Chapter 13

Energy Resources and Distribution

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During the 1990s, demand for energy in the Pacific Northwest continued to increase roughly in proportion to growth in population and economic activity. Entering the twenty-first century, the region was hard hit by an imbalance between energy demand and supply, especially for electricity. Wholesale prices rose dramatically from $30 or less per megawatt-hour to a general range of $200 to $300 per megawatt-hour and to more than $1,000 per megawatt-hour on occasion.

Many observers attributed high prices at least in part to a 1996 law deregulating the electricity market in California. The reasoning behind deregulation was that it would result in a more competitive market and lower prices. Instead, for a variety of reasons, supplies of electricity were not available to meet demand. Higher prices contributed to a renewed emphasis on conservation and new generation, which in turn led to a better balance between demand and supply of electricity. By 2002, prices had fallen closer in line to those suggested by historical trends.

Most of the region's electricity is generated from hydro sources. Compared to other states, the Northwest is considerably more dependent on hydroelectricity. Environmental concerns such as hydro's impact on anadromous fish migration suggest that relatively little of the region's future electricity needs will be tapped from new hydro sources.

Natural gas is accounting for an increasingly larger share of the region's energy consumption, especially for electricity generation and space heating. Increasing demand has been accompanied by higher prices, which in the Northwest are slightly above or below the national average. Gasoline prices are higher in the Northwest than in much of the rest of the United States. Insufficient competition among the region's major distributors is among the reasons cited for high prices. The contribution of coal and nuclear to the region's energy supply and consumption is small and is not likely to increase much if at all in the near future (see figure 13-1).

Conservation is a significant contributor to the Northwestís energy needs. Its contribution, however, ebbs when prices are low and increases when prices

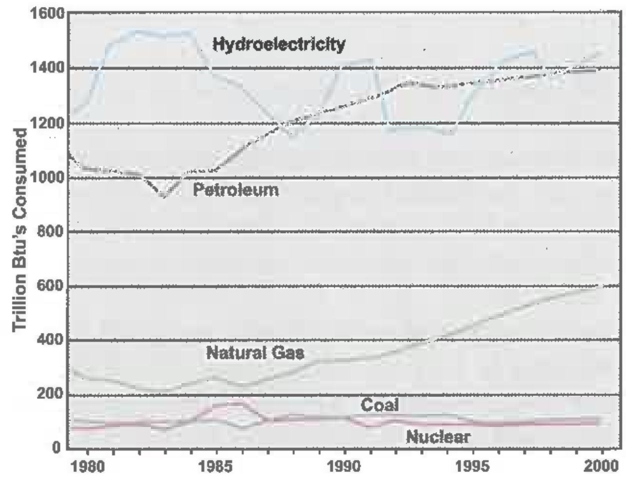


Figure 13-1. Pacific Northwest Annual Energy Consumption, 1980-2000

are high. To promote greater conservation, regional utilities and governments have established a number of non-profit organizations such as the Northwest Energy Efficiency Alliance (see figure 13-2).

The Northwest has vast supplies of renewable energy but, except for hydro, they are not utilized at anywhere near their potential level. Biomass has long been the region's second most important source of renewable energy. Usage of wood-based biomass fuels is declining along with declines in timber production and with concerns about wood burning's impacts on air quality, especially particulate emissions. The production of biogas from waste materials is increasing but is a small portion of the region's total energy supply. Geothermal and solar energy production are important in selected locations but contribute little overall to regional space heating or electricity generation. Wind-based electricity generation has grown substantially and currently is the most promising candidate for future additional development. To expand usage of renewables, regional entities have created "green power" options for consumers to purchase all or a portion of their electricity from renewable sources.

Hydroelectricity

Hydroelectricity accounts for about 40 percent of the energy consumed in the Pacific Northwest, and for about 83 percent of the electricity generated. While just over 3 percent of the nation's population lives in the region, 50 percent of the nation's generation of hydroelectricity occurs there. More than a third of the total hydroelectric capability in the United States is located in the Columbia River Basin. Correspondingly, the three states account for about a third of the nation's renewably generated electricity.

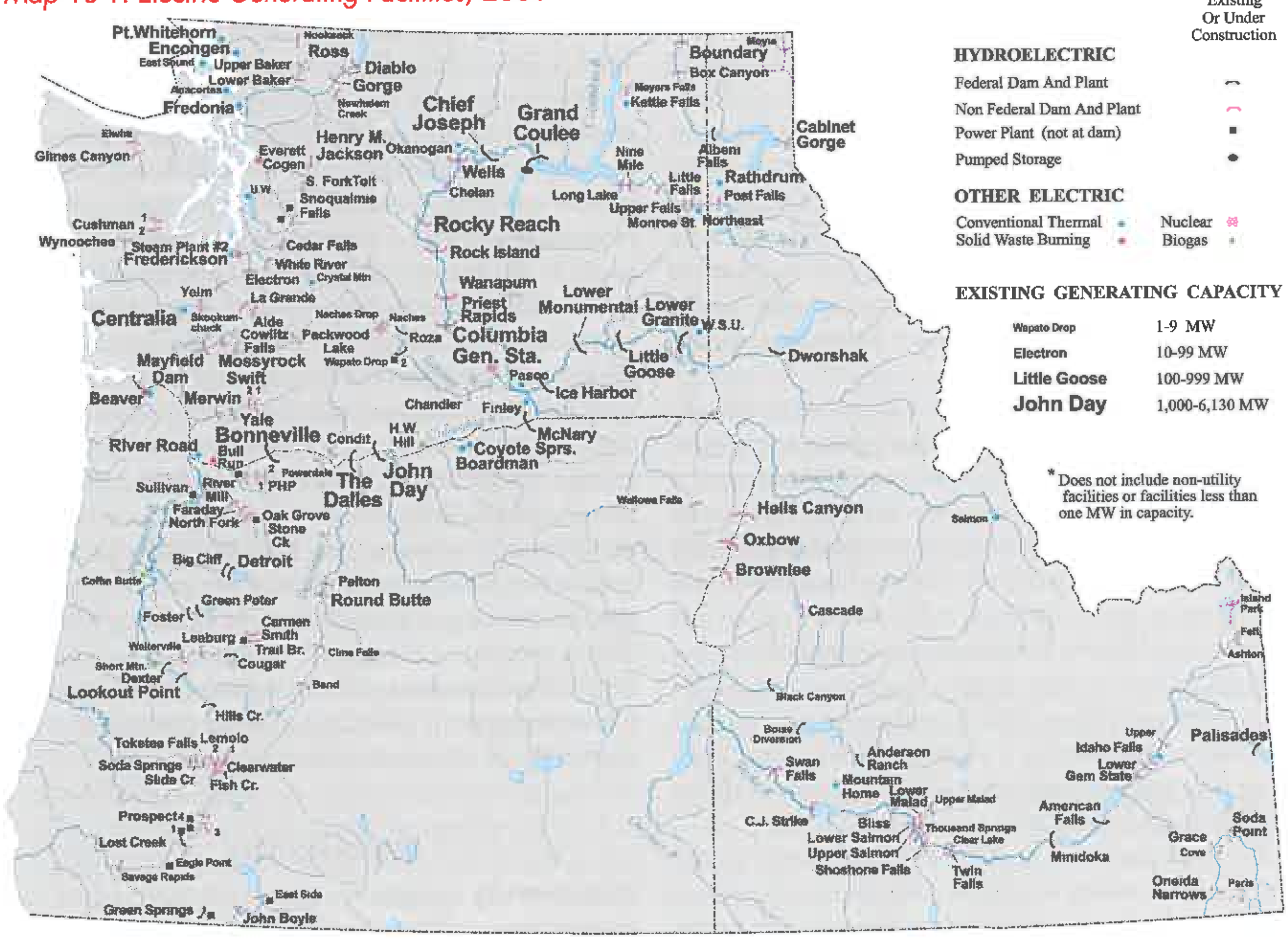
On June 3, 1889, the region's and nation's first long-distance commercial transmission of electricity from hydropower flowed 14 miles between Oregon City and Portland, Oregon. Two waterwheels at Willamette Falls generated electricity which was used primarily for lights and later became important for streetcars.

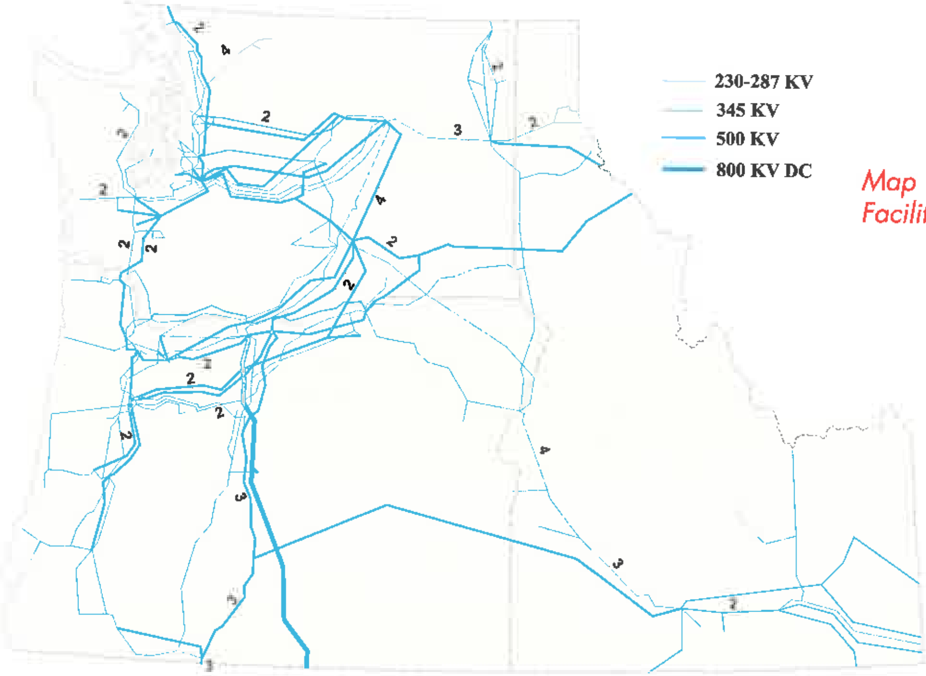
As the importance of electricity increased, dams were built to harness water power. Much of the region's hydroelectricity now comes from generating facilities at Columbia Basin dams built by the U.S. Bureau of Reclamation, the Army Corps of Engineers, and others (see map 13-1). Of the 11 dams and generating facilities on the main stem of the Columbia, the largest is Grand Coulee in northeastern Washington. Generating capability at Grand Coulee is about 7,000 megawatts, which exceeds the total capability in seventeen states and is over six times the capability of the Columbia Generating Station nuclear facility near Richland, Washington. Hydro facilities also are located on streams outside the Columbia River system in western Oregon, western Washington, and southeastern Idaho.

The Bonneville Power Administration, a subagency of the U.S. Department of Energy, markets electricity generated at federal system dams. The BPA accounts for about 45 percent of the region's electricity consumption, and markets electricity to utility districts and cooperatives, investor-owned utilities, and selected industrial customers, the largest of which are companies operating ten aluminum smelters.

Under federal law, power from the BPA must be sold first to publicly owned utilities in the Northwest. If surplus power exists, it is sold to private utilities in the region and to public and private utilities outside the region, primarily California. This "preference" law occasionally comes under attack from producers and consumers in high-cost areas

Map 13-1. Electric Generating Facilities, 2001





Map 13-2. Electric Transmission Facilities, 2000

who would like to acquire low-cost Northwest power or force the BPA to sell at market rates rather than at cost. Pressures to scrap the preference provision have contributed to calls for regional interests to buy or otherwise acquire the BPA.

Due to higher-than-expected costs of electricity associated with deregulation in California, insufficient investment in new power plants and conservation, contractual obligations to sell more electricity than available from federal sources, and other factors, the BPA worked with the region's aluminum industry in 2001 to curtail operations and free-up about 1,000 megawatts of lower-priced electricity from the smelters. About five thousand workers lost their jobs, although at most facilities, they were financially compensated during the shutdown. For a number of reasons including foreign competition, increasing costs, and uncertain supplies, some observers wonder how economically viable the region's aluminum industry will be in the future.

Transmission lines move hydro and non-hydro electricity from production facilities to regional and national markets. The transmission line network is most developed between generating facilities and major population centers (see map 13-2). The BPA owns and operates about 80 percent of the region's bulk transmission capability. Other utilities own the rest.

Growing demand, greater generating capability, and little transmission construction since 1987 have contributed to constraints in regional transmission capability. Constraints are reported to be greatest between Montana and states to the west, between the John Day Dam and locations to the north, and across the Cascade Mountains in Oregon and Washington. The BPA and other groups are addressing constraints and meeting increased demand for capacity by employing more efficient technologies and proposing to build new lines. Where feasible, the lines would be built along existing power line corridors to minimize environmental impacts and costs.

To improve operating efficiency, increase system reliability, and eliminate discrimination in system usage, the Federal Energy Regulatory Commission (FERC) in 1999 issued an order calling for the nation's electric utilities to form regional transmission organizations. In response to the FERC's order, the BPA and a number of major utilities in eight western states and British Columbia have begun to form a regional transmission organization whose proposed name is RTO West. Due to complexities of reaching consensus among the region's utilities, RTO West has been slow to form and is not targeted to become operational until at least 2005.

Historically, the Pacific Northwest and Pacific Southwest have exchanged electricity seasonally: the Northwest exports power in the spring and early summer and imports it in the winter. A large portion of the exchanged electricity moves between the Los Angeles area and Columbia River dams and transmission facilities via a direct current intertie with a northern end near The Dalles Dam, and an alternating current intertie with a northern end near the John Day Dam.

The Celilo Converter Station, which began operating in 1970, is the northern end of an 846-mile direct-current intertie between The Dalles, Oregon, and Los Angeles. This direct-current intertie can carry up to 3,100 megawatts of electricity southward. Converters at Celilo are near the end of their useful lives and are expected to be replaced by the end of 2003. Although the alternating-current lines are more expensive to operate and lose more power than the direct-current lines during transmission, they can be operated more flexibly and hooked up with generating facilities along the line. When operating at full capacity, the direct-current and alternating-current lines can transmit nearly enough power to serve the entire Los Angeles area.

The seasonal exchange of electricity breaks down in low-streamflow years when the Northwest does not have enough power to meet its needs. Seasonal exchanges are further reduced by the need to send water through spillways to enhance downstream migration of salmon smolts. In the 2001 low water year, it was estimated that sending water through spillways for salmon migration rather than through generators may have reduced the amount of electricity generated by about 10 percent of the total marketed by the BPA.

Most, if not all, of the region's sites for large hydroelectric facilities have been developed. Because the development of new small-scale hydro systems is restricted by concerns about protection of habitat for fish and wildlife, most future additions to capacity likely will occur through increased efficiency of existing facilities.

Making streams more fish-friendly is a major consideration in relicensing of operations at electricity-generating and other dams, and in some cases, for dam removal. In all three Northwest states, the FERC has authority for licensing and relicensing dam operations, and state agencies have varying levels of oversight and review authority. Nationally, about four hundred dams will be up for FERC renewal in the next ten to fifteen years; this includes twenty-seven in Oregon and twenty-eight in Washington.

Several dams already have been slated for removal. In 1992, for example, President George H. W. Bush signed the Elwha River Restoration Act calling for the removal of the Elwha and Glines Canyon dams and generation facilities, to enhance salmon migration in the Elwha River on Washington's Olympic Peninsula. Continuing controversy delayed appropriating funds for removal; however, in February 2000, the federal government bought the two dams. Removal of the Elwha Dam is targeted for 2004.

Other electricity-generating dams scheduled or being considered for removal include the Condit Dam on the White Salmon River in Washington, and several dams in Oregon's Sandy River drainage. Breaching four dams on the lower Snake River in

Map 13-3. Pipelines and Refineries, 2002

Washington is among the region's most controversial environmental issues. Breaching the four dams would enhance fish migration but would eliminate more than 1,100 average megawatts of electricity generation and end commercial navigation on the lower Snake.

A portion of the region's electricity comes from the Columbia River system in Canada. The Columbia River Treaty, signed by the U.S. and Canada in 1961 and ratified in 1964, stipulates conditions for coordinating operation of the river system. Half of the Columbia River system's eight major storage dams were built as a result of the treaty. For the first thirty years of the treaty, Canada sold its share of the generation, about 500 average megawatts, to the United States. Under terms of the renegotiated agreements, Canada will continue selling its Columbia system power to the United States.

Petroleum

Petroleum accounts for about 40 percent of the Pacific Northwest's energy consumption. During the 1990s, petroleum consumption exceeded hydro consumption in four of ten years. The transportation sector uses about 75 percent of the region's consumption of petroleum; most of the remaining consumption is attributable to the industrial sector.

No petroleum is produced in the Pacific Northwest, and no regional production is expected in the foreseeable future. Regional crude oil supplies are obtained via the Trans-Mountain Pipeline from Canada, and ocean tankers, primarily from Alaska. Four refineries in Whatcom and Skagit counties in Washington process the crude oil into gasoline and other products. Pipelines, ships, barges, or trucks move oil from refineries in Washington and California to regional markets (see map 13-3).

The Olympic Pipe Line Company operates a 300-mile pipeline between Puget Sound refineries and Portland; the pipeline moves the equivalent of 1,800 tanker trucks of petroleum products daily. Altogether, the Olympic system pipelines move about 4.9 billion gallons of fuel annually. A smaller pipeline operated by Kinder Morgan Energy Partners moves petroleum products between Portland and Eugene, Oregon. Ships traveling via the Columbia River provide about 10 to 20 percent of Portland's petroleum products.

The region also imports petroleum products by pipeline from Montana, Utah, and Wyoming. Chevron Pipe Line Company operates a pipeline from Salt Lake City to Spokane by way of Pasco, Washington. Yellowstone Pipeline runs from Billings, Montana to Moses Lake, Washington. Petroleum products are transported away from pipelines primarily by trucks and by barge from Portland to terminals further up the Columbia River, primarily to Pasco.

In the mid-1990s, the Olympic Pipe Line Company proposed building a 230-mile pipeline between the Puget Sound and Pasco. The Cross-Cascades pipeline would have carried 45,000 barrels of petroleum products daily and reduced the need for barge and truck movements to and from Pasco. In 1999, the company withdrew its Cross-Cascades proposal after fumes and fire from a pipeline leak killed three people in Bellingham, Washington.

Liquefied petroleum gas, commonly known as propane, is used for heating and cooking in parts of the Pacific Northwest, mostly in rural areas and cities without natural gas service. A small amount of propane is used to fuel motor vehicles.

Retail gasoline prices often are higher in parts of the Pacific Northwest than in other states. For example, in 1999, Oregon had the nation's second highest gasoline prices, Washington ranked fifth highest, and Idaho ranked seventeenth. Among the reasons cited for higher prices in the Pacific Northwest are insufficient competition, absence of production, and relatively few pipelines.

Natural Gas

Natural gas accounts for about 15 percent of the Pacific Northwest's energy consumption, up from less than 10 percent of the regional share at the beginning of the 1990s. The industrial sector uses about 50 percent, the residential sector uses 20 to 25 percent, and the commercial sector uses 15 to 20 percent. Transportation and electric utilities represent small but growing markets for natural gas.

Increasing demand for natural gas has resulted in higher prices. Depending on location within the region, prices in the Northwest are below or slightly above the national average, which in 1999 was $4.26 per million Btu. By comparison, state averages and ranking nationally were as follows for the Northwest: Idaho—$4.02 (fortieth), Oregon—$4.39 (twenty-eighth), and Washington—$3.91 (forty-first).

Williams Gas Pipeline–West operates the Northwest Pipeline transmission system and serves all regional investor-owned gas utilities. PG&E National Energy Group's Gas Transmission Northwest, which primarily serves California, also provides natural gas to Northwest customers. Duke Energy Gas Trans-

Coyote Springs Generating Plant in Boardman, Oregon, generates power with a combined cycle cogeneration (gas/oil) unit. (Photo by Steven R. Kale)

mission is a Canadian company whose pipelines connect with Williams gas lines at Sumas, Washington, and Huntington, British Columbia. Avista Utilities, Cascade Natural Gas Corporation, Intermountain Gas Company, NW Natural, and Puget Sound Energy distribute gas from the transmission companies to the region's residential and nonresidential customers.

About 80 percent of the region's natural gas comes from Canada; most of the remainder comes from Colorado, New Mexico, Utah, and Wyoming. Nearly all new gas supplies come from Canada. The region's only producing gas field is near the small community of Mist, Oregon, northwest of Portland. This field, which began producing in 1979, supplies a small amount of the region's natural gas consumption. In Washington, gas previously was produced at several locations, including the Bellingham Gas Field east of Ferndale, the Rattlesnake Hills Gas Field north of Richland, and the Ocean City Gas and Oil Field west of Hoquiam, which ended production in 1962.

NW Natural, formerly Northwest Natural Gas, uses the Mist field to help supply gas to its customers in northwestern Oregon and southwestern Washington. After gas is extracted, the underground reservoirs are used as gas storage facilities. In 2002, the reservoirs had the capacity to store 10.5 billion cubic feet of gas, the equivalent of fifty-six days' worth of supply for the entire NW Natural customer base. Gas also is stored underground at Jackson Prairie south of Chehalis, Washington. Approximately 15 billion cubic feet of gas, enough to heat one million homes for a month in winter, can be stored at the Jackson Prairie site. Above-ground storage facilities for liquefied natural gas are located in Nampa, Idaho; Newport and Portland, Oregon; and Plymouth, Washington.

Deregulation of natural gas prices, higher electricity costs, and concerns about heating with oil or wood have encouraged many consumers in the Pacific Northwest to choose natural gas for heating. About one-third of residences in Idaho, Oregon, and Washington heat with natural gas. New homes rely heavily on gas heating where available.

For utilities and private generating companies, natural gas is the fuel of choice for new electricity-generating plants. In several locations, the new facilities co-generate steam for generation and for industrial uses such as the processing of food or timber products. Pulp and paper mills are major co-generation producers and consumers.

In most communities where natural gas generating facilities are proposed, residents tend to be supportive as a result of the new jobs and increased property taxes and other payments that the new facilities will bring. Some observers, however, question using gas to generate electricity because the process is less efficient than using gas directly for heating. Opposition also has arisen out of concerns that much of the gas-generated electricity is marketed outside the Pacific Northwest, emissions from burning fossil fuels contribute to global warming, and construction and operation of new facilities could have adverse impacts on water quality and supplies, air quality, land uses, and view sheds obscured by new buildings and power lines. The State of Oregon, for example, has established mitigation standards for carbon dioxide emissions when licensing new power plants.

Increased natural gas usage has led to the need for additional capacity in transmission and local distribution lines. Much of the additional capacity is being built to serve new electricity generating plants. Williams Gas Pipeline, for example, is planning to build a 49-mile line to serve a new 600-megawatt generating facility schedule for completion in 2003 at Satsop, Washington. Other examples of new pipeline capacity are proposals to build a 60-mile line between NW Natural's storage fields at Mist and a distribution line at Mollala, Oregon, and a 60-mile natural gas line from the I-5 corridor to the Coos Bay area on the Oregon coast.

Landfill sites and sewage-treatment plants produce biogas, which is more dilute than natural gas and typically must be processed before it can be used. Landfill biogas is used directly to power lime kilns at the Ash Grove Cement plant in Portland, and to generate electricity at the Coffin Butte Resource Project near Corvallis, Oregon; Short Mountain Project near Eugene, Oregon; Northside Landfill in Spokane, Washington; Roosevelt Landfill in Klickitat County, Washington; and Tacoma Landfill in Tacoma, Washington. A number of the region's cities have sewage-treatment plants that use biogas for heating or generating electricity.

As natural gas prices increase, interest grows in finding new supplies. Seeps along fault lines, gas in water wells, and geological formations suggest small but potentially commercially promising gas supplies in several areas of the Northwest. Many parts of the Puget Sound and the Columbia River Basin in Washington have the potential for natural gas production. Methane from coal-bed deposits in western Washington may someday become feasible to develop commercially. Besides the Mist area in Oregon, the Southern Tyee Basin in Coos, Curry, Douglas, and Lane Counties are underlain by geological formations that may have the potential for gas development.

Additionally, the U.S. Department of Energy and private companies are exploring the possibility of tapping gas supplies found in methane hydrates, which are ice-like substances found in the Arctic permafrost and deep ocean sediments. The Hydrate Ridge off the Oregon coast is one of the areas being considered for further exploration.

Coal

Coal provides 3 to 4 percent of the Pacific Northwest's energy. About 90 percent of the region's consumption of coal is used to generate electricity; another 5 to 10 percent is used in the industrial sector.

Coal was mined near Coos Bay, Oregon, in the 1850s primarily for export to California. Coal later was mined east of Seattle and Tacoma and near Ellensburg, Washington. Currently, the only regional production of coal occurs near Centralia, Washington, where the TransAlta Corporation owns and operates a 1340-megawatt electricity generation facility fueled by nearby coal deposits. Due to concerns about air pollution, the company is investing $200 million to install scrubber technologies to reduce emissions. TransAlta also is building a 248-megawatt gas-fired generating facility at the Centralia location.

Portland General Electric operates a 530-megawatt coal-fired plant near Boardman, Oregon; coal for this plant is shipped by rail from Wyoming. The Pacific Northwest also imports electricity from coal-fired facilities outside the region, primarily in Montana and Wyoming.

Nuclear Energy

Nuclear fuels, used to generate electricity, account for about 2 percent of the Pacific Northwest's energy consumption. In 1951, the world's first useable quantities of nuclear power were generated near Atomic City, Idaho, at the Idaho National Engineering and Environmental Laboratory's Experimental Breeder Reactor-1 which is now a National Historic Monument.

The region's only nuclear electricity-generating facility is located on the Hanford Nuclear Reservation near Richland, Washington. The 1170-megawatt Columbia Generating Station, formerly known as Washington Nuclear Plant-2, began operating in 1984. It is one of five nuclear facilities that the Washington Public Power Supply System, known as Energy Northwest since 1998, started in the 1970s near Richland and Satsop, Washington. Due to enormously high cost overruns and the regional oversupply of electricity, construction of four facilities was terminated in the 1980s.

The Satsop nuclear site has become the home of the Satsop Development Park, a business and technology park with 440 acres of developable land and several businesses. Future plans call for a natural-gas electricity-generating facility and possibly the world's second tallest climbing wall at one of the fifty-story nuclear cooling towers.

From 1976 to late 1992, Portland General Electric operated the 1100-megawatt Trojan Nuclear Plant near Rainier, Oregon. Trojan faced considerable opposition in the 1980s and early 1990s, including several ballot measures calling for its closure. In January 1993, PGE decided to close Trojan permanently in response to the high costs of replacing defective generators and the ready availability of replacement power. PGE expects to complete decommissioning of the plant in 2005.

A third nuclear plant, the N-Reactor at the Hanford Nuclear Reservation, was operated by the U.S. Department of Energy from 1963 to 1987 to produce plutonium and steam for the 800-megawatt Hanford Generating Project. The N-Reactor was deactivated in 1998, after which the facility was closed off entirely for fifteen years until safe storage work can begin.

Conservation

Conservation is an energy resource because it reduces the need to obtain new energy supplies. Conservation is often defined as increased efficiency in using energy, and is a significant contributor to the Pacific Northwest's energy needs. Between 1978 and 2000, the region acquired more than 1,300 average megawatts of savings through conservation and energy efficiency improvements (see figure 13-2).

The Bonneville Power Administration and the Northwest Power Planning Council are major players in the region's acquisition of energy savings through conservation. The BPA has been involved with more than half of the region's energy savings from conservation through its support of efforts such as weatherization programs, the Super Good Cents residential program, adoption of energy-efficient building codes and model conservation standards, and programs to wrap water heaters, install low-flow shower heads, and increase insulation standards in manufactured homes. Since their inception, programs of the BPA and the region's private and public utilities have contributed to the weatherization of more than 400,000 homes and over 80,000 new energy-efficient homes.

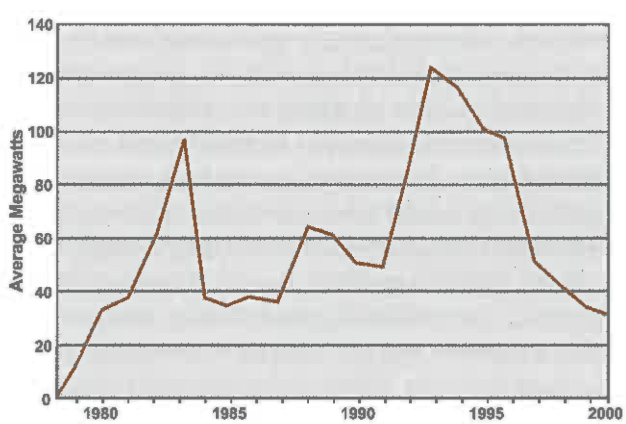


Figure 13-2. Northwest Conservation Savings, 1978-2000

Created after the U.S. Congress passed the Pacific Northwest Power Planning and Conservation Act of 1980, the Northwest Power Planning Council is charged with adopting program measures to protect, mitigate, and enhance fish and wildlife while assuring the Pacific Northwest an adequate, efficient, economical, and reliable power supply. The council has presented its programs in a series of power plans, the most recent of which was in 1998, and expects to complete the region's fifth edition of the power plan in 2003.

The plans identify conservation as the cheapest way to meet the region's energy needs for electricity. The 1998 plan, for example, identified approximately 1,535 average megawatts of conservation that could be cost effective to develop over a twenty-year period. About 60 percent of the savings would be acquired in the industrial and commercial sectors through replacement of lighting, improvements in heating and cooling systems, repair of equipment, and similar actions.

The rate of acquiring energy savings through conservation depends on a variety of factors, including power prices. When prices are high, the incentive to conserve increases; when prices are low, implementation of conservation measures wanes. Relatively low prices in the latter half of the 1990s contributed to a decline in the implementation of conservation measures compared to the latter part of the 1980s and early 1990s. Interest in conservation rebounded with price spikes in 2000 and 2001.

Conservation supporters remain challenged to develop policies and programs to support a steady rate of investments in conservation independent of changes, especially declines, in wholesale prices. To renew the focus on conservation and energy efficiency, the region's utilities and governments have established new entities to promote market transformation activities wherein consumers have more choices for purchasing energy-efficient products. The Northwest Energy Efficiency Alliance, established in 1996, is one of several regional organizations facilitating market transformation through its programs to promote compact fluorescent lights, resource-efficient washing machines, energy-efficient residential windows, and a variety of initiatives for commercial and industrial energy efficiency.

Renewable Energy Sources

Hydroelectricity, biomass, solar, wind, and geothermal are the main types of renewable energy sources in the Pacific Northwest. The three states of the Northwest are more dependent on renewable energy for electricity generation than any other states in the United States. In Idaho, 97 percent of electricity in 1998 was generated from renewable sources; figures for Oregon and Washington were 79 and 80 percent, respectively. Hydro sources account for most of the region's renewably generated electricity.

Federal data for renewable energy are sketchier than data for non-renewable sources. Thus identifying renewables' contribution to the Northwest's total energy demand and supply is challenging. Much of the following discussion is based on regionally generated information.

Biomass. After hydroelectricity, biomass is the second-most used source of renewable energy in the Pacific Northwest. About four percent of the region's total energy consumption is attributable to wood and waste. Industrial uses account for 75 to 80 percent of wood and waste consumption; residential uses account for 15 to 20 percent.

In Oregon, industrial facilities generated about 120 average megawatts of electricity from biomass in 2001. Six of the state's paper mills used pulping liquor to produce steam and recover chemicals; two of the mills co-generated steam and electricity. Additionally, sixty-six industrial facilities used biomass boilers to supply heating or process steam; eight of the sixty-six industrial facilities co-generated steam and electricity.

Historically, wood has been a major source of the region's home heating. In Oregon, about 20 percent of all households use wood for primary or back-up heating. In 1983 Oregon became the first state in the nation to pass a law requiring wood stoves to meet emissions limits for particulates. A similar law was passed in Washington in 1987. Subsequent state and federal legislation further identified measures to improve air quality in non-attainment areas for particulates. To help meet air-quality standards and promote the usage of other fuels, utilities and other groups developed programs to replace older wood stoves with weatherization and either new clean-burning wood stoves or other types of heating systems.

Garbage or sewage is used for heating or generating electricity at several locations in the Pacific Northwest. As noted in the discussion of natural gas, the St. Johns Landfill in Portland helps to power lime kilns at an Ash Grove Cement plant, and landfills in or near Corvallis and Eugene in Oregon and Klickitat County, Spokane, and Tacoma in Washington supply biogas for heating and electricity. In addition, biogas was formerly produced at the Rossman Landfill near Oregon City, Oregon, where it was cleaned and fed directly into pipelines, and for heating adjacent county shop facilities.

The Short Mountain Landfill Gas Project near Eugene, Oregon, and the Coffin Butte Landfill near Corvallis, Oregon, are among the older landfills producing biogas. The Short Mountain Landfill Gas Project began operating in 1992. Methane is extracted, collected, cleaned, and injected into combustion engines where it turns crankshafts which then turn generators. The project generates about twenty million kilowatt-hours annually, enough to power about 1,400 homes. The Coffin Butte landfill site near Corvallis began operating in 1995, is used to power generators with a capability of 2.5 megawatts, and produces enough electricity for two thousand households annually.

A number of the region's cities use biogas from sewage; thirty sewage treatment plants in Oregon alone have anaerobic digesters that produce biogas. One of the better-known projects is the City of Portland's Columbia Boulevard Wastewater Treatment Plant, which began using methane gas from sewage in 1999 to generate 1.4 million kilowatt-hours of electricity annually, enough to save more than $60,000 in energy costs. A fuel cell is used to extract hydrogen from the gas; the gas is then combined with oxygen to create a chemical reaction that produces electricity. The Portland project is only the third commercial fuel cell of its kind in the nation.

Biomass and other solid wastes such as garbage are burned in incinerators to generate electricity. The largest solid-waste incinerator in the region is at Lewiston, Idaho, where a 59-megawatt plant uses biomass and fossil fuels to power a co-generation facility. Other co-generation facilities using biomass and fossil fuels include a 47-megawatt plant at Camas, Washington; a 43-megawatt plant at Everett, Washington; and a 36-megawatt plant near Wauna, Oregon. Incinerators fueled with solid-waste only include a 23-megawatt plant at Spokane, Washington; a 11-megawatt plant near Brooks, Oregon; a 2-megawatt plant in Skagit County, Washington; and a 1-megawatt plant at Bellingham, Washington. A 50-megawatt incinerator at Tacoma, Washington, burns garbage, wood wastes, and coal.

Several dairy operations produce electricity from methane gas resulting from decomposition of cow manure. Craven Farms operated a facility in Tillamook County, Oregon, from 1997 to 1999 when the farm was sold as a result of financial problems. The Cal-Gon dairy farm near Salem, Oregon, converts 35 to 40 tons of manure daily to methane gas, which is used to generate 100 average kilowatts of electricity, enough for about sixty-five homes. In 2004, a dairy operation in eastern Oregon near Boardman is expected to begin producing methane gas to generate about 4 average megawatts of electricity. Similar operations have been considered elsewhere, including near Myrtle Point, Oregon.

Other types of biomass fuels in the Pacific Northwest include agricultural residues and ethanol. Agricultural residues continue to receive increased attention as grass seed growers in Oregon's Willamette Valley and elsewhere seek ways to use straw for fuel or other products rather than burning it in the field.

Ethanol is mixed with gasoline to create an oxygenated fuel sold in gasoline stations in urban areas that do not meet standards for carbon monoxide emissions. In the year 2000, Oregon and Washington consumers used 43 million gallons of ethanol in various gasohol blends; this represented 2.9 percent of the nation's total usage of alcohol used in gasohol. Oregon's and Washington's share of the nation's ethanol-usage total was slightly more than their share of the nation's vehicle miles traveled. Federal statistics do not show any usage of ethanol-based fuels in Idaho in 2000. Northwest consumption of ethanol-based fuels dropped substantially when Oregon in 1993 and Washington in 1995 eliminated state tax exemptions for gasohol.

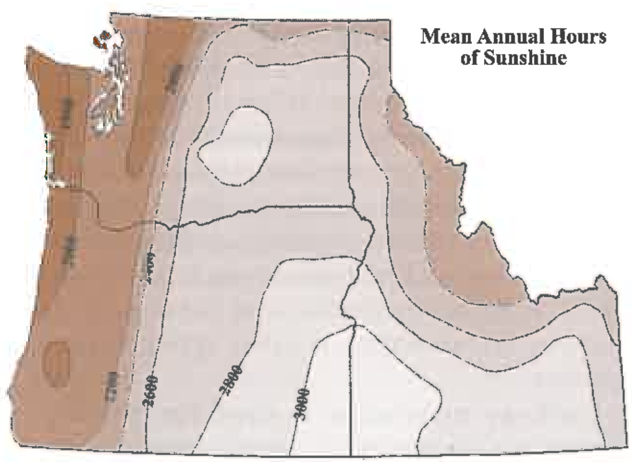
Most of the region's ethanol is imported from the Midwest where it is produced from grain, primarily corn. The J. R. Simplot Company operates the only production facilities in the Northwest at Caldwell and Burley, Idaho, where ethanol is produced from potato wastes. New ethanol facilities have been proposed in Oregon at Clatskanie and Island City, and in Washington at Longview and Moses Lake.

Solar Energy. Active and passive space and water heating are the main uses of solar energy in the Pacific Northwest. The amount of solar radiation east of the Cascade Mountains is almost as much as is available in the southwestern United States The contribution of solar to the region's energy needs, however, is greater west of the Cascades where most of the region's population resides. Cloudy parts of the Northwest receive almost half as much solar energy as the deserts of Arizona and California. Total potential supply of solar energy in the Northwest is estimated at more than 200,000 average megawatts (See map 13-4).

The installation of solar collectors nationally dropped dramatically with the expiration of federal solar tax credits at the end of 1985. State incentives continue to support solar development, and in Oregon, an estimated 16,000 water-heating systems and 1,600 space-heating systems have been installed.

In the 1980s, about three dozen cities and counties in the Pacific Northwest implemented solar access ordinances to ensure that access to sunlight is protected from shading by vegetation or buildings. Field investigations have shown that protection from shading and proper orientation of houses can result in energy savings of 10 to 20 percent without the installation of solar equipment. By the early twenty-first century, most jurisdictions in the Northwest had either eliminated the ordinances or were not aggressively enforcing them for a variety of reasons, including low energy prices, reduced sales of solar collectors, opposition by developers, and a focus on housing density which sometimes precludes good solar access.

Sunlight also can be converted to electricity via solar thermal facilities such as concentrating collectors or salt ponds, and via photovoltaic collectors. No solar-thermal power plants or salt ponds are presently in the region. Small-scale photovoltaic collectors are located at demonstration facilities, remote locations, and sites not easily served by the power grid throughout the Pacific Northwest. These include collectors installed on rooftops of buildings, highway signs and billboards, translator sites for radio stations, signaling devices, lights, water pumping facilities, and restrooms at public



Map 13-4: Solar Power Resources

recreation areas. Oregon's and Washington's net metering laws, which allow customers to sell excess electricity from solar panels or other renewable sources to a utility, have facilitated the installation of photovoltaic collectors in a few locations.

The region's largest photovoltaic installation is a 40-kilowatt facility at the site of the terminated WNP-1 nuclear plant on the Hanford reservation in Washington. This facility, which is estimated to provide enough power for fifty homes, was financed in part through the U.S. Department of Energy's Brightfields Program which provides funding for the installation of solar equipment on abandoned or contaminated industrial properties, sometimes termed brownfields. Such properties are believed to be well suited for photovoltaic arrays because they are sited directly on the ground and do not penetrate the surface or disturb underlying materials.

On April 22 (Earth Day), 2002, Oregon became the only state in the United States to have a photovoltaic system installed on its capitol building. About one-third of the electricity generated by the sixty solar panels is used to light the building's Oregon Pioneer statue. The remaining two-thirds is fed into the regional transmission system. Proceeds from Portland General Electric's "Clean Wind" customers paid for the solar panels, engineering, and the information kiosk in the capitol.

In Ashland, Oregon, the City of Ashland and the Bonneville Environmental Foundation have funded installation of roof-mounted photovoltaic systems on four buildings: the Oregon Shakespeare Festival's administration building, Southern Oregon University's library, and Ashland's police station and city council chambers. Together, the four systems supply 30 kilowatts of generating capability.

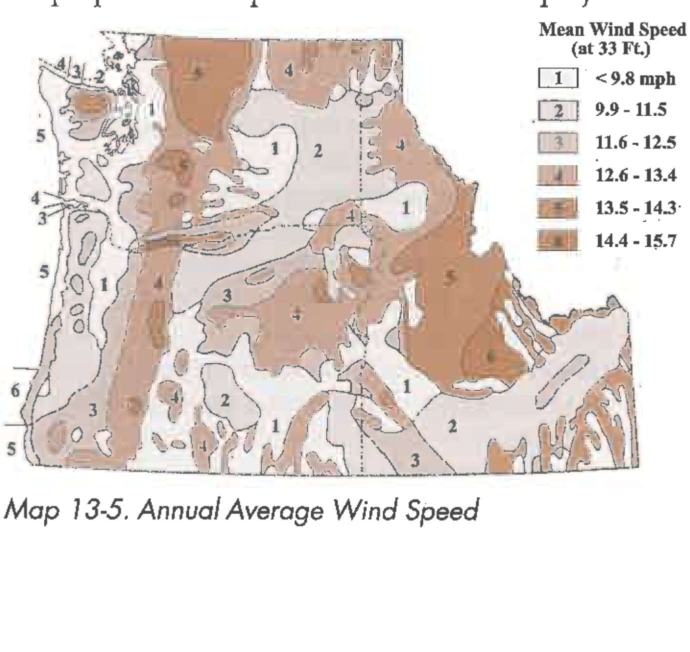
All three Northwest states are participating in the State and Local Partnerships program of the national Million Solar Roofs initiative started in June 1997. The goal of the initiative is the installation of one million photovoltaic and solar water- or space-heating collectors nationwide by 2010. Partners in the program are committed to installing at least five hundred collectors by 2010. Activities in Idaho, Oregon, and Washington focus largely on outreach and fostering education and awareness.

Wind. The potential for generating electricity from wind machines is greatest in the Columbia River Gorge, along the coast, and in selected mountainous parts of the region (see map 13-5). The Pacific Northwest's wind energy potential is estimated at 16,900 megawatts; among states nationally, Idaho ranks thirteenth, Oregon ranks twenty-second, and Washington ranks twenty-third in wind energy potential.

Improved technology, higher energy prices, government incentives, and better mitigation for environmental impacts have contributed to the recent competitiveness of wind energy. In recent years, new wind energy facilities have begun operating at several locations in Oregon and Washington. The first of these was the Vansycle Ridge Wind Farm in Umatilla County, where in November 1998, thirty-eight wind machines began operating with a generating capability of 25 megawatts.

In 2001, generation began at the Stateline Wind Power Project in 2001 near Touchet, Washington, with a generating capability of 263 megawatts from 273 wind machines in WA and 127 machines in Oregon. The Stateline project is the second largest wind farm in the United States, and generates enough electricity to power sixty thousand homes. Also in December 2001, forty-one turbines began operating at the Condon Wind Project near Condon, Oregon. With the completion of forty-two additional turbines in 2002, the project has a 50-megawatt capability and produces about 13 average megawatts. Other projects include the Nine Canyon Wind Farm near Kennewick, Washington, and the Klondike facility near Wasco, Oregon.

With continuation of federal tax credits and other incentives, further wind energy development is expected. A 2001 BPA solicitation for wind energy projects led to twenty-five proposals which, if all were built, would add 2,600 megawatts of generating capability. Ten proposals were for Oregon sites, eight were for Washington sites, and the rest were for sites in other western states and Canada. Only a few of the proposals are expected to lead to actual projects



Map 13-5. Annual Average Wind Speed

Stateline Wind Power Project, Washington and Oregon. (Photo by Steven R. Kale)

in the near term. Utilities in the region also buy electricity generated by wind turbines in other states such as Wyoming.

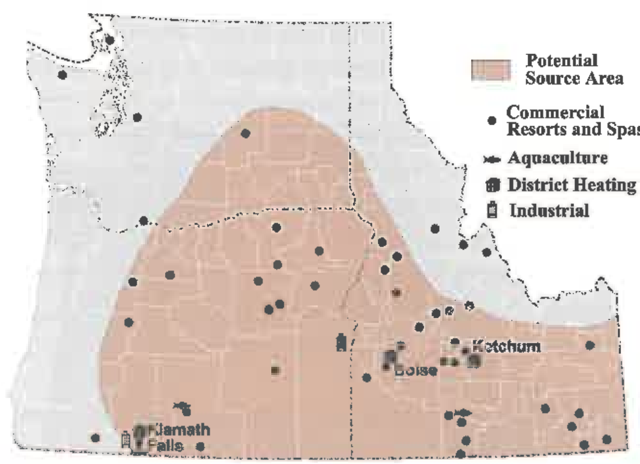
Geothermal Resources. Known and potential geothermal resources underlie much of the Pacific Northwest (see map 13-6). Geothermal's direct use applications in the region include heating buildings, swimming pools, hot tubs, and baths at commercial resorts, heating and cooling water to raise plants and fish, and heating and cooling facilities for industrial purposes. In a few locations, buildings are meeting their heating and cooling needs with heat exchangers using water from low-temperature geothermal wells.

According to the Geo-Heat Center at the Oregon Institute of Technology, Idaho leads the region in the number of sites with direct use applications (sixty-eight), while Oregon has fifty-two and Washington has six. About half of these sites are for resorts and spas.

The first large-scale use of geothermal energy in the region began with construction of the Warm Springs Heating District in Boise, Idaho, in the 1890s. In 1982, water from the newly developed Capitol Mall Geothermal System began heating buildings in downtown Boise. With declining water levels in the geothermal aquifer, the Idaho Department of Water Resources in 1988 imposed a cap on the amount of water that could be withdrawn from the aquifer. This was followed by successful efforts to return reused geothermal water to the aquifer via an injection well. The downtown geothermal heating district now serves about fifty buildings covering more than two million square feet of floor space. In addition, about four hundred homes are heated geothermally in the Boise area.

In Klamath Falls, Oregon, about 550 homes, businesses, schools, and other buildings use geothermal heat. In 1981, the City of Klamath Falls developed a district heating system to serve fourteen buildings in the downtown area. Since its initial development, a number of other downtown-area buildings have been added to the system. Geothermal heat in Klamath Falls also is used to melt snow on sidewalks, ramps for handicapped persons, highways, and the nation's only geothermally heated bus stop and passenger transfer area. A high-tech plant nursery is one of the latest users of the area's geothermal resources.

Idaho, Oregon, Washington, and western Montana have the potential to generate up to 11,000 megawatts of electricity from geothermal power. The Northwest Power Planning Council has identified eleven specific areas where there may be about 2,000 megawatts developable, enough power to serve more than 1.3 million homes. As of spring 2003, however, no electricity generating geothermal facilities were operating in the Pacific Northwest.



Map 13-6. Geothermal Resources and Facilities.
In addition to the locations of facilities shown on the map are a number of locations where geothermal resources heat greenhouses, residences, and other buildings.

Table 13-1. Number of Sites with Direct Use Geothermal Applications

	Idaho	Oregon	Washington
Aquaculture	2	2	0
District Heating	5	2	0
Greenhouses	14	4	0
Industrial	0	3	0
National Labs	1	0	0
Power Plants	0	1	0
Resorts and Spas	36	18	6
Space Heating	10	22	0

Concerns about resource availability, high costs, low electricity prices, land-use and cultural conflicts, and environmental impacts are among the factors that have worked against the development of the region's geothermal resources for generating electricity.

During the early 1980s, experiments to generate electricity using geothermal water began at Raft River, Idaho. After disappointing results, the efforts were discontinued. In the early 1990s, the Northwest Power Planning Council, the Bonneville Power Administration, and others explored the feasibility of pilot geothermal projects near Vale, Oregon; the Newberry Volcano about 35 miles south of Bend, Oregon; and Glass Mountain in northeastern California, about 25 miles south of the Oregon border. In 1993, following preliminary exploration, the developer of the proposed Vale project found that the resource was not cost-effective to develop. After completing environmental documentation and well-testing, work on the Newberry project was suspended in 1996. Although test-hole drilling found temperatures of 600 degrees Fahrenheit, the hottest in North America, the tests did not find sufficient high-temperature water at a shallow-enough depth to make a plant economically feasible.

Spikes in electricity prices and energy policies contribute to ongoing interest in geothermal research and demonstration. Proposals periodically emerge for development at the Newberry site and other sites such as the Alvord Desert south of Burns, Oregon, and Glass Mountain just south of the Oregon border in California. The BPA, for example, continues to work with various groups exploring the feasibility of geothermal development in northern California, and in 2001, signed a Record of Decision to acquire more than 49 megawatts of electricity from the proposed Fourmile Hill geothermal facility in Siskiyou County. If developed, the project would be the BPA's first geothermal resource.

Future Consumption and Supply of Energy

Among the most important forces influencing the future supply and consumption of energy in the region are population and economic growth, and fish and wildlife concerns. Growth is resulting in pressure to use more fossil fuels, especially natural gas. Rapid growth could lead to renewed pressure for nuclear, coal, or coal-gasification facilities; such development would be highly controversial as a result of concerns about costs and environmental impacts.

Restructuring of the electric utility industry is one of the more significant issues facing the region in the future. Supporters of deregulation believe that it will result in a more competitive energy market and lower prices, and use the deregulation of natural gas prices and transmission as an example of successful restructuring. Opponents fear that restructuring could lead to market manipulation and higher prices, and point to the effect deregulation in California had on the Northwest.

By early 2003, Oregon had become the only Northwest state where the legislature and governor had approved a bill restructuring the electric utility market. Originally scheduled to begin on October 1, 2001, the bill's debut was delayed until March 1, 2002 because of high prices and negative backlash from deregulation in California.

Oregon's legislation allows, but does not require, large industrial and commercial consumers to buy electricity competitively from wholesalers. Unlike California's legislation, Oregon's does not require investor-owned utilities to sell generating plants, does not prohibit them from purchasing energy on long-term contracts, and does not put a cap on retail rates.

Under Oregon's legislation, residential consumers continue buying price-controlled electricity from their publicly or privately owned utility, and have the choice of paying the cost-of-service rate or a "green" rate which is based on renewable energy's proportion of the consumer's total bill. Additionally, for 10 years after the legislation becomes operative, 3 percent of revenues from power sales will be set aside for public purposes in the following proportions: 10 percent—schools, 53 percent—other conservation, 19 percent—renewables, 13 percent—low-income weatherization, and 5 percent—low-income housing energy efficiency. At least 80 percent of the conservation funds must be spent in the service territory where the funds are collected and cannot be spent on region-wide market transformation strategies.

Neither Washington nor Idaho has passed deregulation legislation, in part due to concerns that since their electricity prices already are lower than elsewhere, few benefits would accrue from deregulation. Both states, however, have developed pilot programs that allow for different rate options, for example, rates that vary by peak and non-peak usage or for renewable energy purchases.

Partly as a result of the establishment of energy efficiency and "green power" programs, conservation and renewable energy will receive more attention. This attention will increase even more if energy prices rise rapidly. Lower prices could mean reduced or slowly implemented conservation in the absence of public sector incentives and support. Without sufficient mechanisms in place to reduce the burden to stockholders and ratepayers, the possibility of stranded costs will work against implementation of higher-priced conservation technologies.

Non-utility companies will increase their share of the region's energy production, most noticeably for electricity. Few utilities will build new generating facilities, in part because of the uncertainty of the energy market. Much of the power from independent producers will be sold to large utilities or to the Bonneville Power Administration.

Concerns about wildlife and fish, especially anadromous species, will continue to receive much attention. More water for salmon runs could mean less water for the generation of hydroelectricity. Removal or breaching of dams to enhance salmon migration will mean more of the region's power will come from higher-priced sources such as natural gas. While the proposed breaching of the four lower Snake River dams would enhance salmon migration, it could negatively affect other sectors of the economy such as transportation and agriculture.

In the 1990s, global warming became an increasingly important issue. A warmer climate in the Pacific Northwest would probably result in less water for hydroelectricity and other uses. Greater usage of fossil fuels could accelerate the build-up of carbon dioxide and other gases that appear to cause the greenhouse effect and global warming. While the seriousness of this issue is subject to changing political priorities, it remains a long-term concern, both globally and to the long-run energy future of the region.

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