1040	1110	1197	1300
Commercial *	233	256	281	285	290	331	384	401	434	470
Industrial non-DSI **	361	373	403	429	439	446	477	554	561	638
Irrigation	79	79	91	118	133	146	177	214	186	219
TOTAL FIRM SALES	1338	1454	1583	1676	1741	1899	2078	2279	2378	2627
Industrial nonfirm	.	.	.	.	.	.	.	.	.	.
TOTAL NON-GENERATING SALES	1338	1454	1583	1676	1741	1899	2078	2279	2378	2627

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Residential	1281	1237	1262	1148	1230	1296	1211	1195	1266	1355	1364
Commercial *	470	449	458	511	568	593	584	596	638	672	688
Street lighting	10	12	9	7	6	6	6	6	6	6	6
Industrial non-DSI **	629	652	655	586	611	637	640	649	671	735	768
Irrigation	197	217	204	172	181	207	194	203	207	211	226
TOTAL FIRM SALES	2587	2567	2588	2424	2596	2739	2635	2649	2788	2979	3052
Industrial nonfirm	.	.	.	18	21	11	5	0	0	0	0
TOTAL NON-GENERATING SALES	2587	2567	2588	2442	2617	2750	2640	2649	2788	2979	3052

Generating Public Sales in Pacific Northwest Region, 1970 - 1990 (Average Megawatts)										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Residential	844	907	930	932	933	1003	1044	1053	1100	1180
Commercial *	462	503	537	551	538	579	593	593	632	676
Industrial non-DSI **	637	598	633	650	679	665	828	843	886	930
Industrial Colockum	154	158	161	156	170	174	174	177	180	183
Irrigation	20	20	21	28	30	32	39	45	41	49
TOTAL FIRM SALES	2117	2186	2282	2317	2350	2453	2678	2711	2839	3018
Industrial nonfirm	.	.	.	.	.	.	.	.	.	.
TOTAL GENERATING SALES	2117	2186	2282	2317	2350	2453	2678	2711	2839	3018

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Residential	1193	1153	1187	1089	1153	1218	1168	1132	1196	1246	1250
Commercial *	668	690	716	706	753	801	804	823	860	903	936
Street lighting	18	18	18	16	17	15	16	17	17	17	18
Industrial non-DSI **	973	1096	1043	1001	1051	1083	1127	1139	1169	1199	1256
Industrial Colockum	181	178	173	160	167	159	143	164	173	171	153
Irrigation	42	47	47	43	43	52	50	53	56	55	57
TOTAL FIRM SALES	3075	3182	3184	3015	3184	3328	3308	3328	3471	3591	3670
Industrial nonfirm	3	2	0	30	27	20	16	3	1	2	6
TOTAL GENERATING SALES	3078	3184	3184	3045	3211	3348	3324	3331	3472	3593	3676

* Includes street lighting from 1970 thru 1979.

** Includes industrial nonfirm from 1970 thru 1982.

Electricity Use in the Pacific Northwest

HISTORICAL SALES DATA IN PACIFIC NORTHWEST REGION											
A. RESIDENTIAL SECTOR											
(Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Publics	1509	1653	1738	1776	1812	1979	2084	2163	2297	2480	
Privates	1819	1990	2110	2194	2258	2450	2552	2646	2793	3044	
SUBTOTAL	3328	3643	3848	3970	4070	4429	4636	4809	5090	5524	
USBIA	.	.	.	9	9	10	11	11	12	13	
TOTAL REGION	3328	3643	3848	3979	4079	4439	4647	4820	5102	5537	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Publics	2474	2390	2449	2237	2383	2514	2379	2327	2462	2601	2614
Privates	2987	2921	3084	2919	3075	3147	2990	2944	3078	3201	3222
SUBTOTAL	5461	5311	5533	5156	5458	5661	5369	5271	5540	5802	5836
USBIA	14	14	15	14	15	16	15	15	16	15	15
TOTAL REGION	5475	5325	5548	5170	5473	5677	5384	5286	5556	5817	5851
B. COMMERCIAL SECTOR											
(Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Publics - street lighting	.	.	.	.	.	.	.	.	.	.	
Privates - street lighting	.	.	.	.	.	.	.	.	.	.	
SUBTOTAL	.	.	.	.	.	.	.	.	.	.	
Publics	695	759	818	836	828	910	977	994	1066	1146	
Privates	967	1056	1144	1213	1196	1332	1379	1447	1540	1663	
SUBTOTAL	1662	1815	1962	2049	2024	2242	2356	2441	2606	2809	
USBIA	.	.	.	5	5	6	5	6	6	9	
TOTAL REGION	1662	1815	1962	2054	2029	2248	2361	2447	2612	2818	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Publics - street lighting	28	30	27	23	23	21	22	23	23	23	24
Privates - street lighting	34	37	31	31	30	29	29	29	29	30	29
SUBTOTAL	62	67	58	54	53	50	51	52	52	53	53
Publics	1138	1139	1174	1217	1321	1394	1388	1419	1498	1575	1624
Privates	1636	1700	1751	1749	1861	1963	1986	2066	2136	2238	2324
SUBTOTAL	2774	2839	2925	2966	3182	3357	3374	3485	3634	3813	3948
USBIA	7	8	6	6	6	7	6	6	6	8	9
TOTAL REGION	2781	2847	2931	2972	3188	3364	3380	3491	3640	3821	3957

Electricity Use in the Pacific Northwest

HISTORICAL SALES DATA IN PACIFIC NORTHWEST REGION											
C. INDUSTRIAL SECTOR											
(Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Publics	998	971	1036	1079	1118	1111	1305	1397	1447	1568	
Privates	1481	1519	1676	1694	1739	1601	1747	1762	1796	1887	
SUBTOTAL	2479	2490	2712	2773	2857	2712	3052	3159	3243	3455	
Colockum	154	158	161	156	170	174	174	177	180	183	
DSI firm	2217	2071	2019	2226	2434	2371	2375	2421	2440	2469	
DSI non-firm	616	740	719	490	726	471	688	379	731	347	
Public non-firm	.	.	.	.	.	.	.	.	.	.	
Private non-firm	68	67	71	99	73	105	87	94	99	110	
TOTAL REGION	5534	5526	5682	5744	6260	5833	6376	6230	6693	6564	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Publics	1602	1748	1698	1587	1662	1720	1767	1788	1840	1934	2024
Privates	1860	1916	1771	1803	1858	1850	1873	1980	2056	2150	2152
SUBTOTAL	3462	3664	3469	3390	3520	3570	3640	3768	3896	4084	4176
Colockum	181	178	173	160	167	159	143	164	173	171	153
DSI firm	2484	2448	1993	1860	2458	2068	1885	2065	2435	2531	2465
DSI non-firm	340	663	257	510	487	386	325	412	536	490	646
Public non-firm	3	2	0	48	48	31	21	3	1	2	6
Private non-firm	110	110	97	86	94	89	113	145	141	146	142
TOTAL REGION	6580	7065	5989	6054	6774	6303	6127	6557	7182	7424	7588
D. IRRIGATION SECTOR											
(Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Publics	99	99	112	146	163	178	216	259	227	268	
Privates	164	169	191	215	254	246	251	317	268	335	
SUBTOTAL	263	268	303	361	417	424	467	576	495	603	
US Bureau of Reclamation (USBR)	55	55	55	55	55	55	55	59	55	64	
USBR reservoir pumping	.	.	.	109	98	97	110	106	91	135	
US Bureau of Indian Affairs (USBIA)	.	.	.	4	4	4	4	8	4	6	
TOTAL REGION	318	323	358	529	574	580	636	749	645	808	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Publics	239	264	251	215	224	259	244	256	263	266	283
Privates	283	325	290	252	251	297	279	299	322	316	331
SUBTOTAL	522	589	541	467	475	556	523	555	585	582	614
US Bureau of Reclamation (USBR)	60	61	51	54	56	58	60	64	64	58	67
USBR reservoir pumping	57	115	98	84	96	115	121	127	129	128	83
US Bureau of Indian Affairs (USBIA)	4	3	4	4	5	7	6	4	6	3	3
TOTAL REGION	643	768	694	609	632	736	710	750	784	771	767

Electricity Use in the Pacific Northwest

Break Down of BPA-Served Federal Agencies (Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
USBIA residential	.	.	.	9	9	10	11	11	12	13	
USBIA commercial	.	.	.	5	5	6	5	6	6	9	
USBIA irrigation	.	.	.	4	4	4	4	8	4	6	
TOTAL USBIA	.	.	.	18	18	20	20	25	22	28	
Federal Agencies	.	.	.	58	57	61	64	67	73	80	
BPA-SERVED FEDERAL AGENCIES	114	84	80	76	75	81	84	92	95	108	
Break Down of Non-Generating Public Commercial (Average Megawatts)											
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
USBIA residential	14	14	15	14	15	16	15	15	16	15	15
USBIA commercial	7	8	6	6	6	7	6	6	6	8	9
USBIA irrigation	4	3	4	4	5	7	6	4	6	3	3
TOTAL USBIA	25	25	25	24	26	30	27	25	28	26	27
Federal Agencies	81	83	90	95	102	107	100	102	102	101	98
BPA-SERVED FEDERAL AGENCIES	106	108	115	119	128	137	127	127	130	127	125
Break Down of Non-Generating Public Commercial (Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Commercial	232	255	280	284	289	329	381	398	428	411	
Public Facilities	.	.	.	.	.	.	.	.	.	50	
WPPSS Construction *	1	1	1	1	1	2	3	3	6	9	
TOTAL COMMERCIAL	233	256	281	285	290	331	384	401	434	470	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Commercial	411	388	399	461	500	527	520	533	579	615	630
Public Facilities	50	50	51	44	51	58	55	54	51	52	53
WPPSS Construction *	9	11	8	6	17	8	9	9	8	5	5
TOTAL COMMERCIAL	470	449	458	511	568	593	584	596	638	672	688
Break Down of Generating Public Commercial (Average Megawatts)											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Commercial	462	503	537	551	538	579	593	593	632	601	
Public Facilities	.	.	.	.	.	.	.	.	.	75	
TOTAL COMMERCIAL	462	503	537	551	538	579	593	593	632	676	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Commercial	593	615	643	633	675	720	721	740	774	813	845
Public Facilities	75	75	73	73	78	81	83	83	86	90	91
TOTAL COMMERCIAL	668	690	716	706	753	801	804	823	860	903	936

* Washington Public Power Supply System (WPPSS)

Electricity Use in the Pacific Northwest

	Break Down of Private Commercial (Average Megawatts)										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Commercial	967	1056	1144	1213	1196	1332	1379	1447	1540	1661	
Public Facilities	.	.	.	.	.	.	.	.	.	2	
TOTAL COMMERCIAL	967	1056	1144	1213	1196	1332	1379	1447	1540	1663	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Commercial	1635	1695	1747	1746	1858	1960	1983	2062	2133	2236	2322
Public Facilities	1	5	4	3	3	3	3	4	3	2	2
TOTAL COMMERCIAL	1636	1700	1751	1749	1861	1963	1986	2066	2136	2238	2324

EVALUATION FORM

We in the End-Use Research Section are interested in your comments and evaluation of the "Electricity Use Report". We would like to know how you use the information provided and how we can better serve your data needs.

After you have reviewed the document, please fill out this evaluation form and return it to Mary Lange - RPEE (Bonneville Power Administration, P.O. Box 3621, Portland, OR 97208).

1. How frequently do you expect to use this document?

☐ Several times a month	☐ 3-6 times a year
☐ Average once a month	☐ Rarely

2. What section(s) in this document do you find most useful?

☐ Chapter 1	☐ Chapter 5
☐ Chapter 2	☐ Chapter 6
☐ Chapter 3	☐ Appendix
☐ Chapter 4	☐ Other _____
☐ Sector Trends	

3. What do you like most about the document?

☐ Key Observations	☐ Tables
☐ Text	☐ Easy Reference
☐ Graphics	☐ Visual Appeal

4. Given that the Appendix data is provided annually, how often should this formal document be published?

☐ Annually	☐ 5 years
☐ 2-3 years	☐ Other _____

Comments _____

5. How do you use the information provided in the document?

6. What can be added to better serve your data needs?

7. If the document were not published annually, what types of single reports would meet your needs (example: growth rate analysis; sector analysis; state summaries).

8. Additional comments:

Thank you for taking the time to complete this survey. This information will help us better understand your data needs and make future plans for reporting the electricity use data.

END

**DATE
FILMED**

11/12/91