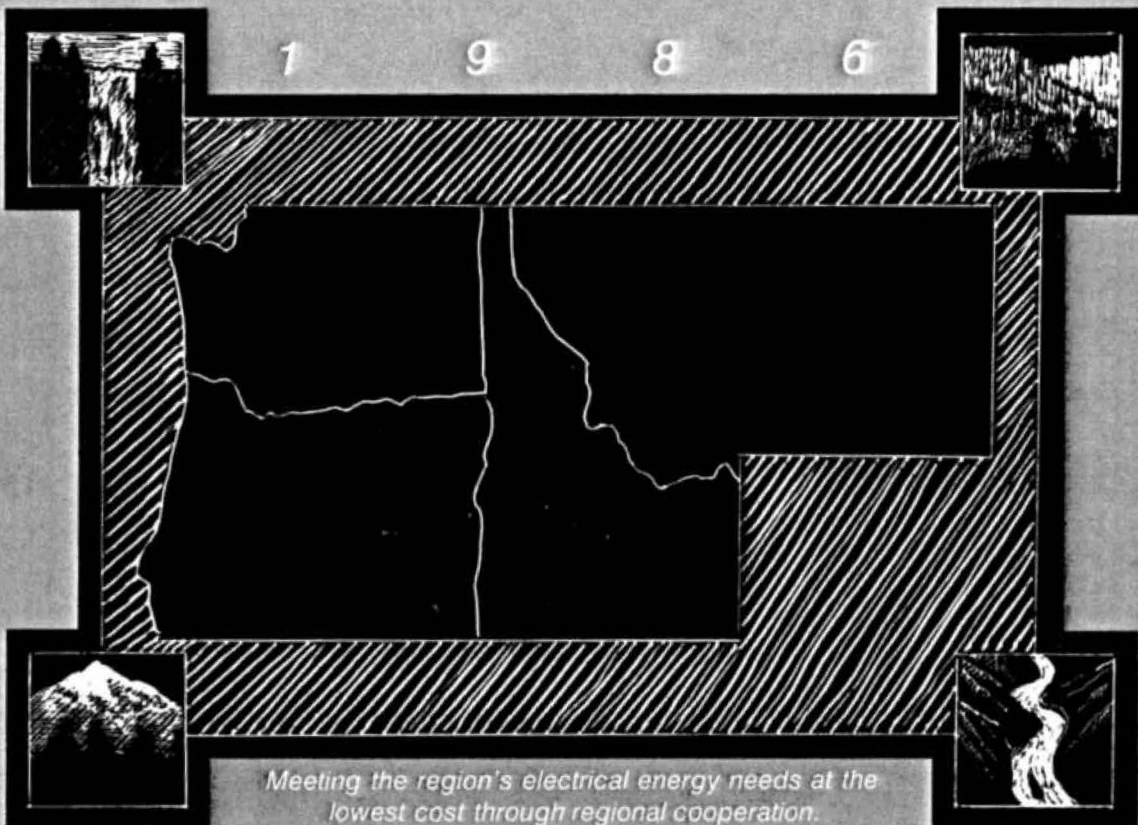

Meeting the region's electrical energy needs at the lowest cost through regional cooperation.

NORTHWEST CONSERVATION AND ELECTRIC POWER PLAN

VOLUME ONE

NORTHWEST POWER PLANNING COUNCIL

1986 **Power Plan** Volume I

Foreword

In December 1980, the U.S. Congress passed the Pacific Northwest Electric Power Planning and Conservation Act—Public Law 96-501 (referred to in this document as the Northwest Power Act or the Act). The Act made sweeping changes affecting the region's electrical power system. Among the most important, it authorized the Northwest states of Idaho, Montana, Oregon and Washington to enter into an interstate compact for the purpose of long-range planning and protection of some specific shared resources. As a result of the Act, each of those four states passed enabling legislation to create the Northwest Power Planning Council in April of 1981. The states' governors each appointed two members to the Council.

The Act required the Council to develop and adopt both a 20-year electrical power plan for the region and a program to protect, mitigate and enhance the fish and wildlife affected by hydroelectric development in the Columbia River Basin. The Act also instructed the Council to conduct these activities with broad-based public involvement.

The Council adopted the Columbia River Basin Fish and Wildlife Program in November 1982 and subsequently adopted an amended version in October 1984. The Council adopted its first Northwest Conservation and Electric Power Plan (the Northwest Power Plan or the plan) in April 1983. This document, the 1986 Northwest Conservation and Electric Power Plan, is the second 20-year power plan produced by the Council with extensive public involvement. It was adopted in January 1986 in compliance with the Northwest Power Act's directive that the plan be reviewed and changed if necessary at a minimum of every five years.

This plan is more than an amended version of the first plan. Because of a number of significant and rapid changes in the Northwest electrical power picture and because of refinements in information availability and processing, the Council conducted a complete review of the power plan. This is essentially a new 20-year power plan and supersedes the 1983 Power Plan. However, the Columbia River Basin Fish and Wildlife Program, as amended, is incorporated as a part of this 1986 plan.

Unlike the 1983 plan, which set up a two-year planning cycle, the Council expects this 1986 plan to be in effect for a substantial period. The Council will report on the status of the regional economy and electrical needs every six months and will regularly monitor developments that affect resource availability. Sections of this plan will then be updated as needed.

Copies of this plan are available at no charge. Address inquiries to the Council's Public Involvement Division, 850 S.W. Broadway, Suite 1100, Portland, Oregon 97205, or phone toll-free 1-800-222-3355 in Idaho, Montana and Washington and 1-800-452-2324 in Oregon.

Note: All figures used in both volumes are in 1985 dollars unless otherwise specified. Since the Northwest's hydropower system is primarily energy constrained, the term "megawatts" refers to average annual megawatts unless otherwise specified. All references to "energy," "capacity," and "power" refer to electrical energy resources only.

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Chapter 1

Chapter 1
Electricity: Cornerstone of the Northwest Economy

For well over half a century, electrical power has been a cornerstone of the Pacific Northwest economy. Thanks to the nation's most productive hydropower system, abundant, low-cost electricity has made the Northwest attractive to business and industry despite the fact that the region is a long way from major markets.

Electricity has lighted and powered the farms of the region and turned deserts and sparse grasslands into highly productive cropland. Aluminum smelting, pulp and paper production, and industrial chemical manufacturing have all benefited from abundant and cheap electrical supplies. Sales of electricity have provided the revenues that made the damming of the Northwest's rivers possible, thus multiplying economic growth through increased navigation, irrigation, and flood control.

Now, however, products from other regions are competing strongly with the region's products. As a result, maintaining low-cost electricity is more vital than ever to the Northwest economy. The goal of this Northwest Power Plan is to preserve and enhance this valuable asset by identifying the steps that need to be taken to ensure the lowest cost electrical energy future for the Pacific Northwest.

The Changing Electrical Power Picture

The story of electrical power development in the Northwest is one of firsts and superlatives: the first high voltage transmission of electricity (Oregon City to Portland in 1889); the largest hydroelectric project in the United States (Grand Coulee); the largest single utility transmission system in the world (the Bonneville Power Administration system); the United States' first and the world's largest high voltage direct current transmission line (Celilo, Oregon, to Sylmar, California); and the largest coordinated hydroelectric system in the world.

But in July of 1983 a new and negative superlative was added to the list—the largest municipal bond default in the history of the United States. The termination of the Washington Public Power Supply System's nuclear plants 4 and 5 called a halt to the notion that future energy needs should be met by larger and larger power plants. With the 1980s, the region entered a new age of electrical power. This new age poses five major new challenges for the region.

First, all new sources of power are much more expensive than the region's existing hydropower system. On a comparable basis, conservation costs five times more than power from the large dams on the Columbia and Snake rivers, and new coal plants cost 11 times more. As a result, electricity prices can only go up as the region adds new resources. As an example, Bonneville's wholesale power rates have increased over 500 percent in the last five years, primarily to pay for new nuclear plants.

Second, the region's industries have divergent needs. The Northwest's traditional industries—pulp and paper, wood products, chemicals, agriculture, transportation equipment and metals—represent the backbone of the region's economy. These industries employ over half a million people and produce much of the economic activity in the region. These basic industries rely on low-cost power to remain competitive with other parts of the country and the world. New industries, such as high technology and consumer services, are not as dependent on low-cost power because power costs represent a smaller portion of their overall operation costs. As these new industries grow, new resources will be needed. The dilemma is that new additions to the power system will raise electricity costs and thereby threaten the traditional industries.

Third, the current surplus of electricity is expensive. The Northwest has frequently had a surplus of electricity. In terms of meeting future needs, the current surplus is no larger than the situation in the late 1970s when Bonneville and the region's utilities were predicting brownouts if new resources were not built. What is different now is the cost. For 40 years, the surplus had been cheap hydroelectric power. In the past, when a new dam came on line too early, the power cost only a fraction of a cent per kilowatt-hour and could be sold relatively easily for that price. Then, the only risk the power system needed to worry about was having too little power. Today's surplus is made up of coal and nuclear plants, which produce far more costly power. The current surplus in the Western United States makes it impossible to sell power from these plants at its full cost. As a result, the region now faces the high cost of having too much power. Given the uncertainty of predicting future energy demands, the region needs risk management strategies to keep costs down.

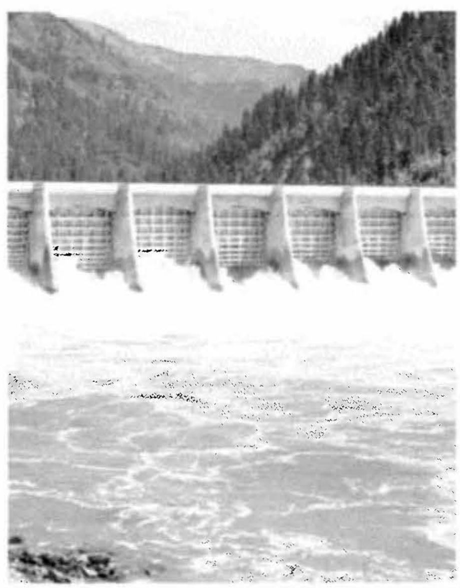
Fourth, the surplus is not evenly shared. Although higher electrical rates have slowed demand for power on the average, parts of the region, particularly those surrounding major metropolitan areas, continue to grow. Many of these high growth areas are served by investor-owned utilities that have fewer resources compared to demand than the publicly-owned utilities. If the region's utilities cannot work together to develop the lowest cost new resources, some areas may have to turn to higher cost or higher risk resources. A divided region developing higher cost resources is not the future envisioned by the Northwest Power Act.

And fifth, the surplus could disappear quickly. If high energy growth occurs, the region would need new supplies in the next few years. Over-reliance on the surplus could waste the time needed to test and demonstrate low-cost conservation programs and thus lead to the development of more expensive resources. Some actions are needed now to achieve the long-term goal of meeting the region's energy needs at the lowest possible cost.

The Northwest's Unique Power System

The Northwest electrical power system is unique in a number of ways. First, more than any other system in the nation, it is dominated by hydropower. The dams of the Columbia River and its tributaries form a base which, even with the construction of a number of thermal plants in the last decade, still supplies about 70 percent of the electricity used in the Northwest.

A hydroelectric system has characteristics which make it different from a thermal-based generation system. First, fuel for a hydroelectric system—falling water—is free. Second, that fuel is limited and, because it depends upon weather, it is unpredictable.



In an average year, the Northwest's hydroelectric system will produce about 16,400 average megawatts of energy. Under very low water conditions called "critical water," the system will generate only about 12,300 megawatts. (For purposes of comparison, the city of Seattle uses approximately 1,000 megawatts.) The power generated under critical water conditions is called firm power because the system can almost always be depended upon to produce it. In record high water years, the annual hydropower system energy capability can add over 60 percent to the critical water capability by producing approximately 20,000 megawatts.

The enormous variations in the region's annual rainfall and snowpack led power planners in the 1960s to seek ways to store as much of the annual runoff as possible. Storage dams were built on headwater streams in both the United States and Canada, and a treaty was signed between the two nations to share the additional power made possible by this storage.

Even with these steps, less than 40 percent of the average annual runoff can be stored in the system's reservoirs. This means that power system operators are limited in their ability to save the spring runoff for the winter's greater energy demand. In high water years, the Northwest produces more hydroelectric power than it can consume (surplus nonfirm power), even after thermal plants burning costly fuels have been turned off. This surplus is sold first to direct service industries,[1] primarily aluminum reduction smelters, and Northwest utilities, and then to California and other Southwest utilities over two major intertie transmission lines connecting the region with California.

The Northwest hydropower system has other technical characteristics that make it unique. Electrical systems are limited by the amount of energy they can produce at any one moment—the peak generating capacity. Most systems take steps to ensure that they have adequate capacity to meet anticipated peaks in demand. The Northwest system, with its high capacity dams and limited "fuel" supply, is more constrained by its ability to meet energy generation needs throughout the year, rather than at a momentary peak. As thermal plants supplemented the hydropower system, the idea was to keep these plants running year around at the same level while using the hydropower system to meet daily and seasonal peak needs. However, in practice, these thermal plants are often shut down during periods of nonfirm surplus to avoid the high costs of running them.

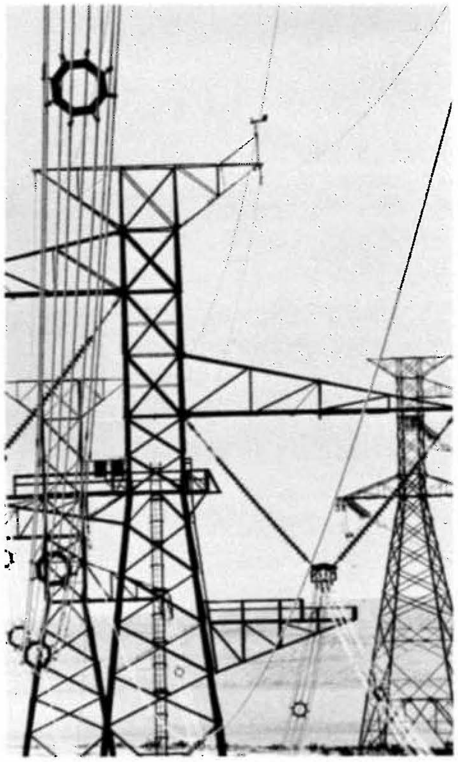
The Northwest electrical system is also unique from an institutional standpoint in that it is nearly evenly split between a public and a private system. The Bonneville Power Administration, the region's federal power marketing agency, functions largely as a wholesale entity supplying about half the region's electrical power needs. Bonneville supplies nearly all the needs of 100 of the region's 115 publicly-owned utilities and only a small portion of one of the region's investor-owned utilities. The other half of the region's power comes from six investor-owned utilities and those public utilities which generate part of their own power.

In addition to supplying utilities, Bonneville also supplies power (approximately 30 percent of its total supply) to direct service industries.

The Last 25 Years: A History of Northwest Electrical Power Development

During the 1960s, it became obvious that hydropower alone could not supply all of the Northwest's electrical needs. For one thing, the region was running out of new river sites that could be developed. The Hydrothermal Power Program was conceived as an answer to this problem in the late 1960s. As the name suggests, it was an effort to mesh new thermal resources with the existing hydropower system. A major goal of this program was to allow construction of large generating plants, while preserving the basic roles of Bonneville and its customers. Bonneville would supply energy peaking needs, and utilities would build large base load[2] generating resources.

By law, Bonneville could not construct or own generating plants. Therefore public utilities would finance, construct and operate the plants, and Bonneville would acquire their output by crediting the owner utilities for the cost of those plants when it billed the utilities. The arrangement was called net billing. An adverse Internal Revenue Service ruling and high costs ended the original Hydrothermal Power Program in 1973.



The second phase of the program followed, with the region's utilities taking power from their own shares of the generating plants while Bonneville provided transmission and "shaping" of the generation to fit power loads. Nuclear plants 4 and 5 of the Washington Public Power Supply System were the principal products of this phase. Bonneville's participation in this phase effectively ended in 1975 with adverse court decisions which required the agency to prepare lengthy environmental impact statements on its role.

By 1977, the forces which were leading to the Northwest Power Act of 1980 were becoming clear. Regional utility planners were frustrated with a plethora of increasingly difficult problems. These led regional decision makers to look to Congress for a comprehensive solution to a set of linked problems.

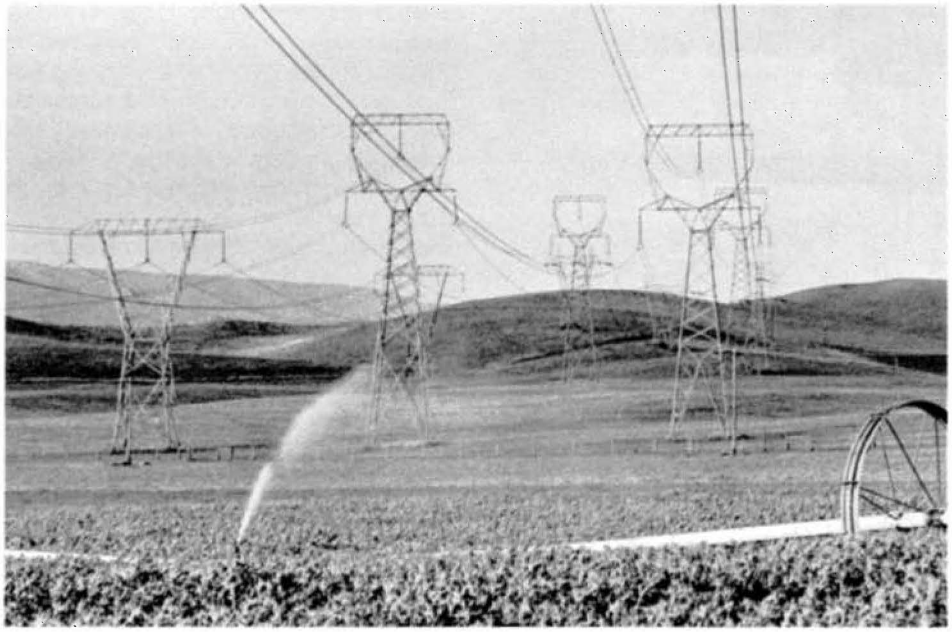
First, hold-ups in siting and licensing and delays in plant construction had become commonplace. Utilities began projecting they would be unable to meet the region's power needs in the early 1980s. Deficits of more than 3,000 megawatts were projected by the mid-1980s in the event of low water years. A mechanism was needed to speed new resources into the system.

Second, while Bonneville and several utilities were promoting construction of large thermal plants, a number of critics were arguing that the region's power needs could be met by conservation programs at substantially less cost. State siting agencies began to consider conservation as an alternative to thermal plants. However, at the time, conservation was a new and unfamiliar resource to most utilities.

Third, with the end of federal dam construction and the limiting of net billing, Bonneville could no longer acquire additional resources to meet new loads. Investor-owned utilities, which had traditionally relied on surplus Bonneville power to meet their growing loads, found in 1973 that they could be cut off from cheap federal hydropower by the "preference clause" of the Bonneville Project Act, which granted public utilities first access to federal hydropower. The investor-owned utilities then began turning to expensive thermal generation, a step which was reflected in their rates by the mid-1970s. Many of the region's public utilities are small, serving only one county or a sparsely populated rural area. But even the larger investor-owned utilities were limited in their ability to move into the thermal age. It was not unusual for an investor-owned utility to have half its assets tied up in construction of generating plants that could not bring in revenue until they were completed.

Fourth, by 1977, investor-owned utility rates, which historically had been comparable to public utility rates, skyrocketed to two or three times those of public utilities. Growing pressure to end these staggering rate increases prompted the state of Oregon to enact the Domestic and Rural Power Authority, which was to lay claim as a publicly-owned utility to federal hydropower for the benefit of all the state's citizens.

Fifth, with limited power supplies and growing customer loads, Bonneville foresaw a day when it could no longer meet all the power needs of its customers. On July 1, 1976, it issued a Notice of Insufficiency, informing its customers that after seven years it could no longer meet all their needs. Bonneville then began a lengthy proceeding to develop a formula to allocate its available power supplies. This effort was expected to be extremely difficult and controversial.



Sixth, the direct service industries' contracts were to expire in the 1980s. The power supplied to these industries would have to be sold to the public utilities under the preference clause. If they were to survive in the Northwest, these industries needed an assured source of power.

And seventh, concerns over the decline of the storied Columbia River salmon and steelhead runs were drawing regional attention. Since the first dams went up in the 1930s, the annual salmon catch had declined 70 percent. While hydroelectric development was not the only cause for the decline, there was widespread agreement that the dams had been a major factor and that remedial measures were needed. Getting a coordinated response was a problem. The river and its tributaries flowed through all the Northwest states and a number of jurisdictions, including Indian tribal lands.

The Northwest Power Act Ushers in a New Power Era

By the end of the 1970s it was clear that not only was a comprehensive solution needed for the region's electrical power problems, but a mechanism for addressing that part of the fish and wildlife problem resulting from the power system was needed as well. That comprehensive solution resulted in the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act) passed by the 96th Congress in December 1980.

Among other things, the Act gave Bonneville an expanded role, allowing it to acquire resources, including the development of conservation programs, and to help restore fish and wildlife. The Act also created a public process for future electrical power planning by allowing the creation of a state-appointed Northwest Power Planning Council to make the judgments about future electrical energy demand and resources, including conservation, to be developed to meet the region's needs. It also gave the Council the authority to plan the actions and investments to be undertaken to rescue the fish and wildlife resources, particularly salmon and steelhead, affected by the Columbia River power system dams.

Bonneville received broad new authorities. In return, the Northwest states, whose ratepayers fund Bonneville, received an increased role in directing their own energy future through the Council. All of the Council's business and decision making are conducted in public, and the Council maintains a broad public information and involvement program to stimulate public participation.

Bonneville's expanded role allowed it to acquire new power supplies through a mechanism where Bonneville would acquire the power generated by a power plant and pledge to pay the costs of building and operating it. This "guaranteed purchase" was intended to give financially strapped utilities better access to financial markets to get funds for new conservation programs and thermal plants and was designed to spread the financial risks of developing new resources across the region.

With the ability to acquire new resources, Bonneville could execute new contracts as well as continue to supply the nongenerating utilities and the growing needs of all other utilities. The Act also authorized Bonneville to sign residential "exchange" contracts with utilities, allowing them to buy power to serve their residential and agricultural customers at the same rate that Bonneville charges public utilities. In turn, the generating utilities would sell Bonneville power at their own average system cost. This exchange gives residential and small farm customers of utilities participating in the exchange access to the Northwest's cheap hydropower, and has saved these customers approximately $750 million since the passage of the Act.

The Act also authorized Bonneville to enter into new long-term contracts with the direct service industries. These industries gave up existing contracts, most of which were scheduled to expire in the 1980s, for higher-priced contracts of 20-years' duration. The direct service industries also agreed to absorb a large portion of the costs to Bonneville for the exchange program described above.

Finally, the Act also set up a system of "rate pools" to assist Bonneville in determining what the various classes of customers would pay for power.

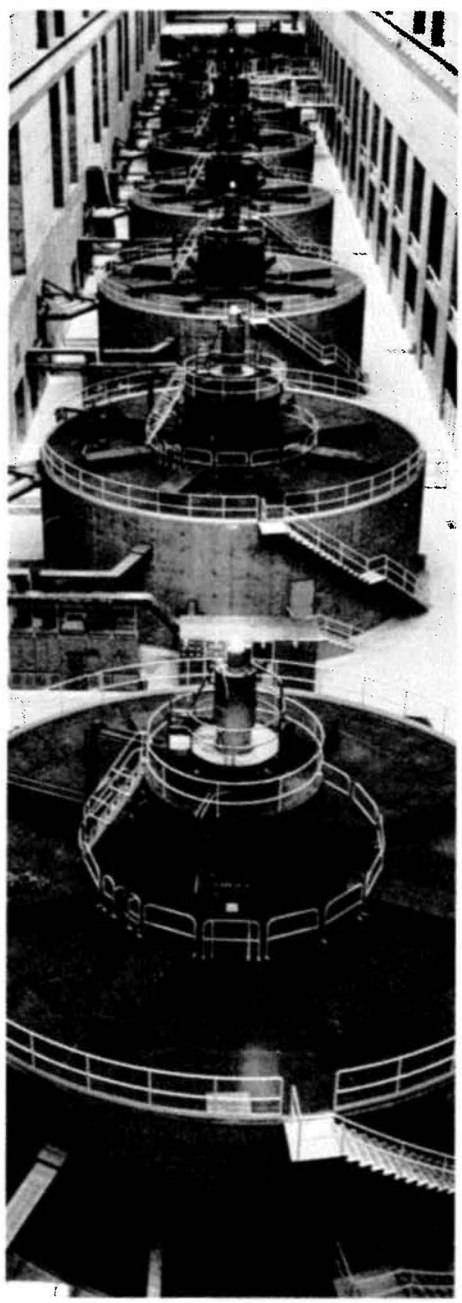
The Northwest Power Planning Council

In the past, dams had been built and transmission lines constructed with relatively little public participation. However, new coal and nuclear plants were seen as affecting both the economy and environment of the Northwest. Electricity rates had begun to climb dramatically in many parts of the region prior to the Act, and the impacts of the dams and thermal generating plants on the environment had become matters of intense public controversy. The public at large as well as state and local governments needed and demanded a voice to express their interest in energy issues.

Public opinion on electrical energy issues had become so strong that future power development seemed stymied. To propose a new generating unit in the atmosphere of the late 1970s was to subject a utility to what appeared to be an endless process before public bodies and a largely uncertain outcome. The lack of consensus was counterproductive to planning. While energy plants were being stalemated, the conservation programs that would be necessary if the plants were not built were not being undertaken either. The need for regional consensus building was a primary impetus for the formation of the Northwest Power Planning Council.

The creation of the Council took place in the framework of an interstate agreement under the "compacts clause" of the U.S. Constitution. The principal duties of the Council under the Act are to: 1) develop a 20-year regional power plan (the plan) to ensure the Northwest an adequate and reliable electrical power supply at the lowest cost; 2) develop a fish and wildlife program (the program) to "protect, mitigate, and enhance" the fish and wildlife affected by hydroelectric development in the Columbia River Basin; and 3) provide for broad public participation in these processes.

According to the Act, Bonneville implements actions consistent with both the plan and program. The Act requires Bonneville to seek the Council's approval for any resource acquisition over 50 megawatts and five years in duration. If the Council finds that any proposed resource acquisition is not consistent with its power plan, Bonneville would have to secure Congressional approval before acquiring the resource.



1980-1985: A Changing Power Picture

As the Council worked to develop its first plan, the Northwest electrical power picture had already begun to change dramatically. Much of the impetus for the Act had been the projection of large deficits in power supply. Because many utility planners in the 1970s assumed they could predict the most likely future, the result was a single energy forecast for the region that led to the start or construction of 17 coal plants and 10 nuclear plants. As recently as 1980, there were predictions of brownouts and severe regional shortages.

But between 1981 and 1983 it became apparent to the Council that the near future would not be characterized by deficits but by an expensive surplus of uncertain duration. This signaled the emergence of a new and different set of problems.

Uncertainties inherent in forecasts of energy needs had led the region to build large expensive generating plants that were not needed, at least not on their schedules for completion. The high electricity rates resulting from these expensive new plants were leading to consumer unrest and even some shutdown of industrial processes in the region.

Other factors also cast a new color on the regional power picture. The region entered its deepest economic recession since the depression of the 1930s. At the same time, due to world prices, a significant portion of the aluminum production capacity in the Northwest shut down, temporarily exacerbating power surpluses. Other traditionally reliable, large industrial power loads, such as the wood products industry, also dropped off. Bonneville and the region's utilities suddenly found themselves with more power than they could sell.

All of these circumstances led the Council to conclude that it was dealing with an environment sharply different from the one anticipated when the Northwest Power Act was being drafted. As the Act developed, planning was considered vital to ensure there would be enough power to support the Northwest economy. But in 1983, as the Council developed its first power plan, it began to promote a second goal of planning—to prevent overbuilding and thus paying for unnecessary resources. To accommodate these two divergent but equally important goals, the Council developed a flexible planning strategy, one that matches resources to a wide array of energy futures.

The Northwest Power Plan: Planning for Flexibility

In April 1983, the Council adopted its first 20-year power plan. That plan spelled out a new kind of planning strategy and set significant new directions for the Pacific Northwest.

1. The plan addressed the surplus of electricity in the region and focused on preventing lost opportunities to the region. Lost opportunity resources are cost-effective resources which, if not secured now or in the near term, could be lost forever to the region. The primary example is incorporating energy efficient features into new buildings when they are constructed, since many of these measures cannot be installed later and the buildings will consume energy long after the surplus is over.

2. The plan called for few new resources to be acquired. Instead it emphasized the need to develop the capability to deliver energy conservation in the commercial, industrial, governmental and agricultural sectors. The plan also called for continued capability in the residential sector with an emphasis on programs to reach low income and renter households.

3. In accordance with the statutory priorities established in the Act, the plan relied primarily on conservation, because improving energy efficiency costs considerably less than building new thermal resources.

4. The plan emphasized the importance of making regional electrical energy decisions in an open process.

Perhaps the greatest departure from traditional planning in the Council's power plan was the explicit recognition that the future is uncertain and the development of risk management strategies to deal with that uncertainty. Past planning had taken off from a single forecast of the region's most likely energy demand. Resources that took ten or 15 years to build were planned and constructed to that best guess; if the future turned out differently, the region faced the problem of either having underbuilt or overbuilt resources. The cost of error on either side was enormous.

The Council explicitly recognized that the future could not be predicted accurately and that uncertainty was a fact of life in power planning. To accommodate this problem, the Council developed a plan to meet a broad range of potential growth in energy demand, setting a boundary of high and low load growth forecasts over the next 20 years. The Council also identified flexible resources such as conservation and options that shorten the lead time of generating resources. Resources were then selected to meet all potential growth needs within this range and ranked in an order designed to produce the lowest total cost across the range. How the Council dealt with uncertainty, and continues to deal with it, are explained more fully in Chapter 3.

The 1986 Power Plan

The 1986 plan differs significantly in many areas from the 1983 plan, because major developments in the regional power picture have taken place in just the past three years. But the two plans have a common feature—the underlying planning strategy has proven sound and continues to be essentially the same in the two plans.

Like the 1983 plan, the 1986 plan emphasizes conservation and calls for no near-term development of new resources except those which are cost effective and could be lost to the region if they are not secured. In addition, this plan emphasizes the following priorities:

- A stronger regional role for Bonneville.
- Development of conservation on a regional basis.
- Strategies to make better use of the hydropower system.
- Building conservation capability in all sectors.
- Demonstration of the cost effectiveness of renewable resources so they are available before the region has to build new thermal generating resources.
- Allocation of costs for two unfinished nuclear plants and elimination of barriers to their completion.
- Study of electrical power sales and purchases between regions.

Key to most of these priorities is cooperation among power organizations, both public and investor-owned. The need for cooperation to solve important power issues is a theme that runs throughout the 1986 Power Plan.

1./ Energy-intensive industries, primarily aluminum reduction smelters, which buy power wholesale directly from the Bonneville Power Administration, the region's federal power marketing agency, are called direct service industries.

2./ Base load resources run continuously except for maintenance and power outages.

Chapter 2

Chapter 2
The Regional Picture Today: Problems and Solutions

When Congress passed the Northwest Power Act in 1980, it was assumed that the Bonneville Power Administration would provide the financing mechanism for most of the new conservation and generating resources in the region. The Council's 1983 Power Plan also assumed that Bonneville would lead the region in developing new power resources and using its existing ones most efficiently, and that all the region's utilities would work with Bonneville to develop the lowest cost resources.

Today the region is divided, with Bonneville supplying power to approximately half the region. Under law, Bonneville must supply power to all utilities that give the required notice of their needs, but currently only one investor-owned utility is placing a small load on the agency.

If the region remains divided, it faces the prospect of developing more expensive resources than if it can unite around a cooperative approach. The worst scenario is one in which low-cost conservation remains undeveloped in surplus utility service areas while other utilities turn to much more costly resources. More costly new resources will mean higher electric rates, a situation which could damage the entire region's economy—especially the basic industries that depend on low-cost power. These resources would lead to a greater disparity of rates among utilities, which could affect the political stability of the region's power system.

The status quo is leading the region in a direction that will benefit neither the Northwest's ratepayers nor the Northwest economy. This plan points to a better future, one in which all the region's power institutions cooperate to develop and share the lowest cost resources for the entire Pacific Northwest.

The Benefits of Regional Cooperation

There are major benefits to coordinated regional action. The development by Bonneville and public utilities of conservation and strategies for using the existing hydropower system more efficiently, and the transfer of these resources to utilities needing energy, have a present value benefit of $1.6 billion for the region. This is what the region could save compared to a situation in which utilities pursue independent paths and do not cooperate in developing the lowest cost resources to meet regional needs. In addition, if Washington Public Power Supply System Nuclear Projects (WNP) 1 and 3 are available to meet regional loads, they will add an expected present value of $630 million.

Thus, the total expected value of developing resources through regional cooperation is $2.2 billion (see Figure 2-1). This value represents the expected or average savings to the region over studies of 300 different future loads within the range of forecasts for future electrical demand. This value rises to a maximum of almost $5 billion in load cases where the transfer of conservation and nonfirm power and the construction of WNP-1 and WNP-3 eliminate the need to construct more expensive new coal plants. The value becomes negative in low load growth cases where the region pays preservation costs for WNP-1 and 3 and no new resources are needed.

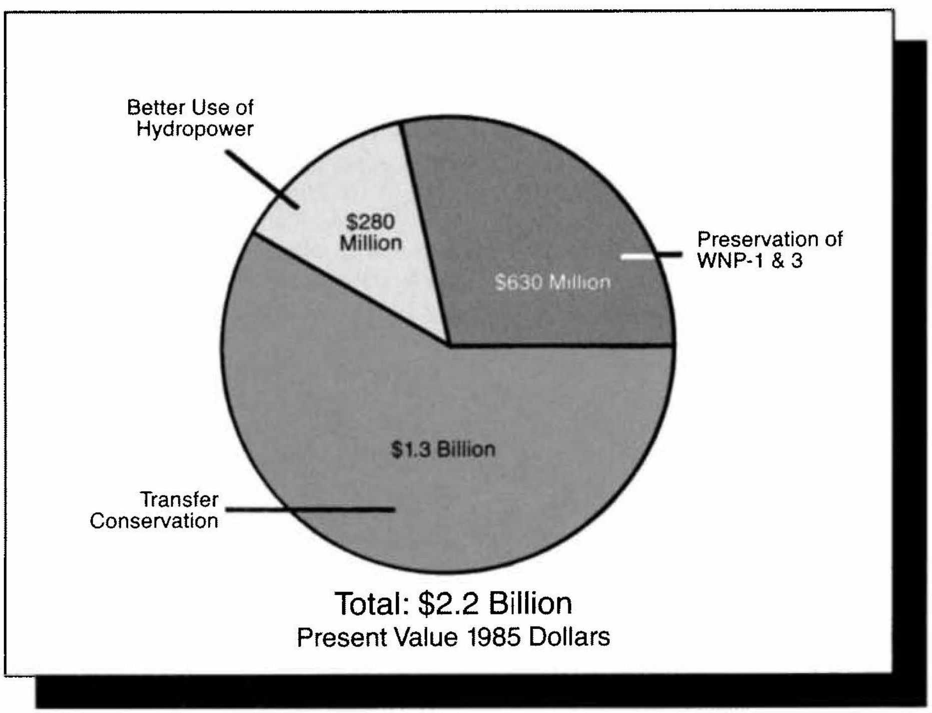


Figure 2-1
Benefits of Regional Cooperation

The greatest values from transferring conservation and better use of the hydropower system come in the more likely medium load cases. In the medium cases, these resources are needed much earlier on a regional basis than if they were developed solely for publicly-owned utility needs. The greatest value from preserving WNP-1 and 3 occurs in the high load cases.

The Council has identified a number of actions to resolve barriers to regional cooperation in order to promote the lowest cost electrical energy future for the entire Pacific Northwest. The actions are addressed below in general, and specifically in Chapter 9, the Action Plan.

The Bonneville Role: Catalyst for Cooperation or Just Another Utility?

Perhaps the most important catalyst for achieving or failing to achieve regional cooperation will be the role the Bonneville Power Administration plays. Bonneville faces the choice of providing the leadership to build cooperative approaches to conservation and resource development, or to settle into the more limited role of being merely another utility focusing solely on the requirements of its current customers. The utility role would be the easiest and would respond to Bonneville's traditional constituencies. Building regional cooperation, on the other hand, poses a tremendous challenge. It requires Bonneville to take greater risks and to involve a number of organizations that have not traditionally been part of Bonneville activities.

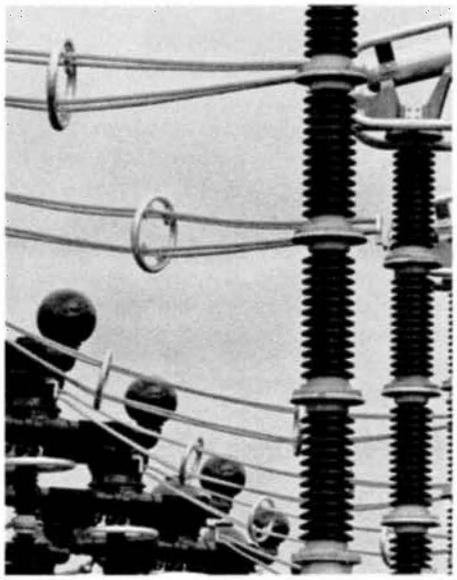
In some ways, great progress has been made; Bonneville's lead in the implementation of the model conservation standards is a noteworthy example. Another example is Bonneville's development of a regional policy for determining access to the intertie, the transmission lines over which surplus power is sold to California.

In other ways, however, the region has been unable to come together to solve major problems. One notable setback to a regional concept was the inability of Bonneville and a number of the region's major utilities to negotiate conservation contracts. These contracts, designed to provide financial assistance for conservation programs, would have been a major factor in achieving a regionwide coordinated conservation program.

The major barrier to regional cooperation is the uncertainty surrounding the wholesale price Bonneville will charge for its new resources pool. The new resources rate is the price investor-owned utilities would pay for firm power to serve their industrial and commercial customers. Bonneville could take a major step in reducing uncertainty in the region by helping utilities decide whether or not they will buy power from Bonneville in the future or develop their own resources. Currently, the unpredictability of future Bonneville rates is a major deterrent to any utility planning to turn to Bonneville for power. Given this instability, investor-owned utilities may choose to pursue independent and more costly resource development. Bonneville is essentially a power wholesaler. If it is going to market power competitively, it needs to determine the cost and availability of resources that would be available to investor-owned utilities, including the transfer of conservation and nonfirm power under mutually agreeable terms and conditions. A predictable new resources rate pool would be a major step in reducing uncertainty about the future.

Another area where Bonneville can promote regional cooperation is in its review of power sales contracts. As a result of a recent court decision, Bonneville must prepare an environmental impact statement on its 1981 long-term power sales contracts. As it reviews these contracts, Bonneville should recognize the opportunities to facilitate conservation transactions, allocate the costs of resource options, and implement strategies to make better use of the hydropower system.

Because Bonneville occupies a central position in the Pacific Northwest, the problems this plan describes cannot be solved unless Bonneville uses its position for the benefit of the entire region. If Bonneville chooses to advance solely its own interest or the interests of its current customers, then the regional division that brought about the regional power problems of the 1970s will be repeated.



The Surplus: Disparities in Its Distribution

Another key area for cooperation is in the treatment of the region's surplus. The surplus brought problems different than the ones the region anticipated when it expected a power deficit. Today, the region has a 2,500 megawatt surplus of electricity which could last anywhere from five to more than 20 years. For the moment, there is little need to develop resources that can be developed later. In historical terms, the size of the surplus is not unusually large. What is large and unprecedented is the cost of that surplus. Avoiding costly surpluses or deficits in the future is a major goal of this plan.

Of the 27 coal and nuclear plants planned in the 1960s and 1970s, 14 have been completed and one remaining unit is nearing completion. Much of the region's surplus is composed of power that cannot be sold for its full cost. Ratepayers are paying some of the construction costs of plants that are not currently needed. Six of the planned thermal plants have been put on hold in various stages of development and six plants have been terminated. The total investment in terminated and uncompleted nuclear plants alone exceeds $7 billion. Clearly, there is a high cost associated with building too many resources of the wrong kind, just as there is with building too few resources. The lesson has been an expensive one for the Northwest.

These new problems are compounded by the fact that the amount of the surplus varies sharply between public and investor-owned utilities as groups and, to a lesser extent, among individual utilities. Because they have priority access to the federal base system,[1] public utilities as a group appear to have a projected surplus of electrical power for a much longer period than investor-owned utilities.

The disparity of resources among utilities makes it difficult to determine what actions various parties will take and what future energy needs Bonneville will have to serve. While only one investor-owned utility is currently purchasing power through a long-term contract from Bonneville, Bonneville is obligated to meet all requests for power upon seven years' notice (or less notice under some circumstances). Thus, Bonneville's obligations could double within the next 20 years.

Lack of experience in developing resources on a regional basis or in allocating resource costs poses the most immediate threat to realizing the lowest cost energy future for the region as a whole. Failure to develop the cooperation that can lead to regional resource development is creating many small regions within the Northwest—Bonneville and each of the individual generating utilities.

Cooperation among power institutions is vital for the realization of a regional plan. There are four key areas for this cooperation: 1) developing regionally cost-effective conservation before turning to more expensive resources; 2) allocating the cost of acquiring and holding resource options that provide flexibility for the regional power system; 3) making better use of the hydropower system (see Chapter 7); and 4) working out mutually beneficial callback provisions and access to transmission lines for surplus power sales (see Chapter 9).

Developing Conservation throughout the Region

Developing cost-effective conservation throughout the region before some utilities invest in expensive thermal plants is estimated to save the region $1.3 billion in expected present value costs. A savings of that magnitude would benefit the entire region, not just the customers of utilities needing power.

Cooperation is currently limited because a utility with surplus power may not feel any real incentive to develop conservation that is cost effective to the region, since the utility itself does not need the resource. However, if the resource could be "sold" to another utility either directly or through Bonneville's rate pools, there would be a definite incentive. But, because conservation is not sold at present in the same manner as generated power, other arrangements are needed.

These arrangements could enable a surplus utility to transfer the power it would have consumed had it not developed its conservation potential. By working together, the deficit utility can get power at a lower price while the surplus utility generates revenues. In addition, the surplus utility's customers will benefit from efficiency improvements someone else pays for and from the fact that the lower-cost, investor-owned power keeps the cost of exchanging power down. Finally, the region will benefit as rate disparities are reduced. Because the savings potential for transferring conservation between utilities is so great, the 1986 Power Plan calls for Bonneville to develop the mechanisms to make such arrangements possible. It also calls on Bonneville to support direct transactions between utilities and to support independent efforts to come up with solutions.

Allocation of Resource Option Costs

Cooperation is also important for developing resource options and for preserving WNP-1 and 3. The Council estimates that preserving these two plants as potential resource options that could be developed later, as needed, has an expected present value benefit of $630 million. This is the average value across all the load cases studied. In medium and high growth scenarios these two plants are needed, and completing them would cost significantly less than starting new coal plants, saving the region up to $2.7 billion. In lower load cases the plants would not be needed.

Although construction of WNP-1 and WNP-3 has been suspended, preservation costs are expected to range between $24 million and $72 million a year. Currently, Bonneville pays all of these costs, and some of its customers believe costs are not properly allocated among the region's ratepayers. This objection stems from the fact that Bonneville may not need the output of the plants unless investor-owned utilities turn to Bonneville for power. Because Bonneville's obligations with respect to investor-owned utility needs are uncertain, some believe that Bonneville should not bear the preservation costs for WNP-1 and 3.

The WNP-1 and 3 cost question reflects a lack of a general policy for allocating the costs of preserving options. Bonneville needs to develop such a policy. Since all of Bonneville's customers benefit from the flexibility offered by options, one alternative would be to spread the costs of securing and maintaining options across all of Bonneville's power sales.

Better Use of the Hydropower System

The third area where cooperation is vital centers on a way to make better use of the hydropower system, particularly the nonfirm power available in most years. Nonfirm power is that power produced by the hydropower system over the level available in a critical water (historic low) year. It is called nonfirm because it is not always available, since it depends on the weather. Nonfirm power is currently sold to serve the top quarter of the direct service industries' electrical power load, to Northwest utilities which use it to reduce operation of their more expensive thermal plants, and to California utilities.

However, this valuable resource could meet a significant portion of the region's firm power loads far less expensively than newly constructed power plants, saving the region $280 million. To realize this potential, Bonneville would have to reallocate this power from customers who currently purchase it to others whose firm loads are growing. This shift will require a careful balance of costs and benefits through the development of a nonfirm power allocation policy. (Strategies for "firming up" nonfirm power are discussed in Chapter 7.)

The Investor-Owned Utilities: A Changing Climate

The lowest cost energy future depends on the cooperation of the region's investor-owned utilities as much as it does on Bonneville and the public utilities. A number of recent developments have influenced decision making by these utilities.

The region's utilities are well ahead of their counterparts in the rest of the nation in their emphasis on conservation and in their treatment of conservation as an energy resource, rather than merely as a consumer service. However, investor-owned utilities have also shown a marked shift in their long-term planning strategies. Understandably cautious after making costly investments in plants that were not needed, some utilities are showing a reluctance to plan for all but the near term. The result in the short term is to rely on the current surplus of electricity. Over time, however, this approach could lead to a reliance on more expensive or higher risk resources, especially if load growth increases quickly.

The problem is a reflection of the fact that the future turned out differently than utility planners in the 1960s and 1970s expected. The cost of borrowing capital went up substantially; the cost of building plants turned out to be much higher, and the time it took to build them turned out to be much longer. As a result, many investor-owned utilities have become "capital averse." That is, they don't want to invest in projects with high capital costs or long lead times. The rewards appear small and the risks high. These risks range from not being allowed to include the cost of plant construction in rates, to the inclusion of such costs to a point where the ensuing high rates drive away customers.

At present, there is little or no incentive for utilities to develop new power resources. In fact, there are a number of disincentives to building any resource. These include the following.

1. Because of the current surplus of electrical power, even utilities which need power are likely to be able to buy inexpensive resources from surplus neighbors on a short-term basis. Most new resources which could be developed are far more expensive than the existing resource base. Because of the large difference in costs, decision makers face significant risk when they begin new resource development.

2. Some utilities are allowed to charge customers for some of the costs of new power plants while they are under construction, but some states prohibit the inclusion in rates of Construction Work in Progress (CWIP). Where CWIP is not allowed in rates, a utility cannot recover direct construction costs, or the interest on money borrowed to finance construction, until the resource is finished. If construction is terminated, the utility shareholders and management face a much greater financial risk, since the company may have to absorb all costs.

3. The Public Utility Regulatory Policies Act (PURPA) has led to acquisition of some high-cost resources. PURPA requires utilities to purchase power from cogenerators and small power producers at the utility's avoided cost—the cost that would otherwise have resulted had utility resources been developed. In some cases, this requirement has promoted the independent development of substantial high-cost new power resources that increase the current surplus.

4. The "used and useful" criteria used by state regulatory authorities prohibit utilities billing consumers for resources until those resources are performing and have proven necessary. The criteria create major uncertainties for utilities which must make investment decisions today for resources that will be completed at some future date. Over the years, circumstances may change so that resources built will not perfectly match load growth later on. As a consequence, the plants may be judged not to meet the criteria. These criteria can have a chilling effect on investments because of the risk of investing in new resources that are later not allowed to be included in rates.

The financial, legal and regulatory environments have made utility decision makers cautious about new resource decisions with good reason. Utility planners now face resource decisions with an extreme aversion to large capital investments that could threaten the financial viability of their company. In most ways, this attitude is positive. A recognition of the high cost of overbuilding is both reasonable and beneficial. But carried to an extreme, it could lead utilities to fail to make long-term capital investments, even when the alternatives that turn out to be available are not cost effective.

To implement the plan, the region's utilities must all share in securing resource options and developing new resources. Bonneville can purchase the output of resources, but it cannot build or operate generating resources. For this reason, the plan relies on utilities and private developers to share in financing and developing both conservation and generating resources. For example, conservation is likely to require more capital than is authorized by Congress for the Bonneville Power Administration. The Council is concerned that the current incentives for developing the long-term resources envisioned in this plan may not be sufficient to assure that resources will be developed when they are needed. The region must rebuild incentives to allow the development of the most cost-effective resources identified in this plan.

Current Uncertainties in the Region

The need to regularly monitor and revise the power plan has been underscored vividly by the major changes taking place in the three years since the original plan was adopted. In addition to the inherent uncertainties in attempting to forecast the future, other factors have surfaced which create even more uncertainty for planners. These uncertainties have made planning both more difficult and more necessary. Major problems are highlighted below.

The Volatility of the Direct Service Industries

One major factor is the unpredictable future of several energy-intensive industries served directly by Bonneville. These direct service industries, mostly aluminum plants, represent a firm load of about 2,500 megawatts, or approximately 15 percent of the regional power requirements. Some of the power needs of these industries can be filled by interruptible power—service that can be curtailed when an energy deficiency occurs. This arrangement provides for varying power delivery based on Bonneville's and the customers' needs. Presently, the top quarter of the direct service industry load is interruptible for almost any reason. The second quarter is interruptible if Bonneville's planned resources are delayed. The entire direct service industry load is interruptible for short periods of time to protect the stability of the electrical system.

Sharply higher electricity prices have raised the relative cost of production for Northwest aluminum smelters. In addition, the strong U.S. dollar has affected worldwide demand for goods made in the United States. These factors, coupled with depressed world aluminum prices and competition from other parts of the world, have made the long-term future of the region's older, less efficient aluminum plants particularly uncertain. Many of the Northwest's plants "swing" with the world price of aluminum—as the price falls, these plants are shut down temporarily. During the last five years, power used by the aluminum smelters has fluctuated by approximately 1,000 megawatts. This volatility not only affects the direct service industries' employment, but also the revenues which the power

system receives from these industries and the rates other customers must pay.

In addition to these fluctuations, there is the serious planning problem raised by the future of these plants. Will some or most of them leave the region? If so, when? Some of the Northwest's aluminum plants are quite old. High production costs make it difficult for them to compete in world markets. Another factor affecting this uncertainty is the 2001 expiration date for the direct service industries' power sales contracts with Bonneville. If these contracts are not renewed or if changes in their terms make the plants uneconomical, the region's firm load could be reduced by up to 2,300 megawatts.

Depending on the circumstances, losing this load could have either benefits or costs for the region's power system. In any event, it would have a major impact on resource decisions made in the decade before 2001. For example, WNP-1 and 3 would not be needed if a significant portion of the direct service industries' load is discontinued (see Chapter 7). The Council has incorporated the uncertainty surrounding the direct service industries into its resource portfolio analysis (see Chapter 8).

Some Conservation Programs Still Need to Be Tested

The cost and availability of conservation resources are also uncertain. In its 1983 Power Plan, the Council called on Bonneville to take four basic steps to reduce these uncertainties. These steps were to:

1. Fine tune its existing residential conservation program to achieve all the conservation savings when the houses were weatherized, and to ensure that the program reached renters and low income people in proportion to their numbers in the population at large;

2. Gain the experience needed to acquire conservation resources in the commercial, industrial, governmental and irrigated agricultural sectors when resources are needed by the region;

3. Provide technical and financial support to state and local governments and other entities implementing the Council's plan, including the Council's model conservation standards; and

4. Conduct research and demonstration activities to reduce the uncertainties regarding the region's ability to meet its electricity needs cost effectively with conservation and other resources.

The results during the three years after the first plan have been mixed. Bonneville, the Council and the region have made substantial progress in carrying out many of these activities. Among the more important advances have been the adoption of the Council's model conservation standards for new buildings by six jurisdictions in Washington state; the construction throughout the region of over 400 single family houses to these standards through the Residential Standards Demonstration Program; approval of statewide building codes in Oregon and Washington containing many of the measures in the Council's model conservation standards; establishment of the Super Good Cents program, a major effort to promote the construction of energy efficient new housing in the region; and initial efforts to gain the capability to develop conservation in the commercial, governmental, industrial and agricultural sectors.

In spite of the progress made since the adoption of the first plan in 1983, there are still significant uncertainties over the region's ability to meet its future energy needs through conservation. Bonneville has gained only limited information and experience in the commercial and industrial sectors regarding the costs, incentives, market penetration rates and lead times necessary to expand programs to the regional level. It appears that Bonneville needs more time to develop this capability.

Uncertainty also remains about how effectively the Council's model conservation standards will be implemented. Regionwide adoption of the standards through building codes, financial assistance, marketing programs or some combination would dramatically reduce the region's reliance on more expensive new generating resources. In the Council's high demand forecast, the electrical power savings from new residential and commercial buildings built to the standards represent more than 700 megawatts of power at a cost significantly lower than that of building new coal plants, the most likely alternative.

Barriers Facing WNP-1 and 3

The cost and availability of generating resources continue to be highly uncertain as well. Cost and schedule overruns have affected a number of generating resources. For example, the original estimate for all five Washington Public Power Supply System Nuclear Projects (WNP) was $4 billion. Each plant was scheduled to be completed in seven years. In the last budget developed prior to the termination of WNP-4 and 5, the Supply System projected a total budget of $23 billion for the five plants. The construction period for nuclear plants in this country has been as long as 16 years.

Another major generating resource uncertainty is whether WNP-1 and 3 can be preserved and constructed, should they be needed to meet regional energy needs. Construction at these two partially completed plants is currently suspended. Together, these plants represent approximately 1,600 megawatts of energy that the region may need in the future. The Council has completed a detailed analysis of the costs of the two plants and the legal, financial, and regulatory issues that may affect their preservation. This analysis appears in Chapter 7 of this volume and in Chapters 6 and 8 of Volume II.

According to this analysis, the plants have an expected present value of $630 million to the region. Even though they are not needed if electrical demand growth is low, they are valuable as insurance in the event of high growth. However, despite their cost effectiveness, the Council found that there are significant barriers that could prevent the plants from being completed. The region needs to take actions to resolve these barriers so that the plants can be preserved and then completed if and when they are needed.

These barriers include litigation involving WNP-3, 4 and 5 and the resulting unavailability of low-cost financing to complete the plants. Another barrier is the incongruence of ownership and need. All of WNP-1 and 70 percent of WNP-3 are owned by the Washington Public Power Supply System and are paid for by Bonneville's current customers. Four investor-owned utilities own the remaining 30 percent of WNP-3. Because it is uncertain whether or not investor-owned utilities will turn to Bonneville for power, it is not clear how long Bonneville and its customers will be willing to pay the preservation costs for the plants. The need for Bonneville to deal with allocation of costs has been described above.

Still another uncertainty is how long the plants can be physically preserved and whether significant regulatory changes will add to their costs. The Council believes it is likely the plants can be preserved for an extended period under the current Supply System preservation program.

Despite these barriers, the Council has determined that the plants are potentially cost-effective resources for the region to complete and should be preserved as potential options in the plan. The Council has identified actions that need to be taken to remove the barriers to these plants' completion. The Council has not included WNP-1 and 3 in the resource portfolio, because they do not appear to be sufficiently reliable and available. The region should not rely on WNP-1 and 3 until the barriers are removed. By this action, the Council intends to focus attention on the problems so that solutions can be found before these resources are inadvertently lost to the region.

Uncertainties with Out-of-Region Sales and Purchases

Since the 1983 Power Plan, several utilities in the region have made long-term firm power sales out of the region totaling approximately 150 megawatts. The Council is also aware of efforts to sell approximately 350 megawatts of additional power to California utilities on a long-term basis. If these negotiations result in sales that do not include provisions permitting the region to recall the power when needed, these resources could also be lost to the region for their entire operating life.

As energy needs grow, the region may have to acquire more expensive resources to replace those that have been sold. On the other side of the balance sheet, there may be a potential to purchase surplus power from the Southwest or British Columbia. The Council expects that it may take several years to clarify the potential size and duration of such purchases. In an effort to examine the costs and benefits of inter-regional cooperation, the Council will conduct a West Coast energy study. This study should provide information on import or export opportunities which the Council can include in its planning process. (See Chapter 9 for more information.)

What Needs to be Done to Ensure the Region's Low-Cost Energy Future

A surplus of power can provide a false sense of security. It reduces the motivation to conserve electricity or even to plan for the future. Yet it is obvious from the present situation that having "plenty of electricity" does not mean lower rates. The goal of energy planning is not only to ensure an adequate supply of electricity, but to prevent overbuilding and to minimize the total cost of electricity to the region and its ratepayers.

This power plan identifies a number of steps that the region, the Council, Bonneville, the region's public utility commissions, and both public and investor-owned utilities can take to increase rate stability and ensure a bright energy future for the Northwest. Specific steps are outlined in Chapter 9, the Action Plan.

The Council's near-term priority is to save "lost opportunity" resources, those cost-effective resources which, unless they are secured now, could be lost to the region. The most important example is making new buildings energy efficient at the time they are built.

The next priority calls for Bonneville to assume a stronger regional role. A great deal depends on Bonneville's ability to lead by stimulating cooperation. A stable and predictable rate for new resources is needed so that investor-owned utilities will be able to turn to Bonneville rather than developing more expensive power resources on their own. Mechanisms must be designed to allow utilities to develop regional resources, particularly conservation, in ways that benefit both the "seller" and "buyer." Bonneville should also support sales of conservation between utilities.

In addition, Bonneville must address the issue of allocating the costs of options, eliminating barriers to preservation and construction of WNP-1 and 3 and reducing the uncertainty associated with the direct service industries. These steps, along with better use of the hydropower system, will also help keep power rates low.

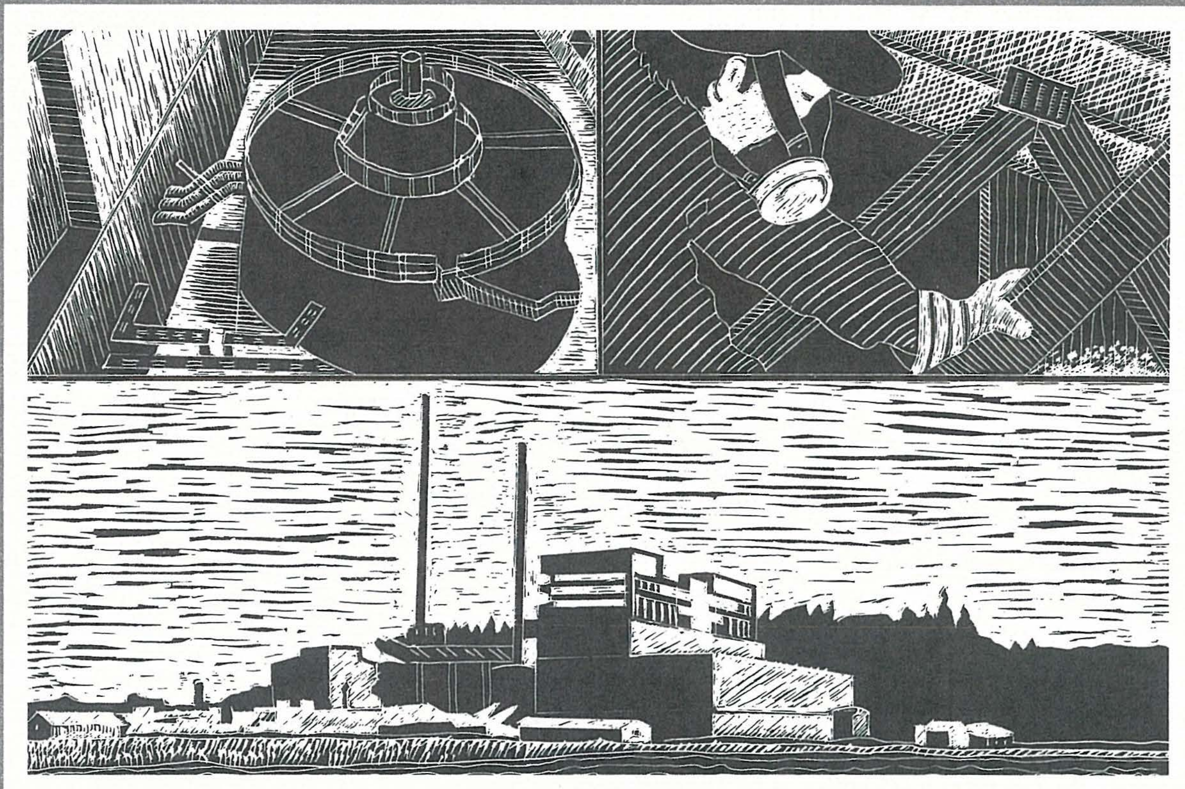
Finally, regional organizations need to build the capability to deliver conservation so that it is ready and reliable when it is needed. These efforts should focus on gaining information and experience, rather than on acquiring new power. The region also needs to coordinate its research and development programs so that renewable resources are available as they are needed.

The common theme through all of these priorities is cooperation. This is not something that can be mandated. It will only come about as the various entities develop a consensus that what affects one affects all of them. Their futures are linked together just as the future of the Northwest power system itself is linked to the future of the Northwest economy.

The current surplus of electricity may last from five to more than 20 years, depending upon the levels of economic activity in the Northwest. When new resources are needed, the Council has identified sufficient cost-effective resources to meet the region's needs while protecting its environment and fish and wildlife. Moreover, if the Northwest's power institutions can cooperate in regional energy development, electricity rates in the region can be much more stable over the next 20 years. In fact, depending on the level of economic activity and the number of new resources that will be needed, rates may actually decline after adjustments are made for inflation.

Solutions to the region's problems will not come easily. The Council believes the region can and will overcome barriers so that a cooperative regional planning strategy can be implemented. The Council is also assuming that mechanisms can be developed to secure the lowest cost resources for the entire region. Accordingly, the Council is continuing to plan for the needs of the entire Pacific Northwest as contemplated by the Northwest Power Act. The Council also has identified actions that Bonneville needs to take to meet its obligations. The Council will continue to work aggressively with all organizations in the region to make the Act work.

1./ The federal base system includes the federal hydropower system, the net-billed nuclear plants (part of Trojan, WNP-2, and, if completed, WNP-1 and 70 percent of WNP-3), plus some other resources such as the Hanford generating project.



Chapter 3

Chapter 3
The Council's Planning Strategy: Risk Management

Because the future is uncertain and conditions are likely to change, this plan is not a static document. Flexibility and risk management are underlying concepts throughout the Council's planning strategy.

The Council developed this plan with the following specific goals in mind:

- To provide the region an adequate and reliable supply of electrical energy at the lowest possible cost;
- To select resources following the cost-effectiveness principles and priorities in the Northwest Power Act;
- To develop a flexible strategy so that the plan can be modified as conditions change and new information becomes available;
- To encourage the greatest rate predictability and stability for the region;
- To evaluate all resources from a total regional system perspective to ensure their compatibility with the existing power system;
- To select resources with the least adverse impacts on the environment, or those with adverse environmental impacts which can be mitigated; and
- To select resources that are consistent with protecting and enhancing fish and wildlife, and that mitigate power system impacts on fish and wildlife.

Planning for Economic Growth

The Council recognizes the shifting nature of energy demand projections and has chosen to deal with this uncertainty by defining the boundaries of the region's potential energy growth. To do this, the Council developed high, medium-high, medium-low, and low electrical load growth forecasts over the next 20 years. The region's actual demand for electricity is expected to fall somewhere within the range between high and low.

The high forecast in the Council's range projects an average annual rate of growth of 2.7 percent. This outcome would be the result of record regional economic growth relative to the nation over the next 20 years. In fact, it is based on assumptions that would produce relative economic growth over 20 years at a higher rate than the rate for the highest five years in the Northwest's recent history. Employment in the region would grow 130 percent faster than projections for a fast-growing national economy. The Council has selected such a high upper bound to ensure that the region has the ability to supply electricity for any potential need. Electrical energy supply should not constrain future economic growth.

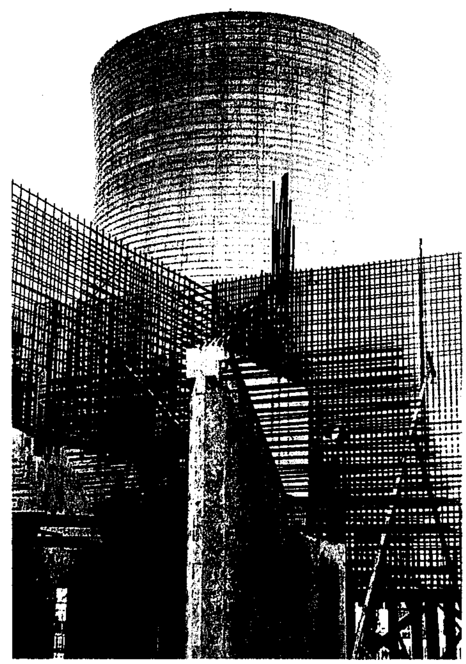
The lower boundary of the range forecast is 0.2 percent. It is based on assumptions that the region might grow more slowly than the rest of the nation, with new employment growing at a rate 40 percent lower than a low national forecast. The economic assumptions in this forecast would be well below what the region has experienced over the last 20 years. The Council translates economic assumptions into corresponding electricity requirements using the best available demand forecasting models.

The range forecast has two important functions. First, it is an explicit statement that the future is uncertain and that the Council will not base decisions on the traditional "most likely" forecast. Rather, the Council evaluates the consequences of specific actions across a wide range of possible futures. Second, the range forecast represents the Council's judgment on the potential futures that the region should plan and invest for. While it is possible that electrical load will grow faster than the high forecast or slower than the low forecast, the Council believes the range represents the prudent span of futures on which to plan. This range defines the magnitude and schedule of actions that are needed to meet potential energy needs.

Planning for Flexibility

Four characteristics were identified as particularly important in providing the flexibility to adapt to uncertainties that could increase the region's electricity rates.

First, as the Council looked for the lowest cost resources, it took into consideration how a resource interacts with the existing power system and all the costs that must be borne



over the entire lifetime of a project, including construction, operation, distribution, decommissioning, and environmental costs.

Second, the Council recognized that resources with short lead times can reduce risk. The region knows a great deal more about the near future two or four years from now than the future ten or 20 years from now. Resources that can be constructed and brought into operation quickly give the region a much better chance of matching supply to energy needs. A major problem with building a large central station plant today is that it forces a utility to make decisions and commit large amounts of capital ten years or more before the power is needed. Such a long lead time exposes the project to increased possibilities of changes in the need for power from that plant.

Third, small plant size also increases flexibility. Resources that can be developed in 50 or 100 megawatt units make it much easier to match resources to loads than a large coal plant that adds enough power to serve a city the size of Portland the year it is completed.

And fourth, the Council determined that resources with low capital costs tend to reduce risk to the region, since they reduce the amount of money that has to be committed on any one project.

Based on these precepts, the Council has developed a planning strategy that has the diversity and flexibility to adapt to a wide range of future outcomes. Using this strategy, the Council has identified a mix of resources in its resource portfolio which takes into account the benefits of shorter lead times and lower risk resources. This portfolio provides the region with the ability to respond to a broad range of future needs at the lowest possible cost.

Conservation: The Flexible Resource

The Council has found that conservation is a highly flexible resource. The Northwest has a large supply of potential conservation measures which cost much less than building a new coal-fired power plant. Conservation programs have relatively short lead times and can be developed in small units.

Once a program has been developed and tested it can create savings quickly, and these savings can be timed to match growing power needs. If the region's electrical energy need grows rapidly the conservation programs can be accelerated. If slower growth occurs they can be maintained at a minimum level. While conservation programs are capital intensive, the expenditures are almost simultaneous with the savings, and they can be paced to deliver the needed amount of savings much more easily than new central station power plants.

An added benefit to conservation is that it helps reduce uncertainty. Because it uses less energy, a well insulated house or an energy efficient industrial plant is more resistant to changes in energy prices and is therefore less likely to contribute to fluctuations in power demand or switching to another fuel.

Options: A Flexible Approach for Generating Resources

If the Pacific Northwest grows rapidly, it will need resources in addition to conservation. The Council has been working to improve the flexibility of generating resources in order to reduce the risk they pose for utility systems and ratepayers. A new arrangement, which first appeared in the 1983 plan, uses resource "options" to add flexibility to the scheduling of those resources which require a great deal of time from inception to completion.

The idea is similar to purchasing an option on a piece of land. It involves paying money now for the right to purchase and develop the project later. More broadly, options are methods for managing the power supply inventory at low cost. Options also include the sale of power from existing surplus resources while preserving the ability to recall the power when it is needed.

A resource option would allow a resource to move through the time-consuming but relatively inexpensive siting, design and licensing stages, after which it can be placed in a "ready condition." In that condition, the project could be scheduled, placed on hold, constructed or terminated, depending on the demand for electricity. To secure an option, the Bonneville Power Administration would provide financial assistance to a resource sponsor in exchange for the right to decide when conditions warrant beginning construction. Such options would provide a relatively low-cost inventory that would allow the region to be ready for high growth rates without prematurely committing to build to those rates.

The cost of developing options is typically very small compared to the costs associated with constructing a resource. Furthermore, options substantially reduce the lead time of resources. By having a licensed or readily licensable resource effectively "on hold," the period over which electricity needs must be forecast could be reduced to the resource construction period, which may be as little as half of the total time that is now needed. Figure 3-1 shows the cumulative costs of the option and construction phases for several resources. For example, the total lead time to site, license, design and construct a new coal plant is about ten years. The activities of siting, licensing and detailed design would take five years and cost $60 per kilowatt, compared to the $1,200 per kilowatt for the construction phase. It would then take another five years to complete construction. Thus, the effective lead time can be reduced by five percent for approximately five percent of the total potential cost.

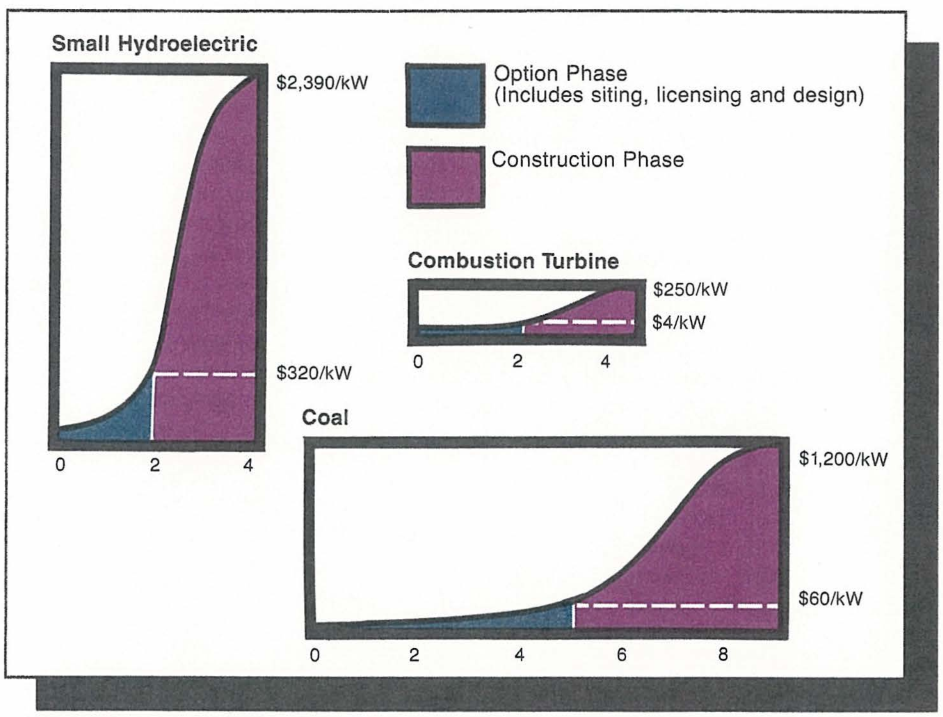


Figure 3-1
Cost and Timing of Optioning and Constructing Resources

The key to the options concept is the separation of decisions related to construction from those of preconstruction. The objective of an effective options planning strategy is to move decisions involving the commitment of large sums of capital as close as possible to the anticipated time power will be needed. This will significantly reduce the likelihood of beginning construction on a project that is not needed. Another benefit of the option approach is its potential for reducing environmental degradation. For example, if generating plant construction can be postponed until need is more certain, the accompanying environmental impacts also can be postponed and, if the plant is not needed, they can be avoided. This approach will have less effect on the environment than building and operating resources that may not be needed.

The Council has planned a large inventory of options to meet a very high level of economic growth. If the region actually experiences lower growth rates, some options would be delayed or even abandoned at a minimal cost to the region. This concept is comparable to an insurance policy—paying low-cost premiums to be prepared for a high-cost event. It improves the region's ability to match energy supply to actual demand and reduces the chance of overbuilding resources, an event which historically has been very costly.

The Council has analyzed the value to the region of being able to option resources. It found that a two-stage decision-making process could save the region $700 million across the range of future load growth.

The Council has identified three specific types of resource options, each of which provides the region with ways to limit future power costs:

- **Resource-banking:** A resource could be sited, licensed, and designed, but the construction phase would be put on hold until actual need for the resource was determined.

- **Sales option:** Another form of an option would involve the sale of surplus power from a new or existing resource. Contract provisions would allow the power to be called back with some notice. These sales options could provide a regional benefit by generating revenue that reduces power costs in the Northwest. At the same time, they would avoid situations where resources are sold for their entire lifetime, potentially forcing the region to build new resources to meet its own needs.

- **Existing resource option:** In response to temporary resource needs, the output of an existing resource could be acquired by paying for its operating costs. (Examples are existing combustion turbines inside the region or excess generation in California or British Columbia.)

Using the Council's planning strategy, the resource option process could include the following five steps:

1. **Option Planned:** The Council identifies a resource as potentially needed, but no decision or financial commitment is necessary. Bonneville could begin developing incentives and requests for options, establishing criteria for selecting options, and resolving potential legal, regulatory and technical questions. Based on the projected cost effectiveness of and need for the resource, its environmental impacts, and the costs of securing an option, different option points may be appropriate for each resource.

2. **Option Initiated:** The Council and Bonneville determine that a resource may be needed in the future, and Bonneville enters into a contractual arrangement to provide financial assistance for the siting, licensing, and design of a resource, in return for control of project timing.

3. **Option Secured:** All technical, legal, and administrative issues have been resolved, and the resource is ready to move into the construction phase. At this stage, the construction of the resource could be delayed without affecting the ability of the region to move ahead on the project at some future date. Expected lifetime of the option would be determined by Bonneville at this time in consultation with state and federal licensing and siting agencies, and the option would be scheduled for a comprehensive review when this lifetime expires. An option could be resecured if it still met environmental and technical standards required to relicense the resource and site.

4. **Resource Acquired:** The Council and Bonneville determine that the secured option should be exercised based on current conditions and forecasts of demand. Under the resource acquisition provisions of the Act, Bonneville would enter into a contract to purchase the capability of the resource, and the project sponsor would begin construction of the resource. The region would not have committed large sums of ratepayer money before this point.

5. **Resource Completed:** The power is available to meet the obligations of Bonneville.

It is important to note that this is a dynamic process. When the region needs to initiate an option it would open a window of opportunity allowing various resources to compete. The cost of the proposed options, the ultimate costs of the resources, and their lead times and sizes would be evaluated in selecting the best options for the region. Prior to a decision to begin construction on a resource, the region would again determine whether any lower cost or lower risk resources had become available.

It is important to note that, even with no additional ability to hold a resource over what current regulations allow, the explicit recognition of a significant second decision to begin construction has value to regional power planning. Separate decision points in resource development will improve the region's ability to minimize the cost of meeting load growth.

The Council believes the options concept has great promise to provide the region additional flexibility in meeting its resource needs at the lowest risk and cost. To establish the practicality of this concept, the Council, Bonneville, utilities and other resource developers have been working to identify and resolve institutional, regulatory and legal barriers to its successful operation.

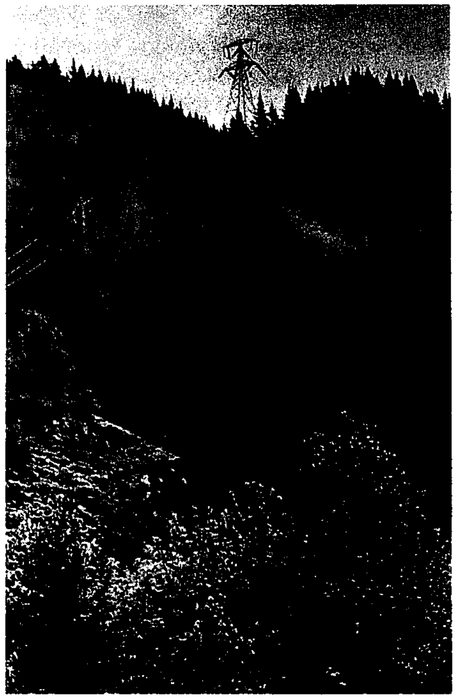
The progress to date has been encouraging. The state energy siting organizations in Montana and Oregon have incorporated the options concept into their procedures. The process in Washington appears to be receptive to optioning resources, but regulatory changes would probably be needed. At the federal level, the Federal Energy Regulatory Commission (FERC) has been working with the Council on ways to incorporate hydroelectric options within FERC's existing regulatory and statutory responsibilities. One promising idea would involve FERC taking an option recognized by the Council and Bonneville through the licensing process and then putting the application on hold just prior to issuing the license. When the project is needed, FERC could reactivate the file and issue the license within a few months. To test this concept, in response to the Council's 1983 Power Plan, Bonneville is currently negotiating with project sponsors to initiate several hydroelectric options.

The Council has also formed several task forces representing utilities, Bonneville, resource developers, environmentalists and other interested parties to work toward making the options concept a reality. A major product of the task forces is a model process for developing options, adopted by the Council in June 1984. Appendix I-A describes the model process. While there has been substantial progress, there are still significant questions and unresolved issues regarding the implementation of options. Therefore, the Action Plan, Chapter 9, identifies actions to further define and test the options process.

The Council's Planning Process

The Northwest Power Act sets down many guidelines for the Council's planning process. First, it requires the Council to develop a plan for developing resources, including conservation measures. The Council must consider environmental quality, compatibility with the existing regional power system, and protection, mitigation and enhancement of fish and wildlife. The Act also specifically requires that the Council include model conservation standards designed to make new electrically heated residences and new commercial buildings use electricity efficiently.

In accordance with the Act, the Council gives priority to resources determined to be cost effective. The Act defines a "cost-effective" measure or resource as one that is forecast to be reliable and available within the time it is needed at an estimated incremental system cost[1] no greater than that of the least-cost similarly reliable and available alternative.



Cost effectiveness is a function of need, relative cost, reliability and availability. The region should buy only the resources that it needs. When the region needs power, it should buy the lowest cost resources, counting all the costs involved on a consistent basis. And, the region should only depend on resources that are reliable and available when they are needed.

The Act requires the Council to give first priority to conservation, second to renewable resources, third to generating resources using waste heat or generating resources of high fuel conversion efficiency, and finally to all other resources. Finally, the Act provides a 10 percent advantage in calculating the estimated incremental system costs for conservation measures.

In selecting the resources described in this plan, the Council followed the direction of the Act. The steps used by the Council to develop a cost-effective power plan are summarized below.

Step One: Initial Determination of Resource Needs

The Council began with an extensive process to determine the range of future electrical energy growth in the region over the next 20 years, based on economic and demographic projections and the price of alternative fuels. Future electricity prices are also a key factor in forecasting future electricity use. At this step, estimates of future costs were used. As described earlier in this chapter, the forecasts characterize the range of uncertainty by displaying four growth patterns for electrical demand (high, medium-high, medium-low, and low). This process is described in more detail in Chapter 4 of this volume and Chapters 2 and 3 of Volume II.

The Council then developed its best estimate of the existing resource base, including any known additions or reductions (e.g., resources nearing completion or power contracts that expire over the next 20 years). The existing regional electrical power system is described in Chapter 5. The existing resources were subtracted from the range of future electricity demands to determine how much additional electricity may be needed in the future.

Step Two: Selection of Cost-Effective Resources

The Council estimated the availability, reliability and cost of both conservation and generating resources. The Council began this step by identifying the costs and performance characteristics of all generating and conservation resources. The environmental impacts also were analyzed for the resources in the plan. Costs were included for technologies to avoid or reduce to acceptable levels each resource's impacts on the environment, including fish and wildlife. The Council simulated how each resource would operate within the existing power system to determine the actual costs the region is likely to incur. This analysis also determined the compatibility of each resource with the existing power system. The products of this analysis are "supply curves" for each resource. Supply curves estimate how many megawatts of a resource are available at different costs.

Resources are divided into the categories of "cost effective" and "promising." Cost-effective resources are those judged to comply with the criteria below. Promising resources may be considered for future resource portfolios if their availability, reliability or system cost improve.

Criteria used by the Council to judge the potential cost effectiveness of resources are as follows:

1. **Commercially Available Technology:** The technology for conserving or producing electrical power must be commercially available.

2. **Predictable Cost and Performance:** The technology must sufficiently demonstrate that its cost and performance characteristics are predictable.

3. **Competitive Cost:** The resource must be cost-competitive using currently available technology.

4. **Demonstrated Resource Base:** The estimates of the amount of capacity and energy available from a given resource require a confirmed primary energy source (e.g., coal, falling water, wind).

5. **Institutional Feasibility:** Development of the resource must not be currently constrained by legal, financial, regulatory or other institutional barriers.

6. **Environmental Acceptability:** The resource must be environmentally acceptable and capable of complying with current environmental policies, laws and regulations of the federal, state and local governments, and the Council's Columbia River Basin Fish and Wildlife Program. Further discussion of the environmental characteristics of the resources used in this plan is provided in Chapter 9, Volume II.

The cost and supply of conservation is discussed in Chapter 6 of this volume and in more detail in Chapter 5 of Volume II. Generating resources are addressed in Chapter 7 of Volume I and Chapters 6 and 7 of Volume II.

The Council then analyzed the lowest cost combination of all resources to meet the entire range of potential energy needs. This analysis took into account the lead time and size of resources, and the cost of overbuilding or underbuilding.

Nondiscretionary resources were the first added into the portfolio. These are cost-effective resources whose timing cannot be scheduled or controlled by the power system. For example, the opportunity for energy savings in new residential and commercial buildings will occur when the buildings are built. The power system cannot control that timing, but it can take action to secure all cost-effective electrical energy savings at the time of construction. The nondiscretionary resources included in this plan are the electrical energy savings from the installation of more efficient refrigerators, freezers, and hot water heaters, and the construction of manufactured housing, and residential and commercial buildings built to the model conservation standards. The Council has found that these resources have low cost compared to other alternatives and have the added benefit that their savings occur simultaneously with load growth.

Discretionary resources can be scheduled by the power system to produce energy when they are needed. Discretionary resources in this plan are conservation programs in the existing residential, commercial, governmental, industrial and agricultural sectors; efficiency improvements to existing hydroelectric dams and the transmission and distribution system; combustion turbines operated in conjunction with nonfirm hydroelectric power; and new hydroelectric dams, cogeneration facilities and coal plants.

Cost Effectiveness of Near-Term Acquisition. Some nondiscretionary resources may represent lost opportunities for the region and require action in the near term. A lost opportunity resource is a potential electrical power generating or conservation resource currently available to the region which, if not acquired or otherwise secured now, will no longer be available and cost effective to the region. If a lost opportunity resource is not secured, it will have to be replaced in the future by a less cost-effective resource. A lost opportunity resource is cost effective and should be secured if the region's present value system cost to secure and maintain the resource, as determined by the Council, is less than the expected present value system cost of other resources which might have to replace it in the Council's resource portfolio.

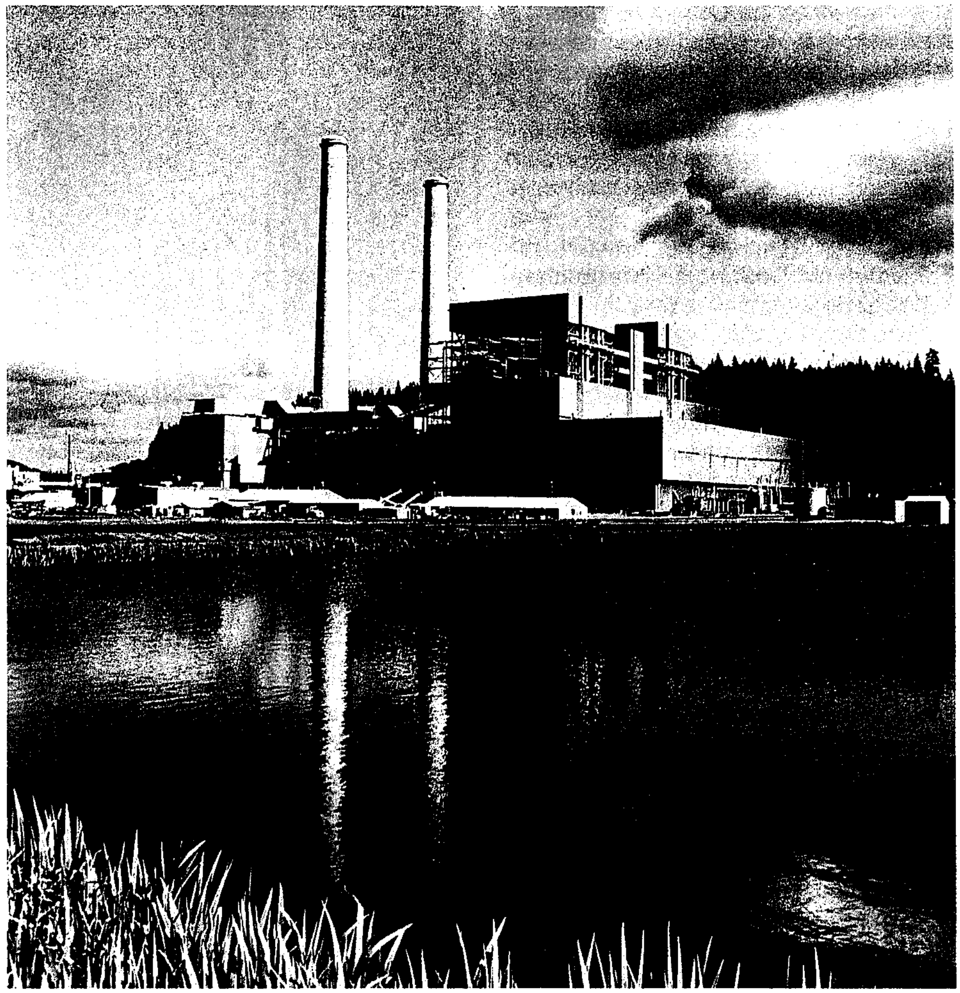
Some lost opportunity resources have additional value to the power system, however, because they occur simultaneously with load growth. The prime examples are the model conservation standards (MCS) for new residential and commercial buildings. In evaluating the value of these resources, the Council used two measurements of cost effectiveness. The first is the value to the region of the most expensive measures in the MCS package. The Council has estimated that currently the value of these marginal MCS investments is between 4.0 and 4.5 cents per kilowatt-hour. For purposes of defining the MCS at this time, the Council has evaluated the individual measures that are in the range of 4.0 to 4.5 cents per kilowatt-hour and selected those measures which in the Council's judgment are cost effective and should be included in the MCS. The cost of the most expensive measure in a typical MCS house is 4.1 cents.

The second test of the cost effectiveness of the MCS was the cost effectiveness of the average energy savings that are acquired in each individual building through a utility-sponsored MCS program over the next several years. In evaluating the cost effectiveness of average MCS savings in 1986, the Council found that the region could afford to pay, on average, 3.6 cents per kilowatt-hour for MCS savings. By 1990, this figure will increase to 4.4 cents per kilowatt-hour based on current estimates of load growth. For this reason, in evaluating the cost effectiveness of the utility MCS programs, the Council used a value of 3.6 cents per kilowatt-hour during 1986, and expects this to escalate to approximately 4.4 cents per kilowatt-hour by 1990. The cost of the MCS adopted by the Council averages 3.0 cents per kilowatt-hour across the region.

Cost Effectiveness of Discretionary Resources. The primary function of the analysis of discretionary resources is to size the amount of each resource that the Council expects to be available in the future in order to meet regional load growth. The cost-effectiveness criteria for discretionary resources are used to cut off the resource supply curves for resources included in the Council's portfolio.

Since most of these acquisitions will be made when the region is assumed to need a number of new resources, it is important that the amount of discretionary resources estimated to be available is based on the cost of the marginal or last resources that will be acquired at the same time. Many of the discretionary conservation programs and generating resource programs would begin at the time the Council's resource portfolio also calls for securing options on new coal plants. Therefore, the Council sized the amount of conservation and generating resources included in the plan based on the estimated costs of a new generic coal plant in the region's power system.

The Council estimated that the marginal resource available to the region was a coal plant costing between 4.0 and 4.5 cents per kilowatt hour. Based on these estimates of the cost of a coal plant, the Council did not include any generating resource costing more than 4.5 cents per kilowatt-hour in the plan. To analyze conservation consistently with generating resources, the Council adjusted the cut-off for conservation programs to 5.0 cents, to account for transmission system losses for generating resources and the 10 percent advantage in the Northwest Power Act for conservation. The cost-effectiveness limits of 4.5 cents per kilowatt-hour for generating resources and 5.0 cents per kilowatt-hour for conservation were used in developing this plan, to estimate the amount of each discretionary resource expected to be available to the region in the future.



The residential weatherization program is the only discretionary resource currently being acquired. The Council believes that the capability to secure this resource should be maintained by continuing to operate the program at a minimum viable level. While the program is operating primarily to maintain capability, it should continue to secure all measures that would be required when the program is needed. For this reason, the Council believes that even under minimum viable operations, the residential weatherization program should be securing all measures up to the cost of a new coal plant.

Finally, in evaluating the cost effectiveness of both nondiscretionary and discretionary resources, there are other significant attributes that must be included in the Council's judgment concerning the cost effectiveness and appropriateness of each resource included in the plan. In deciding on the cost effectiveness of individual actions, the Council included environmental concerns such as indoor air quality, acid rain, mining impacts, transportation, employment, and fish and wildlife. In addition, some of the resources included in the Council's plan will help reduce future load growth uncertainty, and some resources are particularly flexible and assist the region in adapting to the wide range of uncertainty it is facing. Finally, due to the significant uncertainty that exists with respect to the cost and availability of each resource included in the Council's portfolio, the Council must decide whether enough valid cost and performance information is available on which to make an informed judgment.

The portfolio and cost-effectiveness analysis is discussed in Chapter 8 of Volume I and detailed in Chapters 4 and 8 of Volume II.

Step Three: Final Resource Portfolio and Action Plan

The electricity costs from the resource portfolio are used in the forecasting system to develop the final forecasts of energy needs, which are then used to fine tune the amount of resources needed in the resource portfolio.

The Council's planning strategy continues to be based on what has come to be known as a societal perspective. The objective of the Council's plan is to minimize the total present value system costs, whether those costs are borne by utilities, and thus reflected in electric rates, or by individuals, businesses, and governments acting in their own self interest. This approach does not necessarily result in the lowest electrical rates in the short term, but, rather, minimizes the total long-term cost of serving all ratepayers in the region.

The societal perspective allows conservation to be treated as a resource comparable to generating resources. Conservation resources can be acquired through financial assistance, regulatory standards, or rate designs. Although the Council encourages the adoption of energy efficient building codes, in this plan financial assistance is the primary method of acquisition, because those who take action receive the benefit. Financial assistance should not be diluted simply to avoid rate impacts for those who do not act.

The Council has relied upon its demand forecasting, system analysis and decision models as aids to decision making. These computer models are described in Chapters 3, 4 and 8, Volume II.

It is important to emphasize, however, that the models are used to analyze decision alternatives, and not to make decisions. The resource portfolio analysis presented in Chapter 8, Volume I, of this plan outlines a program for managing the uncertainties and minimizing the risks faced by the region in its energy future. That program reflects prudential judgments that necessarily go beyond the Council's analytic models.

Based on the final portfolio of resources to meet potential energy needs over the next 20 years, the Council determines which actions are required in the next few years to prepare the region to meet its future needs. These actions are described in Chapter 9. The Council carefully monitors electrical load growth and the cost and availability of resources to determine when modification of the plan and action plan are needed.

1./ System cost is defined to be an estimate of all direct costs of a measure or resource over its effective life, including, if applicable, costs for distribution and transmission, waste disposal, end of cycle, fuel, and quantifiable environmental measures. The Council is also required to take into account projected resource operations based on appropriate historical experience with similar measures or resources.

Chapter 4

Chapter 4
Future Electricity Needs

The region's need for new resources cannot be determined without forecasting the demand for electricity. Demand forecasts play three important roles in the Council's power planning process. The first is the traditional role; they provide the basis for deciding how much electricity is needed to support a healthy and growing economy. The second role is to explore and define the uncertainty surrounding future electrical resource needs. Finally, conservation, identified as the priority resource in the Act, is directly related to the demand for electricity. Demand forecasts are needed to estimate conservation potential, but, in addition, the forecasting models help determine the effects of conservation actions taken as part of the Council's power plan.

The growth of the regional economy and changes in its composition are the key factors affecting growth in demand for electricity. The prices of fossil fuels and electricity, however, modify the effects of economic conditions. The Council has developed the best available forecasting tools to capture these relationships in considerable detail. Figure 4-1 illustrates the general structure of the Council's forecasting system.

Since future economic conditions are highly uncertain, the Council puts a high priority on exploring alternative possibilities for future economic growth. The process of developing economic assumptions for the 1986 Power Plan began in the summer of 1984 with the formation of the Economic Forecasting Advisory Committee. Based on its own analysis and information gathered from a questionnaire sent to 300 professionals concerned with the regional economy, the Council developed preliminary forecasts of a range of plausible economic conditions. These preliminary forecasts were reviewed widely and revised in response to comments received and further analysis, before the Council adopted the economic assumptions.

Based on revised economic assumptions, the Council developed forecasts of electricity demand. The demand forecasts also underwent public review and revision and were reviewed by the Demand Forecasting Advisory Committee before being included in the draft plan released in August 1985. The demand forecasts in this chapter reflect changes made as a result of comments on the draft plan and the adoption of new building codes by the states of Washington and Oregon.

This chapter first summarizes the demand forecasts. It next describes the assumptions leading to the forecasts. The forecasts of demand are then discussed in more detail by consuming sector, and the corresponding forecasts of electricity prices are presented. Finally, the use of the demand forecasts in resource portfolio analysis is explained.

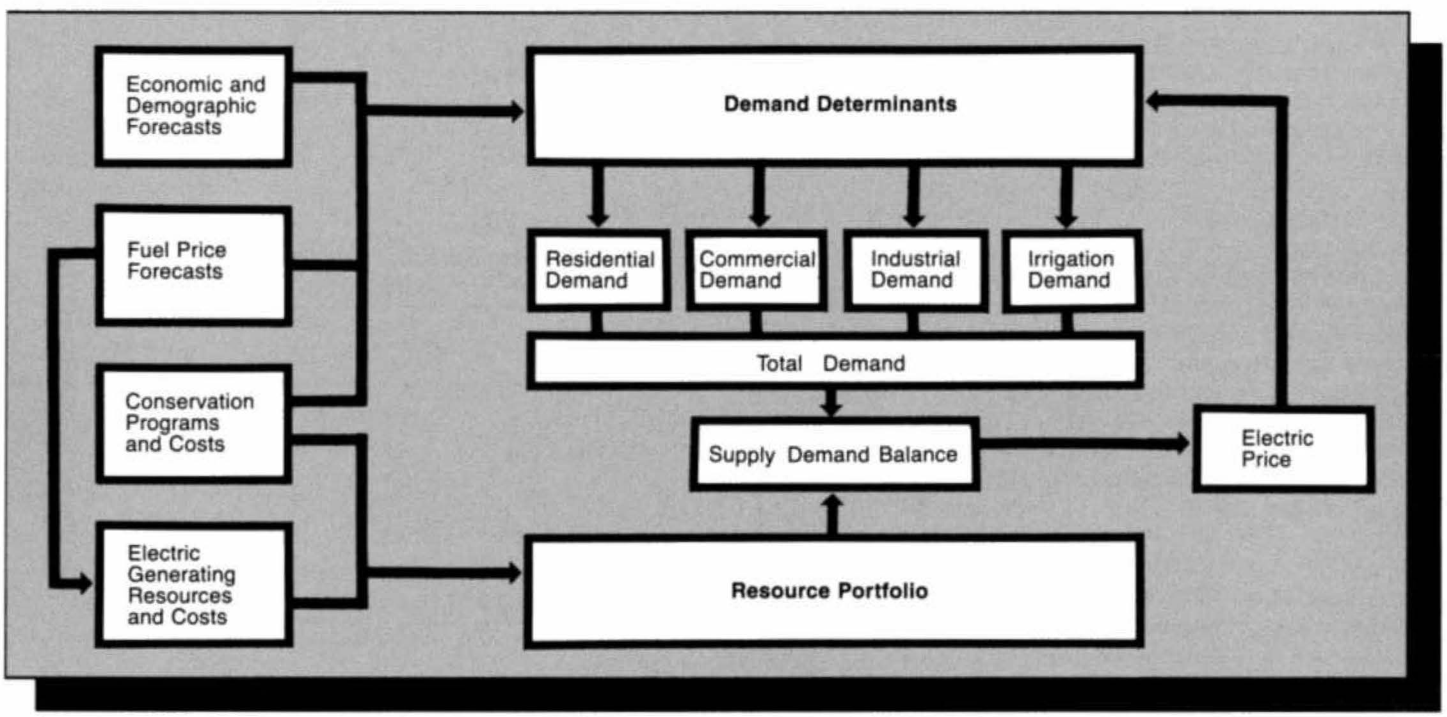


Figure 4-1
Northwest Power Planning Council Demand Forecast System

Summary of Results

In 1983, firm sales of electricity to the final consumer in the Pacific Northwest totaled 14,593 average megawatts, or 127.8 billion kilowatt-hours. The high forecast shows this demand could grow to 26,101 average megawatts by 2005, an increase in electricity requirements equivalent to the power from 18 nuclear plants the size of the Washington Public Power Supply System's Nuclear Project 2 (WNP-2) at Hanford, Washington. Under the set of assumptions leading to the low forecast, demand would only increase to 15,121 average megawatts, an amount little changed from current requirements and an increase substantially smaller than the current firm surplus. Figure 4-2 illustrates the forecast range in the context of historical sales of electricity.

This large uncertainty about future needs for electricity resources represents an important challenge for energy planning. The region needs to deal with this uncertainty in a manner which will neither prevent the region from attaining rapid growth, nor impose large and unnecessary costs should slower growth occur.

Table 4-1 summarizes the demand forecasts. These are "price effects" forecasts which indicate what demand would be if consumers responded to prices but if no new conservation programs were implemented. Two alternative concepts will be discussed in the final section of this chapter.

The numbers in Table 4-1 and other tables in this chapter are expressed to the nearest average megawatt. This is not because the forecasts are known with that degree of accuracy, but for convenience in documentation and analysis. The degree of certainty in forecasts is better characterized by the 11,000 megawatt difference between the low and high forecast in 2005.

Table 4-1 shows that the rate of growth of demand could be as high as 2.7 percent per year, or as low as 0.2 percent.[1] A more likely outcome, however, is between the medium-low growth rate of 1.2 percent and the medium-high rate of 1.8 percent.

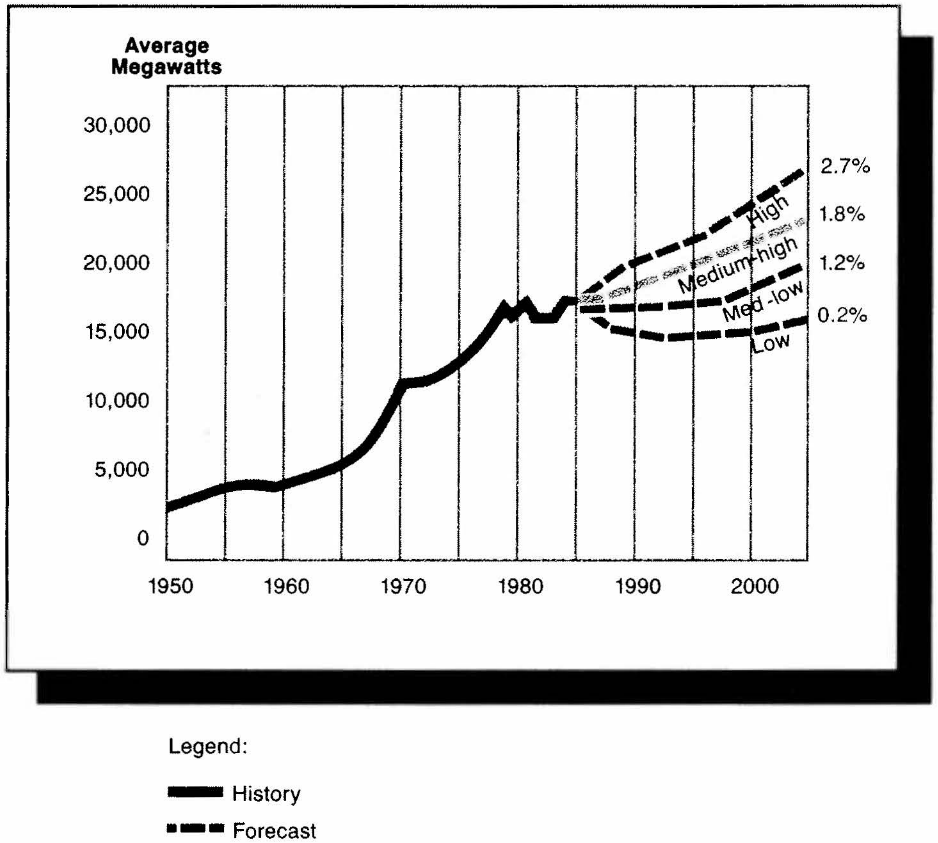


Figure 4-2
Sales of Electricity—Historical and Forecast

Table 4-1
Firm Sales of Electricity
(Average Megawatts)

LOAD GROWTH SCENARIO	ACTUAL 1983	FORECASTS 1990	2000	2005	GROWTH RATE (% per year) 1983-2005
High	14,593	18,044	23,026	26,101	2.7
Medium-high		16,701	20,022	21,687	1.8
Medium-low		15,351	17,538	18,950	1.2
Low		13,697	14,370	15,121	0.2

Figure 4-3 compares the projected growth rates of demand to growth rates experienced in the region since 1950. Between 1950 and 1970 demand for electricity grew by an average of 7.4 percent each year. During the 1970s demand grew much more slowly, at about 3.7 percent per year. The forecasts show a continued decline in the rate of growth, even in the high forecast, over the next 20 years.

Many factors contribute to decreasing growth rates of demand for electricity. These include the rate of growth of the economy, changing standards of living, the price of energy sources relative to other goods and services, and the changing mix of economic activity, both in the nation and in the region. However, the use of electricity is much different in the Pacific Northwest than in the rest of the nation. This difference is illustrated with use of electricity per person in Table 4-2.

Although the historical patterns of growth in electricity use are similar in the region and the nation, there is a striking difference in the amount of electricity used. The Pacific Northwest uses nearly twice as much electricity per person as the nation as a whole. This is due primarily to large supplies of low-cost hydroelectric power in this region. Recent large increases in Northwest electrical prices, however, have changed the outlook for electricity demand. The forecasts show that, while per capita use will remain well above national levels, growth in use per person will be slower and could actually decline in a low forecast. Figure 4-4 illustrates historical and forecast patterns of electricity use per person.

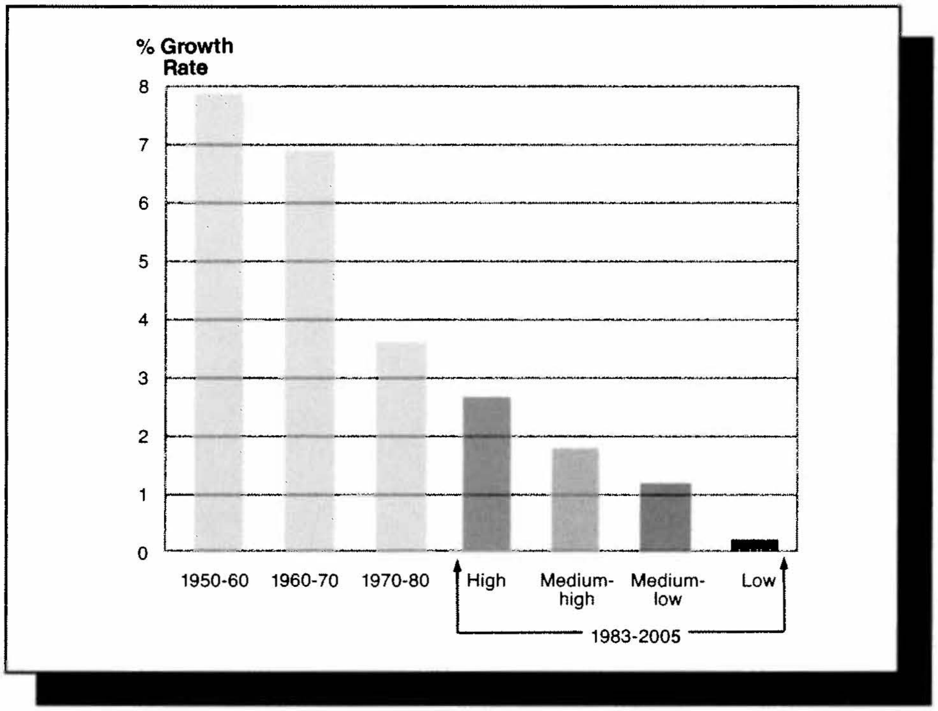


Figure 4-3
Historical and Forecast Growth

Table 4-2
Per Capita Use of Electricity
(Kilowatt-Hours per Person)

	PACIFIC NORTHWEST	UNITED STATES
History		
1960	8,930	3,810
1970	14,790	6,800
1980	17,230	9,230
1982	16,330	9,000
Forecast 2005		
High	18,366	12,310
Medium-high	16,689	12,310
Medium-low	16,588	12,310
Low	15,077	12,310

Key Assumptions

Economic and Demographic Assumptions

Economic and demographic assumptions are the dominant factors influencing the forecasts of demand for electricity. In the absence of other changes, the demand for electricity would parallel economic activity. This relationship is modified by shifts in relative energy prices, including the price of electricity and other fuels; by changes in the composition of economic activity; and by the gradual depreciation and replacement of the buildings and other capital stock of the region. Conservation programs implemented by the region will further affect the future sales of electricity.

The range of forecasts in this plan is similar in many respects to the forecasts incorporated in the 1983 Power Plan. The high forecast allows the Council's plan to accommodate record regional economic growth should it occur. In the high forecast, total regional employment grows 130 percent faster than a high national forecast of employment. The high forecast represents a case where the region grows faster relative to the nation than in any historical five-year period. The low forecast assumes that the Pacific Northwest grows at a rate 40 percent lower than a low growth national forecast. The low case implies a relative performance well below that which has characterized the region in the long term. Table 4-3 compares historical and forecast growth rates for total employment. Figure 4-5 shows the region's total employment growth compared to U.S. growth rates.

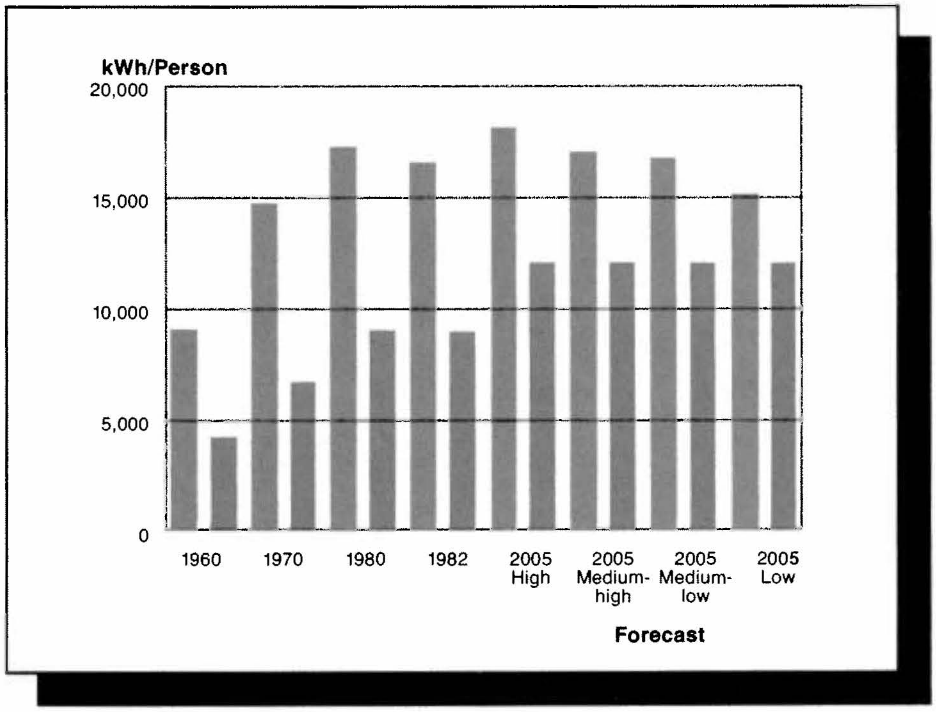


Figure 4-4
Electricity Use Per Capita

Legend:
Pacific Northwest
United States

Major Trends

There are a number of basic trends common to the range of forecasts. Many of the trends relate to demographic patterns in the existing population.

One of the primary changes is the aging of the population. From 1985 to 2005, the nation's population in the 45-54 age group is expected to increase almost 60 percent, while the population aged 20-29 is projected to decline by 10 percent. The population over the age of 55 is projected to increase by 35 percent during this period. Although the age composition in the region will vary among scenarios because of migration, the general patterns of demographic change will persist. Figure 4-6 shows the percentage change in population by age group for the nation from 1985 to 2005.

This aging of the population is expected to affect consumption patterns, the labor force and labor productivity. Although labor force growth is projected to be slower than during the 1970s, growth in productivity is expected to be higher. Productivity growth should be enhanced by the dramatic slowdown in the growth of the labor force during the 20-year period. Slower growth in the labor force will

Table 4-3
Total Employment Growth Comparisons
(Percent per Year)

	PACIFIC NORTHWEST	UNITED STATES	RATIO
Historical			
1960-1980	3.1	2.1	1.5
1973-1978	4.6	2.3	2.0
Forecast (1985-2005)			
High	3.2	1.4	2.3
Low	0.5	0.8	0.6

result in upward pressure on wages. Producers will seek to substitute capital for labor, which tends to increase productivity and stimulate technological change. Consumption patterns are expected to increasingly emphasize personal services, clothing, travel, and health services.

A second major trend is the increase in the proportion of women that are in the labor force. From 1960 to 1980, this proportion increased from 37 percent to 52 percent. This trend is expected to continue to varying extents in all forecasts.

Growth in the importance of nonmanufacturing industries is projected throughout the forecast range. Traditionally, studies of regional economic growth have focused on the manufacturing industries. Recently, the nonmanufacturing industries have attracted more attention because of their size and rapid growth. In 1980, nonmanufacturing industries accounted for 81 percent of total employment in the region. Nonmanufacturing employment increased at a rate nearly 70 percent faster than manufacturing employment from 1960 to 1980.

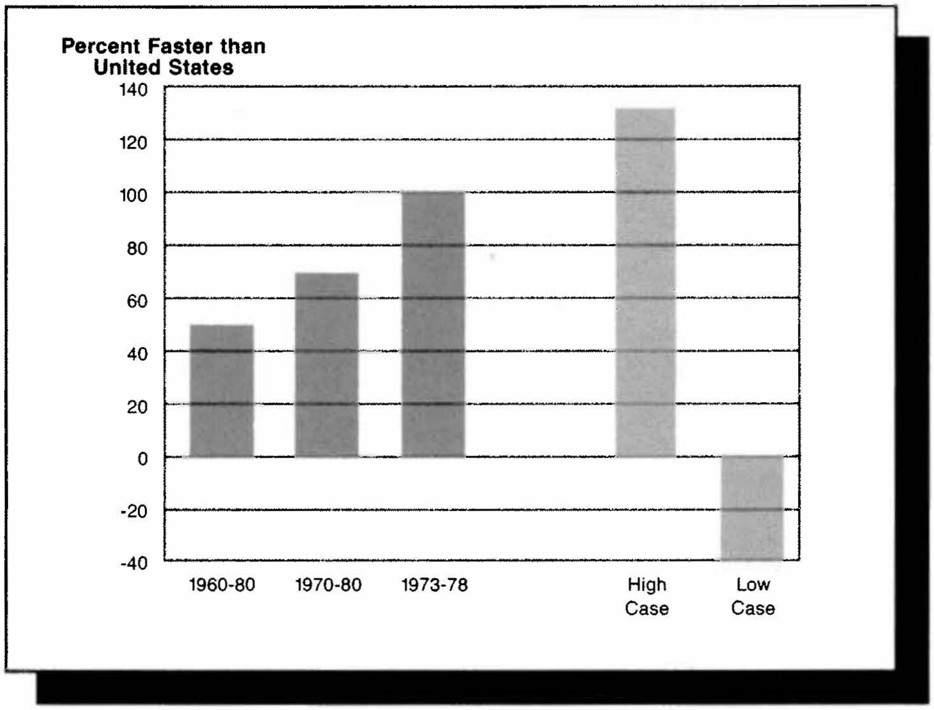
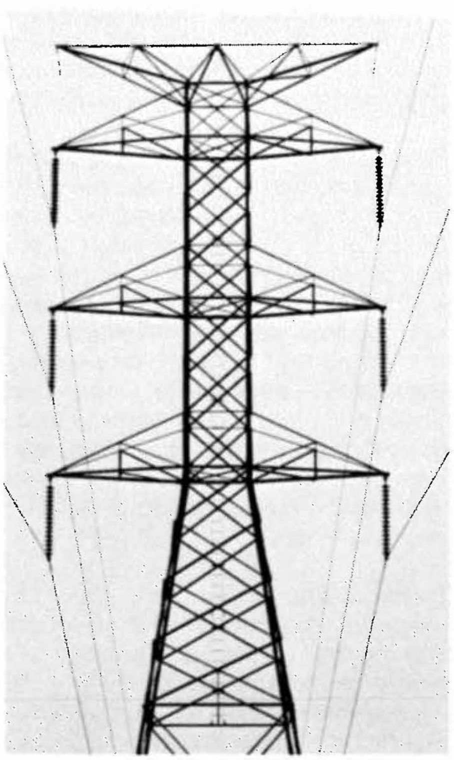


Figure 4-5
Pacific Northwest Employment Growth



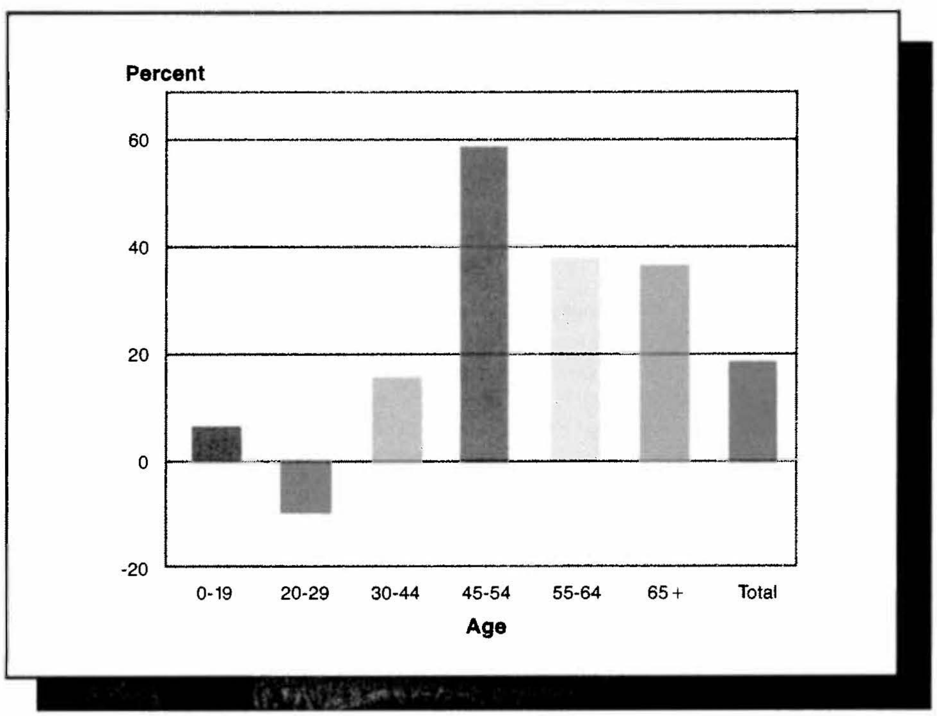


Figure 4-6
U.S. Population Percentage Change by Age Group (1985-2005)

The outlook is strong for industries, such as communications and machinery, that will play a key role in growing technological changes and productivity-enhancing investments. The foreign trade sector is expected to continue to increase in importance. The Pacific Northwest is in good position to participate in trade to the Pacific Rim countries. That possibility is an important component of the higher growth forecasts.

The continued stagnation of the region's large resource-based industries characterizes all of the forecast range. Lumber, aluminum and basic chemicals are not expected to be important sources of economic growth for the region even in the high forecasts.

Description of the Scenarios

The economic and demographic assumptions rely on basic policy assumptions, many of which operate at the national level. Each of the four regional economic forecasts, while built up from regional assumptions about individual sectors of the economy, was made within the context of a corresponding view of the national economy. Each regional forecast includes a wide range of possibilities for the regional economy. For example, there could be nearly 70 percent more jobs in the region in the high case than in the low case by the year 2005. Figure 4-7 shows the employment forecast in the high and low cases. Forecasts developed by Wharton Econometric Forecasting Associates (Wharton)[2] were the primary source for forecasts of national economic variables used in developing regional projections.

In developing the range, the primary objective was internal consistency for each forecast. That is, incompatible assumptions were not combined in any one forecast just to achieve a wide forecast range. In some cases, there are three forecasts for each industry projection or other assumption. These were combined into four scenarios. For example, there are three forecasts for production and employment in the lumber and wood products industry. These were combined with other industries into four scenarios. In the case of lumber and wood products, the high case forecast was included in the high economic growth scenario, the medium case forecast was included in the medium-high economic growth scenario and the low case forecast was included in the low and medium-low scenarios. This combination of assumptions is intended to reflect the downside risk assumed for the lumber and wood products industry.

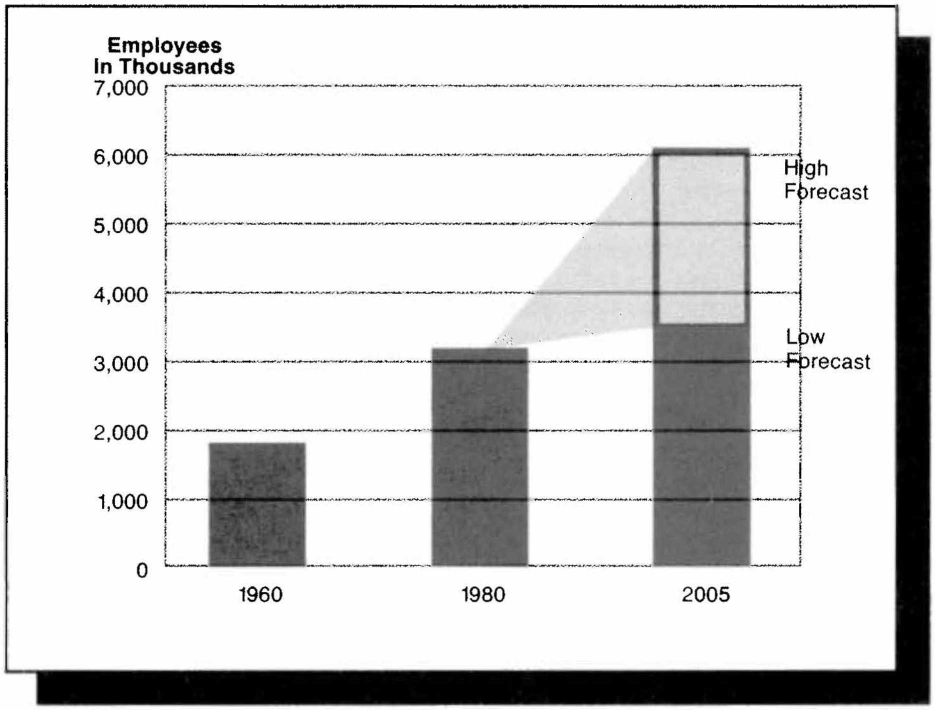


Figure 4-7
Forecasts of Total Employment

In addition to an underlying high growth scenario on the national level, the regional outlook for the **high growth case** implies that the region's economy may fare better, relative to the nation, than it has in the past. The large resource-based industries, such as forest products, aluminum, agriculture and basic chemicals, are expected to maintain a vital presence in the region's economy in the high forecast, but not to contribute to new jobs. Industries such as electronics, trade and services could expand rapidly.

As shown in Table 4-3, high forecast total employment is projected to increase at a rate of 3.2 percent per year, which is slightly higher than the region's growth rate from 1960-1980. Population would grow by 2.0 percent, while the number of households would increase at 2.8 percent per year. It is assumed in these projections that the region will continue to be a favorable location for growth, because of the richness and diversity of its natural resources, the quality of the environment and labor force, the quality of the educational system, relatively lower electricity prices, and proximity to expanding markets in Japan and other Pacific nations.

Rapid growth in high technology and commercial industries coupled with moderate levels of activity in forest products, agriculture and basic chemicals characterize **the medium-high scenario.** This anticipates employment growth of 2.4 percent per year, and population and household growth of 1.5 and 2.0 percent per year, respectively. Although the overall level of employment growth in the medium-high scenario would be slower than what the region experienced in the 1960s and 1970s, it still would be twice as fast as the forecast of national growth in the medium case.

Traditional industries would experience low levels of economic activity while other manufacturing and commercial industries would experience moderate growth levels in the **medium-low forecast.** Total employment is projected to increase at a rate of 1.5 percent per year, with population and households expected to increase at rates of 0.8 and 1.3

percent per year, as shown in Table 4-4. In the medium-low scenario, employment growth would be 25 percent faster than national growth in the medium case; this relative rate of growth is lower than the what the region experienced from 1960 to 1980.

The regional outlook for the **low case** shows total employment could increase at a rate of 0.5 percent per year, indicating a rate 40 percent lower than the low forecast of national growth. Total population is projected to increase at a rate of 0.2 percent per year and households at 0.3 percent. This slow level of growth implies the region will experience net outmigration of population throughout the forecast period. The disproportionate impact of the recent recession on major regional industries would lead to more severe long-term problems than in the other scenarios. Growth in nonmanufacturing would be offset by declines in many of the larger traditional industries.

Alternative Fuel Prices

Future prices for natural gas and oil can have important effects on the demand for electricity because these fuels compete directly with electricity. Particularly important areas of competition are space heating and water heating in homes and commercial buildings.

Forecasts of demand for electricity are not as sensitive to fuel price assumptions as they are to economic and demographic assumptions. A doubling of fuel prices will cause about a 5 percent increase in electricity demand. However, there is a wide range of uncertainty about future fuel prices.

Future retail natural gas and oil prices are expected to be influenced by trends in the world price of crude oil. The forecasts of wholesale prices of refined petroleum products are based on a range of world oil price assumptions. The forecasts of prices of natural gas are based on its competition with oil in industrial markets. Various retail mark-ups are then applied to estimate retail prices for consuming sectors.

World oil prices could increase by as much as 5.4 percent per year more than general inflation between 1985 and 2005. However, it is also conceivable that oil prices could change

Table 4-4
Summary and Comparison of Forecasts
Pacific Northwest and U.S.

	AVERAGE ANNUAL RATE OF CHANGE (%)						
	1960-1980		1985-2005				
	U.S.	PNW	U.S.*	High	Medium-High	Medium-Low	Low
Total Employment	2.1	3.1	1.2	3.2	2.4	1.5	0.5
Manufacturing	1.0	2.0	-0.5	1.6	1.1	0.5	-0.4
Nonmanufacturing	2.4	3.4	1.5	3.4	2.7	1.7	0.7
Population	1.1	1.9	0.8	2.0	1.5	0.9	0.2
Households	2.1	2.8	1.4	2.8	2.0	1.3	0.3

*The U.S. forecast is Wharton's medium case projection.

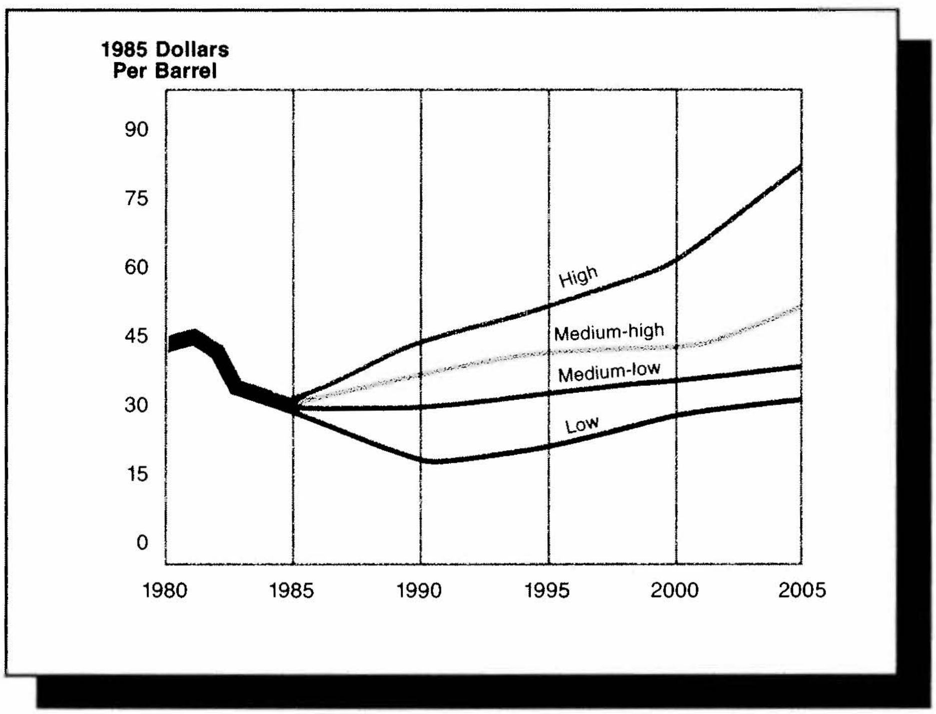


Figure 4-8
Forecasts of World Oil Prices

little from current levels by 2005, with substantial reductions in the early years of the forecast. Figure 4-8 illustrates the range of world oil price assumptions used. The highest assumption for oil prices is used in the high electricity demand forecast, and the lowest oil price is assumed in the low demand forecast. (Chapter 2, Volume II, provides details on these assumptions.)

Table 4-5 shows the world oil price assumptions compared to an estimated 1985 price. Relatively low growth from 1985 to 1990 reflects continued weakness in world oil markets for the next few years. The low case reflects the possibility of a collapse of world oil markets in the near term.

The effects of oil price assumptions on the demand for electricity depend on retail prices of oil and natural gas, retail prices for electricity, and how those prices change relative to one another. Forecasts of electricity prices are determined by the demand forecasts. Higher demand for electricity eventually leads to higher prices, as more expensive new resources must be used to meet growing demands. Therefore, electricity prices in the year 2005 are highest in the high demand case. However, the price of electricity is lowest relative to oil and natural gas prices in the high forecast. This stimulates demand for electricity as a fuel choice in the high forecast. Figure 4-9 illustrates the patterns of relative energy price across forecast scenarios for residential natural gas versus electricity. The graph plots electricity price relative to natural gas price, when natural gas price is divided by 0.75 to adjust for its relative end-use efficiency.

When the ratio in Figure 4-9 is above 1.0, it means electricity is relatively more expensive than natural gas. During most of the 1970s, electricity in the Pacific Northwest was inexpensive relative to natural gas, its main competitor. However, recent large increases in electrical rates combined with decreases in natural gas prices have improved the competitiveness of natural gas. This result is only a general tendency, since the relative prices of electricity and gas can vary significantly for different utility areas. Further, the attractiveness of electricity or natural gas also can depend on consumer tastes and the relative cost of equipment used to convert energy to a useful service, such as heat.

Table 4-5
World Oil Price Assumptions

	1985 $ PER BARREL 1985	1990	2005	GROWTH RATE (% per year) 1985-90	1985-05
High	28	34	80	4.0	5.4
Medium-high	28	30	49	1.4	2.8
Medium-low	28	24	36	-3.0	1.3
Low	28	13	28	-14.2	0.0

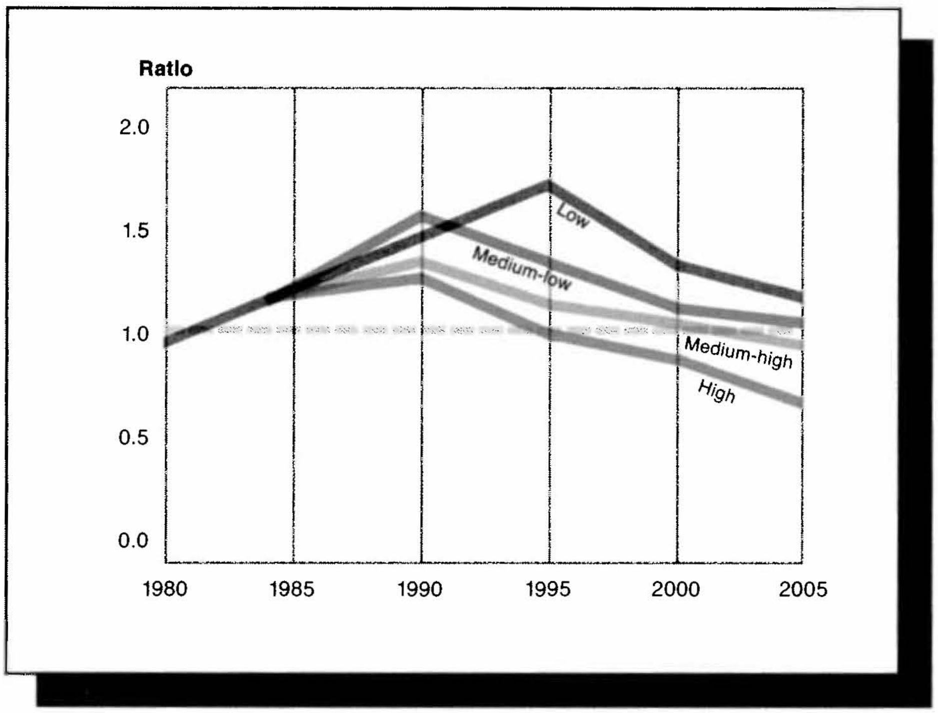


Figure 4-9
Relative Residential Energy Prices
(Ratio of Electricity to Natural Gas)

Figure 4-9 shows that natural gas and electricity prices could remain competitive within a fairly broad range. This is probably a reasonable assumption because there is competition between natural gas and electricity for many uses, and large disparities in the prices of the two sources of energy would eventually be mitigated by demand and marketing responses. The forecasts for electricity prices are discussed in more detail later in this chapter.

Demand Forecasts

In 1983, total regional firm sales of electricity were 14,593 average megawatts. Investor-owned utilities marketed 6,854 average megawatts or 47 percent of the total. Public utilities and the Bonneville Power Administration marketed 53 percent of the firm sales. Table 4-6 shows the 1983 composition of firm sales and the four forecasts for 2005. In all of the forecasts, the investor-owned utility share of firm sales is expected to increase slightly.

Table 4-6 shows the public utility and Bonneville sales separately for direct service industry (mostly aluminum companies) and all other customer components. Direct service industries (DSI) accounted for a third of Bonneville/public utility sales in 1983, but are forecast to increase only moderately from current demand levels in the high cases, and decrease in the low forecasts. Thus, the direct service industry forecast is an important reason for lower growth in the Bonneville/public utility sales than in investor-owned utility sales. However, the other Bonneville/public utility sales are also shown growing somewhat more slowly than investor-owned utility sales.

Figure 4-10 shows the composition by sector of the 1983 electricity sales in the region. The industrial, residential, and commercial sectors account for most of the region's electricity demand. Each of the demand sectors is discussed in some detail in the sections that follow.

Table 4-6
Firm Sales Forecast for Public and Investor-Owned Utilities
(Average Megawatts)

	TOTAL SALES	INVESTOR-OWNED	PUBLIC AND BONNEVILLE SALES Non-DSI	DSI	Total
Actual 1983	14,593	6,854	5,843	1,896	7,739
Forecast 2005					
High	26,101	13,300	10,324	2,477	12,801
Medium-high	21,687	10,896	8,645	2,146	10,791
Medium-low	18,950	9,516	7,692	1,742	9,434
Low	15,121	7,574	6,323	1,224	7,547
Growth Rates 1983-2005					
High	2.7	3.1	2.6	1.2	2.3
Medium-high	1.8	2.1	1.8	0.6	1.5
Medium-low	1.2	1.5	1.3	-0.4	0.9
Low	0.2	0.5	0.4	-2.0	-0.1

Residential Demand

The residential sector accounted for 36 percent of regional firm sales of electricity in 1983. Many social and economic factors influence residential sector demand, including fuel prices, per capita income, and the choices in efficiency of energy-consuming equipment available to consumers (available technology). The most important factor, however, is the number of households. The residential sector demand model reflects this importance by using the individual household as the basic unit. The model simulates future demand for electricity by projecting future growth in households; their choice of housing type; the amount of electricity-using equipment the average household owns; choices of fuel for space heating, water heating and cooking; the level of energy efficiency chosen; and the energy-using behavior of the household. These choices are influenced in the model by energy prices, equipment costs, per capita incomes, and available technology. Estimated 1983 shares for eight residential uses of electricity are shown in Figure 4-11.

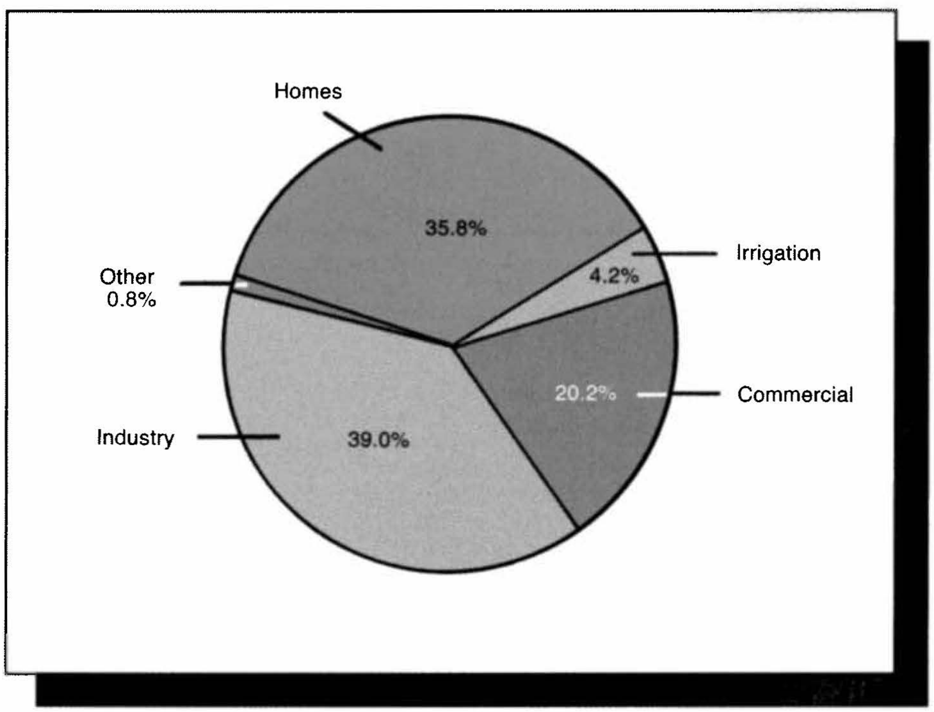


Figure 4-10
1983 Firm Sales Shares

The projections of residential demand for electricity cover a wide range. In the absence of new conservation programs, projected residential demand increases from 5,216 aver-

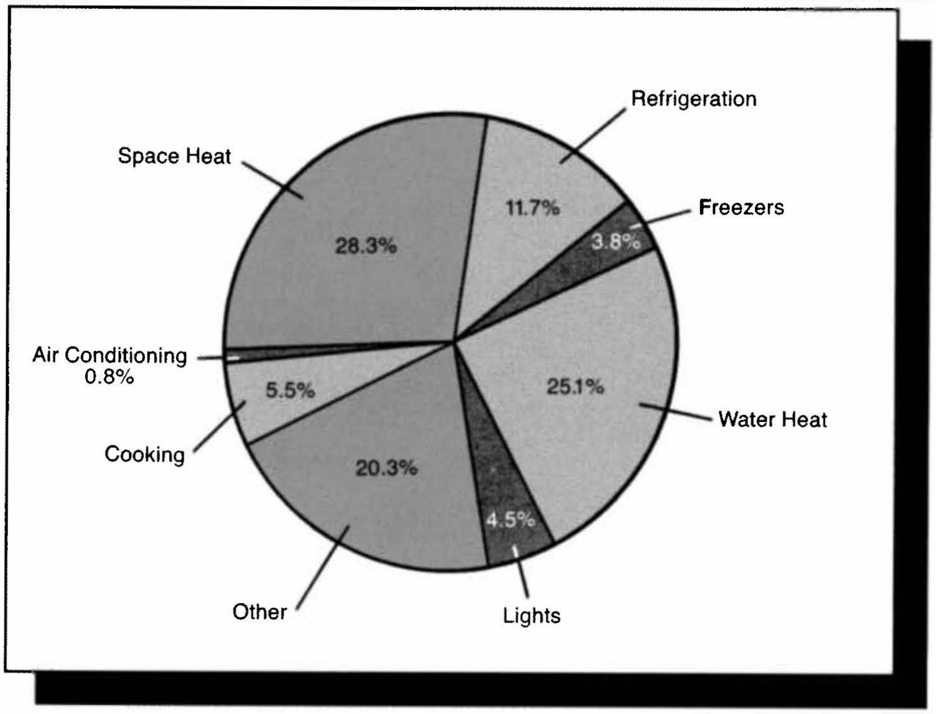


Figure 4-11
1983 Residential Use by Application

Table 4-7
Residential Sector Electricity Demand
(Average Megawatts)

	ACTUAL 1983	FORECASTS 1990	2000	2005	GROWTH RATE (% per year) 1983-2005
High	5,216	6,628	8,613	9,920	3.0
Medium-high		6,273	7,549	8,128	2.0
Medium-low		5,769	6,726	7,720	1.5
Low		5,206	5,535	5,825	0.5

Table 4-8
Share of Housing Stock by Building Type
1980-2005 (%)

	1980	2005 High	Medium-High	Medium-Low	Low
Single Family	78.3	77.4	72.0	68.4	72.4
Multifamily	14.3	14.4	17.1	19.9	17.9
Manufactured Homes	7.5	8.3	10.9	11.7	9.7

age megawatts (MWa) in 1983 to a range which runs from 9,920 average megawatts in the high growth forecast to 5,825 average megawatts in the low growth forecast in 2005. As shown in Table 4-7, the average demand growth rate ranges from a low of 0.5 percent per year to a high of 3.0 percent.

Total residential use of electricity varies widely across the four growth forecasts, but use per household shows much less variation. Figure 4-12 shows use per household for 2005 for the four growth forecasts, as well as historical use in 1980 and 1983. The figure shows a 7 percent drop in use per household between 1980 and 1983. Between 1983 and 2005, changes in use per household are small, ranging from a decrease of less than 1 percent in the medium-high forecast to an increase of 3 percent in the high forecast. The variation in total residential demand is thus due primarily to variation in the projected number of households.

Use per household is the net result of changes in variables such as efficiency, housing type, housing size and fuel choice. The changes in some of these individual variables are substantial, but there is a tendency for them to offset one another in their effects. For example, efficiencies generally improve, tending to reduce use per household. Figure 4-13 shows that the average thermal efficiency of electrically heated single family houses would improve by between 15 and 30 percent in the various growth forecasts even without strengthening building codes beyond their 1986 levels. However, a projected increase in the size of multifamily units and manufactured homes will partially offset increased efficiency.

Housing type and fuel choice also influence energy use per household. The general trend is a reduction in the total share of single family houses and increases in the shares of multifamily units and manufactured homes. Table 4-8 shows the 1980 historical shares of the three building types, along with the projected 2005 shares for each of the forecasts. The forecasts reflect both the share assumptions for new housing and the proportion of new houses in the stock in each forecast. The effect of the trend away from single family houses is to decrease average electrical use per household, since multifamily units and manufactured homes are smaller and tend to require less energy to heat and cool.

Fuel choice projections have mixed effects on per household energy use. As shown in Table 4-9, the share of households with air conditioning is expected to increase in all forecasts; the share with electric water heating is expected to decrease in all forecasts, and the share with electric space heating shows no clear trend. Air conditioning saturations are influenced by electricity prices, per capita incomes and the share of recently constructed houses in the stock. Space and water heating saturations are also influenced by these factors, but in addition are influenced heavily by the relationship of electricity prices to those of competing fuels such as natural gas and oil. As pointed out earlier, the higher growth scenarios have higher electricity prices, but *relatively* lower prices of electricity compared to competing fuels. This pattern helps to explain the higher saturation of electrical space and water heating in the higher growth scenarios.

When all the conflicting influences just described are combined, the net effect is the observed pattern of relatively small changes in per household use.

These projections take into account the recently adopted building codes of Washington and Oregon, but do not reflect efficiency improvements resulting from the Council's proposed conservation programs. The effects of these programs would cause sales of electricity to grow at slower rates. In addition, the use of electricity per household would decline because of the increased thermal efficiency of buildings and improved appliance efficiencies. The effects of these efficiency increases would be somewhat diminished, however, by greater use of electrical services because of cost savings from improved efficiency in space and water heating.

Commercial Demand

Commercial demand for electricity accounted for 20 percent of firm sales of electricity in 1983. Like the residential sector, this sector is influenced by many factors. One fundamentally important factor is used as a basis for energy use projections: the total floorspace of the buildings in the commercial sector. The commercial sector demand model projects the amount of commercial floorspace, based primarily on employment.

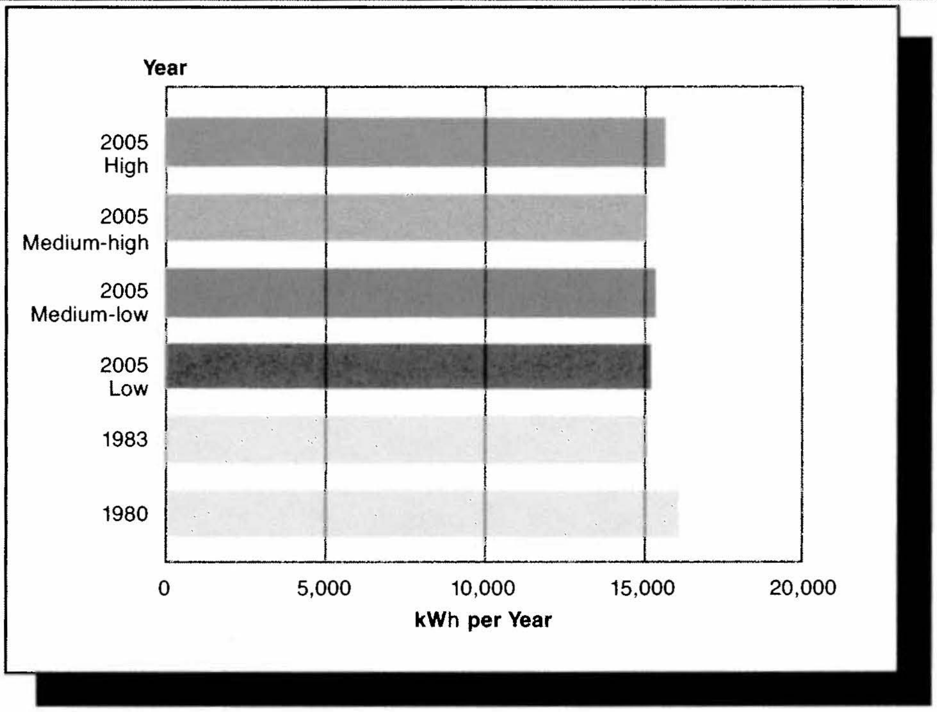


Figure 4-12
Residential Use Per Household

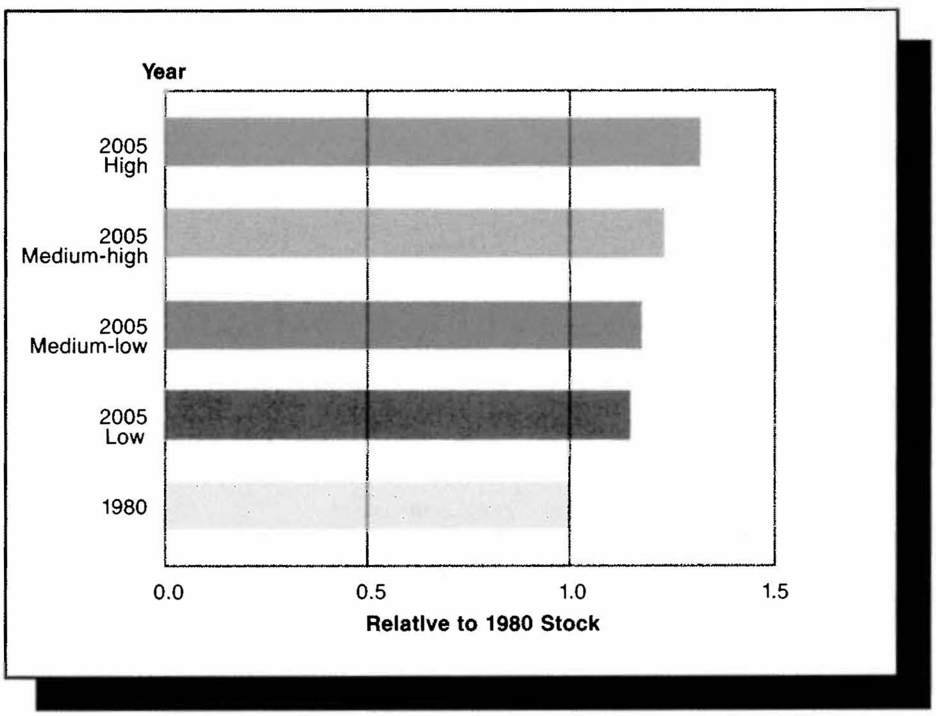


Figure 4-13
Thermal Efficiency of Electrically Heated Single Family Houses

Table 4-9
Regional Appliance Saturations 1980-2005
(% Share of Stock)

	1980	2005 High	2005 Medium-High	2005 Medium-Low	2005 Low
Electric Space Heat	46	51	47	45	39
Air Conditioning	20	38	33	31	26
Electric Water Heat	85	80	79	77	75

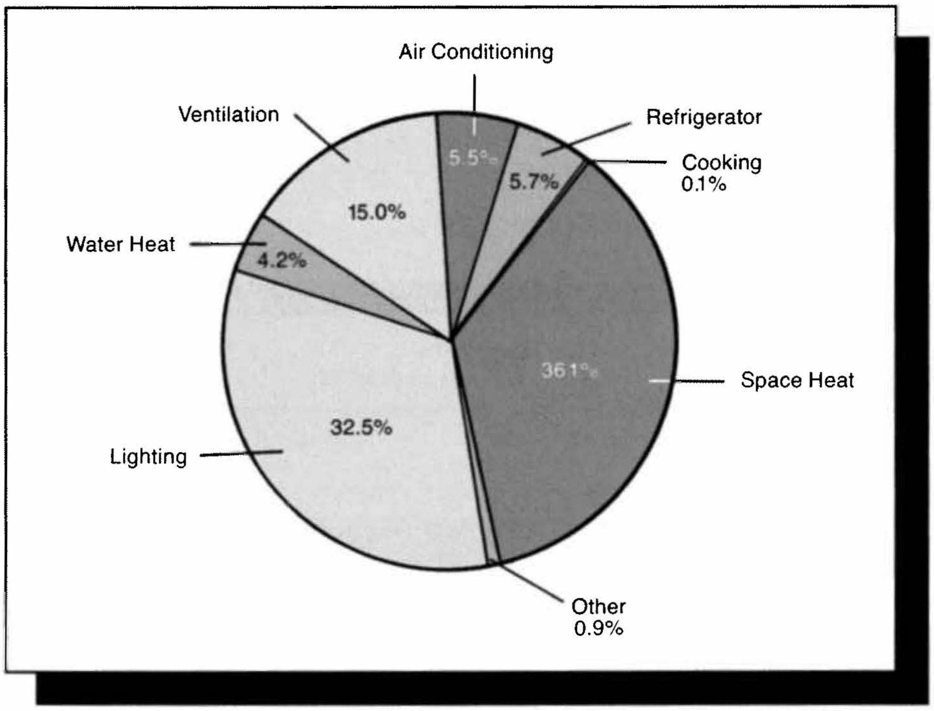


Figure 4-14
1983 Commercial Sector Use by Application

Table 4-10
Commercial Sector Electricity Demand
(Average Megawatts)

	ACTUAL 1983	FORECASTS 1990	FORECASTS 2000	FORECASTS 2005	GROWTH RATE (% per year) 1983-2005
High	2,936	3,654	5,108	5,946	3.3
Medium-high		3,267	4,192	4,651	2.1
Medium-low		2,958	3,483	3,848	1.2
Low		2,727	2,579	2,773	-0.3

The model then predicts fuel choice, efficiency choice, and the use of the energy-consuming equipment necessary to service this floorspace. These choices are based on investment factors, fuel prices and available technology. Energy use projections are made separately for different building types, applications, and fuel types. Shares of historical commercial sector demand for electricity for various applications are shown in Figure 4-14.

Projections of commercial demand for electricity vary widely. In the low growth forecast, commercial demand for electricity decreases from 2,936 megawatts in 1983 to 2,773 megawatts by 2005. In the high growth forecast, it reaches 5,946 megawatts. As shown in Table 4-10, the average rate of growth of demand ranges from −0.3 to 3.3 percent. The size of this range is due principally to the range of employment projections in the commercial sector (floorspace projections are based on employment). Examining some components of these projections gives a clearer picture of the developments that would produce these totals.

Use of electricity per square foot of floorspace, shown in Figure 4-15, decreases in all growth forecasts. As in the case of use per household in the residential sector, the decrease in use per square foot from 1983 to 2005 is modest for all forecasts, ranging from 4 percent in the medium-low growth forecast to 15 percent in the low growth forecast.

The relatively small projected changes in energy use per square foot are the net result of changes in various components of the forecast that are significant but which tend to offset one another. For example, the fraction of commercial floorspace that is air conditioned is projected to increase in all forecasts, with greater increases occurring in the higher-growth forecasts. This would tend to increase the use of electricity per square foot except for offsetting changes in building and equipment efficiency. Figure 4-16 shows the change in average efficiency of electrical space heating in commercial buildings between 1980 and 2005 for each of the four growth forecasts. Efficiency improvement is substantial, ranging from 30 percent in the low growth forecast to 85 percent in the high growth forecast. Smaller improvements in lighting efficiency are projected, as shown in Figure 4-17.

These projections do not take into account the conservation programs included in this plan, but are based on existing building codes and market response to energy prices. The Council's programs will reduce overall demand for electricity, reduce demand per square foot, and improve equipment efficiency. Conservation savings estimated in the Council's conservation analysis may be partially offset by increases in the intensity of electricity use, since the programs will decrease operating costs, making the use of electricity more attractive.

Industrial Sector

The industrial sector is the largest consumer of electricity of the four consuming sectors. In 1983 the industrial sector consumed 5,659 average megawatts of firm power, accounting for 39 percent of total firm demand in the region. In addition, the direct service industrial customers of Bonneville consume varying amounts of nonfirm electrical energy, depending on economic and hydroelectric conditions.

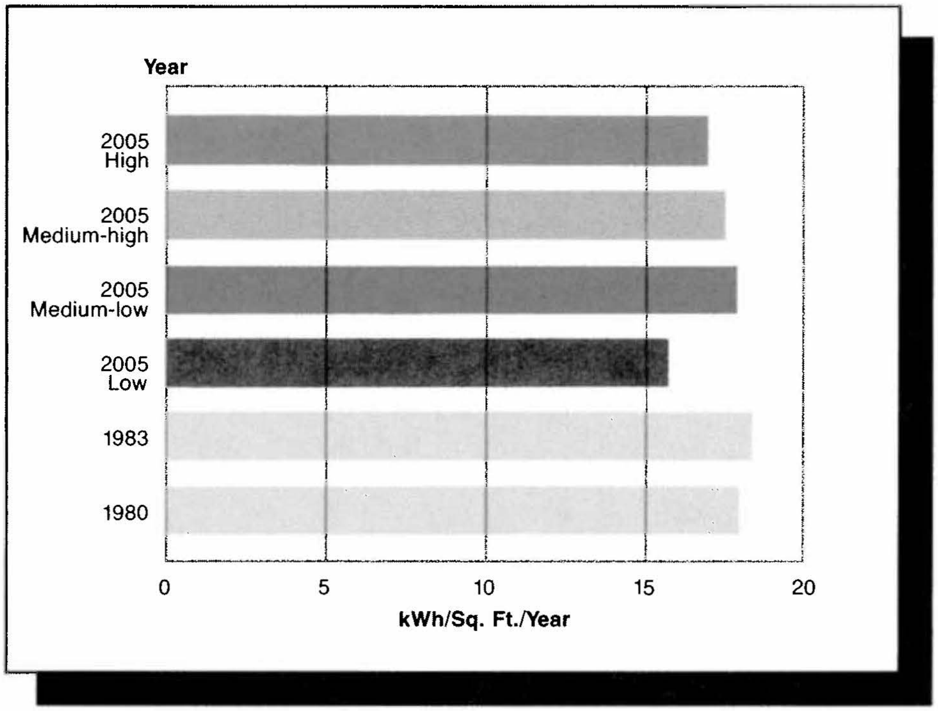


Figure 4-15
Commercial Electricity Use Per Square Foot

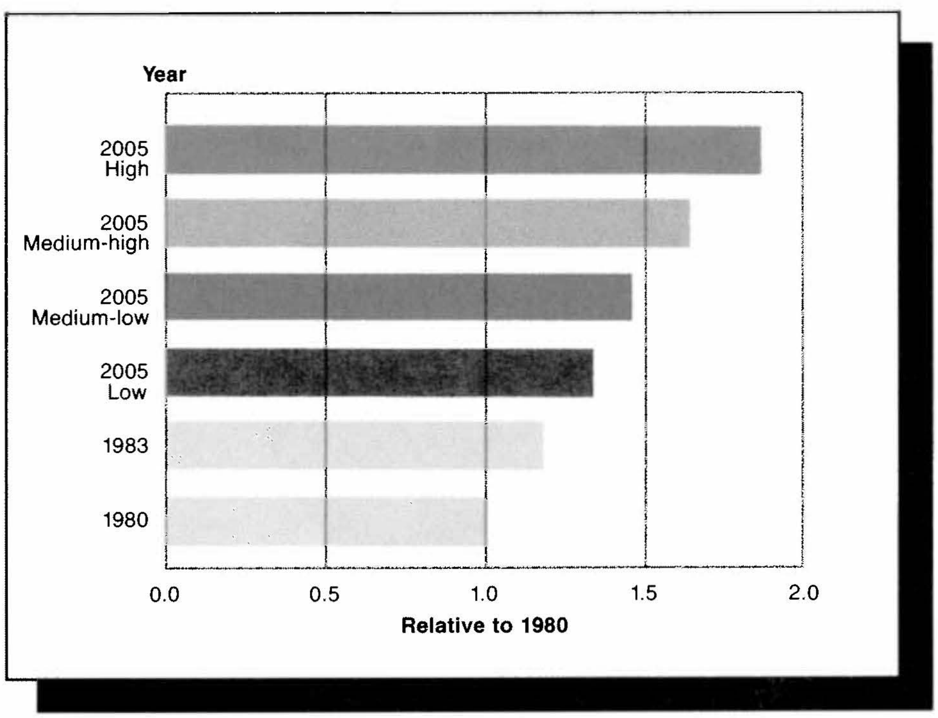


Figure 4-16
Relative Efficiency of Commercial Electric Space Heat

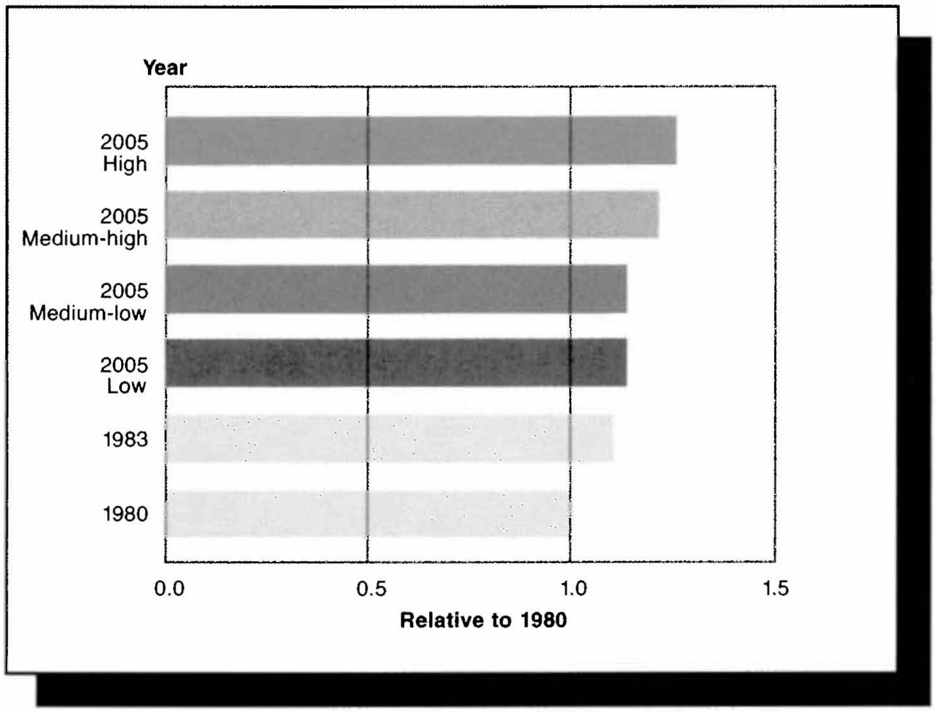


Figure 4-17
Relative Efficiency of Commercial Lighting

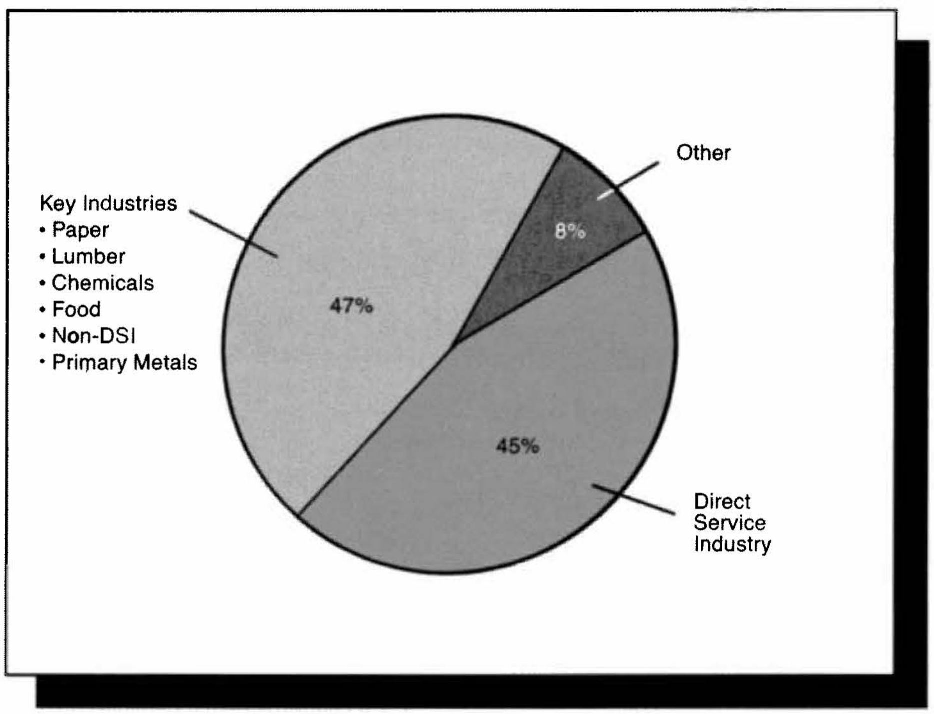


Figure 4-18
Industry Demands

Unlike the residential and commercial sectors, where the general uses of electricity are similar in different houses or buildings, the industrial uses of electricity are extremely diverse. It is very difficult to generalize about the end-uses of energy or the amounts of energy used in a "typical" industrial plant. For example, the primary metals industry uses about 80 times as much electricity per dollar of output as the apparel industry.

The industrial use of electricity in the Northwest is highly concentrated in a few industries. Five industries account for about 85 percent of the non-direct service industries industrial demand for electricity. These industries are lumber and wood products, pulp and paper, chemicals, food processing, and primary metals. These five industries combined with the direct service industries account for over 90 percent of the region's industrial demand for electricity. Figure 4-18 illustrates the composition of total industrial demand for electricity.

The data for Figure 4-18 are based on 1977, the most recent year for which a comprehensive accounting of industrial energy use detailed by industry type in the Northwest was attempted. Direct service industry customers accounted for 45 percent of total industrial demand for electricity, or about one fifth of total regional sales to all sectors. The direct service industry sales are dominated by ten aluminum plants that consume about 90 percent of the direct service industry electricity. One fourth of the direct service industry demand is considered interruptible without limitations—it is served by nonfirm hydropower that may not always be available. Thus, only the firm portion of direct service industry demands are included in the the Council's forecasts of energy requirements. However, the interruptible portion of direct service industry demand is considered in system operation and electricity pricing analyses.

The composition of industrial demand today probably differs somewhat from the 1977 profile. The aluminum companies are currently operating at about 70 percent of capacity. In addition, the trends away from energy intensive industries, which will be discussed in the forecast, have already had some effect since 1977. For example, the medium-high forecast for 1985 shows the direct service industry share of total sales at 33 percent, key industries at 50 percent, and the minor industries' share up to 17 percent, a doubling of the smaller consumer's share in eight years.

Forecasts of industrial demand for electricity reflect production forecasts for the various industrial categories, the amount of energy used per unit of output, and the effects of prices on their use of energy. Table 4-11 shows industrial firm demand forecasts for selected years for all four forecasts.

In the high forecast, consumption of electricity by the industrial sector grows to 9,219 average megawatts (MWa) by 2005—an average annual growth rate of 2.2 percent. In the low forecast there is no growth in industrial demand. The more likely range of industrial demand growth is from 0.9 to 1.6 percent per year.

These growth rates are considerably smaller than the projected rates of growth in industrial production. Production by Northwest manufacturing industries is expected to grow by 4.7 percent per year in the high forecast, 3.9 and 3.3 percent per year in the medium-high and medium-low forecasts, respectively, and by 1.8 percent per year in the low forecast. The relative growth rates of electricity demand and output imply an overall reduction in the electricity intensity of the Northwest industrial sector. The ratios of electricity use to production decline over the forecast period in all four forecasts. The rates of decline vary from 2.4 percent per year in the high case to 1.8 percent per year in the low case. Although these rates of decrease are significant, they are lower than recent regional history. Between 1977 and 1983, regional industrial electricity intensity is estimated to have declined by about 2.8 percent per year. Such decreases in energy intensity are not unprecedented. At the national level, for example, total energy use per unit of production in the industrial sector has been estimated to have decreased by 3.3 percent per year between 1970 and 1982.

Several factors operate to reduce industrial rates of electricity growth relative to production growth. The most important is a change in the mix of industry. Many large users of electricity are not expected to grow as fast as industry does on average. The direct service industries, a very large portion of the industrial demand, are not expected to increase at all and may, in fact, decline.

Table 4-11
Industrial Sector Electricity Demand
(Average Megawatts)

	ACTUAL 1983	FORECASTS 1990	FORECASTS 2000	FORECASTS 2005	GROWTH RATE (% per year) 1983-2005
High	5,659	6,907	8,348	9,219	2.2
Medium-high		6,342	7,392	7,992	1.6
Medium-low		5,828	6,470	6,956	0.9
Low		5,006	5,417	5,655	0.0

The assumptions regarding direct service industry demand for electricity are shown in this chapter as a range of demand levels associated with specific forecast scenarios. (As will be discussed later, for resource planning purposes the direct service industry loads are treated differently.) Figure 4-19 shows the percent of current aluminum plant demand that is assumed to remain in the region by the end of the forecast period.

Since Bonneville currently has contractual obligations to serve all direct service industry capacity, 100 percent of direct service industry demands are included in the high forecast. It is assumed that 15 percent of direct service industry capacity will cease to operate in the medium-high forecast. The reductions in direct service industry demand in the medium-low and low forecast are 30 and 50 percent, respectively.

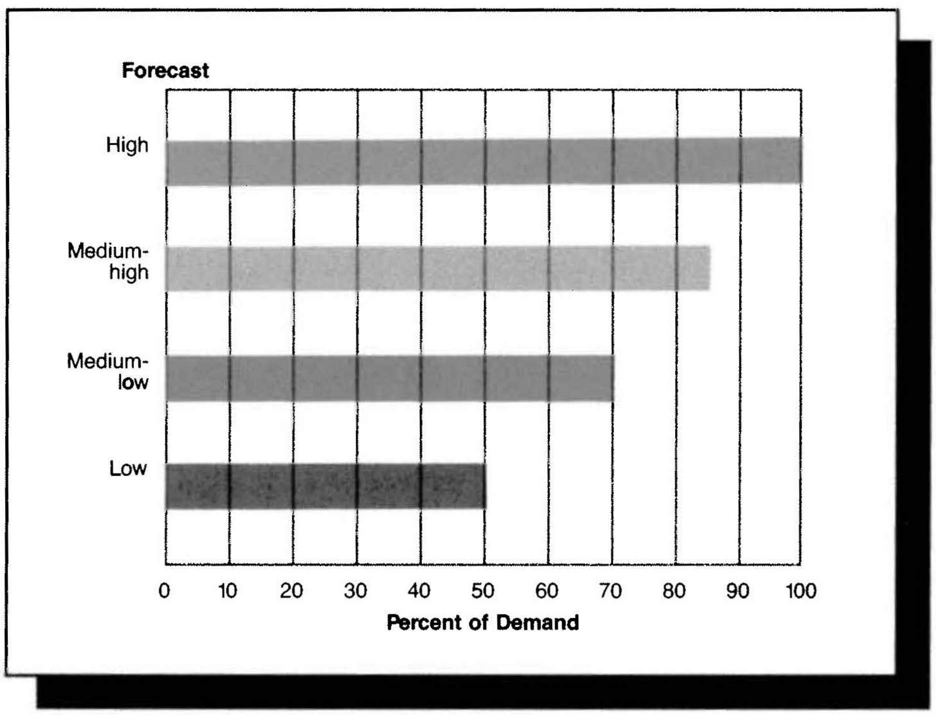


Figure 4-19
Assumed Aluminum Operating Rates

Table 4-12
Composition of Industry Growth, 1983-2005: Medium-High Forecast

	HISTORICAL SHARE OF CONSUMPTION (% per year)	PRODUCTION GROWTH RATE (% per year)	DEMAND GROWTH RATE (% per year)
DSIs	45	N/A	0.6
Key Industries	47	2.1	1.6
Minor Industries	8	5.1	4.8
Total	100	3.9	1.8

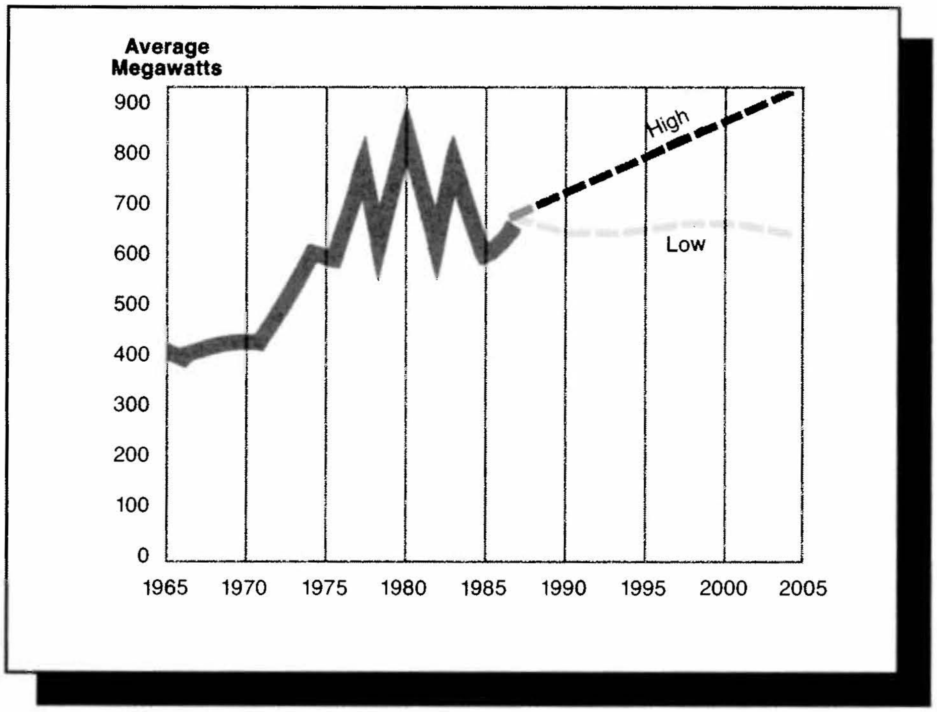


Figure 4-20
Irrigation Demand

Table 4-13
Irrigation Sector Electricity Demand (Average Megawatts)

	ACTUAL 1983	FORECASTS 1990	2000	2005	GROWTH RATE (% per year) 1983-2005
High	615	735	838	896	1.7
Medium-high		699	768	796	1.2
Medium-low		676	739	756	0.9
Low		638	718	748	0.9

The forecast of industrial electricity use is further dampened by the fact that some other large industrial users such as lumber and wood products, food processing, and pulp and paper are not growing as rapidly as less energy-intensive industries. As shown in Table 4-12, production growth for the key non-direct service industries combined is expected to be 2.1 percent per year in the medium-high forecast, compared to 3.9 percent per year for all industrial production. Thus, the two components of the industrial sector that accounted for over 90 percent of electricity demand historically will show relatively weak growth over the next 20 years.

The second major reason for lower electricity growth relative to production is the effects of the large changes in the relative price of electricity in the region over the last several years. The effects of price on industrial demand can not be separated into components as they can for the residential and commercial sectors. Conceptually they include efficiency improvements, fuel switching, and product mix changes within individual industrial sectors.

Irrigation Sector

Irrigation use of electricity is less than 5 percent of total regional firm electricity sales. In 1983, 615 average megawatts of electricity were used for irrigation. Until 1977, use of electricity for irrigation was increasing. As shown in Figure 4-20, irrigation sales since 1977 have become erratic and have not grown.

In 1981 there were 8.6 million acres of irrigated land in the region. Most electricity use in irrigation is associated with sprinkler irrigation. Currently about half of the irrigated land in the region is irrigated with sprinkler systems.

Table 4-13 shows the forecasts of use of electricity for irrigation. The forecasts show some growth from 1983 levels in electricity used for irrigation, but the growth is small relative to historical growth, which averaged nearly 4 percent a year from 1967 to 1983.

Current use of electricity for irrigation, under normal weather conditions, was assumed to be 700 average megawatts, the average annual use from 1976 to 1983. The forecasts of demand for electricity by the irrigation sector began with assumptions about growth in irrigated acres. The assumptions about growth in irrigated acres were made judgmentally, based on various studies in the region. There is sufficient growth to allow for the possible completion of the proposed Columbia Basin East High Project in the higher forecasts. The development of new irrigation, such as the East High Project, would be accompanied be reduced electricity generating capability of the region's hydroelectric system and could impose additional costs on the Bonneville Power Administration. These effects have not been included in the Council's analysis of the higher cases.

The growth in demand for electricity implied by assumptions about increases in irrigated acres is modified by assumptions about how irrigators will respond to the price level. A range of price responsiveness was assumed based on more detailed models of this sector's behavior. The lower forecasts were assumed to have more price response. Real electrical rates decline the most in the lowest forecasts, so the price response tended to raise those forecasts the most.

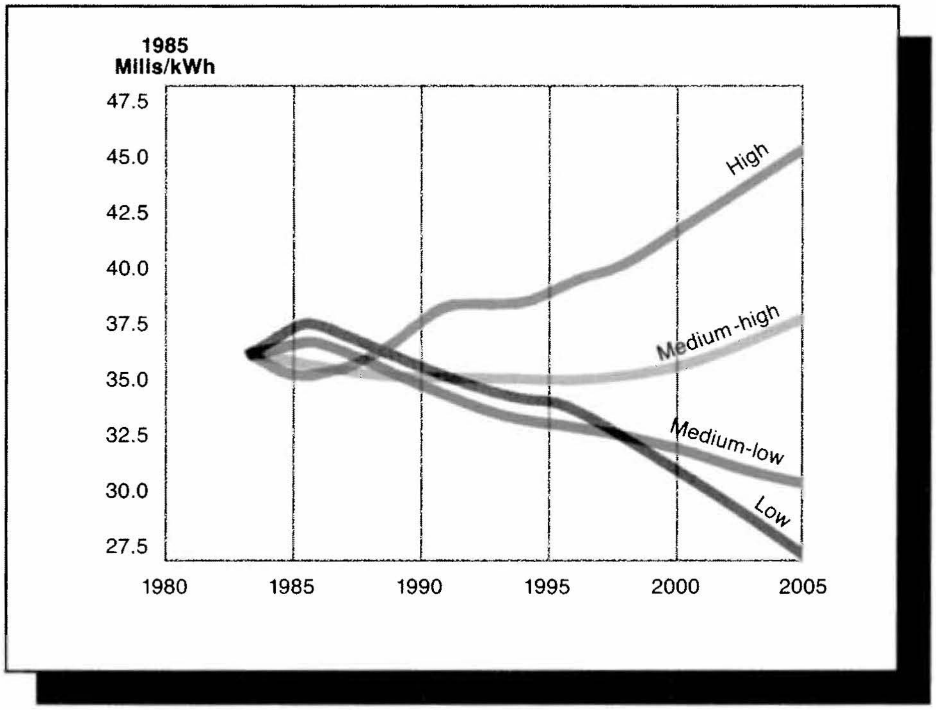


Figure 4-21
Average Retail Electric Rates

Electricity Prices

The Council's forecasts of electrical rates in the Pacific Northwest show relatively stable prices over the next several years. The exact price outlook, however, varies substantially in the different forecasts, due to differences in the amount of new resources that have to be acquired. Because nearly all new resources are more costly than the existing resource base, adding new resources will raise electrical rates. Figure 4-21 shows the four rate forecasts. The rates in Figure 4-21 are real average retail rates in 1985 dollars.

As can be seen from Figure 4-21, real retail rates are projected to begin to decline in real terms after 1985. The exception is the low case, where it was assumed that the region would lose half of the aluminum companies by 1987. This loss of electrical sales during the surplus increases the rates that other consumers would have to pay and delays the downturn in real prices. The low case also assumes that the debts from two terminated nuclear plants—Washington Public Power Supply System Nuclear Projects (WNP) 4 and 5—fall on the region's ratepayers. This reflects the fact that doubt remains about the final settlement of WNP-4 and 5 debts. If those debts were to fall on ratepayers, it would contribute to a low case demand. That WNP-4 and 5 assumption accounts for most of the difference in the beginning price level for the low forecast.

Table 4-14 shows 1984 estimated average electrical rates, forecasts for 2005, and average annual rates of change for four different kinds of rates. The rates shown include Bonneville wholesale rates for preference customers, average retail rates paid by all consumers combined, average retail rates paid by customers of public utilities, and average retail rates paid by customers of investor-owned utilities.

Bonneville preference customer rates increase faster than inflation in the high and medium-high forecast. In the medium-low and low forecasts real rates decline. Similar results are shown for retail rates of both public and investor-owned utilities.

These results depend on the assumptions used in the pricing model. One important assumption is that the Council's resource portfolio is implemented, including the assumption that the region will be able to cooperate to develop the lowest cost electrical resources available. Another important assumption is that no dramatically revised repayment requirement will be imposed for the federal debt on the region's hydroelectric system. Some of the more extreme versions of the revised repayment proposals would have a significant effect on electrical rates.

The Role of Demand Forecasts in Planning

The role of demand forecasts in the Council's resource planning is significantly different from the traditional role of demand forecasts. The traditional role of demand forecasts could be characterized as deterministic. That is, a "best-guess" demand forecast determined the amount of new electricity generation needed. Before the early 1970s it was generally assumed that demand for electricity would grow at close to historical rates. That growth had been rapid and relatively

Table 4-14
Electric Price Forecasts
(1985 Cents per Kilowatt-Hour)

	BPA PREFERENCE WHOLESALE	AVERAGE RETAIL, ALL CONSUMERS	AVERAGE RETAIL, PUBLIC UTILITIES	AVERAGE RETAIL, PRIVATE UTILITIES
Estimated 1984	2.3	3.6	2.8	4.2
Forecast 2005				
High	3.0	4.5	4.0	5.3
Medium-high	2.4	3.8	3.3	4.6
Medium-low	1.7	3.1	2.7	3.7
Low	1.3	2.8	2.4	3.4
Growth Rates (1984-2005)				
High	1.3	1.1	1.7	1.1
Medium-high	0.2	0.3	0.8	0.4
Medium-low	-1.4	-0.7	-0.2	-0.6
Low	-2.7	-1.2	-0.7	-1.0

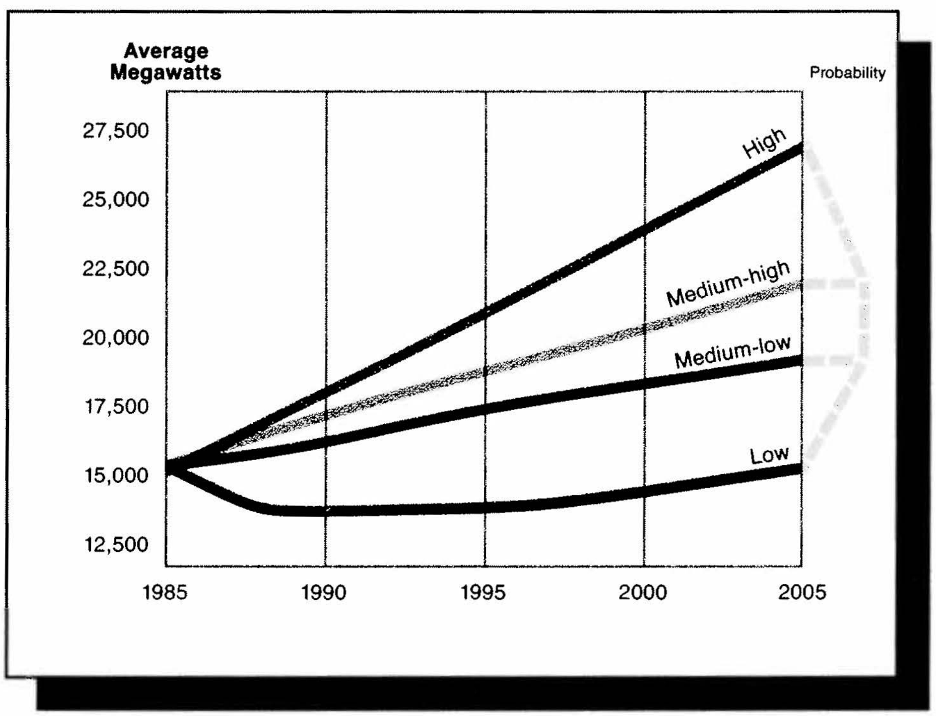


Figure 4-22
Demand Uncertainty

steady. It was assumed that economies of scale in power generation could be relied on to keep prices for electricity from increasing as new generating plants were added. Planners saw little reason for demand growth to slow down. In fact, it was widely assumed that there would be little or no response to price changes if they did occur.

The dramatic reduction in demand growth that occurred in response to increases in electricity prices in the early 1970s caught most planners by surprise. The initial response seems to have been to develop much more sophisticated forecasting tools. The forecasting models adopted by the Council represent the results of those efforts. However, the Council has recognized that, even with the best available forecasting tools, the forecasts of future demands remain highly uncertain. This recognition is moving forecasts away from their deterministic role in planning, to what may be described as an integral role.

The integral planning role of demand forecasts has three major components. First, forecasts of demand define the extent and nature of uncertainty that planners must face. Second, the level of demand is not independent of resource choices, but will respond to the costs of resource choices to meet future demands. Finally, sophisticated demand models are needed to assess the potential impacts of choosing conservation programs as alternatives to building new generating resources.

Defining Range of Uncertainty

The Council's range of forecast of demands is based primarily on variations in the key assumptions. The forecast range has been described above in terms of four forecasts. A probability distribution (Figure 4-22) describes the likelihood that any given level of future electricity demand within the range will occur. For planning purposes, the Council has adopted the trapezoidal distribution. The implications of the trapezoidal distribution are: (1) that demands outside the high and low forecasts are judged to be of sufficiently low probability that they are not formally considered in resource planning, and (2) that demands between the medium-high and medium-low forecasts are most likely and considered equally probable.

Resource portfolio analysis is based on the entire probability distribution of future loads. This is a major change from the 1983 plan and is made possible by the new Decision Model. The Decision Model analysis utilizes hundreds of possible load paths that are distributed according to the trapezoidal probability distribution defined by the original four demand forecasts, as illustrated in Figure 4-22.

Effects of Resource Choices on Price

As shown in Figure 4-1, there is an electricity pricing model in the demand forecasting system. This model translates resource decisions made by the Council into retail prices. The price model ensures that the implications of future resource decisions, including conservation programs, are reflected in future prices and demands.

Conservation Analysis

In addition to defining uncertainty, the demand forecasting models play an important role in defining and evaluating conservation opportunities. This is particularly true for the residential and commercial sectors, where the demand models are most detailed and conservation opportunities are best defined.

There are two major roles for the demand models in conservation analysis. The first is to help define the size of the potential conservation resource. The second is to predict the effectiveness of programs designed to achieve some portion of the potential conservation available.

The stock of energy-using buildings and equipment, including fuel type and efficiency characteristics, essentially determines how much additional efficiency can be achieved to offset the need for new electricity generation. The building energy demand models provide the necessary stock forecasts to analyze potential conservation. Obviously, the demand models will show different amounts of conservation potential for different forecasts.

The effects of conservation programs can be quite complicated and the demand models are designed to help assess those effects. For example, an energy efficient building code can affect all three components of building owner choice: efficiency, fuel type and use. While the direct impact is on efficiency choice, there are also likely to be unintended effects on fuel choice and intensity of use.

A more stringent code for residential electrical efficiency will tend to increase the construction cost of electrical homes. This relative increase in the initial cost of electrical homes, if borne by homebuyers, may cause some increase in the number of homes heated by natural gas or oil, even though the operating cost of the electrically heated homes would be reduced. For cost-effective conservation actions, the cost of providing an end-use service, such as space heating, will decrease. With the decrease in cost, the consumer's intensity of use may increase. Another important complication is that appliances give off waste heat that affects the heating and cooling requirements in buildings. More efficient appliances give off less waste heat and, therefore, more heating and less cooling will be needed than with less efficient appliances. These secondary effects can be evaluated in the detailed building models to give a more accurate assessment of the actual effects of conservation programs on demand for electricity.

Forecast Concepts

The Council uses three different demand forecast concepts in its planning activities. Most Council presentations and publications, including the preceding sections of this chapter, describe "price effects" forecasts. Price effects forecasts show what the demand for electricity would be if customers were allowed to respond to price, but no new conservation programs were implemented. Price effects forecasts reflect building codes as of 1986 but do not assume further adoption of the Council's model conservation standards. An important factor affecting price effects forecasts is what resource mix is assumed in the electricity price that is provided to the demand models.

A "sales" forecast is a forecast of the demand for electricity after the effects of the model conservation standards and other conservation programs have been taken into account. This is the amount of electricity that would actually be sold by utilities.

The third demand concept, the "frozen efficiency" forecast, attempts to eliminate double counting of actions that are taken in response to price, but could also be achieved through the Council's proposed conservation programs. The methods of developing frozen efficiency forecasts vary by sector, and are described further in Volume II, Chapter 3.

This section summarizes and explains the differences among the three forecast concepts. The three forecasts for the high scenario are shown in Figure 4-23 to help visualize the following discussion.

Table 4-15 shows the growth rates for the three forecast concepts for each of the forecast scenarios. The price effects growth rates are the same as those shown in Table 4-1 and Figure 4-2. The frozen efficiency growth rates are slightly higher because part of the demand decreases due to price response have been eliminated. The differences between price effects and frozen efficiency forecasts are relatively small, because prices are not forecast to increase much in most forecast scenarios. Demand growth is significantly lower for the sales forecasts than for the other two forecasts, reflecting potential conservation savings from the Council's programs. Only in the low forecast are the differences among the three forecast concepts small, because only new building standards savings are acquired.

The difference between the highest forecast (the frozen efficiency forecast) and the lowest (the sales forecast) is the total effect on electricity demand of conservation resources and cogeneration. The price effects forecast divides that total effect into two parts, that which would result from price response and the incremental effect of conservation programs and cogeneration acquisition. The difference between the frozen efficiency and price effects forecasts represents the price response portion. The difference between the price effects and the sales forecasts represents the incremental program impacts.

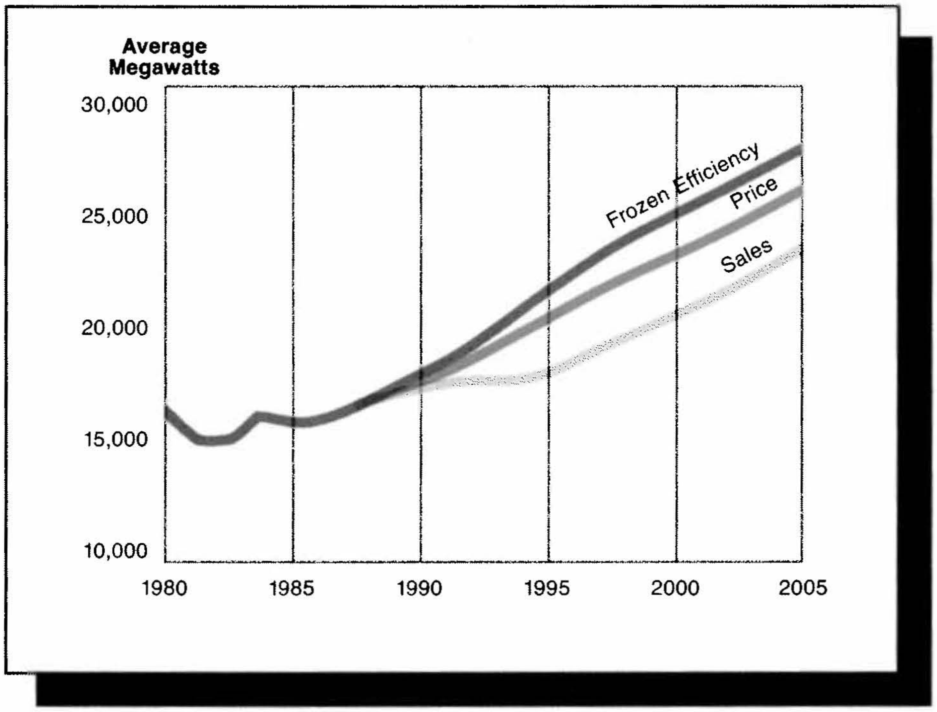


Figure 4-23
Comparison of High Forecasts

Table 4-15
Demand Growth Rates by Forecast Concept
(Average Annual Rate of Change, 1983-2005)

	HIGH	MEDIUM-HIGH	MEDIUM-LOW	LOW
Price Effects	2.7	1.8	1.2	0.2
Frozen Efficiency	2.9	1.9	1.3	0.2
Sales	2.2	1.3	0.7	0.0

Electrical Loads for Resource Planning

Demand forecasts serve as the basis for the Council's resource portfolio analysis. This section describes what forecast concepts are used and how they are modified for resource planning analysis.

In the 1983 plan, resource loads were based on frozen efficiency forecasts of demand in order to avoid counting conservation potential twice. The 1986 plan loads are also based on frozen efficiency forecasts. However, several adjustments are made to these forecasts before they are used for resource planning.

The assumptions regarding direct service industry demand for electricity are shown in this chapter as a range of operating levels associated with specific forecast scenarios. The direct service industry loads are treated differently, however, in the analysis of electrical loads faced by the region for resource planning. In the resource portfolio analysis, direct service industry load uncertainty is modeled by including 50 percent of aluminum direct service industry load in all load cases and randomly adding portions of the remaining 50 percent of aluminum industry loads. Thus, for resource analysis, the risk associated with the upper half of the aluminum loads is not linked to any particular load scenario. This facilitates a better assessment of the uncertainty, since it is not clear that the health of the aluminum industry in this region will be related directly to the general economy. The positive influences of a healthy economy may be offset for aluminum producers by the higher electric rates that would come with a faster growing region.

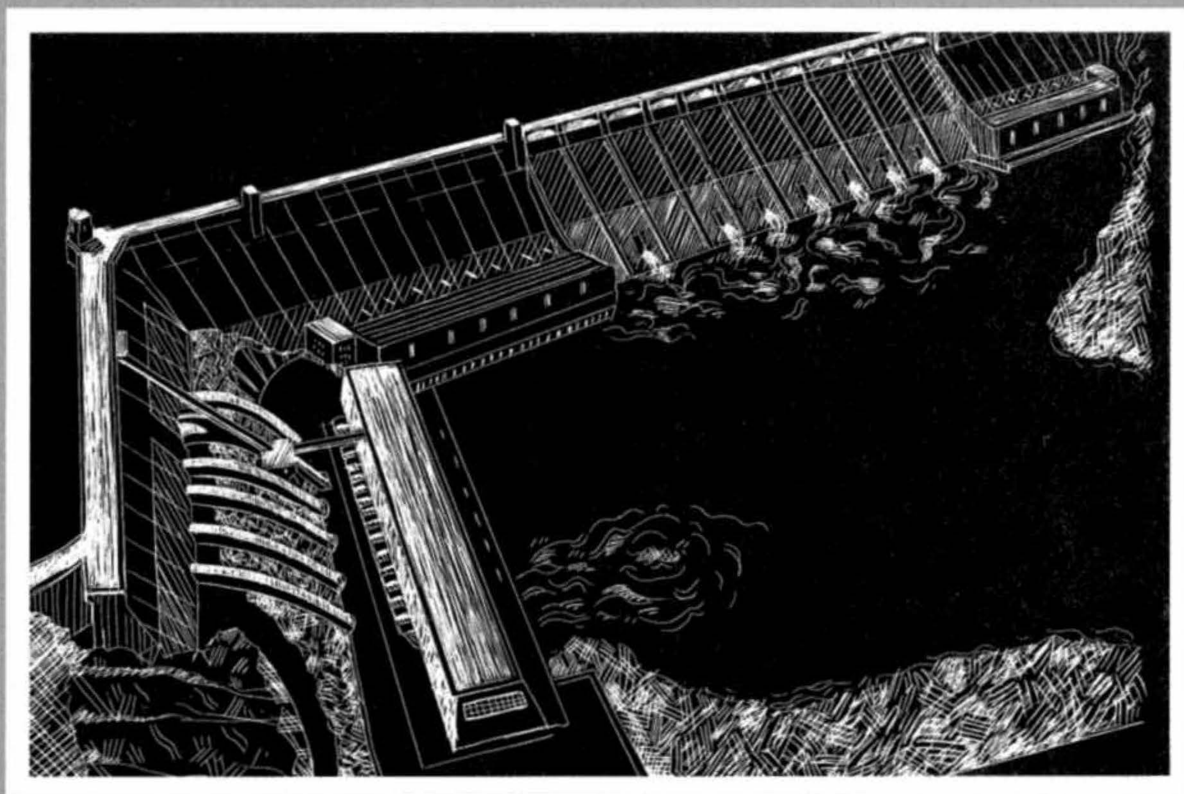
Several adjustments are made to the demand forecasts to create the load forecasts for resource planning. First, demand forecasts are converted to load forecasts by adding transmission and distribution losses. The demand forecasts are for consumption of electricity at the point of use, while loads are the amount of electricity that needs to be generated. More electricity has to be generated than is actually consumed by utility customers, because some electricity is used or lost in the transmission and distribution of power. The demand forecasts are converted to loads by adding 2.4 percent to direct service industry demand, and 7.5 percent to other demand.

Most resource analysis is done on an operating year basis. Since the demand forecasts are done on a calendar year basis, the demands must be converted from a year that begins in January to a year that begins the previous September. This is done by calculating a weighted average of the previous and current calendar years. The previous year receives a one-third weight, and the current year a two-thirds weight. In addition, for resource planning, the 1985 and 1986 calendar year forecasts are set to be the same across forecast scenarios. This was done by averaging the four forecasts. The resulting 1986 forecast (a proxy for actual loads) is then interpolated to each scenario's respective 1990 level.

The demand forecasts along with the economic assumptions underlying them and their role in resource planning are discussed in Chapters 3 and 4 of Volume II.

1./ Growth rates are used as a means of summarizing the demand forecasts. They can vary substantially depending on the specific base year used in their calculation and should, therefore, be interpreted with caution.

2./ Wharton Econometric Forecasting Associates, *Long-term Alternative Scenarios and 20-year Extension,* July 1984, Volume 2, Number 4.



Chapter 5

Chapter 5
The Existing
Regional Electrical Power System

The Pacific Northwest electrical power system began in the late nineteenth and early twentieth centuries as a collection of small independent power systems relying on small hydroelectric and coal-fired steam-electric power stations. Growth of these systems through the 1920s and early 1930s was supported by additional small-scale hydropower development and, to a lesser extent, by steam-electric capacity.

From the early 1930s through the 1970s, the enormous hydroelectric resource of the Columbia River was developed, and with it the regionwide transmission grid that transmits power from the Columbia River dams to the region's electrical load centers. This phase of development resulted in an electrical system based predominantly on hydroelectric power.

By the 1960s it had become evident that hydropower alone would not be capable of meeting the growing electrical needs of the region. As described in Chapter 1, construction of large coal and nuclear plants was initiated to meet new energy demand. Many of the large thermal plants planned under the Hydrothermal Power Program were eventually canceled or mothballed due to slowing demand growth. Many plants were completed, however, producing the mix of hydropower and thermal plants that characterizes the present-day regional power system.

Additional system diversity is provided by numerous independent small hydropower, cogeneration and small thermal plants developed in response to the Public Utility Regulatory Policies Act of 1978 (PURPA).

This chapter describes the composition and operation of the regional power system. The chapter concludes with a discussion of the allocation of generating resources between the publicly-owned and the investor-owned utilities.

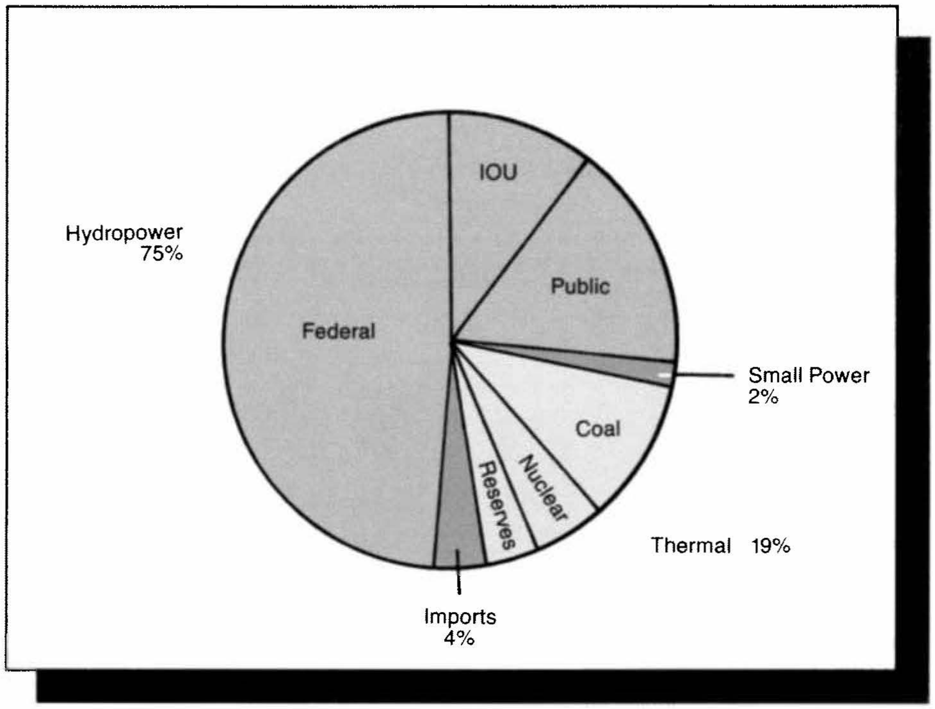


Figure 5-1
Existing Regional Generating Capacity

Regional Generating Resources

This section provides an overview of the generating resources comprising the regional power system. Tables listing specific generating projects are provided in Appendix 6A of Volume II. Conservation resources are described in Chapter 6 of this volume.

Large Hydropower Resources

Hydropower represents approximately 78 percent of the installed capacity and produces approximately 70 percent of the total electricity used by the region (Figures 5-1 and 5-2). Even with demand growth at the Council's projected high level, hydropower would still produce almost half the region's electricity at the turn of the century.

If all the dams in the system were fully operational on January 1 of any year, approximately 29,800 megawatts of power could be generated.[1] That is the ultimate or peak capacity of the hydro system. But the annual *energy* capability varies widely, depending upon annual rainfall and snowpack accumulation. The firm energy capability of the hydropower system, representing energy that can be expected in all but the worst water years, is about 12,300 megawatts. On the average, however, the system can be expected to produce about 16,400 megawatts. The 4,100 megawatt difference between average water years and the firm energy capability of the system means that in most years the system produces substantial amounts of additional power called nonfirm energy.

This summary of regional hydroelectric generating capability includes power from all the existing hydropower dams in the region (except those of Montana Power Company and Utah Power and Light), including generation in the United States resulting from storage regulation of three Canadian reservoirs—Duncan, Arrow, and Mica—in accordance with the Pacific Northwest Coordination Agreement. Following established Northwest power planning practice, Montana Power Company and Utah Power and Light hydro generation used to serve regional loads is accounted for as imports to the region.

The regional hydropower capability has been adjusted to take into consideration the effects of the Council's fish and wildlife program. An important element of this program is the water budget to improve streamflows for downstream migration of salmon and steelhead. The water budget has reduced the firm electric energy load carrying capability of the region's power system by approximately 250-270[2] megawatts.

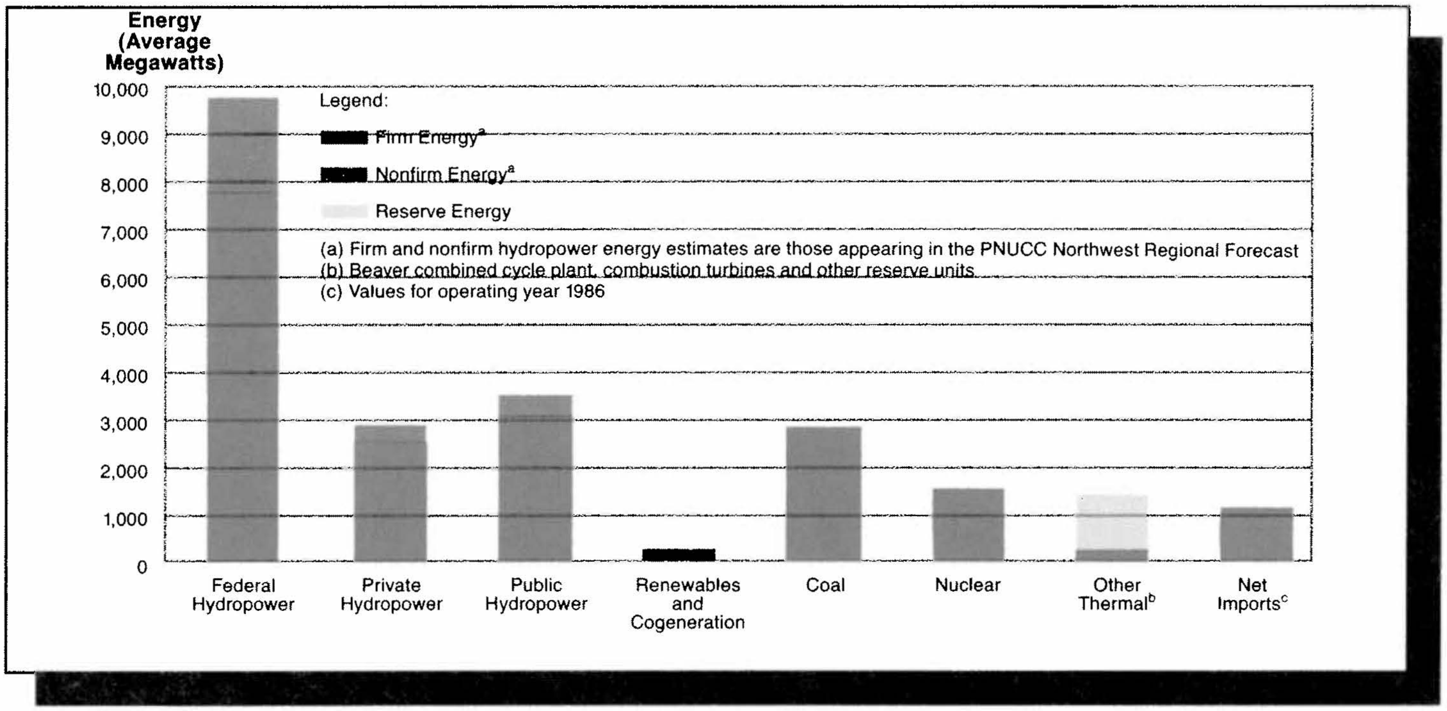


Figure 5-2
Existing Regional Energy Resources

This capability includes new hydropower projects in cases where construction is considered to be assured. A listing of the regional hydroelectric generating projects is provided in Chapter 6, Appendix 6A of Volume II.

Large Thermal Resources

Large thermal resources currently available to the region include 12 coal units,[3] two conventional nuclear stations,[4] the Hanford Generating Project and the wood-fired Kettle Falls station. These projects total approximately 9,050 megawatts of installed capacity. Because these projects are not wholly dedicated to the region, not all of this capacity and energy are available to serve regional loads. Approximately 5,780 megawatts of capacity and 4,540 megawatts of energy from these resources are available for serving regional loads.[5]

The Council has assumed that operation of the Hanford Generating Project will continue through July of 1993 as specified in the contract between the U.S. Department of Energy and the Washington Public Power Supply System. Because this contract is subject to cancellation with one year's notice, the Council will continue to monitor the status and performance of this resource.

One thermal project, the coal-fired Colstrip 4 unit at Colstrip, Montana, is currently under construction. This project, totaling 778 megawatts of installed capacity, will provide approximately 490 megawatts of capacity and 370 megawatts of energy to the region. As before, the Montana Power Company share of Colstrip 4 that serves regional load is not included in this accounting.

Washington Public Power Supply System Nuclear Projects 1 and 3 have not been included as assured resources because of institutional questions regarding the ability to complete these projects. (See Chapter 7 of this volume.)

A number of thermal units serve primarily as reserve resources. These units, which include the Beaver combined-cycle plant, a number of combustion turbines, older steam-electric units and several diesel generators, have a total peak capacity of approximately 1,620 megawatts. The operators of these plants have declared 171 megawatts of energy from these plants to be available to the region as a firm energy resource. Some have operating restrictions based on fuel use, air quality or noise control regulations that prevent them from operating at rated capacity or which limit the amount of time that they can operate. Others, particularly the diesel generators, are installed in remote locations and are intended to provide backup to local load in case of transmission or distribution system failure. However, the combustion turbine and combined-cycle units not subject to Fuel Use Act or other operating restrictions could likely provide significantly more firm load than currently declared. The Council estimates that approximately 615 additional megawatts of firm energy could be provided by combustion turbines and combined-cycle units not subject to operating restrictions. This energy would be cost effective if these units were displaced by nonfirm hydropower when available.

Small Power Projects and Other Contracted Resources

Small power and cogeneration projects with output contracted to regional utilities include numerous hydropower projects, five wood-fired power plants, one wind farm and numerous cogeneration projects. These projects include more than 830 megawatts of capacity, producing approximately 400 average megawatts of energy.[6] A listing of these projects is in Appendix 6A of Volume II. Not included in these estimates are hydropower projects, cogeneration and small thermal plants that produce electricity for the on-site use of industries or large institutions.[7]

Imports to the Region

Interconnecting transmission lines with neighboring systems allow power transfers between the Northwest and other regions. Total firm resources available to this region include the net effect of these transfers. These transmission interconnections also support sales of nonfirm power to other regions. Nonfirm power sales, however, do not affect firm regional resources.

Firm power transfers can involve the sale or purchase of firm energy or the sale or purchase of peaking capacity. Transfers can take the form of sales or exchange agreements between utilities in different regions, or intra-company transfers by utilities that serve both regional and extra-regional loads, including the capability of thermal resources that are outside of the region's boundaries but are intended to serve regional loads. Exchange agreements between utilities can include combinations of firm energy and peaking capacity exchanges. Generally, three types of arrangements are made:

- A peaking capacity exchange in which the agreement is to return not only the borrowed energy, but also additional energy to "pay" for the cost of the exchange. This type of arrangement represents an energy import into the region.
- A peaking capacity sale in which the payment for the capacity is made in dollars instead of energy. The energy provided in meeting capacity requirements is typically returned. This type of arrangement results in no long-term net exchange of energy.
- A firm energy sale or purchase in which payment is made in dollars for long-term delivery or receipt of firm energy. This type of arrangement represents a reduction in the region's firm resources for the duration of the sale.

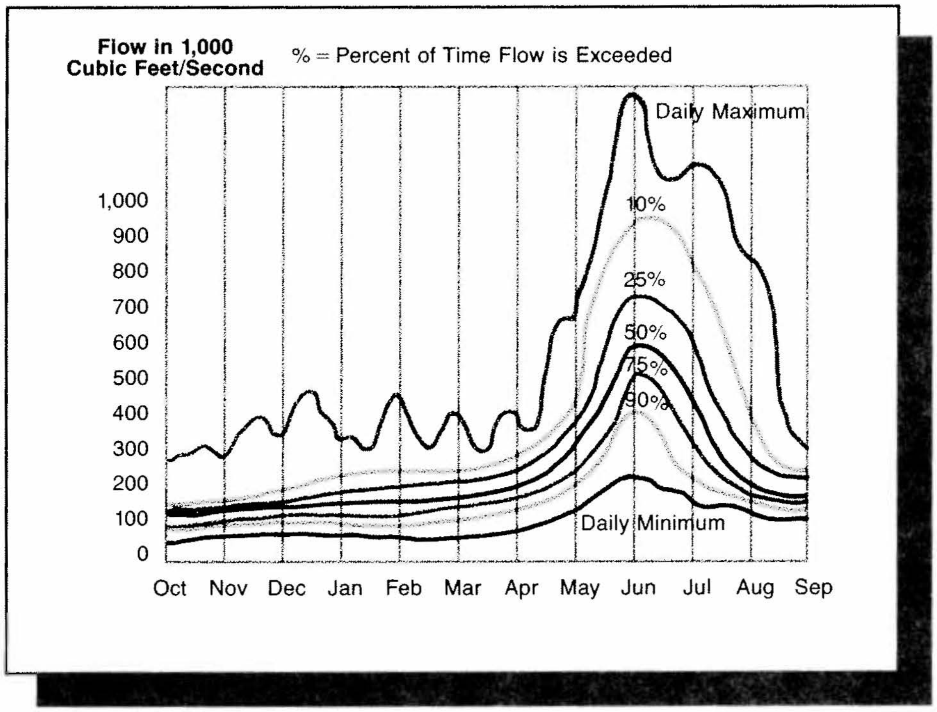


Figure 5-3
Average Daily Columbia River Natural Flow at The Dalles, Oregon

In general, the region imports more firm power than it exports. This is due primarily to imported energy from Pacific Power and Light's thermal resources outside the region, which are used to meet regional loads. The sum of all the power exchanges represents a net energy import to the region of about 1,200 megawatts in 1986. This amount decreases as these exchange contracts expire, leaving a net of about 200 megawatts in the year 2005.

Regional firm energy capacity and exchanges are described in additional detail in Chapter 6 of Volume II.

Operation of the Regional Power System

There are two key characteristics of the Northwest hydropower system. First, the annual energy capability of the system varies widely, depending upon rainfall and the snowpack accumulated in the region each year. A second equally important characteristic is that the variation within the year can be even greater than the variation across the water conditions from year to year.

Over half the annual firm energy from the Northwest hydropower system comes from natural streamflows; less than half comes from reservoir storage. Figure 5-3 shows the variation in natural streamflow at The Dalles on the lower Columbia. The curve of Figure 5-3 indicates the percent of time that the indicated flow is exceeded. The relatively low amounts and low variability of natural streamflows between September and the onset of the spring runoff in March or April are important in considering the risks that can be taken in using the reservoir storage.

The reservoir storage itself is significantly limited. A large part of the hydropower system water supply comes from the snowpack in the upper Columbia and upper Snake river basins, in the mountains of British Columbia, Montana and Idaho. However, only 40 percent of even the average January to July runoff is storable in the system's reservoirs. This means large portions of the total annual water supply come during the spring runoff from April through July. Moreover, most of the water from the melting snow must pass through the generators or over the spillways if it cannot be used in the springtime, because it cannot be stored for use in the following fall and winter when demand is higher.

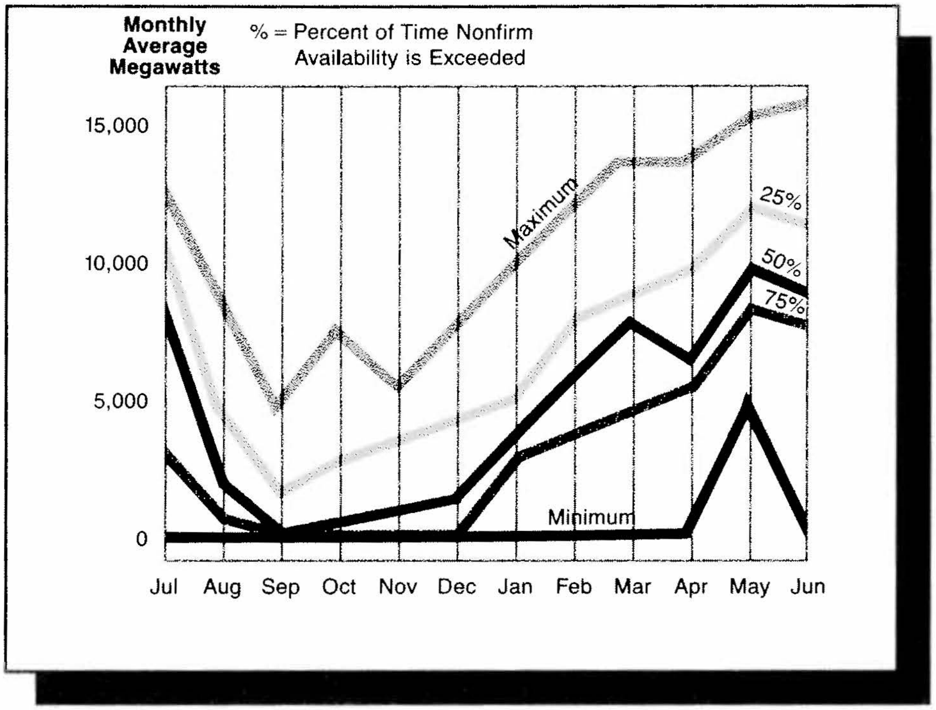


Figure 5-4
Probability of Nonfirm Energy Availability

Figure 5-4 shows the amounts of electrical energy available at various probability levels above the critical period quantities over the 102-year historical record. It indicates, for instance, that the maximum amount of nonfirm energy available in November is about 5,000 megawatts. There is more than 3,700 megawatts only 25 percent of the time. Similarly, no nonfirm power is available in November 25 percent of the time.

The variability of the hydropower system affects the economics of other existing and new resources, because it influences the way they operate. The total amount of resources required assumes that the hydropower system will not produce more energy than it did during the worst conditions, or "critical period," of the past. To the extent nonfirm energy is available, it can be used to displace or shut down regional generating resources with high operating costs, thus saving these operating costs. Alternatively, the output of these regional generating resources can be sold to Southwest markets if they can be sold at a profit over their operating costs.

Allocation of Regional Generating Resources

To help determine the potential obligations of the Bonneville Administrator, it is necessary to break down estimates of existing regional resources into those for the federal, public utility, and investor-owned utility systems.

Because of energy exchanges between utilities, contracted resources for one sector sometimes meet loads of another sector. Simply totaling the resources for the three sectors will give incorrect regional resource amounts. To obtain accurate estimates of resources for each sector, the *net* energy after transfers should be used. Three types of transfers are involved:

- **Extra-regional transfers:** Transfer of firm energy between a utility within the region and a utility outside the region.
- **Intra-regional transfers:** Transfer of firm energy between utilities within the region.
- **Canadian treaty benefits:** The Canadian half of downstream power benefits from the Canadian storage reservoirs. This energy is sold to U.S. utilities.

After the above adjustments were made, proportions of ownership of total regional resources for each of the three sectors were calculated. These proportions were then applied to the regional totals used in the system models to produce estimates for modeling purposes. For any scheduling studies concerning Bonneville's obligations, the public and federal resources were combined into a single system. Table 5-1 shows the resulting firm resources used in the analysis for the region, the investor-owned utilities, and for Bonneville.

Table 5-1
Allocation of Existing Regional Resources

OPERATING YEAR	PRIVATE (MWa)	FEDERAL AND PUBLIC (MWa)	REGIONAL TOTAL (MWa)
1986	8,485	10,260	18,745
1987	8,453	10,300	18,753
1988	8,374	10,142	18,516
1989	8,300	10,159	18,459
1990	8,254	10,174	18,428
1991	8,238	10,181	18,419
1992	8,172	10,186	18,358
1993	8,136	10,176	18,312
1994	8,003	9,900	17,903
1995	7,983	9,925	17,908
1996	7,883	10,005	17,888
1997	7,601	10,308	17,909
1998	7,541	10,304	17,845
1999	7,521	10,292	17,813
2000	7,426	10,255	17,681
2001	7,413	10,280	17,693
2002	7,373	10,304	17,677
2003	7,346	10,291	17,637
2004	7,310	10,230	17,540
2005	7,451	10,236	17,687

./ January peak capacity, average energy and critical period energy estimates are for operating year 1986 (September 1985 through August 1986). They are based on figures from the 1985 Pacific Northwest Utilities Conference Committee's (PNUCC) *Northwest Regional Forecast.*

./ The reduction in the current impact of the water budget, from that initially expected, is due to two factors. First, the water budget, as specified in the Council's Fish and Wildlife Program, is not being met on the Snake River in the second and third years of the critical period. Second, there appear to have been additional shifts of thermal maintenance into the water budget period. The Council's use of these results does not imply that it has changed the water budget. The impact is measured on the coordinated system, and does not include effects on Idaho Power, which are small currently.

/ Boardman, Centralia 1 and 2, Colstrip 1, 2 and 3, Jim Bridger 1-4 and Valmy 1 and 2.

/ Trojan and Washington Public Power Supply System Nuclear Project No. 2.

5./ Capacity and energy available to serve regional loads excludes out-of-region Montana Power Company (MPC) generation and Pacific Power and Light (PP&L) generation at Jim Bridger, even though some of this capacity and energy is used to serve loads within the region. MPC resources, and PP&L resources outside of the region serving regional loads, are accounted for in the Council's models as imports to the region. This is in accordance with normal regional power planning practice.

6./ The estimated energy production of the small power and cogeneration projects is based on the output purchased by contracting utilities in 1983. This number does not necessarily represent the total output of these projects, as some output may have been used to offset the electrical needs of the operators of the projects. Moreover, this output may not be representative of future years.

7./ Operators of industrial and institutional generating facilities which normally generate for on-site use will often establish short-term contracts for sale to local utilities when electricity and fuel prices are favorable.

Chapter 6

Chapter 6
Conservation Resources

Conservation is a key resource for meeting the Northwest's future electrical energy needs. Each megawatt of electricity conserved is one less megawatt that needs to be generated. The Council has identified close to 3,700[1] average megawatts of conservation in the high demand forecast available at an average cost of 2.4 cents per kilowatt-hour—enough energy to replace more than eight coal plants, at about half the cost. Conservation remains a large and extraordinarily cost-effective resource for the region to acquire.

In the Council's plan, conservation is the more efficient use of electricity. This means that less electricity is used to produce an amenity level comparable to the one existing before the implementation of the conservation measure. Conservation resources are measures[2] that ensure new and existing residential buildings, new and existing commercial buildings, appliances, and industrial and irrigation processes use energy efficiently. For example, buildings that cut down heat loss through insulation and tightening require less electricity for heating. These "savings" of electricity mean that fewer power plants must be built to meet growing demand. Conservation also includes measures to reduce electrical losses in the region's generation, transmission and distribution system. These latter conservation resources are discussed in Chapter 7.

Conservation is also a uniquely flexible resource. Some conservation programs automatically match growth in electrical demand, as happens when new buildings are constructed to be energy efficient. Each new building adds load to the electrical system but can also save energy if it is better insulated than current practice. Conservation can also be developed more quickly than generating resources when more electricity is required. However, some cost-effective conservation resources could be lost to the region forever if they are not secured at the appropriate time. The plan refers to these as "lost opportunity" conservation resources.

This chapter summarizes the Council's estimates of conservation resources available to the region. The narrative is based on calculations from the Council's high demand forecast, but similar calculations were done for the low, medium-low and medium-high forecasts. More detailed descriptions of the analysis for the high demand forecast can be found in Volume II, Chapter 5.

Estimating the Conservation Resource

The evaluation of conservation resources involves three major steps. The first step is to develop conservation supply curves. This step entails evaluating the levelized life cycle cost[3] of all the conservation measures and rank ordering them with the least-cost measure first.

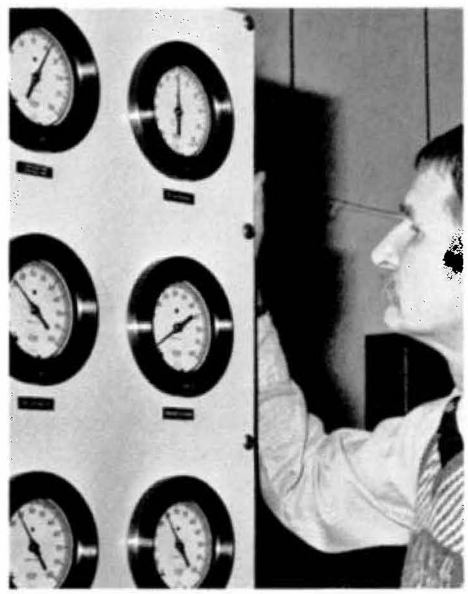
The second step is to group into programs all measures with levelized costs less than a given avoided cost. The avoided cost is the cost of the resource that would be used in the electrical system should conservation not be developed. This cost varies somewhat, depending on the specific characteristics of the conservation program, such as whether savings from the program can be developed as need occurs or whether it is developed today during the current surplus. In general, the avoided cost for discretionary resources in this plan is the cost of a new coal plant. The avoided cost for all resources is discussed further in Volume I, Chapter 3.

The third step involves using the cost and savings characteristics of each program to evaluate the conservation resource's cost effectiveness and compatibility with the existing power system. Cost effectiveness is determined for each conservation program by comparing the program against electricity generating resources to develop a least-cost resource portfolio.

The bulk of this chapter deals with steps one and two, which are preliminary cost-effectiveness screens to size the conservation resource for the resource portfolio. Step three is described primarily in the resource portfolio, Volume II, Chapter 8.

Supply Curves

Conservation supply curves are used to evaluate the amount of conservation available at various costs. A supply curve is an economic tool used to depict the amount of a product available across a range of prices. In the case of conservation, this translates into the number of average megawatts that can be conserved, and made available for others to use, at various costs. For example, an industrial customer may be able to recover waste-heat from a process load and conserve 3 average megawatts at a cost of 2 cents per kilowatt-hour. This same customer may be able to conserve a total of 6 average megawatts for an investment of 3 cents per kilowatt-hour, and 7 average megawatts for 4 cents per kilowatt-hour. These figures represent points along the conservation supply curve for this particular customer. Individual conservation estimates for end-uses in each sector are merged to arrive at the regional supply curve for that sector.



The supply curves used in this plan do not distinguish between conservation resulting from specific programs and conservation motivated by rising prices of electricity. This is a regional perspective; regardless of whether the consumer or the utility invests in a conservation measure, the region is purchasing savings at a particular price and the conservation resource is secured.

Conservation supply curves are primarily a function of the conservation measure's cost and electrical savings. Each measure's savings and cost are used to derive a levelized cost, in terms of cents per kilowatt-hour, for that measure. The absolute value (in terms of kilowatt-hours per year) of the savings produced by adding a given conservation measure is a function of the existing level of insulation. The less efficient the existing structure or equipment, the greater the savings obtained from installing the measure. The potential for conservation is thus directly related to the amount of energy currently used. In order to minimize the costs of efficiency improvements, conservation measures are applied with the least costly measure first until all measures are evaluated.

The levelized costs used to generate the supply curves are based on the capital, operating and maintenance expenditures incurred over the lifetime of the conservation measure. To ensure consistency between the conservation supply curves and the system models,[4] capital recovery factors used in the levelized cost calculation are the same ones used in the system models. This means that the tax treatments, rate requirements and other financial considerations specific to the developer of the resource are accounted for in the levelized cost of the conservation resource.

Conservation Programs for Portfolio Analysis

After the supply curves are generated for each end-use or sector, the amount of conservation in the portfolio analysis is first sized by cutting off the supply curve at the point where the levelized cost of the last measure included is equal to or just slightly less than the avoided cost. An avoided cost is an investment guideline, describing the value of conservation and generation investments in terms of the resources they displace. Because the characteristics of conservation resources vary with the resource being developed, the avoided cost also varies. The avoided cost is described in detail in Volume II, Chapter 4.

As shown here, the avoided cost is 5.0 cents per kilowatt-hour for conservation resources that can be scheduled to meet load. These are called "discretionary resources" because they don't need to be developed during the current surplus. Conservation resources that fit into this category are based on existing end-uses—for example, commercial retrofit programs and residential weatherization. Residential weatherization is a special case within the discretionary resource category, since this resource is being secured today to maintain capability, even though a surplus exists.

The avoided cost for residential weatherization measures purchased in 1986 is approximately 3.5 cents per kilowatt-hour and increases over time up to 5.0 cents per kilowatt-hour as the surplus nears an end. The plan calls for reducing the residential weatherization program to a minimum viable level in the near term, and the majority of savings should not be developed until near the end of the surplus. In addition, any weatherization that does occur should be aimed at developing the capability to deliver the full amount of savings when the program is required to be run at full speed. Over the next few years, the weatherization program should be aimed primarily at the low-income and rental subsectors, where capability needs to be developed. As a consequence of these factors, the Council used the 5.0 cents per kilowatt-hour cutoff to size the weatherization resource in the portfolio. Even so, the vast majority of measures included in the residential weatherization program cost less than 3.5 cents per kilowatt-hour.

The 5.0 cents per kilowatt-hour avoided cost also applies to conservation resources that grow automatically with economic development but are not expected to be developed until the later years of the forecast, when the region is no longer in a surplus condition. Savings from refrigerators and freezers, not anticipated to be developed until 1992, fall into this category.

The avoided cost is between 4.0 and 4.5 cents per kilowatt-hour for conservation resources that grow with loads, have lifetimes longer than the duration of the surplus, and must be acquired today or their savings are lost forever. However, the avoided costs for these resources will increase over time. Savings from the model conservation standards in new residential and commercial buildings epitomize this type of conservation resource.

The "technical" conservation potential is the amount of conservation available at less than the avoided cost. The technical conservation potential is reduced in the analysis to reflect the portion of the conservation resource that is considered achievable. Achievable conservation is the net savings the Council anticipates after taking into account factors such as program design, changes in consumer behavior, consumer resistance, quality control, and unforeseen technical problems. The Council believes that the wide assortment of incentives and regulatory measures the Act makes available can persuade the region's electricity consumers to install a large percentage of the technically available conservation. As a consequence, the proportion of technical potential considered achievable in this plan varies from 50 to 90 percent. These achievable savings are used by the Council in the system models.

Each conservation program is comprised of the package of measures that cost less than the avoided cost. At this point, the present value costs and the achievable savings for each program are adjusted in the following manner before they are used in the system models to determine compatibility with the existing power system and to derive a least-cost resource portfolio.

First, since the system models use conservation programs instead of individual measures in the resource portfolio, capital replacement costs have to be added to those measures with lifetimes shorter than the lifetime of the major measure in the program. For example, caulking and weatherstripping have shorter lifetimes than insulation; therefore, replacement costs are incurred over the expected lifetime of the insulation to maintain the benefits of caulking and weatherstripping. Consistent with generating resources, these capital replacement costs were escalated at 0.4 percent per year for the first 20 years after netting out the effects of inflation.

Second, in addition to the direct capital and replacement costs of the conservation measures, administrative costs to run the program must be included in the overall cost. The Council believes that the administrative cost of a given program is largely independent of the level of measures that the program installs. For example, the administrative expense of requiring an insulation contractor to install full levels of cost-effective ceiling insulation is no more than if the contractor were only required to install half the cost-effective amount. Processing of contracts, quality checks, and other administrative actions still need to be taken. The Council reviewed current utility conservation programs and those operated by other agencies. This review indicated that conservation program administrative costs range from 10 to 30 percent of the direct cost of measures. As a consequence, the Council has assumed a 20 percent administrative cost in its calculations of cost effectiveness for conservation. This means that the average cost of the conservation programs is increased 20 percent before the conservation is compared to generating resources to determine which is cheaper. As more data become available on fully operational conservation programs, the Council will develop estimates based on dollars per application instead of percent of direct cost.

A third factor that must be accounted for when comparing conservation programs with generating resources is the 10 percent credit given to conservation in the Northwest Power Act. This credit means that conservation can cost 10 percent more than the next lowest cost resource and still be considered cost effective under the Act. This 10 percent benefit is given to all conservation measures.

Finally, to ensure that conservation and generating resources are being compared consistently, the costs and savings of both types of resources must be evaluated at the same point of distribution in the electrical grid. Conservation savings and costs are evaluated at the point of use — for example, in the house. In contrast, the costs and generation from a power plant are evaluated at the generator (busbar) itself. Thus, to make conservation and the traditional forms of generation comparable, the costs of the generation plant must be adjusted to include transmission system losses (7.5 percent) and transmission costs (2.5 percent).

The net effect of all these adjustments is different for the marginal conservation measure than for the average program, since administrative costs are assigned to the average program and not the marginal measure. The cost threshold for investment in the marginal conservation measure is the busbar cost of coal plants, the resource that generally establishes the avoided cost, plus 20 percent—10 percent for the Act's credit, 7.5 percent for transmission system losses and 2.5 percent for transmission costs.

The effect on the average cost of conservation programs that are compared to generating resources is to increase the average cost of the conservation programs by 7.5 percent—20 percent added for administrative costs minus 10 percent for the Act's conservation credit and 2.5 percent saved in transmission and distribution costs—and to increase the average savings from the program by 7.5 percent to account for line loss credits.

The adjustments to the average costs and savings from conservation programs permit comparison on an equal basis between conservation and generating resources. This is done in the models used by the Council to simulate how the various resources will actually operate in the existing power system. However, in this chapter, in order to portray the true cost of conservation programs, the 10 percent benefit from the Act is not included in the average cost calculations. As a consequence, the levelized program costs in this chapter are 10 percent higher than those used in the system models. In addition, this chapter is based on conservation savings at the end-use, so the savings presented are 7.5 percent lower than those used in the resource portfolio.

Compatibility with the Power System

After these adjustments are made, each conservation program is evaluated in terms of its compatibility with the existing power system and is compared to the cost and savings characteristics of other electrical energy resources. To assess compatibility, and ultimately the cost effectiveness of the conservation programs, the Council used both the Decision Model and the System Analysis Model. These models serve as a final screen to determine whether the conservation resource is regionally cost effective.

The Decision Model determines how much conservation is needed in each of the Council's forecasts. The conservation that the model secures in any one year to meet energy needs depends on how fast a program can become operational, and on the ultimate amount of cost-effective conservation available. If the region is surplus for a long time, but a conservation program is already operating, the speed at which the program can slow down and the minimum viable level of that program are also important in determining available conservation. The minimum viable level of the program, if above zero, determines the amount of savings that would accrue even though the region would prefer to delay purchase of the resource during the surplus period.

Residential Sector Results

In 1983, the region's residential sector consumed 5,216 average megawatts of electricity—about 36 percent of the region's total electrical consumption. Space heating is by far the largest single category of electricity consumption in the residential sector; water heating is second.

More is known about end-uses in the residential sector than in any other electricity consuming sector. End-uses described in the residential conservation assessment include space heating in existing and new residences, water heating, refrigerators and freezers. The plan identifies close to 1,900 average megawatts of achievable conservation in the residential sector. Slightly more than 60 percent of this resource is available from reducing the energy required to heat homes.

Space Heating Conservation in Existing Buildings

Savings from space heating in existing residences can be achieved through improving a house's insulation level, adding storm windows, and reducing air leakage. Figure 6-1 shows the estimated space heating savings available from existing residences at various electricity prices. The technical potential for conservation from existing electrically heated homes totals 500 average megawatts, with no single measure included in this estimate exceeding 5.0 cents per kilowatt-hour. The Council estimates that up to 85 percent (425 average megawatts) of these savings are achievable. This represents about 37 percent of projected space heating loads in the year 2005. The average cost of insulating and weatherizing existing residences is estimated to be 2.9 cents per kilowatt-hour.

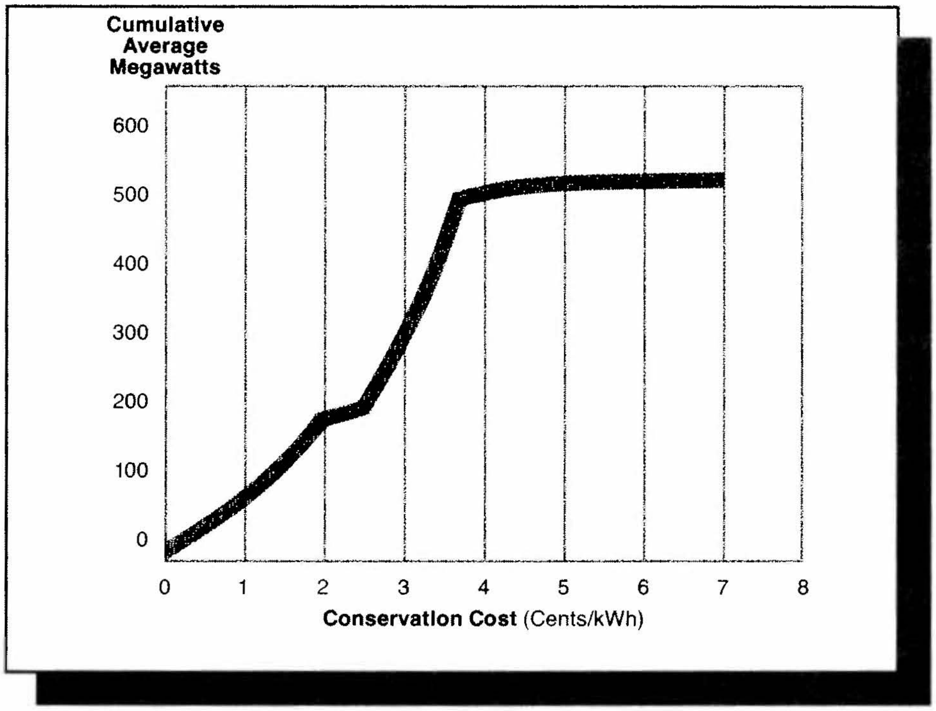


Figure 6-1
Technical Conservation Potential from Space Heating Measures in Existing Residences

The estimates of conservation available from space heating in existing houses are based on the costs of weatherization measures reported by current utility programs and on estimates of weatherization costs made for the Council's 1983 plan. The savings estimates are based on regional average conditions and reflect the assumption that people will be more likely to turn thermostats up and heat the entire house after their homes have been weatherized.

Both the costs and savings used by the Council to derive the conservation from weatherization correlate well with utility experience. In general, the Council found regionally cost-effective levels of residential weatherization are higher than the levels currently installed by most utility programs. The Council believes that the full cost-effective level of all conservation measures should be installed the first time a house is weatherized so that individual weatherization measures do not become lost opportunity resources. Should a weatherization program only install part of a measure, it may not be possible to return to the house and install the additional insulation or windowpanes cost effectively. This is primarily a consequence of fixed overhead costs associated with any modification to a house.

As described in Chapter 3, the resource represented by residential weatherization is discretionary and ideally should not be acquired until the current surplus has passed. However, the Council recognizes that residential weatherization programs need to continue at a minimum level of activity in order to remain viable. This minimum level may be a program to specifically target renter and low-income households, since conservation acquisition capability needs to be developed in these subsets of the residential sector. Even in these subsectors it is important not to create lost opportunity conservation measures when a house is weatherized; any house weatherized should be insulated to fully cost-effective levels.

Space Heating Conservation in New Residential Buildings

The Act directs the Council to establish model conservation standards for the construction of new electrically heated residential buildings and new commercial buildings. These standards must be designed to secure all power savings that are cost effective for the region. In addition, they must be economically feasible for consumers, taking into account financial assistance made available under the Act. That is, buying and operating the house will cost less over its 30-year financial lifetime than if the conservation measures had not been installed.

These model conservation standards represent the most significant opportunity to protect a resource that could otherwise be lost forever to the region. Since most residential and commercial buildings constructed today are likely to last considerably longer than the current surplus of electricity, all cost-effective conservation should be captured at the time the buildings are constructed. Where such cost-effective measures are not installed at the time of construction, it can be prohibitively expensive if not impossible to return to the structure and add the measures later. The result is that this cost-effective resource is a lost opportunity for the region that cannot be recaptured at a later date.

The region would be expected to experience \$620 million in additional expenditures on electricity generation to replace lost savings if the model conservation standards for new residences and commercial buildings are not implemented. Even delaying adoption of the residential and commercial standards for five years is expected to cost the region \$175 million.[5] For these reasons, and because new houses will last longer than the current surplus, it is important that the region act now to secure this resource. Bonneville actions to achieve this goal are included in the Action Plan, Chapter 9.

Figure 6-2 shows the technical space heating savings available from new residences at various costs. New single family houses represent approximately 770 average megawatts of technical potential. Multifamily and manufactured houses each represent approximately 90 average megawatts of technical potential. The Council's plan calls for developing 610, 70 and 45 average megawatts of the technical potential as achievable for single family, multifamily and manufactured homes, respectively. The total achievable potential is about a 48 percent savings from new space heating loads projected for the year 2005. Achievable savings are from building 85 percent of new single family and multifamily houses to the level of the model conservation standards starting in 1990[6] and from securing efficiency improvements that are equivalent to those required by the model conservation standards for single family residences in 50 percent of newly purchased manufactured homes. The average cost of the conservation resource from new residences is about 3 cents per kilowatt-hour.

Conservation available from single and multifamily houses is based on the model conservation standards adopted by the Council in the 1983 Power Plan and amended in December 1985. The savings resulting from the model conservation standards will help the region avoid the construction of more expensive resources. The residential standard is given in Table 6-1. Although programs and schedules for implementing the energy efficiency requirements were amended in 1985, the standards themselves will achieve savings equivalent to the efficiency level set in the 1983 Power Plan. The primary change resulting from the 1985 amendment is to introduce a high degree of flexibility that allows governments and utilities to implement the standards based on the unique circumstances in their jurisdiction. Although the Council still believes energy codes are the ultimate goal to best secure savings from new buildings, it is emphasizing utility marketing and incentive programs to gain the energy savings from the model conservation standards for the next several years, rather than relying primarily on the regulatory authority of governments. These programs will increase regionwide experience with improved techniques for constructing energy efficient buildings. (See Appendix I-B for more information on the programs provided in the amendment)

The conservation potential available through improvements in the energy efficiency of new residential buildings was based on the most recent information available. The Council used costs reported in the Residential Standards Demonstration Program, a regionwide demonstration program to build energy efficient new homes, and also used experience from areas in the region that had adopted energy efficient building codes. Since the Council's first regional power plan was adopted in 1983, over 400 houses have been built to the residential model conservation standards through the Residential Standards Demonstration Program. This program was a

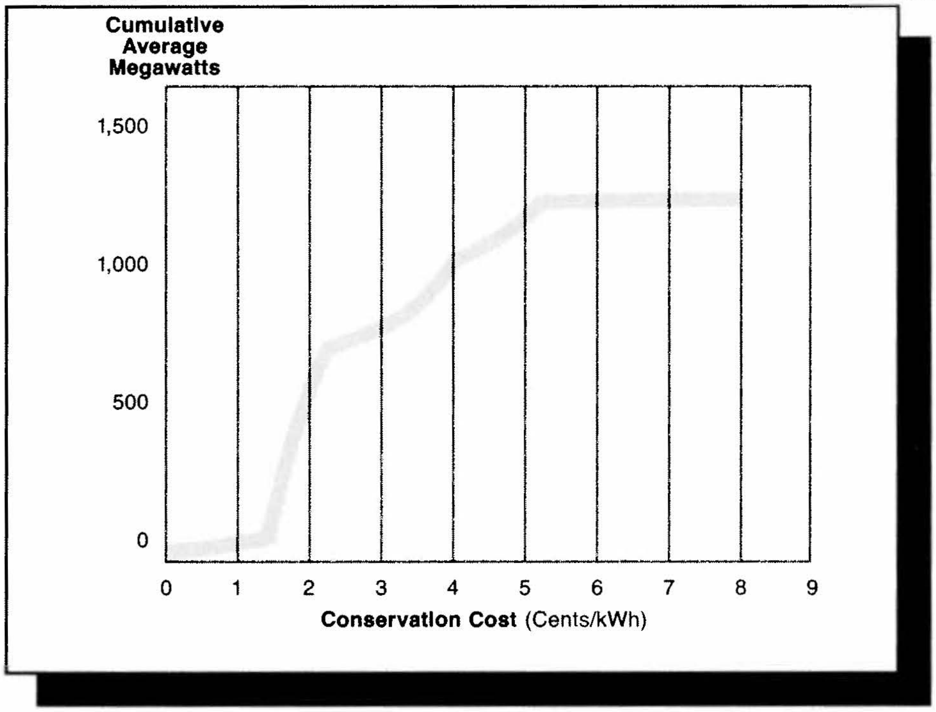


Figure 6-2
Technical Conservation Potential from Space Heating Measures in New Residences

Table 6-1
Requirements for the Residential Model Conservation Standards[a]

COMPONENT	Zone 1	CLIMATE ZONE[b] Zone 2	Zone 3
Ceilings	R-38	R-38	R-38
Walls	R-19	R-25	R-31
Floors	R-19	R-30	R-30
Glazing	R-2.5	R-2.5	R-2.5
Maximum Glazed Area[c]	15	15	15
Exterior Doors	R-7	R-7	R-7
Infiltration Control	0.1 ACH[d]	0.1 ACH	0.1 ACH
Mechanical Ventilation with Heat Recovery	0.5 ACH	0.5 ACH	0.5 ACH

[a] This is an abbreviated version of the standard. For a full description, please refer to Appendix I-B.

[b] The Council has established climate zones for the region based on the number of heating degree days as follows: Zone 1: 4,000-6,000 heating degree days; Zone 2: 6,000-8,000 heating degree days; and Zone 3: over 8,000 heating degree days.

[c] Expressed as percent of floor area.

[d] ACH stands for air changes per hour.

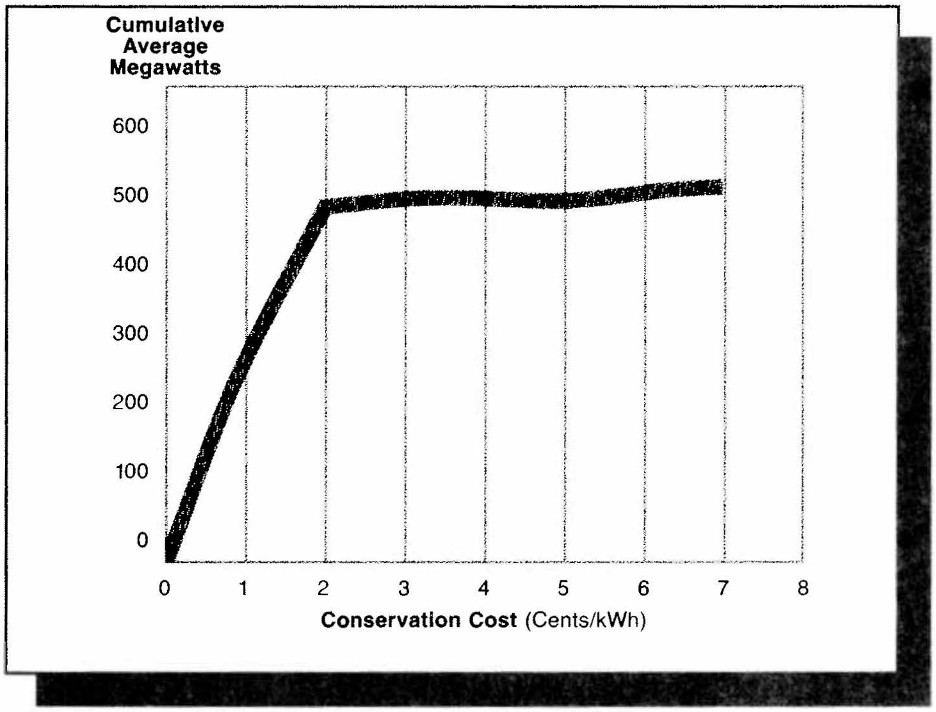


Figure 6-3
Technical Conservation Potential from Residential Water Heating Measures

training effort for builders and code officials, and other interested parties in the shelter industry. Even though the program's data have statistical limitations, the Council is encouraged by the fact that costs reported by the majority of builders were consistent with the Council's 1983 cost estimates. This result is remarkable in that most builders in the program were constructing a model conservation standards house for the first time. For manufactured homes, the Council relied on costs of improving energy efficiency from work done for the Manufactured Housing Institute.

Water Heating Conservation

The energy used to heat water is the second largest end-use of electricity in the residential sector. Figure 6-3 illustrates the potential for improving the efficiency of residential water heating at various costs. These savings represent better-insulated water heaters, pipe wraps, and more efficient appliances that use hot water (e.g., clotheswashers and dishwashers).

The cost-effective technical potential identified by the Council for electric water heaters is about 514 average megawatts. The achievable portion of this, about 377 average megawatts, represents a savings of about 18 percent of water heating loads in 2005. The average cost of improving the efficiency of electric water heaters is 1.8 cents per kilowatt-hour.

The Council's assessment of the conservation available from improved residential water heating efficiency is based on cost and savings data collected by utilities, Bonneville and various research organizations. Many measures are highly cost effective, producing the low average cost of the Council's recommended water heating measures. Two items—heat pump water heaters and solar water heaters—were found not to be cost effective to the region under average conditions. If a household uses significantly more than average amounts of electricity for heating water, heat pump water heaters approach the cost-effectiveness threshold. However, savings from heat pump and solar water heaters are not currently included as cost-effective water heating conservation technologies.

Conservation in Other Residential Appliances

Approximately one-quarter of the electricity currently consumed in the residential sector is used to operate refrigerators, freezers, stoves and lights. The Council's conservation assessment is based on the savings available from improving the efficiency of newly purchased refrigerators and freezers.

The Council has included 409 average megawatts[7] in its estimates of technical conservation from refrigerators and freezers, which is less than the amount that could technically be accomplished for measures costing less than 5.0 cents per kilowatt-hour as described below. Achievable potential is 368 average megawatts or 90 percent of the technical potential. These megawatts are based on the estimated number of refrigerators and freezers to be purchased between 1992 and 2005. Achievable conservation represents a 23 percent savings of projected loads in 2005. At an average cost of about 0.8 cents per kilowatt-hour, savings from refrigerators and freezers are the most cost-effective conservation resource available to the region.

The savings identified by the Council are based on efficiency improvements resulting from revised appliance standards recently adopted in California, which become effective in 1992.[8] The cost of the marginal measure included in the 1992 standard is less than 2 cents per kilowatt-hour. Because refrigerators and freezers that go beyond the California 1992 standard are not commercially available in the region, only the savings from going to the 1992 standard in the years after 1992 are included in the resource portfolio. However, the technical analysis indicates that the savings from going beyond the standard are substantial and represent a promising resource for future conservation assessments if such refrigerators and freezers become commercially available in the United States.

The current estimates of costs and savings for efficiency improvements are based on work done for the U.S. Department of Energy and for hearings on standards before the California Energy Commission. Based on these data, the Council has concluded that improvements to refrigerator and freezer efficiency up to the California standards and beyond are cost effective for the Northwest region. This conclusion has been corroborated by work done for the Bonneville Power Administration and other organizations.

Commercial Sector Results

The commercial sector consumed approximately 20 percent of the region's total energy sales in 1983, or about 2,936 average megawatts. Space heating, space cooling, and lighting dominate this sector's energy consumption. Office buildings and retail stores consume almost 50 percent of the electricity used in the commercial sector.

The commercial sector consists of many diverse buildings that use electricity in myriad ways. The conservation potential in this sector is based on the electricity use in conventional commercial buildings, such as offices and schools, as well as from less well known sources, such as pumping in municipal waste-water treatment plants. This sector includes savings from both privately and publicly-owned buildings. The sector's diversity, along with the lack of good data, do not allow the estimates of conservation potential to have the precision that is possible in the residential sector. However, projects are currently underway in the region that will enable analysts to better understand the commercial end-uses of electricity and better evaluate conservation potential in this sector.

Figure 6-4 shows the amount of technical conservation potential available from the commercial sector at various costs in existing and new commercial buildings, and waste-water treatment facilities. In the high demand forecast, the Council estimates 780 average megawatts of technical conservation potential in existing commercial buildings, 514 average megawatts from new commercial buildings, and 15 average megawatts from waste-water treatment plants.

Achievable conservation in existing commercial buildings is 732 average megawatts and is available at an average cost of 2.3 cents per kilowatt-hour. This represents about a 25 percent savings of projected electricity load in these buildings in 2005. Achievable savings from new commercial buildings are 430 average megawatts, available at an average cost of about 2.0 cents per kilowatt-hour and representing about 12 percent savings from new building loads in the year 2005. The amount of conservation potential from new commercial buildings includes only those savings achievable from the commercial model conservation standards. The savings from going beyond the standards are a promising resource; the Action Plan, Chapter 9, calls for activities to identify additional measures that can be included in the commercial model conservation standards for average building types.

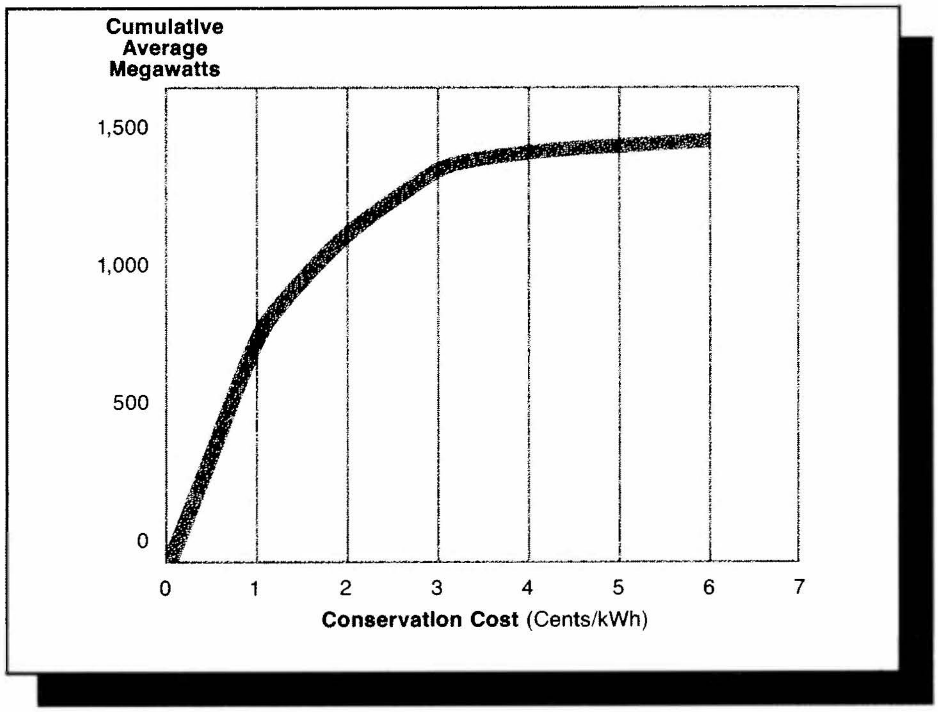


Figure 6-4
Technical Conservation Potential from the Commercial Sector

The Council's conservation assessment for existing commercial buildings is based on engineering estimates of how electricity can be saved within each building type and on experience gained from commercial retrofit programs operating in the region. These studies show that a significant amount of electricity can be saved from existing commercial establishments.

The Council estimated savings from new commercial buildings built to the model conservation standards using engineering estimates performed for the U.S. Department of Energy and engineering estimates developed for the 1983 Power Plan. Savings from new commercial buildings accrue mostly from improved lighting design in buildings constructed to the level of the model conservation standards. Lowered energy use for lights has a double benefit in commercial buildings, since it also results in a net reduction in space conditioning energy use, which is primarily for cooling.

Evidence suggests that significant savings beyond the model conservation standards may be available in new commercial buildings. Estimates developed for the 1983 plan indicate that significant potential savings beyond the standards could be secured from efficiency improvements costing less than 5.0 cents per kilowatt-hour in new commercial buildings. In addition, the 1983 Power Plan contained activities for Bonneville to develop energy use and cost data on energy efficient commercial buildings in climates similar to those found in the region. Bonneville's contractor searched the region for

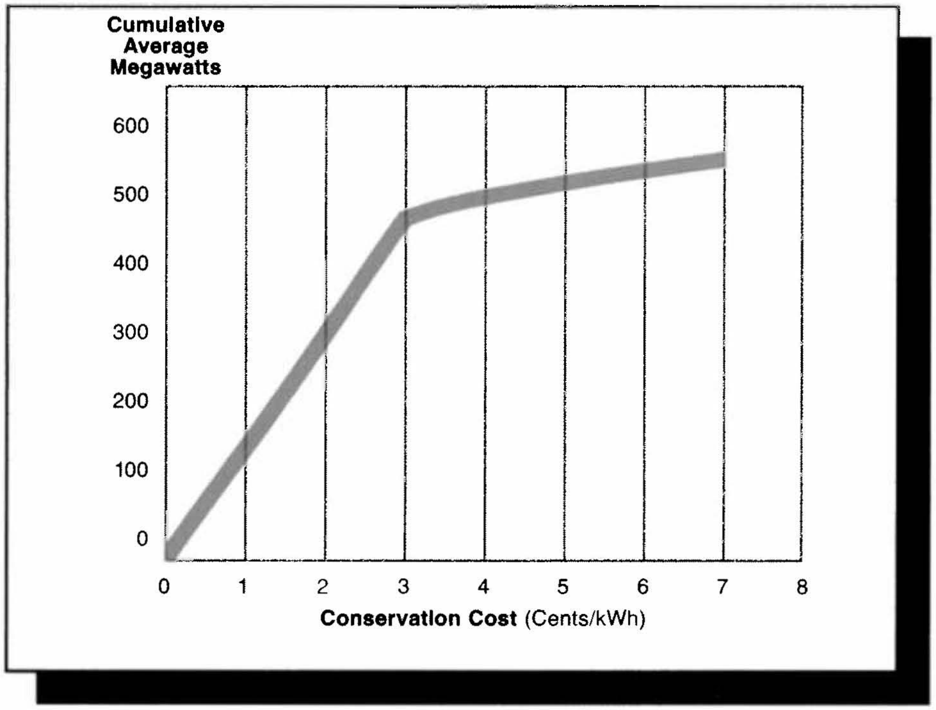


Figure 6-5
Technical Conservation Potential from the Industrial Sector

energy use data on buildings that were reputed to be energy efficient. Slightly less than half the buildings found in this study exceeded the energy efficiency of the commercial model conservation standards. A few bettered the standard by 30 percent.

While the Council is not currently counting as a reliable and available resource any savings from constructing buildings more efficiently than the commercial standards, such savings do reflect a very promising resource. The region needs to better identify and determine the cost of actual measures that can exceed the current commercial standards and that can be generically recommended for average buildings. Mechanisms to secure this resource need to be developed aggressively in order to bring the resource into the portfolio. Additional activities to gather information and demonstrate savings are included in the Action Plan.

Industrial Sector Results

In 1983, firm sales to the industrial sector were 5,659 average megawatts, which was about 39 percent of firm regional consumption. About 34 percent of these sales were consumed by the direct service industries, which are mainly the aluminum industry and other primary metals and chemical producers. Other large industrial consumers, representing about 85 percent of non-direct service industry demand, are lumber and wood products, pulp and paper, chemicals, food processing and primary metals.

The Council used 500 average megawatts as the technical and achievable conservation potential from the direct service and non-direct service industries. These are the savings that plant managers said could and would be secured for given prices, up to 5.0 cents per kilowatt-hour. These savings represent about 5 percent of projected industrial use in the year 2005. Industrial sector savings cost an average of about 3.1 cents per kilowatt-hour. Figure 6-5 depicts this conservation potential at various costs.

Assessing the technical and economic potential for industrial conservation presented a more difficult problem than in any other sector. Not only are industrial uses of electricity more diverse than the commercial sector, but the conservation potential is also more site specific. Moreover, because energy use frequently plays a major role in industrial processes, many industries consider energy-use data proprietary. Estimating conservation potential is not yet possible for new industrial plants, because they are unique in their energy use, and a "base-case" plant from which to estimate savings has not been established.

In the past, industrial representatives have been skeptical of studies that estimate the potential of industrial conservation based on a "typical plant" within an industry. Such studies extrapolate results from a typical plant analysis to estimate the potential for the whole industry. Industrial representatives argued that typical plants for most industries do not exist. Among other reasons, differences in product lines and the age of plants do not allow the comparison of individual plants within the same industry. Industrial representatives were concerned that, even though their plant was not like the typical plant used in the analysis, policies and programs affecting them would be based on those analyses.

While preparing the 1986 Power Plan, the Council considered ways to estimate conservation potential in the region's direct service and non-direct service industries that would have the support of industrial representatives. The approach that received support was a survey asking individual plant managers to estimate conservation potentials in each specific plant. The surveys were coordinated by industry trade associations such as the Northwest Pulp and Paper Association and the Industrial Customers of Northwest Utilities. Data for specific firms were masked to protect proprietary data. Each firm was asked how much conservation would be available at specified prices in each of four areas: 1) motors, 2) motor controls, 3) lighting, and 4) other, a category that depended on the nature of the firm. The firm was also asked to estimate the lifetime of equipment in each of the four categories. Answers from respondents to the survey were extrapolated to nonrespondents in order to capture regional conservation potential. Results from this survey served as the basis for the Council's conservation estimate. One hundred percent of the average megawatts identified as achievable by plant managers was considered available in the plan for the high demand forecast.[9]

Irrigation Sector Results

In 1983, the region's irrigated agriculture consumed 615 average megawatts of electricity, less than 5 percent of the region's total consumption. Figure 6-6 shows the estimated irrigation savings available from existing and new irrigation systems at various electricity prices. The technical potential of measures not exceeding a cost of 5.0 cents per kilowatt-hour is 146 average megawatts. The Council's plan calls for developing up to 85 percent of this potential, or 124 average megawatts. These savings represent about 14 percent of projected electricity use for irrigation in 2005 and are available at an average cost of about 1.8 cents per kilowatt-hour.

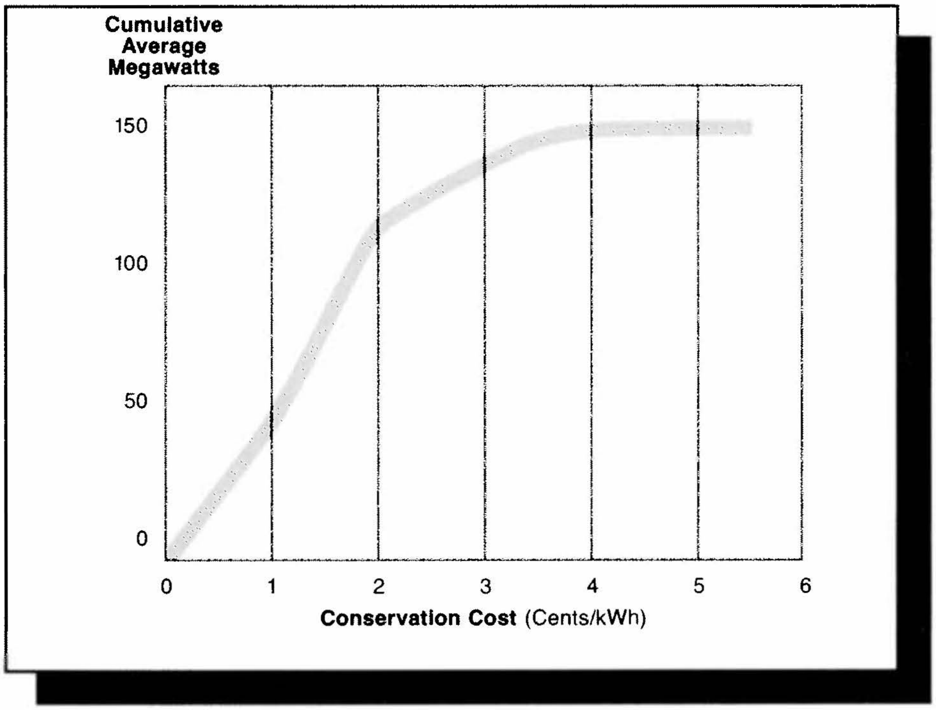


Figure 6-6
Technical Conservation Potential from Irrigated Agriculture

The Council assessed conservation potential for this sector by evaluating more efficient water application systems and water application scheduling improvements for both new and existing acreage. The estimates were based on a model that combines engineering and economic principles to derive energy savings and levelized costs per kilowatt-hour.

Conservation in the Existing Power System

Efficiency improvements to existing generating units as well as the region's transmission and distribution system represent a source of conservation savings. These savings are described in detail in Chapter 7, "Generating Resources," and Volume II, Chapter 6.

Direct Application Renewables

Technologies are available which use renewable energy forms to perform the same task as electricity. These energy sources and their functions include wood, solar, and geothermal space and water heating, and wind machines used for mechanical drive (such as pumping). These technologies are called direct application renewables. Their cost effectiveness is highly site specific, and their environmental impact varies. For example, the economics of geothermal district heating depends upon the distance between the geothermal resource and its ultimate point of use. The economics of solar space and water heating depend upon (among other things) whether a house has clear access to the sun. Wood heating may be cost effective if consumers have close access to an adequate wood supply and take measures to reduce air pollutants emitted from their stoves.

Although the site-specific economics of these direct application technologies prohibit a general statement regarding their cost effectiveness to the region, the Council has calculated the levelized cost of one technology, solar water heating. These calculations show that, in general, solar water heating is not yet a cost-effective resource. Based on average conditions, savings from solar water heaters cost about four times more than the avoided cost. In a household with large water use, the cost of conservation from solar water heaters is reduced to about 1.5 times the avoided cost. As direct application technologies become more developed it is expected that their costs will decline. The Council anticipates that some of these technologies, applied in the right circumstances, will make significant contributions toward offsetting the need for new generating resources during the next 20 years. The Council will accommodate development of direct application resources in subsequent revisions to the power plan.

Planned Conservation — All Sectors

Table 6-2 and Figure 6-7 present a summary by sector of projected loads and planned conservation for the Council's high growth forecast. Conservation resources in the Council's plan reduce the projected overall demand for electricity by 14 percent in the year 2005 under the high forecast.

The actual rate of conservation development between 1986 and 2005 will depend on the level of population and economic activity during that period. Thus, the Council's resource portfolio for its high growth forecast contains significantly more conservation than for its low growth forecast. This is because, with low growth, fewer resources are required, fewer

Table 6-2
Summary of Projected Loads and Conservation in the High Forecast in 2005 (Average Megawatts)*

SECTOR	LOAD IN 2005 With Current Efficiencies	With Plan's Conservation	PERCENT SAVINGS	CONSERVATION INCLUDED IN COUNCIL'S PLAN
Residential	10,230	8,337	20%	1,893
Commercial	6,718	5,544	17%	1,174
Industrial	9,219	8,719	5%	500
Agricultural	896	772	14%	124
Total	27,063	23,372	14%	3,691

* Does not include line losses.

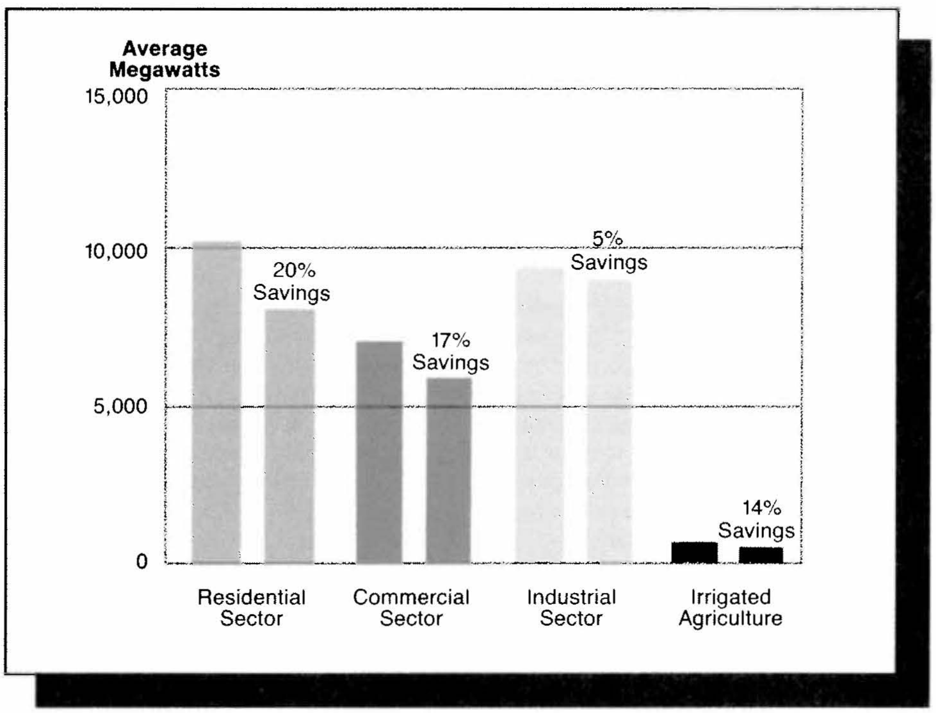


Figure 6-7
Summary of Projected Loads and Conservation in 2005 (High Demand Forecast)

buildings built, fewer appliances bought, and fewer potential savings can be obtained from new customers.

In the high demand forecast, all conservation resources are developed. In the low forecast, however, less electricity is required to meet projected load growth and the energy from discretionary conservation programs is not needed. Programs such as the model conservation standards do continue to supply energy as new buildings are constructed in the low demand forecast. The Council's conservation goals and near-term actions for developing conservation are described in the Action Plan, Chapter 9.

1./ These savings must be increased by line losses to be consistent with evaluations in the resource portfolio, as described later in this chapter.

2./ A "measure" means, as appropriate, either an individual measure or action or a combination of actions.

3./ Levelized life cycle cost is the present value of a resource's cost (including capital, financing and operating costs) converted into a stream of equal annual payments; unit levelized life cycle costs (cents per kilowatt-hour) are obtained by dividing this payment by the annual kilowatt-hours saved or produced. Unlike installed cost, levelized costs that have been corrected for inflation permit comparisons of resources with different lifetimes and generating capabilities. The term "levelized cost" as generally used in this chapter refers to unit levelized life cycle cost.

4./ The system models are the Decision Model and the System Analysis Model. These are briefly described in the conservation chapter, Volume II, Chapter 5, and fully described in Volume II, Chapter 8.

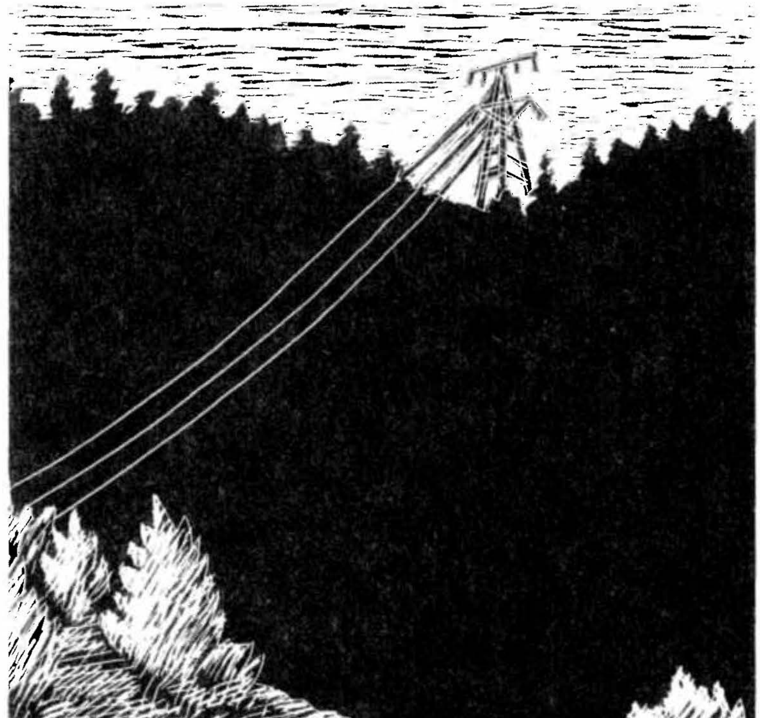
5./ The result is from a comparison of the current program, which anticipates a slow increase in savings until full implementation in 1990, with a program that would start in 1990 and attain the full savings promptly (without gradual ramp-up).

6./ Achievable savings phase in over time between 1986 and 1990.

7./ See Volume II, Chapter 5, for a discussion about the base case energy use of refrigerators and freezers from which these savings are derived.

8./ The new California standard will be phased in starting in 1987, with a more stringent standard becoming effective in 1992. The Council's estimate of savings is the result of the 1992 standard only.

9./ As noted in the resource portfolio chapters, load from the direct service industries varies by the year 2005, depending on factors not necessarily related to the general economic health of the region. When load was reduced in the portfolio analysis, conservation available from the direct service industries was reduced accordingly.



Chapter 7

Chapter 7
Generating Resources

Generating technologies can evolve quickly. The Council took a new look at the resources considered in the 1983 plan to reassess cost and performance. Compared with the 1983 plan, some resources proved less available and some have acquired more potential value for meeting regional needs. In addition, a new resource appears in this plan—a set of strategies to make better use of the existing hydropower system by firming nonfirm energy.

Electrical power generating resources examined in this chapter include system efficiency improvements, strategies for better use of the hydropower system, renewable resources and cogeneration, coal, Washington Public Power Supply System Nuclear Projects 1 and 3, and imports. The discussion focuses on central station generation of electricity. Solar photovoltaics might be used to generate electricity at the point of consumption, and low temperature geothermal energy might replace electricity for space heating. But all such onsite (direct) applications, other than cogeneration, are treated in the Council's planning as conservation.

The capacity and energy capability, and cost, of resources described in this chapter are based on the net output of the plant to the transmission and distribution system ("at the busbar"). This is consistent with the approach used for the system analysis of Chapter 8, where resource needs are assessed at the busbar.

Background information on the resources discussed in this chapter is provided in Chapters 6 and 7 of Volume II.

Selection of Available Resources

Resources are assessed to be "cost effective" or "promising." Cost-effective resources are those judged to be cost effective in accordance with the Northwest Power Act. These resources were used in preparing the resource portfolio as described in Chapter 8. Promising resources may be considered for future resource portfolios if their availability, reliability or system cost improve. The Action Plan (Chapter 9) proposes research, development or demonstration activities to better establish the role of promising resources in future power plans.

The Council judged the potential cost effectiveness of resources using the following criteria, further described in Chapter 3:

- Commercially Available Technology
- Predictable Cost and Performance
- Competitive Cost
- Demonstrated Resource Base
- Institutionally Feasible
- Environmentally Acceptable

The conclusions described below represent the best judgment of the Council given the information presently available.

Transmission and Distribution System Efficiency Improvements

The resource portfolio includes 34 megawatts of efficiency improvements to the region's transmission and distribution systems, having levelized life cycle costs[1] from less than 1.0 cent per kilowatt-hour to 4.0 cents per kilowatt-hour. This is a conservation resource under Regional Act definitions.

For the 1984-85 operating year, estimated Bonneville losses on serving firm load were estimated to be 135 megawatts. Losses for the balance of the regional system were estimated to be about 1,200 megawatts, for a total regional loss of about 1,340 megawatts. Transmission and distribution system efficiency improvements can reduce these losses, freeing up this energy for useful applications.

Measures that improve the efficiency of transmission and distribution have several attractive characteristics. Like many conservation measures, transmission and distribution efficiency improvements typically can be implemented with a relatively short lead time, and are available in small increments, facilitating close coordination with load growth. They reduce peak loads (the greatest amount of power that needs to be generated). Older transformers and capacitors containing PCB fluids can be disposed of if this equipment is replaced to improve system efficiency. Because system efficiency improvements do not affect sales of the implementing utility, they do not reduce revenue to that utility.

Commercially available and demonstrated measures for reducing transmission and distribution losses include replacement of conductors, capacitors and transformers with high efficiency equipment; increasing the voltage of transmission lines; power factor correction; and system reconfiguration. Other measures not yet fully demonstrated include amorphous core transformers, improved voltage regulation and optimized generating plant dispatch.

Bonneville maintains a Loss Savings Task Force that periodically assesses potential loss reduction projects on the Bonneville system. In its Fiscal Year 85-86 report, the Loss Savings Task Force identified 36 possible loss reduction projects, totaling 34 megawatts, which are estimated to be available at costs of less than 5.0 cents per kilowatt-hour.

Bonneville has established the Customer System Efficiency Improvement project in response to Action Item 11.2 of the 1983 Power Plan, to estimate the loss reduction potential on non-Bonneville regional transmission and distribution systems. There are in excess of 170 such systems in the region, including those of publicly-owned and investor-owned utilities, Bonneville's federal customers and direct service industrial customers. The technically available loss reduction potential was estimated in this study to be between 350 and 585 megawatts (approximately 30 to 50 percent of current system losses). Preliminary supply functions were prepared for two specific loss reduction measures: replacement of existing distribution transformers with high efficiency transformers, and replacement of subtransmission and primary distribution feeder conductors with larger conductors. These supply functions indicate that, at costs of 5.0 cents per kilowatt-hour or less, approximately 115 megawatts of energy could be obtained from high efficiency distribution transformers. An additional 30 to 35 megawatts of energy could be obtained at similar costs by reconductoring subtransmission lines and distribution feeders.

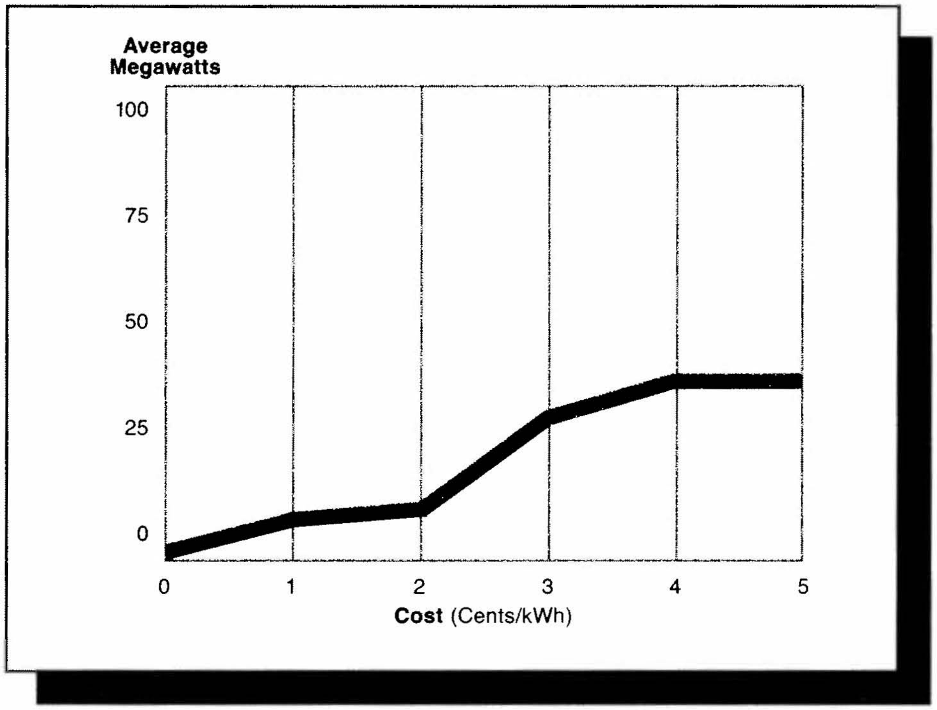


Figure 7-1
Availability and Cost of Transmission and Distribution Efficiency Improvements

Table 7-1
Hydropower Efficiency Improvement Measures

Turbine Improvements: Measures for improving the efficiency of hydraulic turbines include turbine blades of improved design and materials, air injection, and seal improvement.

Turbine Governor Improvements: Electronic turbine governors are capable of adjusting the turbine gates and blades to maintain optimum efficiency.

Generator Windage Loss Reduction: Improvements in the design of generator cooling systems reduce losses due to air friction.

Generator Rewinding: Rewinds using modern conductors allow a greater amount of conducting material to be placed in the generator. Resistance losses are reduced and the rated capacity may be increased.

Solid State Exciters: Solid state generator exciters reduce losses and lower maintenance costs.

High-efficiency Transformers: High-efficiency main transformers (located between the generator and the transmission system) reduce electrical losses. (A conservation resource.)

Improved Water Use: Bypass water energy losses can be reduced through improved fishway attraction systems, navigation lock operation, fish ladders, juvenile fish bypass systems and spillway gate position indicators.

Increased Hydraulic Head: Turbine output can be increased by increasing the hydraulic head. This may be accomplished by raising reservoir levels and by reducing friction losses in water intakes, canals and penstocks.

Reduction in Station Service Loads: Hydroelectric station pump, motor, lighting, heating, ventilation and air conditioning electrical loads can be reduced by use of industrial and building conservation measures. (A conservation resource.)

The 36 Bonneville loss reduction projects are included in the resource portfolio. These projects use commercially available and demonstrated technology and do not appear to be encumbered by institutional constraints or unacceptable environmental effects. Because the estimates of loss reduction potential on non-Bonneville systems are preliminary, the Council has not included them in the resource portfolio of the 1986 Power Plan.

Figure 7-1 shows the resulting supply curve of available improvements to the efficiency of the regional transmission and distribution system.

Because of the potential magnitude and cost effectiveness of loss savings on both Bonneville and non-Bonneville systems, continued work leading to better understanding of the availability, cost and methods of acquiring these resources is desirable. Actions to further confirm this resource and to facilitate its development when needed are included in the Action Plan.

Hydropower Efficiency Improvements

It is possible to retrofit many of the older hydropower projects in the region using advanced designs, materials and equipment that have become available since these projects were built. These retrofit measures offer the potential for improving project efficiency, capacity and energy capability. Measures which reduce electrical losses, such as improvements in transformer efficiency, are conservation resources under the Regional Act definition. Others are renewable resources. The Council has estimated that 112 megawatts of hydropower efficiency improvements are currently cost effective at individual measure costs ranging from 0.1 cents per kilowatt-hour to 1.1 cents per kilowatt-hour.

These measures are attractive because of their low cost, typically short lead time, small increments of capacity and potential environmental benefits (improvements to turbine efficiency appear to reduce the mortality of fish passing through the turbines). Because the improvements are implemented at currently licensed sites, siting and licensing problems should be minimal.

The Council has prepared estimates of the generic cost and availability of energy savings from the nine hydropower efficiency improvement measures described in Table 7-1. These estimates are based upon an assessment of regional hydropower system efficiency improvement potential prepared by Bonneville, in cooperation with regional hydropower operators. This assessment was prepared in response to Action Item 11.2 of the 1983 plan. The estimated costs of these measures range from as little a 0.1 cents per kilowatt-hour to nearly 40 cents per kilowatt-hour (Table 7-2).

However, all measures, with the exception of generator rewinding and main transformer replacement, meet the 4.5 cent per kilowatt-hour generating resource cost criterion. Generator rewinds and high efficiency transformers may be cost effective if undertaken to meet other requirements, such as the need to replace deteriorating equipment. If these opportunities are not used when they occur, potential savings will be lost. The cost of measures such as electronic governors is so low (0.1 cents per kilowatt-hour) that it may be cost effective to install these even during the current surplus.

The Council's estimates of potential regional energy savings from hydropower efficiency improvements also appear in Table 7-2. Energy classified as cost effective can be obtained when needed. Energy classified as promising requires further confirmation of availability or cost. Savings attributable to turbine runner replacement and installation of electronic governors are sufficiently well understood that these resources, totalling 112 megawatts, have been included in the resource portfolio. The availability and cost of energy from the remaining measures, which constitute an additional 144 megawatts of promising energy, require further confirmation. Twenty-one megawatts of this promising resource from transformer replacement and generator rewind is conditional, because these measures are likely to be cost effective only if equipment replacement or upgrade is undertaken for reasons other than efficiency improvement. A supply curve of cost-effective hydropower efficiency improvements is shown in Figure 7-2.

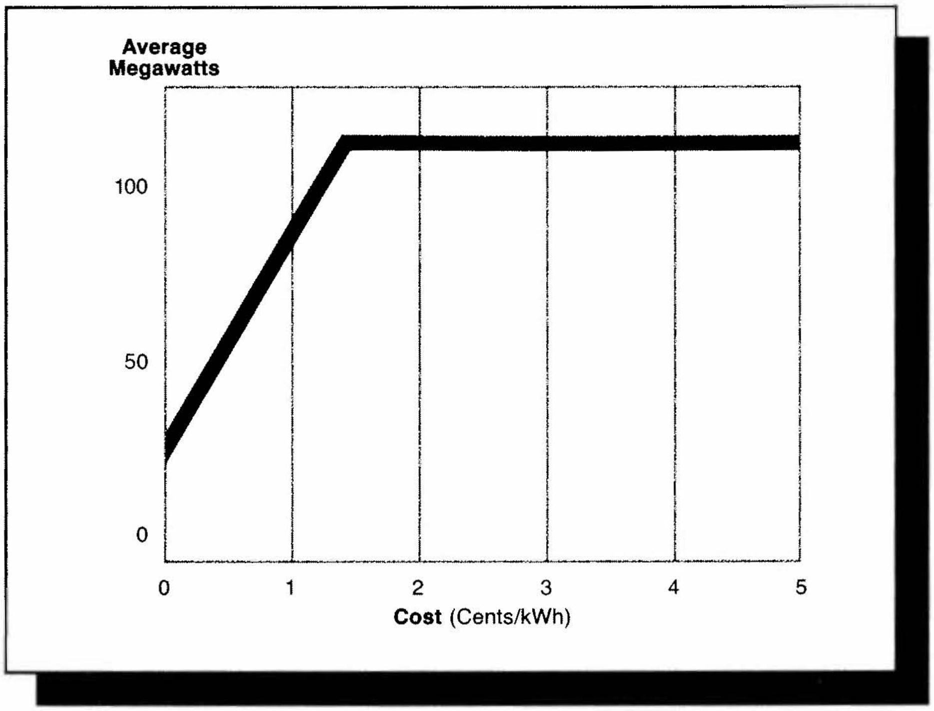


Figure 7-2
Availability and Cost of Hydropower Efficiency Improvements

Hydropower turbine runner replacement and electronic governors do not appear to be subject to institutional constraints preventing implementation, or to unacceptable environmental effects.

Additional information about the cost and availability of hydropower system efficiency improvements will assist in developing future plans. Also needed are methods of controlling the timing of the development of this resource, and ways of transferring the resource from utilities with surplus to utilities needing additional power. Development and demonstration of advanced measures, such as governors incorporating automatic index testing, may lead to further improvements in the efficiency of hydropower units. Actions to further confirm this resource and to facilitate its cost-effective development are included in the Action Plan.

Thermal Plant Efficiency Improvements

Upgrading the efficiency of existing thermal plants may reduce their operating costs and increase plant capacity and energy output. Major modifications—for example, the incorporation of advanced design heat sources—are unlikely to be cost effective at present because of the relatively contemporary design of most of the region's thermal plants. However, component upgrades typical of industrial conservation efforts, such as variable-speed motor controllers, and efficient pumps, motors and lighting, may prove to be cost effective.

The Council is not aware of any assessment of the regional potential for thermal plant upgrades. Because of the lack of information, the Council has not incorporated this resource into the resource portfolio. Actions to improve understanding of this resource are included in the Action Plan. Future revisions to this plan will incorporate this resource, if it is found to be cost effective.

Better Use of the Hydropower System

Electrical resources are planned, and long-term contracts are signed, on the basis of a defined minimum capability of the streamflow and reservoir system — a standard called "critical water." Critical water is the worst sequence of low water conditions encountered since recordkeeping began in 1879. The average annual output of the hydropower system, however, exceeds energy from critical water by 33 percent, or approximately 4,100 megawatts — equal to the output of five nuclear plants and enough power to supply four cities the size of Seattle.

The large amount of hydropower available in most years in excess of energy from critical water offers the Northwest a resource which could be put to better use than it has been previously. This "nonfirm energy" (so-called because it is not always available) was not included in the resource portfolio of the 1983 plan. In this plan, the Council explores ways to turn this nonfirm energy into firm energy, and has determined that approximately 700 megawatts of firm energy from this source would be cost effective.

Current Uses of Nonfirm Energy

Nonfirm energy is currently sold to direct service industries (mostly aluminum companies), the region's generating utilities, and Southwest utilities. The average prices for nonfirm transactions from November 1983 to February 1985 were approximately 1.0 cent per kilowatt-hour from Northwest utilities and 1.3 cents per kilowatt-hour from Southwest utilities. Both the amount of energy and the low prices indicate the potential for significant economic benefits to the region if better strategies can be developed for using nonfirm energy.

The current Bonneville intertie access policy has increased the average price of nonfirm energy. While this policy has helped the region secure a better price, the price the region now receives is still significantly less than the cost of new resources. Significant benefits to the region can be secured through strategies to make nonfirm energy more reliable, so it can be used to serve new and existing firm loads (loads which have a long-term contractual right to service). These strategies appear to be much less costly than developing new resources.

Table 7-2
Cost and Availability of Energy from Hydropower Efficiency Improvements

MEASURE	ENERGY COST cents/kWh	ENERGY (MWa) Cost-effective	Promising
New Turbine Runners	1.1	85	0
Electronic Governors	0.1	27	28
Windage Loss Reduction	0.3	0	46
Generator Rewinding	40	0	5
Solid-state Excitors	4.3	0	9
High-efficiency Transformers	13*	0	16
Improved Gate Position Indicators	0.1	0	23
Reduced Station Service Loads	1.0-3.1*	0	17
Total		112 MW	144 MW

*Excludes conservation credit.

Strategies to Back Up Nonfirm Power

There are a number of strategies to back up the region's hydropower system and thereby achieve more economical use of nonfirm energy. These include the use of combustion turbines, the purchase of energy from California and British Columbia on a short-term basis when needed, and load management. Load management involves a contractual right to reduce service in exchange for a rate reduction or other consideration. If the output of the hydropower system drops, the region could curtail an equivalent portion of load.

Load management might allow the region to relax the critical water standard. This would mean planning for an increased amount of firm energy without developing back-up generation. In many cases, the new standard would not require increased use of reservoirs or any other measures to reduce demand for electricity. However, the benefits of this strategy are very sensitive to the value imputed to loss of service if demand does need to be reduced.

The Council has not completed sufficient studies to recommend any particular strategy at this time. In estimating the amount of cost-effective new firm energy that might be made available, the Council conservatively assumed the region would rely on a high-cost nonfirm strategy—the development of new combustion turbines. Some strategies should be achievable at less than the cost to construct and fuel new combustion turbines. Planning assumptions regarding combustion turbines are described in Volume II, Chapter 6.

To estimate the amount of nonfirm hydropower that could be backed up cost effectively by new combustion turbines, the Council used its system models to simulate the addition of new combustion turbines to the system. Each added increment of combustion turbine capacity must operate more often than the previous increment, since less nonfirm hydropower is available to displace operation of the combustion turbine. Each increment of nonfirm energy firmed by combustion turbines is therefore more expensive than the increment that preceded it. Combustion turbines capable of backing up about 700 megawatts of nonfirm energy (about 825 megawatts of capacity) were found to be more cost effective than new coal plants.

Although combustion turbines, by themselves, are an expensive source of electric power, the Council's studies show combustion turbines would only need to be operated about 20 percent of the time on average. The rest of the time, sufficient nonfirm hydropower would be available to serve firm loads and to allow the combustion turbines to be shut down.

Benefits of "Firming" Nonfirm Power

Among the benefits expected from firming nonfirm power would be regional savings due to reduced need for new thermal plants. Using about 700 megawatts of combustion turbines rather than the same amount of coal plants, for example, could save the region approximately $175 million in present value costs.

These strategies to use nonfirm power can also have a role in verifying unexpected load growth. Sudden upturns in load may or may not represent changes in long-term trends. Until it is clear that the upturn will persist, meeting such new loads with combustion turbines, for example, would be relatively cheap insurance against overbuilding capital-intensive resources. For example, installation of combustion turbine capacity to meet a potential new load of 500 megawatts would cost about $260 million. In comparison, construction of new coal plants to meet this same load would cost about $1.6 billion.[2]

The Council recognizes that several of the nonfirm strategies must overcome hurdles. For example, it is unclear whether additional combustion turbines, constructed to back up nonfirm energy, could qualify for exemptions to the Powerplant and Industrial Fuel Use Act. However, there is an established base of combustion turbine and combined-cycle plants in the region which already have such exemptions. The Council estimates that about 615 megawatts of nonfirm power could be backed up by increased reliance on existing exempted combustion turbines and combined-cycle plants.

Because the critical water standard is incorporated in a number of existing contracts and agreements, as well as the Columbia River Treaty with Canada, formal departures from that standard would be very difficult to negotiate. Questions of discrepancy between ownership and need, described in Chapter 2, generally affect the nonfirm strategies, because most of the nonfirm energy is on the federal and public systems, while the need may occur earliest on the investor-owned utility systems. The existing combustion turbines are owned by investor-owned utilities.

Another issue that arises when relying on strategies such as these, which have low fixed costs but potentially high operating costs, is rate variability. If no steps are taken to anticipate the variability, years of low rates could be punctuated by years with very high rates. Poor water conditions could force high-cost purchases or the extended operation of the combustion turbines. This effect can be mitigated by using reserve accounts, which are built up during good years and drawn down during bad years, evening out the rate impact. Rates would be lower overall, since the nonfirm resource is more cost effective than alternative resources. This issue is addressed further in the Action Plan, Chapter 9.

Other uncertainties are described in Table 7-3. Because of the diversity of potential alternatives for improving the use of nonfirm hydropower, the Council believes it is likely that at least some alternatives will be feasible. Hence, the Council considers this resource to be available for the resource portfolio.

It is clear that the region has an opportunity to develop a low-cost and substantial resource in the form of better use of nonfirm energy. This resource is not needed immediately, and the region has several years to design and implement strategies. Actions to further confirm this resource and to facilitate its development when needed are included in the Action Plan. (See, also, Table 7-3.)

Table 7-3
Uncertainties in Nonfirm Strategies

UNCERTAINTY	ACTIONS TAKEN	COUNCIL CONCLUSIONS
1. Exemption from Fuel Use Act for combustion turbines.	Investigate legal requirements.	No exemptions granted on prospective basis. Reduced combustion turbine requirements can be almost entirely met with grandfathered plants; Action items to investigate out-of-region backup.
2. Mismatch of water ownership and potential need.	No specific actions.	Action Plan items to increase regional cooperation.
3. Coordination agreement and treaty assume critical water.	No specific actions.	Formal changes in critical water standard may be difficult.
4. Limited flexibility in hydro system.	No specific actions.	Action Plan items for BPA to investigate increased use of Canadian reservoirs; proposed amounts of combustion turbines cost effective even with current limitations.
5. Rate variability.	No specific actions.	Reserve accounts can mitigate rate swings; left alone, rate variability could be used to dampen demand.
6. Fuel availability.	No actions taken.	Action Plan item to investigate possible limitations.

Geothermal

No geothermal-electric power plants presently operate in the Pacific Northwest. However, the resource assessment prepared for Bonneville by the four Pacific Northwest states (The Four-State Study) indicates that approximately 4,400 megawatts of cost-effective electrical energy could potentially be obtained through development of regional geothermal resource areas. Estimated levelized life cycle costs for this energy are as low as 3.4 cents per kilowatt-hour.

Ninety-two resource areas thought capable of producing electric power were assessed in the Four-State Study. Ten of these have estimated costs less than 4.5 cents per kilowatt-hour when evaluated using the Council's financial assumptions. These ten sites are listed in Table 7-4. These ten sites could potentially support nearly 5,500 megawatts of installed capacity, producing about 4,400 megawatts of energy.

Because of the apparent magnitude and cost effectiveness of this resource, the Council considers this resource potential to be promising. However, additional information regarding the character and extent of these areas is needed to permit this resource to be considered as available for the resource portfolio. The Four-State Study identifies the exploration and testing required to confirm these geothermal resource sites:

> *"In general, the exploration process for high temperature resources will proceed through four phases. Phase I includes literature searches, regional spring sampling and heat flow studies, reconnaissance mapping, and regional geophysics. Much of the Phase I work has been completed for the high temperature sites in the region. Phase II consists of site-specific heat flow studies (including shallow temperature gradient drilling), water and soil chemistry, geologic mapping, and geophysics. A considerable amount of Phase II work has been completed at many sites, but exploration at most sites is not far advanced. Phase III includes hydrologic modeling and intermediate depth drilling to further define the thermal anomaly identified in Phase II. Very little Phase III work has been completed in the Northwest. Phase IV consists of deep drilling, reservoir testing and evaluation, and quantitative estimates of the reservoir. Only Raft River, Idaho, has progressed to Phase IV."*[3]

In addition to the geothermal exploration and testing described in the Four-State Study, additional assessment of environmental and institutional constraints to development at promising sites would likely be required. A geothermal resource research, development and demonstration agenda is needed, which identifies and schedules actions to confirm the resource. The Action Plan calls for development of methods for confirming this resource so that it can be available when needed.

Hydroelectric Power

Existing and assured Pacific Northwest hydropower projects provide approximately 29,800 megawatts of firm capacity and about 12,300 megawatts of firm energy. Most environmentally acceptable large-scale hydropower sites have been developed. Remaining potential includes adding generation equipment to non-power water projects such as flood control and irrigation projects, and adding generating equipment to existing hydropower projects. There are also many sites with new small-scale development potential.

New small hydropower development has attractive characteristics, including short construction lead time and small increments of capacity. However, development at some sites can create significant environmental problems, including impacts on resident and anadromous fish.

The Council counted on 920 megawatts of firm energy from new hydropower in its 1983 Power Plan. A reduced amount of 200 megawatts is included in this plan, reflecting widespread concerns over the environmental impact of hydropower projects, especially the potential impact on fish and wildlife of projects at newly developed sites. The 200 megawatt figure was determined by removing projects requiring development of presently undeveloped sites from the 920 megawatt potential included in the last plan, and by removing, to the category of existing resources, approximately 50 megawatts of hydropower that have come into service

Table 7-4
Promising Geothermal Resource Sites and Areas

	POTENTIAL CAPACITY[a] (MW)	POTENTIAL ENERGY[a] (MWa)	ESTIMATED COST[b] (cents/kWh)
Cove and Crane Creek, Idaho	220	180	3.4
Big Creek Hot Springs, Idaho	30	20	3.5
Newberry Volcano, Oregon	1,950	1,560	3.8
Wart Peak Caldera, Oregon	150	120	4.2
Glass Buttes, Oregon	350	280	4.2
Raft River Area, Idaho	15	12	4.3
Cappy-Burn Butte, Oregon	470	380	4.3
Mickey Hot Springs, Oregon	140	110	4.4
Bearwallow Butte, Oregon	760	610	4.5
Melvin-Three Creek Buttes, Oregon	1,380	1,100	4.5

[a] From the Four-State Study.

[b] Levelized life cycle costs estimated by the Council using capital and operating cost estimates from the Four-State Study and the financial assumptions of this plan.

since the 1983 estimates. The Council judges this conservative approach to be acceptable at present, since sufficient time is available to further assess the hydropower resource before development of less desirable resources would be required. These 200 megawatts of available hydropower were considered as a single block of resource in preparing the resource portfolio.

Because permits or licenses for many of the potential hydropower projects in the region are held by independent power developers, the Council assumed that this resource would be contracted to the region's utilities at their avoided cost of major new resources. Since the marginal new resource of this plan is new coal plants, the cost of new hydropower was estimated to be 4.0 cents per kilowatt-hour, slightly less than the cost of new coal plants.

The Council, the Corps of Engineers and Bonneville are developing the Pacific Northwest Hydropower Data Base and Analysis System. This data base will contain cost and performance information on all presently identified Northwest hydropower sites, and will be fully operational in 1986. In addition, the Council and Bonneville are sponsoring the Pacific Northwest Hydropower Assessment Study to improve the ability to identify environmentally acceptable hydropower projects. This study is also scheduled to be complete in 1986. Until the Hydropower Data Base and the Hydropower Assessment Study are available, the Council will use the conservative estimate of 200 megawatts of energy potentially available from future hydropower development. Future revisions to this plan will incorporate estimates of hydropower availability based on these improved inventories and estimating tools.

The Council will continue to monitor development of hydropower in the region and will adjust future estimates of the availability of this resource accordingly. Actions calling for completion and maintenance of the Pacific Northwest Hydropower Data Base and Analysis System, and the Pacific Northwest Hydropower Assessment Study are included in the Action Plan.

Municipal Solid Waste

The first regional project using municipal solid waste for fuel is the 15 megawatt Ogden-Martin (Trans-Energy) plant in Salem, Oregon. This project is currently planned to come into service in 1987. A small (less than 1 megawatt) unit in Coos County, Oregon, is scheduled to come into service in December 1986. Tacoma, Washington, is converting a retired steam plant into a cogeneration facility that will co-fire coal, wood residue and refuse-derived fuel prepared from municipal solid waste. By way of comparison, municipal solid waste projects potentially producing an aggregate of 70 megawatts of energy were planned or under consideration at the time of the 1983 plan. Uncertain public acceptance and air pollution concerns pose the main obstacles to development of electric generation projects using municipal solid waste for fuel.

The technology is well established for using municipal solid waste to fire steam-electric power plants. The energy costs for typical projects are estimated to range from 0.7 cents to 10 cents per kilowatt-hour. Estimates prepared for the 1983 Power Plan indicated that municipal solid waste sufficient to support 147 megawatts of electric energy production would be available in the region by 1985. Regional waste availability was expected to increase to an amount capable of supporting 169 megawatts by the year 2000. These still appear to represent the most current estimates of regional generation potential.

Plants burning municipal solid waste (MSW) offer an attractive alternative for the disposal of MSW. However, the potential impacts of these plants, including air pollution, truck traffic, noise and odor, must be carefully considered during plant siting, design and operation to avoid unacceptable environmental impacts and to ensure public acceptance. Potential pollutants created by combustion of municipal solid waste include particulates, carbon monoxide, hydrocarbons, heavy metals, dioxin, chlorides and fluorides. Dust and micro-organism release from fuel storage and handling systems can also occur. Conventional flue gas particulate removal technologies may be used to control particulates and heavy metals. Carbon monoxide, hydrocarbons and dioxins can be controlled by maintaining specific combustion conditions and by providing afterburners. Properly designed and operated municipal solid waste plants may offer improved control of pollutants, compared to other disposal alternatives.

The more cost-effective projects would likely be located near metropolitan areas, because of the higher charge operators can assess for accepting waste (tipping fee), reduced waste transportation costs, and greater availability of waste, allowing larger, more cost-effective plants to be built. The tipping fee defrays expenses and therefore has a considerable impact on plant cost effectiveness.

Although municipal solid waste generation is potentially cost effective, the Council does not plan for a major regional contribution from this resource because of issues regarding air quality, siting and general public acceptance. The Ogden-Martin plant is included in current estimates of available cogeneration potential, although the plant has been redesigned as a stand-alone facility. The remaining municipal solid waste resource is considered promising. Should these issues be resolved satisfactorily, future revisions of this plan will include MSW. The Council will continue to monitor the development of MSW plants in the region and will adjust future revisions of the plan accordingly.

Solar

The high cost of solar-electrical generation technology precludes it from consideration as an available resource in this plan. The Council recognizes its large regional potential, however. For example, southeastern Oregon and southwestern Idaho areas receive about 83 percent of the direct normal solar insolation received by Phoenix, Arizona. Areas west of the Cascades receive far less solar insolation; western Oregon, for example, receives only about 52 percent of the insolation received in Phoenix.

Using cost and performance information supplied by the Oregon State Energy Office, the Council has prepared representative estimates of cost and performance for five promising solar-electrical generating technologies. These include a solar-thermal central receiver, a solar thermal Stirling dish, and

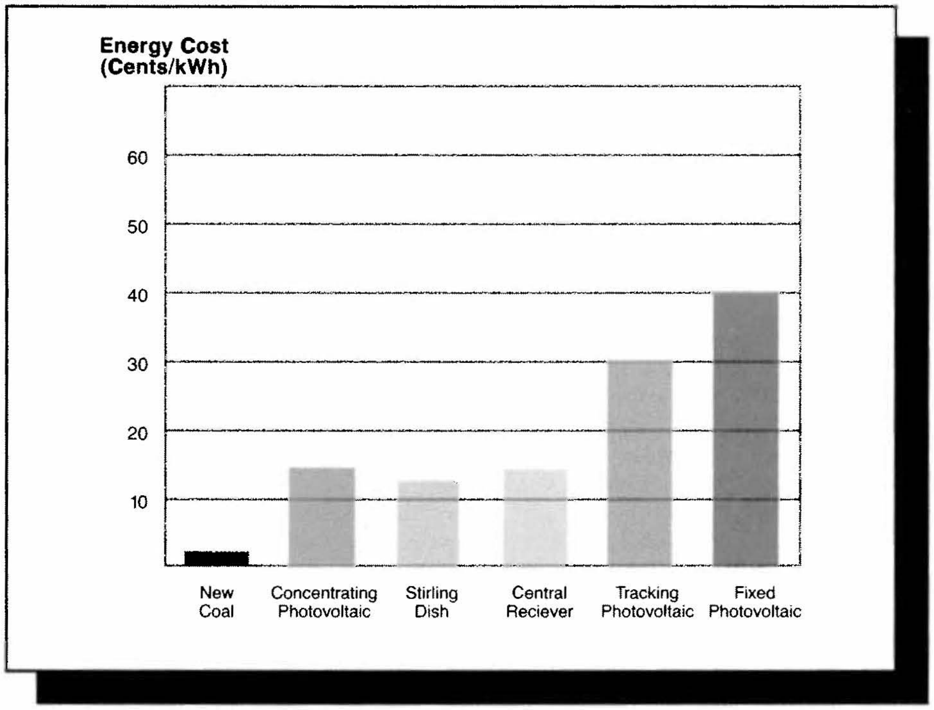


Figure 7-3
Cost of Leading Solar Generating Technologies

fixed, tracking and concentrating photovoltaic stations. The costs represent present-day costs and do not reflect possible future cost reductions. The levelized energy costs of these technologies are compared to the cost of new coal plants in Figure 7-3.

As is evident from Figure 7-3, solar-electrical technology is not yet cost-competitive with other resource alternatives for central-station electricity generation.

Solar energy is renewable and has relatively benign environmental effects. Furthermore, many of the leading solar-electrical technologies have desirable planning characteristics such as small module size and short lead time. These features would permit matching resource development to the rate of load growth. On the other hand, solar is an intermittent resource and is at its prime in areas of the region remote from major load centers. Despite these problems, solar electricity generation may be highly desirable if costs can be reduced. Only the currently high cost of solar electricity generation keeps the Council from further considering this resource in this plan.

Reductions in costs for solar technologies are continuing, and the region needs to continue monitoring further developments. Photovoltaic devices, in particular, have experienced significant cost reduction. Cost estimates for photovoltaic systems appearing in the 1983 plan (adjusted to 1985 dollars) ranged from 85 to nearly 100 cents per kilowatt-hour. Current estimates range from a low of 14 cents per kilowatt-hour for concentrating photovoltaic receivers to a high of 38 cents per kilowatt-hour for fixed flat plate photovoltaic receivers.

A solar resource research and development agenda would identify and sequence specific actions required to ensure the availability of this resource to the region if it becomes cost-competitive. Because this is an intermittent resource, the value of this power to the regional system must be determined. Planning tools are needed to better assess the value of intermittent resources to the regional power system. Actions to support these needs are called for in the Action Plan. The Council will continue to monitor the development of solar conversion technologies.

Wind

Wind was not included as a cost-effective resource in the 1983 plan because of the uncertain cost and performance of wind turbines and the lack of information concerning Northwest wind resources. Since 1983, however, the reliability and availability of wind turbines have been amply demonstrated, and identification and monitoring of potential sites in the Northwest have been continued. Wind is not included in this plan, primarily because of cost.

Windpower has developed rapidly in California since 1981 due to attractive state and federal income tax deferments and credits, abundant in-state investment capital, high avoided cost for power purchased under the Public Utility Regulatory Policies Act, and a favorable wind resource near load centers. It is estimated that, as of December 1985, approximately 13,000 turbines having an aggregate nameplate rating of about 1,100 megawatts will have been installed in California. This represents about 98 percent of installed U.S. wind capacity. It is not clear that this rate of development will continue with the pending expiration of federal energy tax credits.

The California experience has stimulated the evolution of the wind turbine from a novel machine of questionable reliability to a fairly well-proven generation technology. A somewhat unexpected development has been the evolution of the intermediate-scale machine (50 to 500 kilowatts) as the machine of preference. This contrasts with the utility-oriented research of the late 1970s, which focused on megawatt-scale machines. Although multi-megawatt, utility-operated machines may become common in the future, the present trend is to intermediate-scale machines developed in windpark settings by independent investor-operators. Windpower is now considered as a commercially available and demonstrated technology.

A regional resource assessment sponsored by Bonneville and performed by Oregon State University (OSU) has identified 46 wind resource areas in and adjacent to the region having good potential. The Oregon State Department of Energy has estimated the number and cost of wind turbine generators that could be installed at the better areas and the resulting energy production. The Council has estimated the levelized energy costs of these areas to be as low as 5.5 cents per kilowatt-hour. These promising areas are listed in Table 7-5. These areas may be capable of producing 2,800 to 6,300 megawatts of energy at costs no greater than 6.8 cents, 150 percent of the 4.5 cent generating resource cost-effectiveness criterion.

Table 7-5
Promising Wind Resource Areas

	POTENTIAL CAPACITY (MW)	POTENTIAL ENERGY (MWa)	ESTIMATED COST (cents/kWh)
Columbia Hills East I, Washington	4-9	1-3	5.5
Albion Butte, Idaho	23-52	7-17	5.6
Rattlesnake Mountain, Washington	12-28	4-9	5.8
Sieban I, Montana	76-170	23-51	6.4
Bennett Peak, Idaho	3-6	1-2	6.4
Goodnoe Hills, Washington	6-13	2-4	6.4
Sevenmile Hili, Oregon	34-77	10-22	6.7
Blackfoot Area I, Montana	9,700-21,800	2,800-6,200	6.7

The estimated cost of wind energy from even the best areas indicates that wind is not presently cost-competitive with new coal plants. Continuation of the cost reductions that have occurred in the wind generating equipment industry over the past several years may make this resource cost-competitive in the future. The resource potential is large. These projects would be highly modular and would likely have short development lead times. They would likely be environmentally acceptable if properly developed. On the other hand, the resource is intermittent and several of the areas receive their best winds in the spring, at the time of the hydropower surplus, when energy is least valuable. Many of the areas, especially the large Blackfoot area, are remote from load centers. The characteristics of many of these sites are not sufficiently well understood to consider the resource as confirmed.

A wind resource research and development agenda is needed to better understand the characteristics of promising wind resource areas and to ensure that the resource can be developed if it becomes cost-competitive. Tools are needed to assess the value of intermittent resources to the regional power system. Development of siting and performance standards by state and local governments is also desirable, to ensure environmentally acceptable wind resource development when cost effective. The Action Plan calls for actions to assess the regional wind resource, to monitor the development of wind conversion technologies, and to facilitate the development of wind when cost effective.

Wood

One utility-operated generation plant using wood residue (the 45 megawatt Kettle Falls Generating Station) is currently operating in the region. In addition, the output of several small stand-alone wood-fired plants operated by small power producers is contracted to regional utilities. Many of the cogeneration projects operating in the region use wood as a fuel.

Previous studies by the Council have estimated that the wood residue resources of the region (waste wood from logging and milling) are sufficient to support generation of about 215 megawatts of energy, exclusive of existing wood-fired projects. Previous studies by the Council have also indicated that both stand-alone and cogeneration plants fired by wood are cost effective. There is, however, considerable uncertainty regarding the cost and availability of this resource. This uncertainty is created by changing and competing uses of the resource (such as the use of wood for residential heating in recent years) and changing economics within the forest products and pulp and paper industries.

Better definitions are needed of the cost and availability of this resource, and the factors that impact cost and availability over time. Bonneville, through the Pacific Northwest Regional Biomass Program, has contracted for studies to improve the understanding of the cost and availability of regional wood resources. The Action Plan calls for continuation and refinement of such studies and of assessments of new technologies for using wood to generate electricity.

Cogeneration

Cogeneration is the simultaneous production of electricity and useful heat energy. The heat energy is typically used for industrial process or space heating applications. Cogeneration providing about 230 megawatts of capacity and 130 average megawatts of energy is currently contracted to regional utilities. Additional projects providing 80 megawatts of capacity and 60 megawatts of energy are scheduled to come into service by 1989. The Council included 500 megawatts of future cogeneration in the 1983 Power Plan.

Using more recent assessments of the availability of cogeneration, the Council concludes that approximately 320 megawatts of energy may be available to the region from future cogeneration development in high load growth cases. Because of the sensitivity of this resource to economic activity, lesser amounts of cogeneration will likely be available under lower load growth conditions. For example, decline of the forest products industry, a major source of cogeneration opportunities, is foreseen under lower load growth cases. The Council currently considers approximately 190 megawatts of energy to be available under medium levels of load growth and 130 megawatts to be available under low levels of load growth.

Cogeneration is typically developed by independent power producers under the provisions of the Public Utility Regulatory Policies Act (PURPA). PURPA requires contracting utilities to pay for electricity produced by independent power producers at the avoided cost of new resources. Because the marginal resource of this plan is coal plants, cogeneration is considered to be available at 4.0 cents per kilowatt-hour, slightly less than the cost of new conventional coal resources.

Addition of power generating equipment to the Fast Flux Test Facility (FFTF) located on the Hanford Reservation in Washington would provide an additional 101 megawatts of capacity and 65 to 70 average megawatts of energy at a cost less than 4.5 cents per kilowatt-hour. Restrictions on the scheduling of the power plant addition give this resource some characteristics of a lost opportunity resource.

The cost-effective cogeneration identified above includes only those cogeneration applications which could produce energy for less than 4.5 cents per kilowatt-hour. A much larger cogeneration potential, of 700 megawatts or more, could be developed at somewhat greater cost. It may be possible to reduce the cost of this resource through innovative financing mechanisms. For example, use of utility financing in lieu of typical industrial financing would lower the cost of capital for cogeneration. These methods would also alleviate the competition for internal company capital that cogeneration projects often face.

The cost and availability of cogeneration may also be improved by development of advanced cogeneration concepts such as application-specific cogeneration package units for commercial and industrial processes and for climate control in buildings.

Future assessments of cogeneration potential should consider the effect of economic activity on cogeneration availability. These assessments should also consider the effect of utility financing of cogeneration equipment upon the availability of this resource. The Action Plan addresses these needs.

Coal

Coal is the resource that establishes the upper cost limit for resources included in the portfolio, as it would prove a plentiful and reliable source of energy if rapid regional growth exceeds the capability of other resources.

The Pacific Northwest power system currently includes 12 coal-fired units capable of providing about 2,480 megawatts of energy to the region. One additional unit, Colstrip 4 at Colstrip, Montana, is scheduled to come into service in 1986. The regional share of this unit will be about 370 megawatts of energy. As discussed later, additional coal-fired projects have been proposed or licensed.

Proven reserves of coal, far in excess of those required to meet electricity needs for the foreseeable future, are available to the region. Coal resources capable of supporting a limited expansion of generating capacity are found within the region, in Washington. Coal is also available from Northern Great Plains sources, including eastern Montana and Wyoming; and from Utah, Alberta, British Columbia and Alaska. Out-of-region coal resources could be used by generation plants located at the minemouth, with the electrical power transmitted into the region. Alternatively, out-of-region coal could be transported to power plants located nearer major load centers. Because of the uncertainties associated with the availability and cost of in-region coal, the cost of potential future coal plants is based on Northern Great Plains coal delivered by unit train to plant sites located in eastern Washington or Oregon.

The direct-fired steam-electric power plant is the established technology for producing electricity from coal. Although direct-fired coal steam-electric plants are a mature technology, enhancements in plant control, efficiency and reliability have improved the cost and performance of new plants compared with earlier designs. A range of unit sizes is available, allowing additions to be matched to load growth. Smaller plant sizes have somewhat shorter construction lead times and greater reliability, but are generally more costly to build and operate than larger units.

Advanced designs hold promise for more efficient and less polluting conversion of coal to energy. Fluidized bed plants operating at atmospheric pressure are commercially available and were considered in the development of this plan. Demonstration of plants using gasified coal is underway. Development and testing are underway for fluidized bed designs operating at elevated pressures (allowing more efficient operation than atmosphere pressure plants). Research is continuing on magnetohydrodynamic technology involving direct conversion of coal combustion energy to electricity.

The Council, assisted by its Coal Options Task Force, assembled cost and performance characteristics for representative plants of each commercially available design. These included a large conventional plant, consisting of two units of 603 megawatts of capacity each; an intermediate size conventional plant, consisting of two units of 250 megawatts each; and a small atmospheric fluidized bed combustion (AFBC) plant consisting of a single 110 megawatt unit. Characteristics of these plants are described in detail in Chapter 6 of Volume II, and are summarized in Table 7-6. The AFBC plant was found not to be cost-competitive at this time, and was not considered in the resource portfolio. The two conventional plants were further tested using the system analysis models. Although preliminary estimates of levelized cost for the smaller plant were greater than the cost of the larger plant, its shorter lead time and smaller plant size might have made it more cost effective than the larger plant. This was not found to be the case. Thus, the 603 megawatt large plant was used when developing the resource portfolio.

Three sites within or adjacent to the region are either currently licensed for construction of new coal plants or appear readily capable of being licensed. Two additional sites have been proposed for development by prospective sponsors. These sites and their associated development capabilities are shown in Table 7-7.

The Council, after reviewing the status of potential coal sites, concluded that sites in an essentially fully licensed condition are available to support approximately 1,350 megawatts of new coal-fired generating capacity. This amount of capacity would be capable of producing about 950 megawatts of energy that could be made available to the region. These sites could be developed for approximately $1,216 per kilowatt of capacity (Table 7-6).

The Council also concluded that currently identified sites in partially licensed condition are available to support approximately 2,700 megawatts of new coal-fired generating capacity. These sites would be capable of producing about 2,025 megawatts of energy for the region. They could be developed at the full cost of new coal, approximately $1,255 per kilowatt of capacity (Table 7-6).

Table 7-6
Key Characteristics of Generic Coal Projects

	DIRECT-FIRED STEAM ELECTRIC	DIRECT-FIRED STEAM ELECTRIC	ATMOSPHERIC FLUIDIZED BED COMBUSTION STEAM ELECTRIC
Size	Two 603 MW Units	Two 250 MW Units	One 110 MW Unit
Time to Option[a]	48 mos	48 mos	48 mos
Time to Build	72 mos[b]	60 mos[b]	72 mos
Cost to Option[a,c]	39 $/kW	55 $/kW	38 $/kW
Cost to Build[c]	1,216 $/kW	1,717 $/kW	1,793 $/kW
Energy Capability	452 megawatts	193 megawatts	83 megawatts
Levelized Cost	4.2 cents/kWh	5.0 cents/kWh	5.4 cents/kWh

[a] License and site acquisition. The option process can be further extended to include preliminary engineering design. This will result in somewhat greater optioning time and cost but reduced construction time and cost.

[b] To first unit on line; second will lag by 12 months or more.

[c] "Overnight" capital costs (not including interest or escalation costs incurred during construction).

Additional coal development, if required in the higher growth cases, would have to be located at new sites such as the proposed Thousand Springs site in northern Nevada. Development at these sites is assumed to be at the full cost of new coal ($1,255 per kilowatt). Actual development costs at presently unlicensed sites are less certain than estimated costs for fully or partially licensed sites.

Because coal will likely remain the marginal resource in the resource portfolio for the next several years, it is important that the cost and availability of coal, availability of sites and cost and performance of conventional and advanced technologies continue to be monitored. Such monitoring is called for in the Action Plan.

Table 7-7
Potential Sites for New Coal Plants in the Pacific Northwest

SITE	LOCATION	POTENTIAL CAPACITY (MW)	POTENTIAL ENERGY (MWa)	COMMENTS
Boardman	Boardman, Oregon	2,700	2,025	One unit (Boardman) exists at this site. The site is licensed for two additional units of 1,350 (maximum) MW capacity each, to be completed by 1991 and 1993 respectively. The Site Certificate would have to be changed to allow more than two additional units, and to extend the construction completion date to a time more consistent with likely regional need. New plants at this site are considered as partially licensed in this plan.
Creston	Creston, Washington	1,016	760	Originally licensed for four units of 508 MW capacity each. Because Units 3 and 4 will likely be prohibited by redesignation of Spokane Indian Reservation to PSD Class I, only Units 1 and 2 are considered as fully licensed in this plan. Licenses and permits are being maintained.
Salem	Great Falls, Montana	330	255	All output potentially available to the region via Montana Power Company. The license application for this site is inactive.
Wyodak	Gillette, Wyoming	332	250	One unit (Wyodak I) exists at this site and a license was obtained for a second unit. Not all of the second unit's output would be available to the region because of Wyoming policy encouraging all units to provide some in-state service. The Prevention of Significant Deterioration permit for the second unit has been allowed to elapse. The air quality increment for the PSD permit remains available.
Thousand Springs	Thousand Springs, Nevada	2,500	1,725	A project proposed to be jointly developed by Sierra Pacific Resources and several non-utility investors. Output could be sold to utilities throughout the West. Application for regulatory permits has commenced.

WNP-1 and WNP-3

Three nuclear power plants of 2,980 megawatts aggregate installed capacity presently operate in the region. The annual energy production of these plants is approximately 1,930 megawatts. Five years ago, eight additional nuclear plants were in various stages of planning or construction. At present, all have been terminated with the exception of Washington Public Power Supply System Nuclear Projects 1 and 3 (WNP-1 and WNP-3).

WNP-1 is located at the Hanford Nuclear Reservation, and its construction is 63 percent complete; WNP-3 at Satsop, Washington, is 76 percent complete.[4] Construction at both plants is currently suspended. Combined, these two plants represent approximately 1,600 megawatts that may be available to meet the region's future energy needs. The Council has completed a detailed analysis, summarized here, of the cost of the two plants and the legal, financial, and regulatory issues that may affect their preservation and construction. Extensive supporting material for this analysis can be found in Volume II, Chapters 6 and 8.

The 1983 Power Plan included WNP-1 and WNP-3 as part of the region's existing resources and resources under construction, because the Council assumed the projects would be completed as then scheduled—in 1991 and 1986, respectively. Also, Bonneville had acquired the public share of the plants prior to the Northwest Power Act. Although no special cost-effectiveness assessment was performed, comparisons of the levelized costs of these projects with the cost of other resources indicated the projects would be cost effective.

Events since adoption of the 1983 Power Plan have altered the status and the potential cost effectiveness of WNP-1 and WNP-3. Construction has been suspended indefinitely, based upon the findings of a Bonneville study completed in November 1984. Because construction is suspended indefinitely, and because significant barriers affect the ability to preserve and eventually construct these plants, they have been removed from the resource portfolio and are considered by the Council to be potential resource options.

It was necessary to reassess these projects for the 1986 Power Plan to determine the costs and likelihood of preserving, financing and completing them. The Council found that these plants could likely be physically preserved so that completion could be deferred until the end of the planning period. The Council found these plants to be more cost effective to complete than several resources included in the portfolio. The Council also determined that the expected present value benefit to the region of preserving these plants is $630 million more than if the plants were terminated. However, this value can only be achieved if the plants can be preserved for a period of up to 15 years. Furthermore, the plants have this expected value only if restart of construction is not fixed, but is allowed to "float" such that construction is resumed only when a need for the output of the plants has been established. Moreover, the expected value of $630 million is sensitive to the assumed performance of the plants, the amount of money spent on preservation, future regional electric loads, and the cost, performance and availability of competing resources. The Council has therefore concluded that:

- The plants should continue to be preserved for possible future regional need.
- Actions are needed to resolve barriers to preservation and completion of the plants.
- Preservation planning should assume a floating restart.
- Preservation should be planned for a minimum of ten, and preferably 15 years.
- Preservation cost should be reduced to the minimum level consistent with the foregoing preservation objectives.
- The cost effectiveness of these projects to the region should periodically be reassessed.
- Factors significantly influencing the value of these projects to the region should be monitored and adjusted as necessary in future reassessments of the cost effectiveness of these projects.

WNP-1 and WNP-3 Planning Assumptions

The Council's analysis of WNP-1 and WNP-3 commenced with the development of planning assumptions regarding the two projects. The Council, in cooperation with the Supply System, assembled cost and performance information for WNP-1 and WNP-3. This information was reviewed by the Council and also received extensive public review during the development of the planning assumptions for the two projects. Key planning assumptions for WNP-1 and 3 are summarized in Table 7-8. More detailed discussion of these assumptions is provided in Volume II, Chapter 6.

Table 7-8
Key Characteristics of WNP-1 and WNP-3

	WNP-1	WNP-3
Capacity	1,250 megawatts	1,240 megawatts
Availability	65 percent	65 percent
Energy Capability	813 megawatts	806 megawatts
Shelf Life	15 years (minimum)	15 years (minimum)
Option Cost	$8 million	$21 million
Preservation Cost	$12 million/year	$12 million/year
Cost to Complete Construction	$1,415 million*	$1,344 million*
Construction Period	63 months*	63 months*
Financial Risk Premium	1 percent	1 percent
Operating Life	40 years	40 years

*Includes remobilization and balance of construction to complete.

The Council's analysis of cost effectiveness is based on the Washington Public Power Supply System's cost estimates to complete each of the two plants ($1.4 billion for WNP-1 and $1.3 billion for WNP-3, exclusive of escalation and interest during construction), plus minimum preservation costs of $12 million per year per plant. To date, $3.99 billion has been spent on these projects. These, however, are sunk costs. Because sunk costs are not subject to future decisions, they are not included in this analysis.

Next, the Council examined uncertainties that might impact the ability to preserve and to complete the projects, if they are needed by the region. This assessment also received extensive public review. The principal uncertainties considered by the Council, and the Council's conclusions regarding these, are summarized in Table 7-9.

Table 7-9
WNP-1 and WNP-3 Uncertainties

UNCERTAINTY	ACTIONS TAKEN	COUNCIL CONCLUSIONS
Preservation Financing: Because many of the utilities presently sponsoring the projects may not need the capability of the projects, it is possible that preservation funds may not continue to be available.	Bonneville is supporting preservation of WNP-3 through rates. Preservation of WNP-1 is funded through reinvested construction bonds.	There is an unacceptable probability that preservation funding may not continue to be available. To ensure continued preservation of the projects, equitable methods of allocating costs in proportion to need should be investigated.
Construction Financing: Because of current litigation, it would currently be difficult to finance these projects using conventional bond financing. An interest premium due to risk perception may remain following settlement of litigation.	BPA has negotiated an out-of-court settlement of IOU suits regarding WNP-3 construction suspension in which BPA proposes to acquire the IOU share of WNP-3. A settlement master has been appointed for WNP-4/5 litigation.	Because conventional financing to complete the projects is precluded by unsettled litigation, the projects are not considered as secured options. A risk perception premium estimated to be 1% will likely remain after litigation is resolved.
Physical Preservation: Prolonged suspension of construction could result in unacceptable deterioration of structures and equipment.	Preservation programs are in place at both WNP-1 and WNP-3.	The projects can likely be maintained such that completion of the plants can be deferred until the end of the planning period.
Maintenance of Site Certification Agreement: The National Pollutant Discharge Elimination System (NPDES) permit for WNP-3 could be challenged by a competing beneficial use.	No evidence of a potentially competing use.	There is an acceptable probability that the WNP-2 NPDES permit can be renewed.
Claims against WNP-1 or WNP-3 Assets by WNP-4/5 Bondholders: Successful prosecution of claims by bondholders of WNP-4 and WNP-5 could result in their reaching other assets of the Supply System, including WNP-1 and WNP-3.	A settlement master has been appointed for litigation in process.	Unsettled litigation precludes conventional financing of WNP-1 and WNP-3. Because the cost of successful claims would be borne by the region whether or not WNP-1 or WNP-3 were completed, these costs would be sunk and would not affect the cost-to-complete of WNP-1 or WNP-3.

(table continued on next page)

Table 7-9 (continued)

UNCERTAINTY	ACTIONS TAKEN	COUNCIL CONCLUSIONS
NRC Construction Permit and Operating License: Loss of the Nuclear Regulatory Commission construction permits or inability to obtain NRC operating licenses would preclude completion and operation of the plants.	Construction permits are being maintained. WPPSS has reviewed the preservation program with NRC. WPPSS and NRC are applying a readiness review to work completed to date. Likely backfits are included in the estimated costs-to-complete.	There is an acceptable probability that the construction permits can be maintained and the operating licenses can be obtained when needed.
More Stringent Seismic Design Criteria for WNP-3: Hypothesized aseismic subduction of the Juan de Fuca oceanic plate has raised the possibility that the design-basis seismic event for WNP-3 may not be adequate.	A program to assess the aseismic hypothesis has been implemented by WPPSS.	Finding of aseismic subduction would not likely preclude operation of WNP-3. The additional costs to comply with increased seismic design criteria are unknown.
Continued Availability of Nuclear Components: The hiatus in U.S. nuclear construction could jeopardize completion of the projects through lack of design-specific equipment and materials.	The bulk of equipment has been procured. The large inventory of U.S. commercial and military nuclear plants plus foreign plants will provide a continuing market for equipment.	There is an acceptable probability that equipment and materials will remain available.
Technical Continuity: Long-term suspension of construction may result in loss of technical continuity, increasing eventual costs-to-complete.	An objective of the preservation program is to provide adequate documentation of the projects. The readiness review program and on-going licensing and engineering will further maintain technical continuity.	Current and planned preservation programs are likely to ensure adequate technical continuity.
Costs of Shared Assets: WNP-4/5 bondholders argue the full costs of the shared services and facilities should be assumed by WNP-1 and WNP-3. If successful, this could result in additional costs for WNP-1 and WNP-3.	A settlement master has been appointed for litigation in progress.	Successful claims by WNP-4/5 bondholders, regarding assets shared with WNP-1 or WNP-3, would be sunk costs to the region and would not impact the costs to complete WNP-1 or WNP-3.
Operating Availability: The plants, though completed, might not operate as designed over the assumed operating life.	No specific actions.	The cost-effectiveness of the plants is very sensitive to plant operating availability. The Council will monitor the performance of designs similar to WNP-1 and WNP-3 and revise future estimates of availability, appropriately.

Three of the uncertainties are particularly significant: 1) the continued ability to fund preservation; 2) the ability to finance completion of the plants when needed; and 3) the ability to physically preserve the projects for an extended period.

Preservation funding: The first, and most immediately significant, uncertainty is the continued availability of preservation funding. This uncertainty largely results from the incongruence of project ownership and likely need for power. Public utilities (Bonneville preference customers) own all of WNP-1 and 70 percent of WNP-3. Under the terms of a September 1985 settlement, Bonneville has the contractual right to acquire the capability of the 30 percent share of WNP-3 held by four investor-owned utilities and to assume 100 percent of the preservation costs of this project. This acquisition would have to be in accordance with the provisions of section 6(c) of the Northwest Power Act.

In contrast with the predominantly preference customer ownership of the two projects, the Council's analysis indicates that power from these plants would probably not be needed to serve public agency loads over the 20-year planning period. On the other hand, WNP-1 or WNP-3 would be cost-effective resources to meet investor-owned utility loads as early as 1995 if high load growth occurs.

If investor-owned utilities do not put additional loads on Bonneville, it is not clear how long Bonneville and its current customers will be willing to pay their portion of preservation costs. During review of this plan, several Bonneville preference customers stated that they are unwilling to pay indefinitely for the preservation of resources they are likely never to need. Unless a policy can be established to allocate the preservation costs of WNP-1 and WNP-3 equitably to those likely to need them, it may be politically difficult to continue to fund preservation.

Construction financing: The second significant uncertainty is the ability to finance completion of the two plants. Litigation regarding the terminated WNP-4/5 projects could possibly affect WNP-1 and WNP-3 assets, and therefore the risk associated with bonds issued to complete these projects. This risk could impair the availability and the cost of bonds needed to complete the plants.

The uncertainties surrounding the plants make it difficult at this time to secure conventional bond financing for completion of the two plants. Completion could be financed directly from rates. However, it is unlikely that Bonneville customers would agree to the resulting rate increase unless methods were established for allocating these costs to customers needing the projects.

The WNP-3 settlement and appointment of a settlement master for WNP-4/5 litigation have, in recent months, provided evidence of some progress on resolving barriers to financing construction of the projects. With the WNP-3 settlement and appointment of a WNP-4/5 settlement master, the barriers to financing completion are arguably not as significant as observed during development of this plan. On the other hand, impediments to continued funding of preservation appear to be even more significant than when first observed during development of this plan. This has occurred because of the significant discrepancy between ownership and prospective need, and resulting concern regarding the cost of preservation among many of the publicly-owned utility sponsors of the projects.

Physical preservation: Finally, prolonged suspension of construction could result in unacceptable deterioration of structures and equipment.

The current WNP-1 and WNP-3 preservation programs were established to preserve the plants for a relatively brief period. These programs appear to be generally adequate to ensure long-term preservation, although several problems remain to be resolved. These include the adequacy of the temporary roof of the WNP-3 reactor building and the need to protect exposed reinforcing steel from excessive corrosion. The current situation is acceptable for the near term, and there is time to resolve these problems.

An assessment of the ability to preserve inactive equipment and structures indicates that, with proper controls, long-term preservation of equipment and structures is possible. The Council has therefore concluded that the projects can likely be physically preserved for a minimum period of 15 years. This would allow completion of the plants to be deferred, if necessary, through the 20-year planning period.

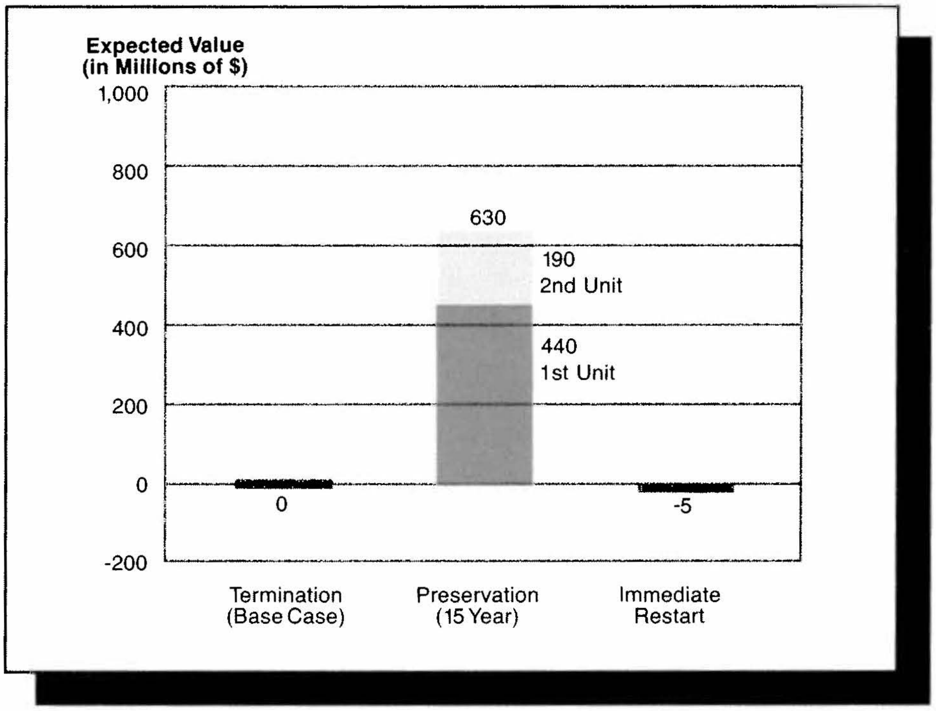


Figure 7-4
Value of WNP-1 and WNP-3 Restart, Termination and Preservation

Alternatives for WNP-1 and 3

There appear to be three basic alternatives available to the region for these two plants: 1) The plants could be terminated; 2) they can be preserved in the event that they are needed to meet regional energy needs; or 3) the region could attempt to restart the plants immediately. Figure 7-4 shows the results of the Council's analysis of these three alternatives.

The Council used the termination of WNP-1 and WNP-3 as the base alternative and assumed that, if needed, other resources would be built to meet regional energy loads. The Council compared this alternative to a situation where the plants could be preserved for 15 years with construction commencing, when needed, any time during that period. This alternative has an expected present value benefit of $630 million compared to the termination alternative.[5] Approximately $440 million of this $630 million could be secured by the region if one plant is maintained as an option, and is available for completion for a period of 15 years, and the second plant is terminated immediately.

The Council also analyzed an alternative where construction of one plant was resumed in 1986. Under this alternative, there are a large number of possible load cases where the plant is surplus to the region's needs for all or part of the 20-year planning period. When surplus, the output of the plant is sold outside the region. The present value cost of immediately restarting one plant, across all load cases, is $5 million. This result is very sensitive to the price of the sales of power outside the region. The alternative of immediately restarting both plants was not analyzed; however, this alternative would be even more costly to the region than restart of a single unit.

Based on the Council's analysis, the decision with the greatest expected value benefit for the region is to continue to preserve the two plants.

Preservation Planning

Having established the value of the fundamental alternatives for WNP-1 and WNP-3—termination, preservation and immediate restart—and having concluded that continued preservation of the two projects offers the greatest expected value to the region, the Council next examined preservation alternatives.

Preservation planning could either be based upon forced restart or a floating restart. Forced restart would involve establishment of a scheduled date for restart of construction. Preservation would be planned with the objective of restarting at that date. In contrast, floating restart would involve indefinite deferral of the restart of construction until a need for the output of the plants had been established.

To determine the preferred approach to preservation planning, the Council assessed a series of preservation cases involving alternative forced restart dates for one plant.

The results of this analysis are illustrated in Figure 7-5. The expected value of forced restart rises to about $100 million for a 1989 restart and is relatively constant through a 1996 restart, thereafter decreasing rapidly to a negative value. In contrast, the expected value of floating restart for one plant (assuming the plant can be preserved up to 15 years) is much greater at $440 million.

The Council therefore concludes that preservation planning should be based on restarting construction only when need is evident for the output of the projects.

Next, the Council examined the effect of preservation shelf life on expected value, with the objective of determining the minimum preservation capability that preservation planning should strive for.

The Council compared the value of the two plants, assuming they can be preserved for various lengths of time, to situations where the plants were not available and the region had to turn to more expensive resources in the higher load cases. Three preservation capabilities were considered: the ability to preserve for a maximum of 15, ten and five

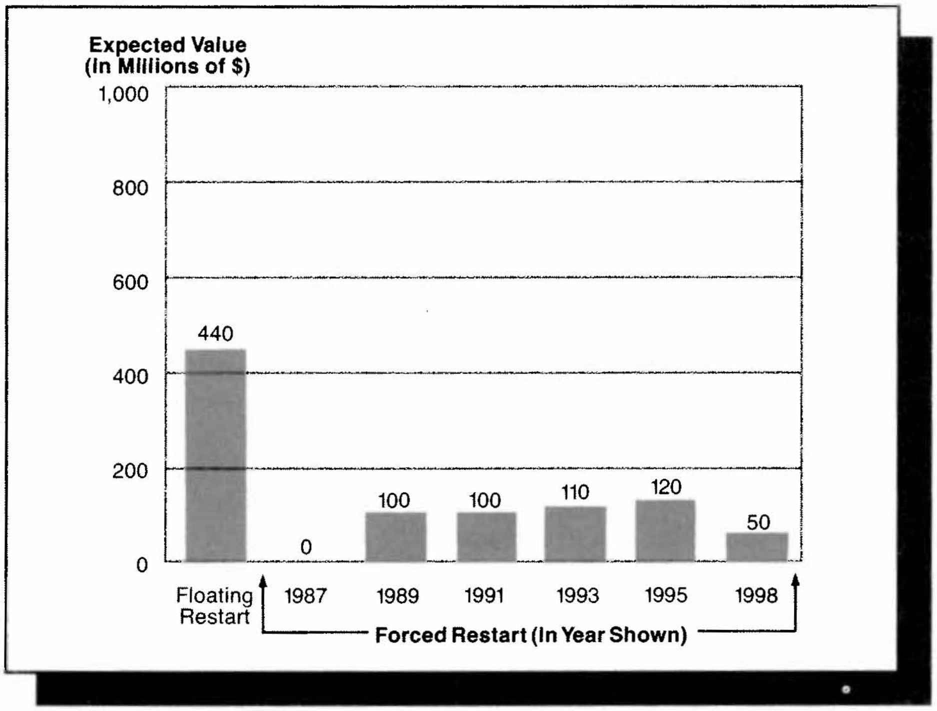


Figure 7-5
Value of Floating Restart vs. Forced Restart

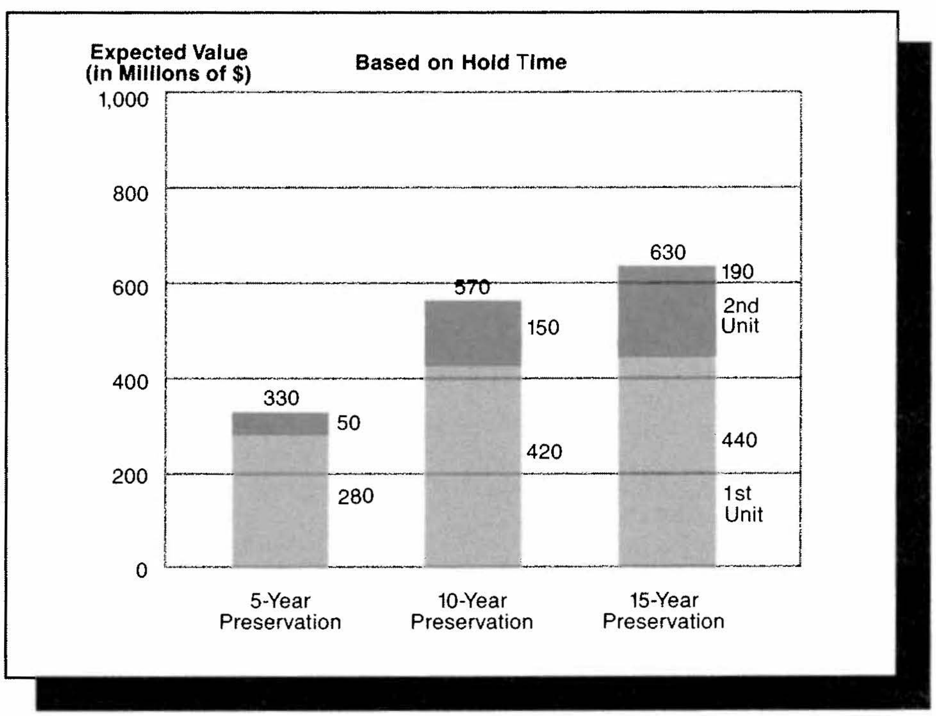


Figure 7-6
Value of Alternative WNP-1 and WNP-3 Preservation Capabilities

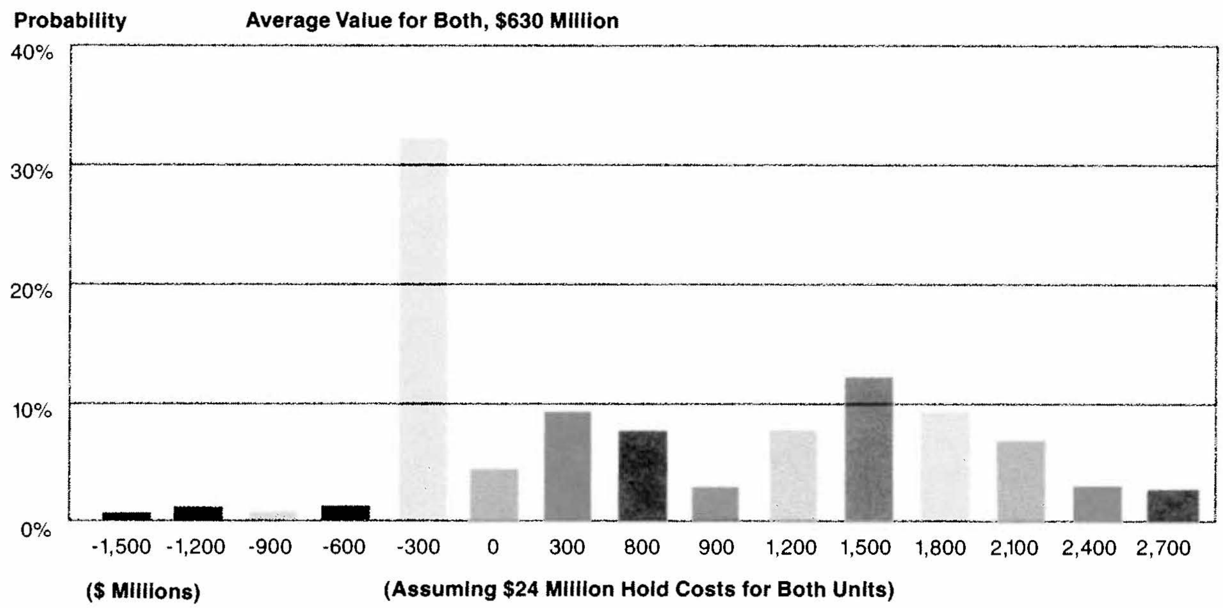


Figure 7-7
Distribution of Outcomes for WNP-1 and WNP-3 15-year Preservation Case

/ears. Figure 7-6 shows the expected pres-ɜnt value benefits of three preservation ;ases.

ˉhe Council used a 15-year preservation ›eriod as the upper limit for its analysis, ›ecause this period plus a five-year con-·truction period would put the two plants at ıe end of the 20-year planning horizon of the 986 Power Plan. In this alternative, the ɔouncil assumed that both plants could be ıeld for up to 15 years, after which they would ›e lost to the region if not previously built. In ɔwer load growth cases the two plants are ot needed during the next 20 years. The ɜgion would pay the preservation costs for 5 years and then the plants would be termi-ated, resulting in net negative value. How-ver, in higher load growth cases where the vo plants are needed to meet regional load, ıe costs of preserving, completing and oper-ting the nuclear plants are substantially less ıan the alternative of building and operating ew coal plants. This situation provides the ɜgion with a significant positive value. cross all load cases, the ability to resume ɔnstruction of both of the plants during the ext 15 years would result in an expected resent value for the region of $630 million.

The Council also looked at shorter preservation periods. The ten-year preservation assumed that if construction did not commence within ten years the two plants would be lost. In this case there were fewer instances where the plants were needed before the end of the ten years, and they therefore provided less value. The ability to preserve the plants for ten years has a present value benefit to the region of $570 million.

The Council found that even a five-year preservation period would provide a present value benefit to the region of $330 million. In this case the Council assumed that the two plants could only be held until 1990 before the plants would be lost. Using this assumption, the plants would only be needed in the highest load growth cases. Again, because they are significantly less expensive than new coal plants, the two plants provide significant value to the region.

Based on this analysis, the Council concluded that preservation planning should be based upon a minimum preservation period of ten years, and preferably 15 years.

Finally, the Council examined the effect of preservation costs on the expected value of WNP-1 and WNP-3. In assessing the effect of preservation costs on the expected value, it is important to understand that $630 million is the expected value of a large number of possible future load growth cases tested using the Council's Decision Model. There is not necessarily any particular outcome having a value of $630 million; the $630 million is the average of a large number of outcomes, ranging from losses of as much as $1.5 billion to gains of $2.7 billion. The actual distribution, shown in Figure 7-7, is bimodal. Cases where the plants are needed during the planning period result in high value outcomes, clustering about $1.5 billion. Conversely, load growth cases where the plants are not needed produce loss outcomes, clustering about $300 million. The average of these outcomes produces the expected value of $630 million.

The downside risk to preservation (i.e., the loss outcomes) are largely attributable to preservation costs.[6] If preservation were free, nearly all outcomes would be positive, producing a much higher expected value. To test the effect of preservation costs on the expected value of the plants, the Council looked at two alternative preservation programs. One was $24 million per year per plant, twice as expensive as the base case minimum level of preservation. The other alternative was half as expensive, $6 million per year per plant. The results are shown in Figure 7-8.

As indicated in Figure 7-8, doubling of preservation costs will reduce the expected value of the two projects from $630 million to $390 million. Halving of preservation costs, on the other hand, will increase expected value to $750 million.

The Council therefore concludes that preservation costs should be minimized, consistent with the objective of maintaining adequate physical preservation and project continuity for an indefinite period of up to ten and preferably 15 years.

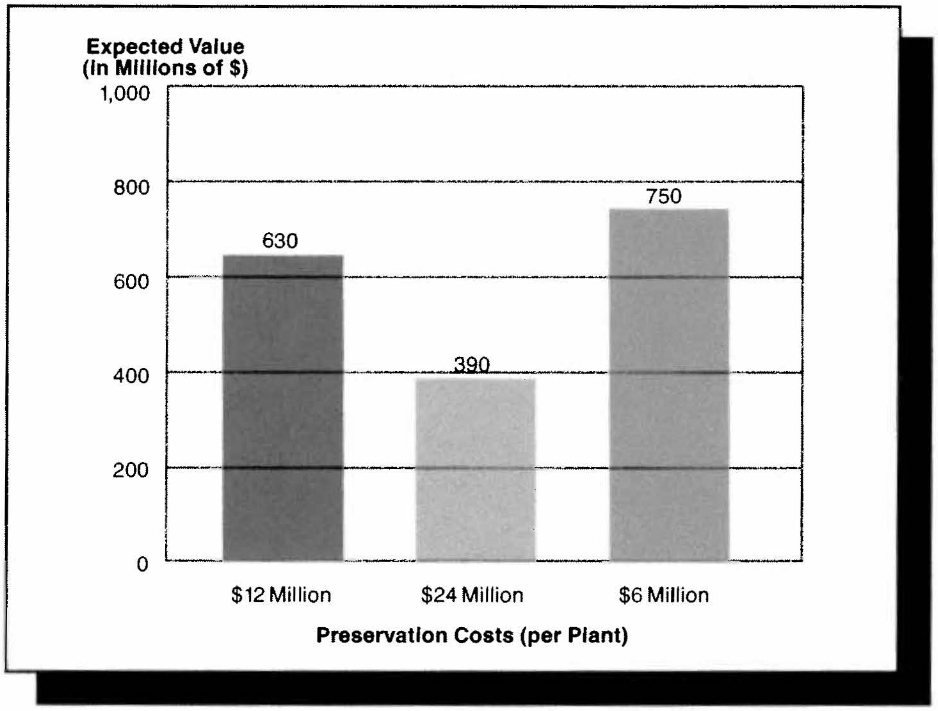


Figure 7-8
Value of Alternative Levels of WNP-1 and WNP-3 Preservation Funding

Additional Uncertainties

The analyses described above are based on the Council's judgment of the best available information on the cost, financing and operating assumptions for WNP-1 and WNP-3. If the plants do not operate as long or as well, if financing changes, or if future loads drop (for instance, if a significant portion of the direct service industries leave the region), the value of preserving the plants would be reduced. On the other hand, if the plants perform better, or if the cost of alternative resources is greater than currently expected, the value of preserving the plants increases.

The Council tested the sensitivity of the net present value of WNP-1 and WNP-3 to planning assumptions that appear to be particularly uncertain. A number of these sensitivity analyses were performed, as described in Chapter 8 of Volume II. The results of these analyses, which test effects of operating availability, plant life, capital cost, cost of competing resources, and loss of direct service industry load, are summarized here.

Plant availability: Figure 7-9 illustrates the present value of preserving WNP-1 and WNP-3, and constructing them when needed, under several different planning assumptions, in comparison to alternative resource strategies. The net present value of WNP-1 and WNP-3 under base case assumptions is depicted by the left-hand bar of Figure 7-9. As discussed earlier in this section, this value is estimated to be $630 million. The next two bars illustrate the sensitivity of present value to the plants' availability for operation, once they are constructed. Operating commercial nuclear plants have experienced a wide variation in availability, creating considerable uncertainty as to the probable future availability of any given plant. The Council chose an equivalent availability of 65 percent as a base case assumption for WNP-1 and WNP-3. To test the effect of possible variations in availability, the Council examined the effect of 55 percent and 75 percent availability on the present value of the plants. The effects are significant. If the plants perform at 55 percent availability over their operating life, their present value decreases to a negative $110 million. If the plants perform better than expected, and are able to maintain an availability of 75 percent, their present value nearly doubles, to $1.25 billion.

Operating life: The potential operating life of a commercial nuclear plant is also uncertain. While the plants are designed for a 40-year lifetime, it is possible that the plants may not be capable of operating for this entire period. Conversely, research into plant life extension is underway that might lead to lifetimes in excess of 40 years. To test the effect of possible variations in plant lifetime, the Council examined the effect of 30-year and 50-year operating lives on the present value of the plants. The effects are moderate. As shown in the fourth and fifth bars of Figure 7-9, 30-year life reduces the net present value to $260 million, and a 50-year life increases the net present value to $910 million.

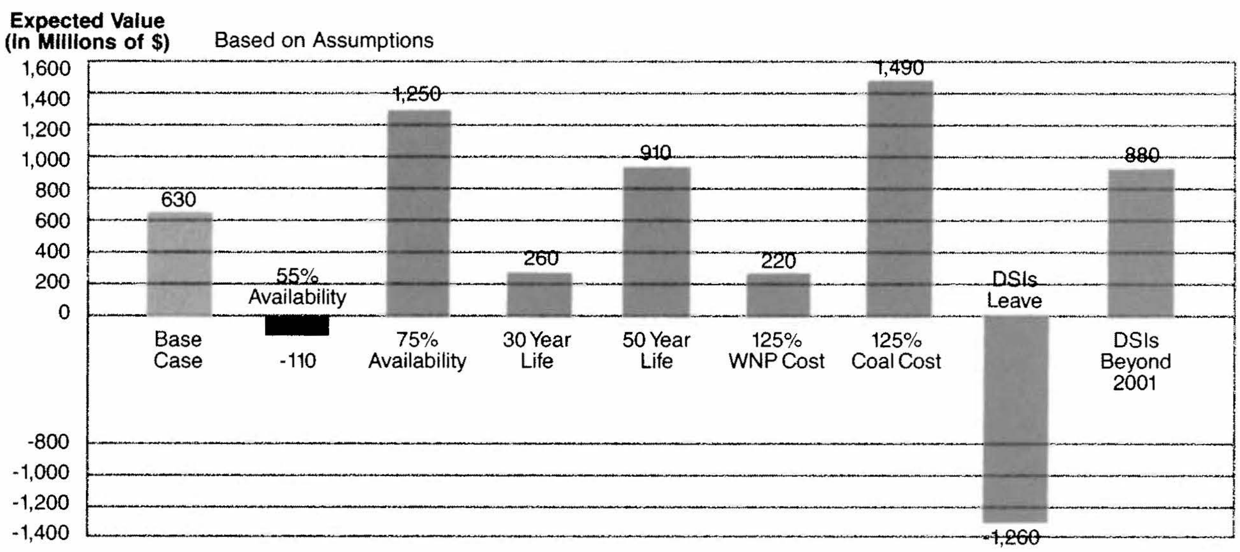


Figure 7-9

Effects of Variation in WNP-1 and WNP-3 Planning Assumptions on Value

Cost to complete: Capital cost estimates for commercial nuclear plants have also been highly uncertain in the past. Consequently, the Council examined the sensitivity of the present value of the plants to a possible 25 percent increase in their capital cost to complete. The sixth bar of Figure 7-9 shows that this increase reduces the net present value of the plants to $220 million, approximately one-third of the base case value. However, it is also possible that the costs of other, competing resources might be greater than currently estimated. Therefore, the Council examined the effect of a 25 percent increase in the construction and operating costs of new coal plants. The present value of WNP-1 and WNP-3 more than doubles, to $1.49 billion, as shown by the seventh bar of Figure 7-9.

Direct service industry load: Next, the Council tested the effect of uncertainties in direct service industry (DSI) load. The aluminum industry, comprising most of the direct service industry load, uses large amounts of electricity. Uncertainties in the industry's electrical needs must be taken into account in long-range resource planning. However, the long-term economic viability of the Northwest aluminum industry is not clear, and at this time it is not known under what conditions the direct service industry contracts will be renewed when they expire in 2001.

To analyze greater uncertainties in future DSI loads, it was necessary to run special studies. These studies, shown in Figure 7-9, assessed the impact of major changes in the long-term viability of DSI load. The results of this analysis are highly significant. As illustrated in the eighth bar of Figure 7-9, preservation and completion when needed of WNP-1 and WNP-3, followed by loss of the DSI load, has a present value cost to the region of $1.26 billion. This was estimated by comparing a resource strategy relying on WNP-1 and 3 with a strategy that anticipated the reduction in DSI loads and used short-term power purchases until regional loads decreased.

Finally, the Council examined the effect of 100 percent retention of direct service industry load on the value of WNP-1 and WNP-3. As illustrated in the right-hand bar of Figure 7-9, the present value of these plants increases to $880 million, if all direct industry loads continue beyond 2001.

The estimated present value of WNP-1 and WNP-3 could be affected significantly by changes in some essential planning assumptions. Therefore, factors affecting these uncertain assumptions must be monitored closely. Actions taken with respect to these plants should be reexamined if there is evidence that the base case planning assumptions should be changed. The highly significant impact of long-term direct service industry loads on the value of WNP-1 and WNP-3 suggests that uncertainties regarding these loads need to be reduced prior to resumption of construction of either plant. The Council will continue to monitor commercial nuclear plant performance, the cost of competing resources, and other factors affecting the value of these plants to the region.

WNP-1 and WNP-3 Conclusions

Based on the analysis described above, the Council has made the following conclusions:

First, WNP-1 and WNP-3 can be cost effective for the region and should be preserved as potential options.

Second, there are significant barriers to preserving and completing the two plants. In the Action Plan, the Council has identified actions that need to be taken to resolve these barriers. Until the barriers are resolved, the resource portfolio should not include WNP-1 and WNP-3. The plants may be included in a future portfolio when it is clear they can be preserved and completed cost effectively. In the meantime, the portfolio includes resources that could replace the plants if they were not available to meet future load growth.

The Council has decided not to include these plants in the portfolio because they were judged not to be sufficiently reliable and available when compared to other resources, and because it is important to ensure that the region is not counting on resources that are not or may not be available. Relying on such resources could lead to expensive actions in the future. In addition, the Council believes it is important to focus immediate attention on the serious barriers that, if unresolved, could mean the region may lose these cost-effective resources. The Council also believes the region should plan for other resources that could substitute for WNP-1 and 3 in the event the barriers to completion and operation of these projects are not removed.

Preservation planning should not be based on a fixed restart date, but instead should employ a floating restart concept, where the plants would be restarted only when need was established. A floating restart preservation plan is of far greater expected value to the region than forced restart.

The greatest expected value is obtained if restarting the plants can be deferred up to 15 years. Preservation should be planned for a minimum of ten and preferably 15 years.

The downside risk of preservation is largely attributable to accumulated preservation costs. Reduction in preservation cost increases the expected value of these projects. For this reason, preservation costs should be reduced to the minimum level consistent with the objectives cited above.

The expected value of these projects is sensitive to a number of planning assumptions that may change over time. For this reason, factors influencing these assumptions should be closely monitored and the cost effectiveness of the plants reassessed if significant changes are observed.

The Council will closely monitor factors that may affect the availability, reliability and cost effectiveness of these projects. Revisions will be made to this plan should changes in these factors affect the treatment of these projects in the plan or warrant changes to actions called for with respect to these projects.

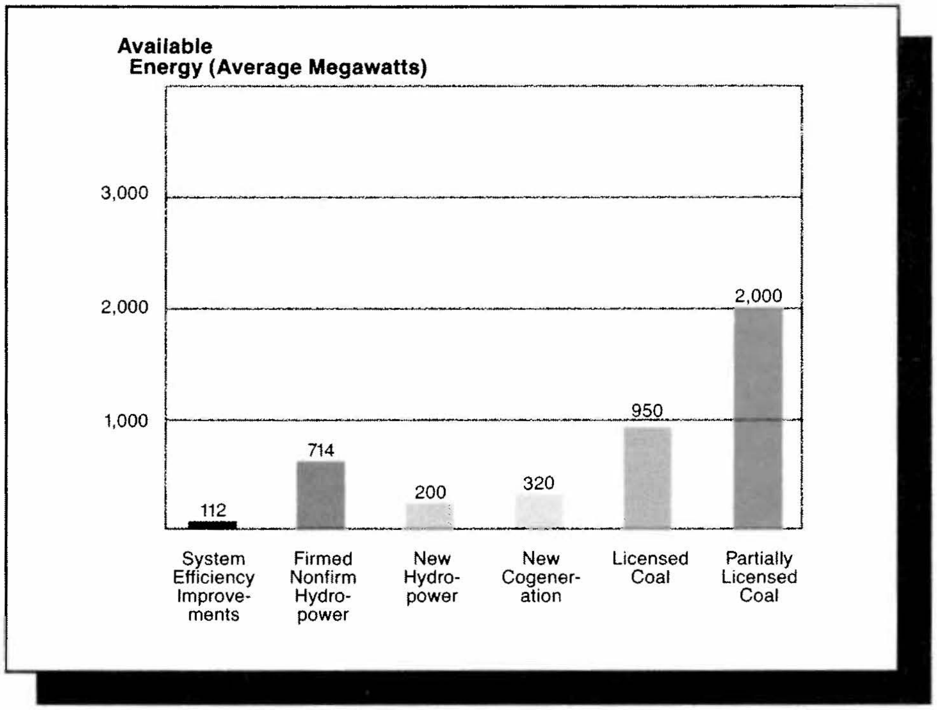


Figure 7-10
Energy from Available Generating Resources

Imports

Resources available to the region may include out-of-region imports—from the Southwest and Canada, for example—but not enough is known about the cost and availability of such energy. Reciprocal exchange arrangements and outright purchase of energy could prove advantageous.

Based on previous analysis, it appears that substantial benefits could result from closer interaction of regional power systems. These potential benefits, however, may be constrained by inadequate interregional transmission capacity. Moreover, imports require complex agreements with out-of-region suppliers. Because of these uncertainties, the Council has assumed, for the development of the resource portfolio, that existing import contracts will not be renewed and that no new contracts will be available. Because of the potential benefits, however, the Council will conduct a West Coast Energy Study to further analyze opportunities and constraints (see Action Plan, Chapter 9).

Cooperation with other regions can only occur if both regions perceive the effort to be in their best interests. The Council recommends that the region engage in detailed discussions with out-of-region suppliers to evaluate potential benefits, especially when it appears that out-of-region resources are more cost effective than resources developed in the region.

Summary of Resource Potential

Cost-effective generating resources included in the resource portfolio are summarized in Figure 7-10. These include 112 megawatts of energy from improvements to the efficiency of existing hydropower projects, and 34 megawatts of energy available from loss reduction on regional transmission and distribution systems. Also considered to be available for the resource portfolio are 714 megawatts of firm energy from strategies to back up existing nonfirm hydropower, and 200 megawatts of energy from new hydropower projects. The portfolio includes 320 megawatts of energy from new cogeneration projects (for the high load growth case). Construction of new coal plants at currently licensed sites would provide approximately 950 megawatts of energy; new coal plants at partially licensed sites could provide an additional 2,000 megawatts of energy. Additional newly sited and licensed coal plants would be required in high load growth cases if currently promising resources do not become cost effective during the 20-year planning period.

Promising resources identified in this plan include an additional 144 megawatts of energy from system efficiency improvements, and about 4,400 megawatts of potential energy from geothermal. Additional cost-effective energy may be available from environmentally acceptable hydropower development at currently undeveloped sites, municipal solid waste, wood and cogeneration. Wind is rapidly becoming cost-competitive, and several thousand megawatts of energy from this resource may be available in future plans. Substantial cost reductions are required before solar resources will become cost effective. Additional energy may be available from out-of-region imports.

The availability of energy from WNP-1 and WNP-3 depends upon resolution of legal and institutional barriers that currently affect the ability to complete these projects.

The Council will continue to monitor the confirmation of promising resources and will incorporate these into future revisions of the plan as they become cost effective.

1./ Levelized life cycle costs: The present value of a resource's cost (including capital, financing and operating costs) converted into a stream of equal annual payments. Unit levelized life cycle costs (cents per kilowatt-hour) are obtained by dividing this payment by annual kilowatt-hours saved or produced. Levelized life cycle costs permit comparisons of resources having different patterns of cash flow over their lifetimes. The term "levelized life cycle cost," as generally used in this chapter, refers to unit levelized life cycle costs.

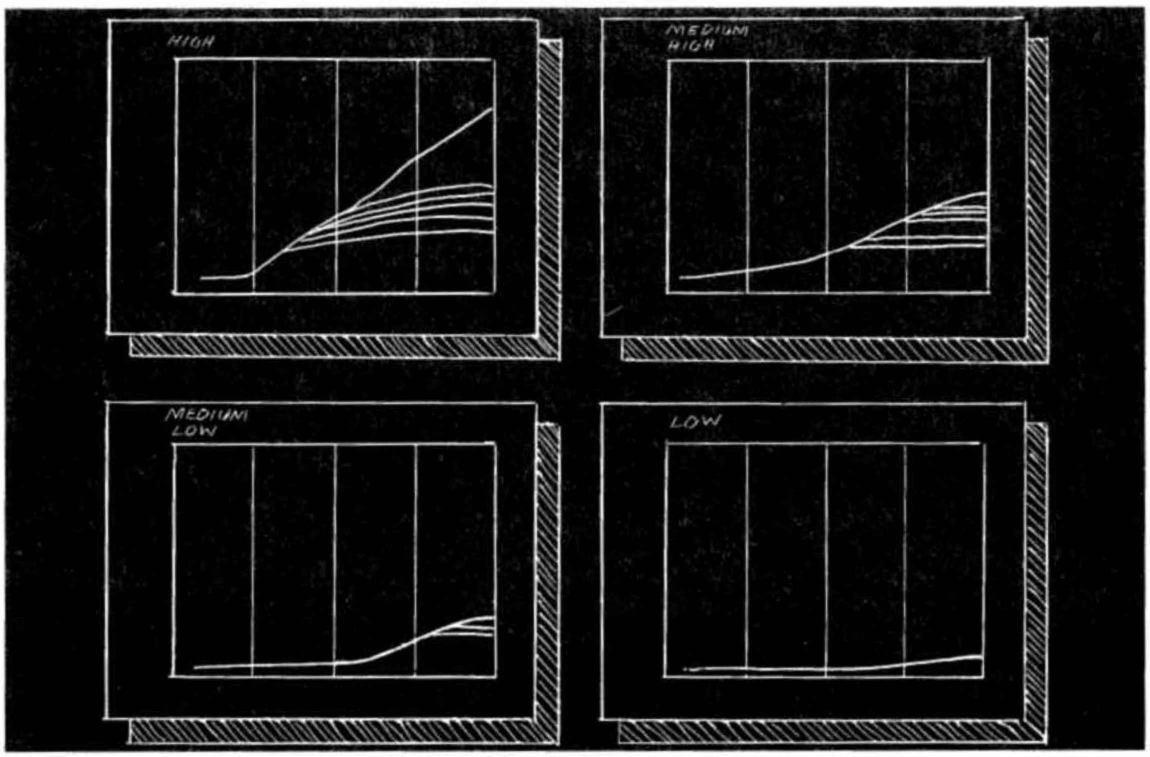
2./ New site, 1995 inservice, nominal dollars.

3./ Bonneville Power Administration, 1985. Evaluation and Ranking of Geothermal Resources for Electrical Generation of Electrical Offset in Idaho, Montana, Oregon and Washington.

4./ These estimates are of the physical completion of the projects. The proportion of total estimated construction costs expended to date is smaller, due to effects of inflation and other factors.

5./ The termination alternatives assume that the salvage of terminated plants would offset termination costs.

6./ Losses are attributable primarily to the accrued preservation costs in load growth cases where the projects are not needed. In some cases the plants are anticipated to be needed, are built, and then are not needed due to downturns in load growth. This latter type of loss is present in only a small proportion of cases where losses are experienced.



Chapter 8

Chapter 8
Resource Portfolio

Introduction

The concept of a resource portfolio is analogous to an investor's portfolio. The Council selecting the best mix of resources is like the investor choosing the best mix of stocks. Both are trying to manage uncertainties by diversifying their investments to reduce risks. Both have investment criteria. The Council is seeking lowest system cost,[1] and the investor desires greatest return. Finally, both must use judgment to include in the decisions those attributes that cannot be quantified.

The Council selects resources for inclusion in the resource portfolio so that the region can minimize the cost of electricity over the next 20 years. In developing this portfolio, the Council assumed that current relationships among utilities will change, allowing the region to cooperate in developing the lowest cost resources first. This assumption implies a level of cooperation that is unprecedented in this region. However, only through this level of cooperation can the region secure the lowest cost electricity for all ratepayers.

The resource portfolio identifies actions the region will need to take as the future unfolds. Because large uncertainties exist, it is not possible to predict all of the conditions that will occur or how regional decision makers will react to them. In spite of this uncertainty, the Council and the region must identify actions that may be necessary in the future and select the ones that must be undertaken now. These actions are described further in the Action Plan (Chapter 9). Because the Action Plan represents a commitment of the region's resources, it contains the most significant decisions resulting from the Council's resource portfolio and plan.

In selecting the resource portfolio described here, the Council estimated the availability, reliability and cost of both conservation and generation as resource alternatives. The Council developed a forecast of the region's future load growth, characterizing the range of uncertainty with four basic load scenarios. Since actual loads are not likely to grow along any one scenario, the Council analyzed hundreds of alternative ways the region might actually grow. These are called load paths. Many combinations of resources were then analyzed, leading to a resource mix that provided the lowest expected cost of constructing and operating all resources in the portfolio. These costs include environmental control technologies to reduce each resource's environmental and fish and wildlife impacts to acceptable levels.

The Council's load forecasts required development of four economic scenarios for the region, including high, medium-high, medium-low, and low rates of economic growth. These scenarios provided the basis for a range of load forecasts in each sector of the region's economy.

The Council established its high load scenario as a practical upper limit for planning. There is very little chance that future loads will exceed this level. On the other end of the spectrum, actual loads are not expected to fall below the Council's low load scenario. Between these two extremes, the Council developed medium-high and medium-low load forecasts to encompass the most likely range of growth.

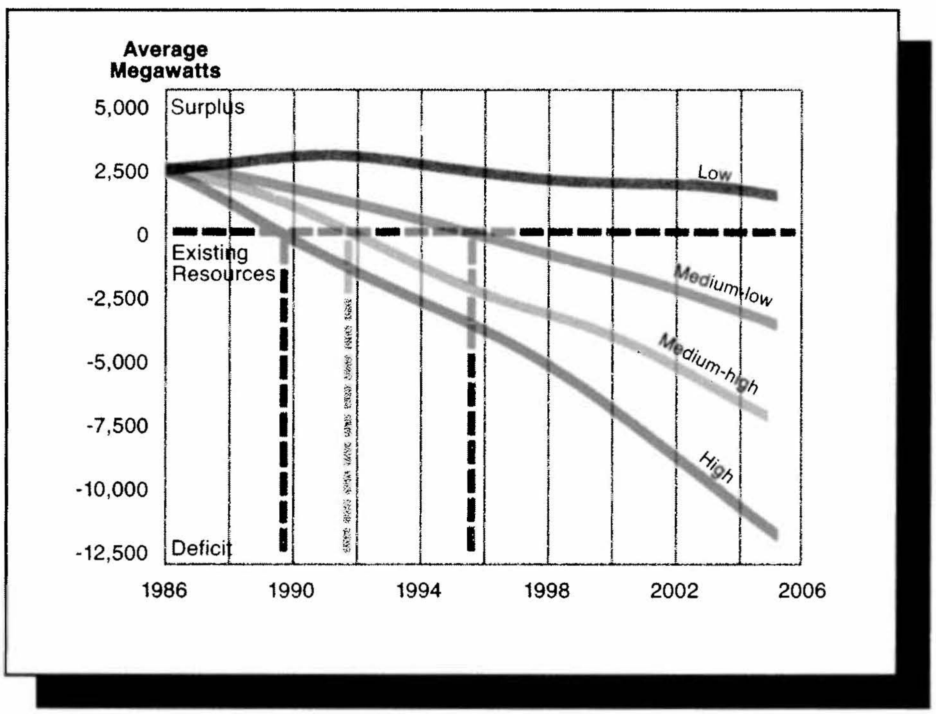


Figure 8-1
Regional Surplus and Deficit

Determining the Region's Need

The region's need for new resources is developed by subtracting the region's existing resources from each load scenario. The resulting resource requirements are shown in Figure 8-1. The total amount of resource additions which might be required over the 20-year planning horizon ranges from 0 to almost 12,000 average megawatts. Figure 8-1 also shows the points where the region would run out of existing resources in each load scenario, assuming the region secures no more conservation than has already been acquired. This figure also assumes there is no additional consumer initiated conservation in response to price increases.

In the low forecast, no new resources are needed, although the region should still acquire cost-effective resources which will be lost if not acquired at this time. An example of a resource opportunity that must be used or lost is the construction of energy efficient new buildings. Heat-loss prevention measures cannot be installed as cheaply or as effectively after the building is finished.

If high loads occur, the region needs new resources as early as 1990.

To analyze alternative resource portfolios, the Council assumed a trapezoidal distribution of probability, as shown in Figure 8-2. This distribution assumes that the high and low scenarios bound the scope of the plan; loads outside the high and low forecasts, while possible, are considered too unlikely to justify actions at this time. Demands between the medium-high and medium-low forecasts are most likely and considered equally probable. In Figure 8-2 the probability of loads between the high and medium-high is 27 percent; between the medium-high and medium-low, 42 percent; and between the medium-low and low, 31 percent.

Resource portfolio analysis focused primarily on the needs of the region as a whole. From this starting point, those actions that are most cost effective for the region as a whole can be identified. Once the most cost-effective actions have been found, it is possible to identify the appropriate entities to carry them out. The plan focuses both on those actions that Bonneville must undertake and on actions outside of Bonneville's responsibility. By starting with a regional perspective, the resource portfolio helps illustrate the independent responsibilities of the region's power institutions and the need for their cooperation. Regionwide cooperation is needed to assure the lowest cost actions to meet the collective needs of the region.

Bonneville Obligations

The Northwest Power Act requires the Council to forecast electrical energy demand and plan for the resources to serve Bonneville's customers. The plan must therefore set forth those actions Bonneville should pursue in order to meet the Administrator's obligations. At this time, because of the surplus, only small loads have been placed on Bonneville

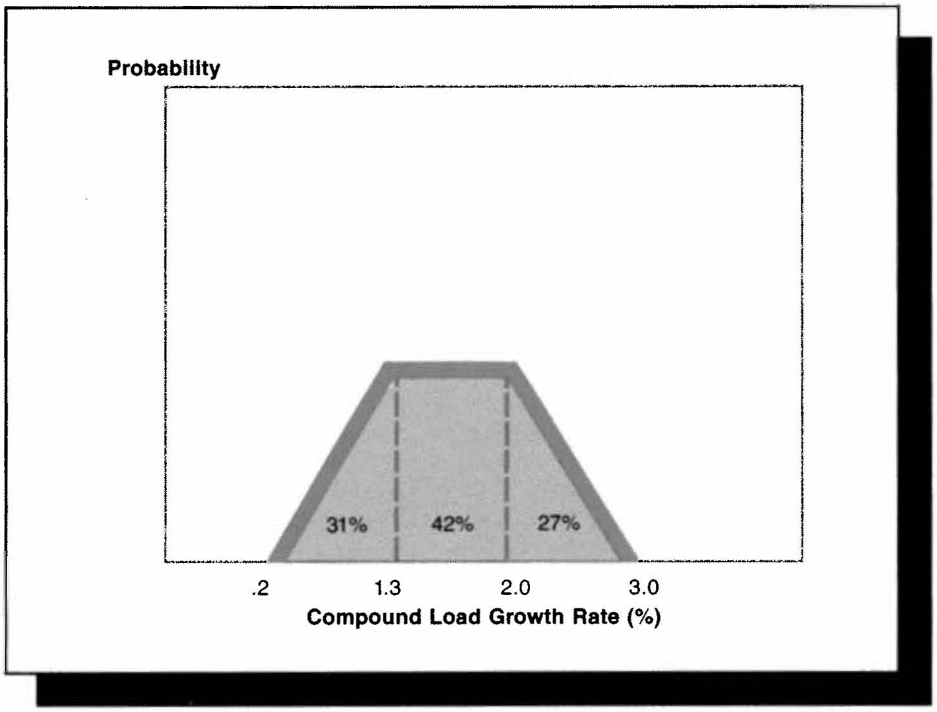


Figure 8-2
Probabilities of 20-Year Load Growth

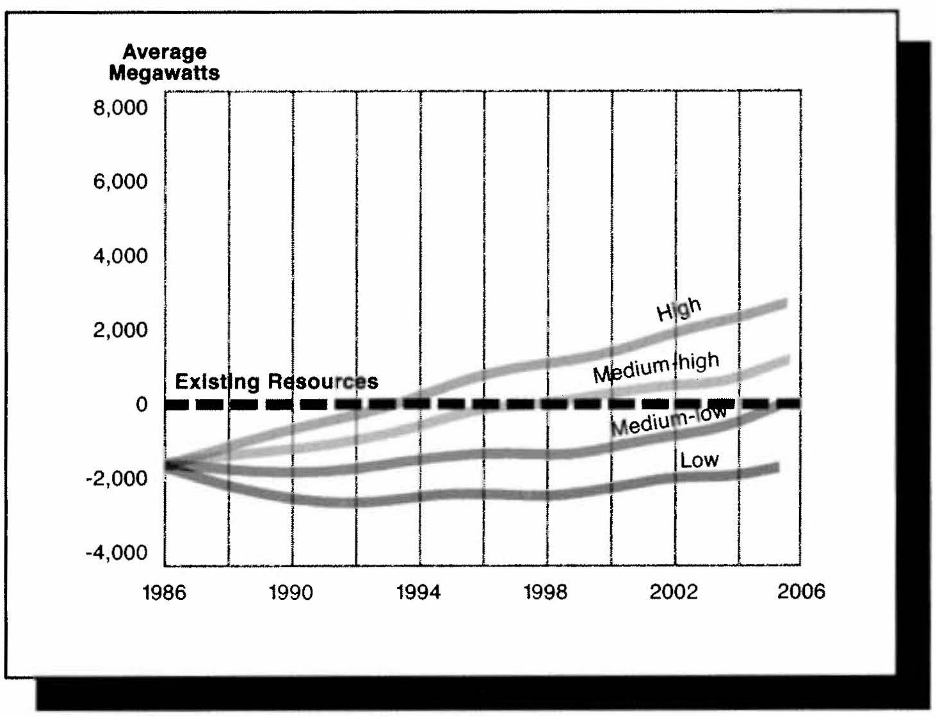


Figure 8-3
Bonneville Power Administration Resource Requirements

by investor-owned utilities through the power sales contracts. The Council has analyzed Bonneville's potential exposure to future investor-owned utility loads under two scenarios. First, using a conservative view of the Administrator's future obligations, it was assumed that Bonneville would remain a power marketing agency primarily serving the public utilities and the direct service industries. The resource requirements for the Administrator in this case are shown in Figure 8-3.

The second scenario assumes that Bonneville's resource requirements will include nvestor-owned utility loads after those utilities have used their current surplus resources. The current regional surplus of approximately 2,500 megawatts is not evenly shared among the region's utilities. The public utilities and Bonneville hold almost 1,900 negawatts of the region's surplus. Also, the uture load growth projections for Bonneville and its customers are lower than for the priate utilities as a whole. Therefore, as the egion's loads grow, the investor-owned utilties are likely to need new resources sooner han would Bonneville, if Bonneville coninues to serve only its current customers. This scenario bounds the high side of Bonneville's future load obligations by planning on all the region's resource requirements being met through Bonneville acquisition. Under this scenario, Bonneville could be equired to meet the region's needs shown in Figure 8-1.

Resource Availability

o be included in the portfolio, a resource has be available, reliable and cost effective, nd its environmental impacts must be conollable and acceptable. Previous chapters ave described the Council's findings on the ailability and cost of conservation and generating resources. The following sections riefly summarize these findings and escribe the resource alternatives from hich the Council selected the resource ortfolio.

onservation

ne Council evaluated conservation oppornities in every sector of the region's econny. The evaluation began by identifying dividual conservation measures that could improve the efficiency with which electricity is either produced or consumed. The Council evaluated each individual measure separately as well as in combination with other individual measures.

In developing a resource portfolio, the Council estimated the availability of discretionary conservation programs by selecting all measures with a levelized life cycle cost less than the estimated levelized life cycle cost of a new coal plant. Based on the resource mix in the medium-high load scenario, the coal plant was assumed to be placed in service in the year 2000. Taking into account the interaction of new resources with the existing hydropower system by using the System Analysis Model, the cost of energy from this coal plant was estimated to be approximately 4.0-4.5 cents per kilowatt-hour in 1985 dollars. For sizing the conservation programs, the cost of a coal plant must be adjusted to account for transmission system losses (7.5 percent), transmission costs (2.5 percent), and the 10 percent advantage to conservation provided in the Act. Thus, the cost of a new coal plant is adjusted upward by 20 percent to 4.8-5.4 cents per kilowatt-hour for selecting conservation measures to be included in the resource portfolio. The Council sized discretionary conservation by choosing all measures with a projected cost of 5.0 cents per kilowatt-hour or less, thus accounting for transmission system losses and costs and the 10 percent cost advantage granted to conservation under the Act.

For lost opportunity conservation that the region is acquiring over the next few years, the Council used the Decision Model to evaluate cost effectiveness. For example, the analysis showed that the expected value of additional model conservation standards measures in the Council's resource portfolio was approximately 3.5 cents per kilowatt-hour. When adjusted for transmission losses, transmission costs and the 10 percent advantage of the Act, the marginal model conservation standards measures should be less than 4.2 cents per kilowatt-hour. In deciding to include or exclude measures in the range of 4.0 to 4.5 cents per kilowatt-hour, the Council used judgment concerning the validity of cost and performance information and nonquantifiable environmental factors.

Figure 8-4 illustrates the amount of conservation savings that the Council estimates to be available in each of the four load scenarios. This figure shows that the Council has identified ten individual conservation program areas that in the high case can save 3,900 megawatts. The average cost of all conservation is 2.1 cents per kilowatt-hour. The portfolio plans on programs in the residential sector (including appliances and manufactured homes), and the commercial and governmental, industrial, and agricultural sectors.

The portfolio also includes improvements in the efficiency of the regional transmission and distribution system. These system efficiency improvements, while only representing 34 megawatts in this plan, could be increased when additional analysis is available concerning the availability of potential savings in Bonneville's customers' transmission and distribution systems.

Hydropower Efficiency Improvements

The region's existing hydropower system offers several opportunities for improvements in overall generating efficiency. These opportunities are primarily a result of advanced designs, materials and equipment that have become available since the design and construction of the region's hydropower system.

Based on several studies of the region's hydropower system, energy savings from turbine runner replacement and electronic governors have been identified as cost effective and are included in the Council's resource portfolio. The Council estimates that the installation of these hydropower efficiency improvements will result in an increase of 112 megawatts of hydropower output. This resource portfolio therefore includes this 112 megawatts of hydropower efficiency improvements as a cost-effective resource for the future.

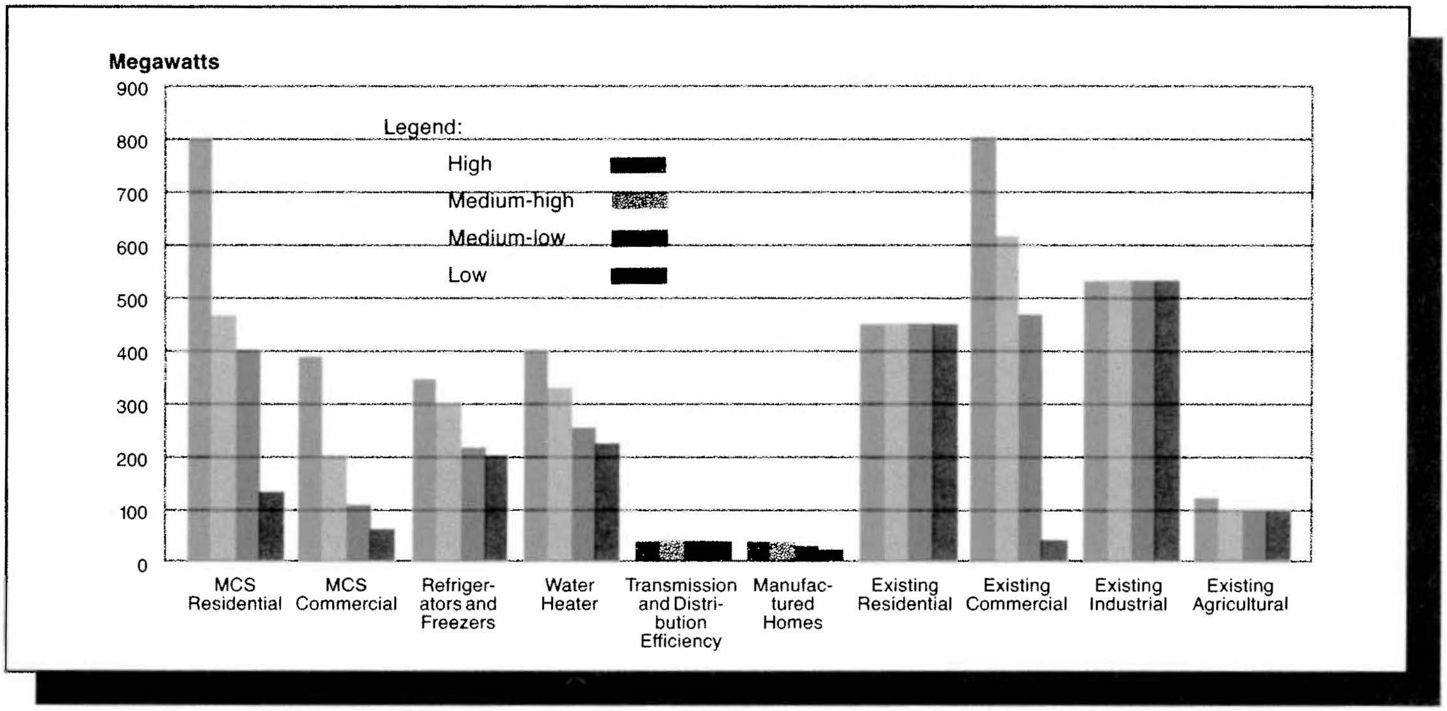


Figure 8-4
Conservation Availability

Better Use of the Existing Hydropower System

There are a number of strategies to make better use of the region's existing hydropower system and thereby achieve better economic use of nonfirm energy. The region could develop combustion turbines, or purchase energy from California and British Columbia on a short-term basis when needed. Alternatively, the region could follow a variety of load management strategies and/or rate designs in order to match the region's loads more closely with the output of the hydropower system, adjustments to the region's load in response to hydropower availability could allow the Northwest to change the critical water standard by which the development of new resources is planned.

Any of these strategies has the potential of impacting fish and wildlife resources and therefore the Fish and Wildlife Program. The Action Plan calls for additional studies of strategies to better use nonfirm, and the Council will continue to monitor the potential impacts on fish and wildlife.

The Council is not prepared to recommend any one of these strategies at this time. The Council, as a conservatism, assumed the region would rely on the highest cost nonfirm strategy—the development of combustion turbines. Combustion turbines provide an estimate of the upper limit of the costs of nonfirm strategies, since the other strategies should be achievable at less than the cost to construct and fuel new combustion turbines. Even so, the Council's studies show combustion turbines as a cost-effective way to firm 714 megawatts of nonfirm hydropower. The plan therefore incorporates into its resource portfolio strategies to convert 714 megawatts of what is currently nonfirm hydropower into firm energy.

New Hydropower

In the 1983 plan, the Council identified 920 megawatts of cost-effective hydropower potential. Since that plan, concern has developed about the potential environmental effects of new hydropower. Recent efforts to license new hydropower have been affected by significant objections over environmental issues, fish and wildlife impacts, and scenic and recreational effects. For this reason, until the Council completes its more detailed hydropower data base and river assessment studies, this draft assumes a conservative estimate of 200 megawatts of available new hydropower. This estimate includes only the addition of generating equipment to existing hydropower projects and to existing nonpower sites such as flood control and irrigation dams and irrigation canals. Development of hydropower is likely, of course, to include both existing projects and new sites. The Council anticipates that new sites will be developed when needed if they are found to be both cost effective and environmentally benign.

Cogeneration

There is great uncertainty over the amount and cost of the cogeneration potential in this region. The Council used the Pacific Northwest Utilities Conference Committee's (PNUCC) estimate of 320 megawatts of cogeneration which would be available in high load cases, based on a survey of industrial companies in the Pacific Northwest. The estimates of the amount of cogeneration available are sensitive to the assumed scenario of regional economic growth. In addition, when economic and load growth is high, prices offered for cogeneration will also be high. For this reason, 320 megawatts were assumed in the high load scenario, while only 190 megawatts of cogeneration were assumed to be available in the medium-high and medium-low load scenarios and only 130 megawatts were assumed to be available in the low.

Cogeneration is not needed in either the medium-low or low scenario. Based on the current regional surplus, it appears that new cogenerated energy is not widely needed until the latter part of the 1990s. Therefore, the region and the Council have time to study the overall potential and cost of this resource.

Coal

Finally, the Council's portfolio turns to new generic coal plants as the resource of lowest priority and highest cost. Coal plants are the region's marginal resource, in that substantial quantities of new coal plants probably can be added if loads grow rapidly or other resources prove unavailable.

Several alternative coal plants were evaluated to determine the overall cost effectiveness of various plant sizes and lead times. The Council's cost estimates are based on plants of 603 megawatt capacity and 75 percent equivalent availability. The plants are assumed to burn coal sent by unit-train from Wyoming and Montana to plant sites in Eastern Washington and Oregon. The Council has used the estimates recommended by Bonneville and the Northwest utilities for constructing, financing and operating new coal plants. These plants are somewhat more thermally efficient than those in the last plan and can produce electrical energy at a levelized life cycle cost of about 4.0 to 4.5 cents per kilowatt-hour (1985 dollars), assuming the plant is placed in service in the year 2000 and is financed with an 80/20 debt-to-equity ratio.

In developing the resource portfolio, the Council used the resource availabilities shown in Table 8-1. Not all of the resources in Table 8-1 are required to meet the needs of each load scenario. Twelve coal plants are needed in the high forecast, but no coal plants are required in the medium-low and low. Other resources, including wind, geothermal, and solar, were evaluated by the Council and found not to be cost effective, available or reliable.

Table 8-1
Resource Availability
(Average Megawatts)

	LOAD SCENARIO			
	High	Medium-High	Medium-Low	Low
Conservation Program				
MCS Residential	792	468	405	129
MCS Commercial	398	195	109	51
Refrigerators & Freezers	352	293	224	206
Water Heat	396	324	266	219
Manufactured Homes	35	36	32	13
Existing Residential	455	455	455	455
Existing Commercial	802	614	475	345
Existing Industrial (DSIs @ 100%)	538	538	538	538
Agriculture	124	105	105	105
Transmission & Distribution Efficiency Improvements	34	34	34	34
Generating Resource				
Hydropower Efficiency Improvements	112	112	112	112
New Hydropower	200	200	200	200
Nonfirm Strategies	714	714	714	714
Cogeneration	320	190	190	130
Licensed Coal (2 Units)	905	905	905	905
Unlicensed Coal (10 units)	4,520	4,520	4,520	4,520

Financial Assumptions

Table 8-2 shows the Council's economic and financial assumptions for evaluating the costs of new resources. A 3 percent real discount rate for the time value of money to society and a long-term inflation rate of 5 percent were used. It was assumed new resources will be publicly or privately financed in a ratio that reflects the needs of public and investor-owned utilities for new resource development. New coal plants are only needed to meet investor-owned utility load growth. Therefore, the coal included in the portfolio was assumed to be sponsored by investor-owned utilities with Bonneville acquisition. Utility comments on this plan have recommended that, because of Bonneville acquisition, the investor-owned utilities could secure an 80/20 debt/equity ratio. See Volume II, Chapter 4, for a more complete discussion of financial assumptions.

Consideration of Environmental Quality and Fish and Wildlife

In compliance with the Northwest Power Act, the Council has considered environmental quality and fish and wildlife concerns throughout the development of this energy plan. The Council began its consideration of environmental concerns by studying the potential effects of resources on the environ-

Table 8-2
Financial Assumptions

VARIABLE	REAL RATE (Percent)
1) Home Mortgage	6.2
2) Investor-Owned Utility Debt	7.0
3) Public Utility Debt	4.0
4) Treasury	5.0
5) Investor-Owned Utility Equity	8.5
6) WPPSS Borrowing	5.0
7) Consumer Discount Rate	10.0*
8) Social Discount Rate	3.0
9) Inflation	5.0

*Council has done sensitivity studies of the economic feasibility to consumers of various conservation actions at both 4 and 10 percent.

ment and fish and wildlife in the development of the 1983 plan. These studies and important issues arising from them, along with public review and comment, guided the Council as it drafted this plan.

The Council's resource cost-effectiveness evaluations include quantifiable costs for pollution abatement equipment and fish and wildlife mitigation required under state and federal regulations. The Council developed a method to quantify other environmental costs and benefits to be used by Bonneville in measuring the cost effectiveness of specific resource acquisition decisions. This method is presented in Volume II, Chapter 9, and Appendix II-A. The Council expects Bonneville to use this method in evaluating each resource and resource site prior to acquisition.

While selecting the individual components of this resource portfolio, the Council assessed all available energy technologies, including their environmental benefits and impacts. The Council also considered the amounts of power to be expected from each resource type, how effects on environmental quality and fish and wildlife could be mitigated, and how mitigation measures might affect energy production.

To assure that only environmentally acceptable new hydropower is secured as a part of the plan, specific criteria for hydropower acquisition were developed by the Council. These criteria are included in Appendix II-B.

Resource Portfolio Analysis

There are considerable uncertainties about the future resource needs of this region. To address these uncertainties, the Council developed a Decision Model that explicitly models the cost outcome of many different resource decisions under hundreds of possible load growth paths. This model was developed in conjunction with Bonneville, the Pacific Northwest Utilities Conference Committee (PNUCC), and the Intercompany Pool.

In developing the resource portfolio, the Council recognized that future loads were not likely to grow along any one of the four forecasts. Therefore, it used hundreds of load growth paths to describe how the region's future load levels might change. The Council's analysis follows each load path and simulates the acquisition of new resources over the next 20 years. Based on the needs of each load path, the region may hypothetically begin conservation programs, acquire options on generating resources, or construct resources that have been optioned previously. This analysis thus simulates the process of making decisions based on forecasts of future loads. Because these decisions must be made without specific knowledge of actual load growth, the analysis incorporates decisions that lead to both over-and under-building of new resources. This process is meant to simulate accurately the inherent uncertainties that lead to periods of surplus or deficit.

A resource strategy is developed for each of the load paths by following resource priorities and policies for optioning and building resources. The analysis then calculates the cost of constructing and operating the resources within the existing Northwest power system. The result across all load paths gives a distribution of present value expected costs. This allows the Council to identify the resource strategy with the lowest expected costs. It is also useful in identifying strategies to manage the wide range of uncertainty the region faces.

Another system model provided more explicit analysis of the cost of building and operating resources. The System Analysis Model begins with a given load and given resources to meet that load. This model assesses operation of both existing and new resources within the region's power system in much greater detail and, therefore, was useful to validate and check the results of the Decision Model and to perform special cost-effectiveness studies.

Using these analytical models, the Council evaluated a variety of resource priorities. Through the analysis of various sequences of resource acquisition (see Volume II, Chapter 8), the Council was able to establish a resource priority order for the region to meet its power needs at the lowest possible cost.

The estimates of resource availability in Table 8-1 can be thought of as individual investment opportunities to be used in developing the regional resource portfolio. A number of cost-effectiveness studies were performed using the Decision Model to determine the best priority order for resource development. These studies were conducted by comparing alternative orders of programs and generating resources until the order which led to lowest expected value system cost was found. This analysis of priority order involved only the discretionary conservation programs and generating resources. The nondiscretionary programs were excluded from the priority order tests. However, they were used in the model runs to include their system effects and impact on the cost effectiveness of other resources. The initial priority order was based on levelized cost estimates for the programs and resources. The process allowed generating resources to compete with conservation programs for priority order.

Table 8-3
Resource Priority Order

NONDISCRETIONARY RESOURCES	DISCRETIONARY RESOURCES
Residential MCS	Hydropower Efficiency Improvements
Commercial MCS	Agricultural Conservation
Refrigerators & Freezers	Existing Commercial
Water Heat	Transmission & Distribution Efficiency Improvements
Manufactured Homes	Existing Residential Conservation
	Existing Industrial Conservation
	Combustion Turbines (Nonfirm Strategies)
	Small Hydropower
	Cogeneration
	Licensed Coal
	Unlicensed Coal

The results of this analysis are shown in Table 8-3. This priority order was found to produce the lowest expected present value system cost across the entire load range. This order was used as the basis for developing the resource portfolio, conducting sensitivity analysis, and developing of Action Plan items. As stated earlier, the nondiscretionary programs are all given equal and top priority in resource development, and are only shown in the table for the sake of completeness.

The cost differences due to a switch of the order for any pair of resources are generally quite small. This results primarily because these studies begin with the resources ordered by judgment according to general cost effectiveness. In addition, the similarity of resource costs, relatively small amounts of energy for some resources, and parallel resource development schedules all contribute to small cost changes as resource priorities are changed. Because development of many of the resources in the portfolio occurs simultaneously, a one-step change in priority order may lead to only small timing differences in resource development over most of the load range. Given that the same total amounts of two resources are developed, small changes in the timing of development will have a small present value impact. Moving unlicensed coal to the top of the discretionary resource list would have a huge cost impact.

The resource portfolio priority order shown in Table 8-3 is used by the Council as a general priority for development of resources during periods of acquisition. It does not mean that all of the potential of one type of conservation program or generating resource should be exhausted before moving to the next. As mentioned above, constraints on program development rates and resource lead times are likely to require parallel development paths for many of the resources in the portfolio.

Additionally, the methodology used in this analysis necessarily treats programs and resources as generic blocks. For instance, all of the potential cogeneration units have the same physical characteristics, capital costs, operating costs, lead times, seasonal distributions, etc. In reality there are likely to be significant differences between individual cogeneration installations competing for resource acquisition. The Action Plan calls for Bonneville to develop a resource acquisition process where resources of different types are in competition to meet the region's needs at the lowest cost. In selecting resources for acquisition, all resource alternatives should be evaluated on their merits, taking their unique characteristics into account.

In evaluating resources for inclusion in the portfolio, the Council chose policies for securing options and acquiring or building resources. These option and build policies guide the analysis of resource alternatives in the Decision Model. Following particular option and build policies permits the analysis to account for the impact on the resource portfolio of a resource's lead time and plant size (see Volume II, Chapter 8).

In developing this plan, the Council assumed that the region would secure options sufficient to meet 90 percent, and acquire resources sufficient to meet 50 percent, of the possible range of future loads. This is an oversimplified model of the actions the region will take in the future, not a recommended policy for option and build decisions. The decisions for each resource will obviously be dependent on many factors outside of the Council's current analysis.

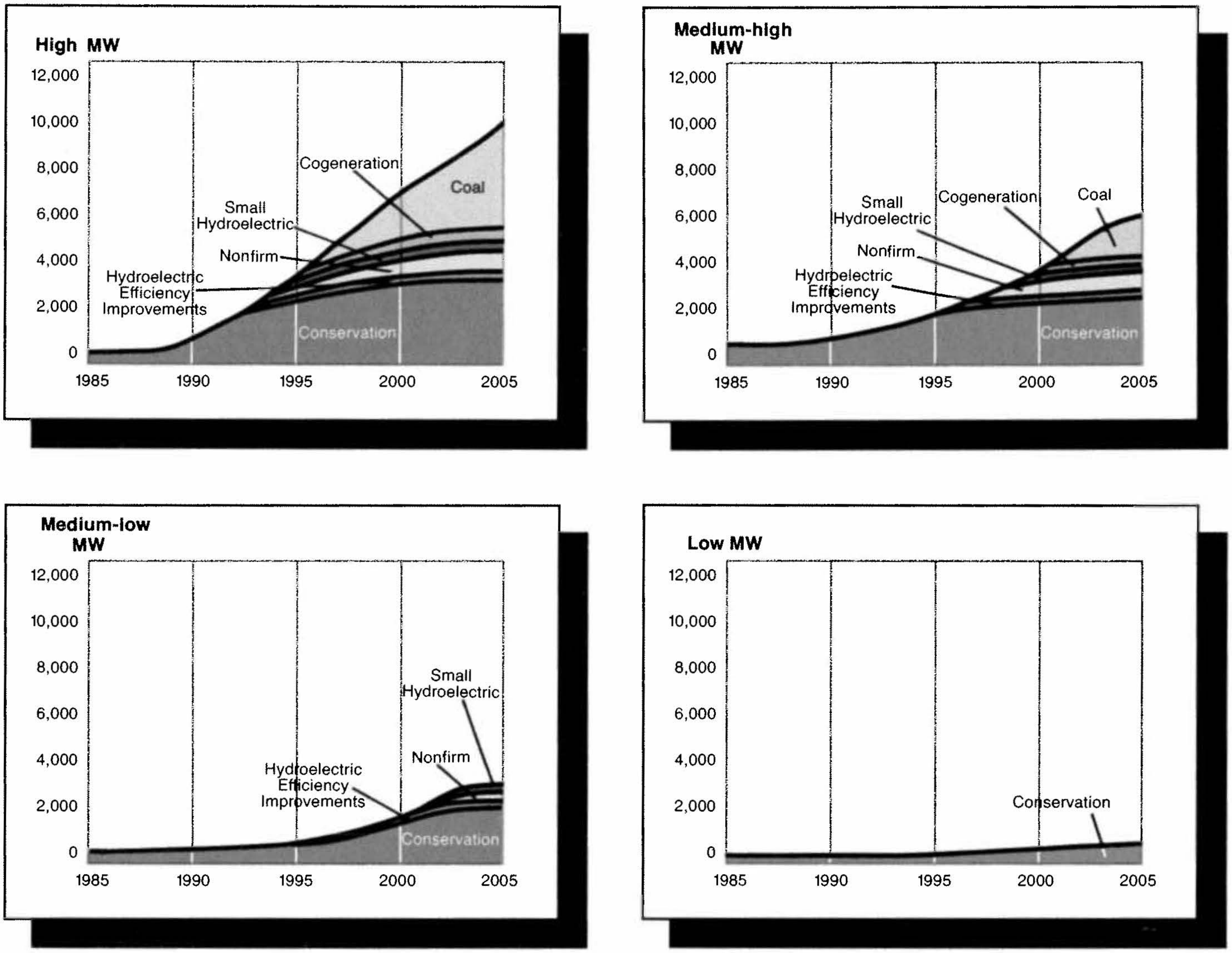


Figure 8-5
Regional Resource Schedule (High, Medium-High, Medium-Low, Low)

Resource Portfolio

The resource requirements for the Pacific Northwest in each of the four primary load scenarios were shown in Figure 8-1. Although no one knows how the region will actually grow in the future, Figure 8-5 shows the resources that would be needed to meet the requirements of each of the four basic load scenarios.

In developing the resource portfolio, the Council assumes that the region's utilities cooperate in securing the lowest cost resources first. This level of cooperation is unprecedented in this region, since resources available to some utilities would be developed earlier than needed by those utilities to serve the needs of others. Through this new level of cooperation, the region will substantially reduce the future cost of electricity.

The four resource schedules shown in Figure 8-5 are provided to identify the actions that the region may have to take in the future if any one of the four load scenarios materializes. It is not likely that many of these future resource acquisitions will actually occur, since conditions are likely to change as the future unfolds. However, these resource schedules show the actions the region should take in the future to achieve the lowest cost of electricity. Those actions that are necessary in the next few years to prepare for the range of future needs are identified later in this chapter and in the Action Plan (Chapter 9).

The **high load scenario** has regional loads growing quickly enough to consume the current surplus by about 1990. Beginning in the late 1980s, all of the major conservation programs are brought up to full speed and achieve a total savings of over 3,900 megawatts by 2005. The second resource acquisition required in the high load scenario is better use of nonfirm hydropower. Strategies to better use nonfirm achieve by 1994 the full

714 megawatts that the Council estimates to be cost effective. In 1993 through 2003, the high load case would require the region to acquire all of the hydropower available at developed sites, approximately 200 megawatts. Cogeneration resources would need to be acquired beginning in 1995, with the full 320 megawatts secured by 2003. Beginning in the year 1995, the high load scenario would require the region to begin adding new coal plants to the power system. In order to fulfill the requirements of the high load forecast, 12 large coal plants are needed by 2005. Some of these could be avoided if more cost-effective alternatives are identified and developed prior to the point of needing these coal plants.

Similar types of resource actions are needed to meet the requirements of the medium-high forecast. The **medium-high load scenario** shows the region beginning discretionary conservation programs by 1990. This load scenario anticipates new building activity growing more slowly than in the high case, so only about 3,000 megawatts of conservation would be available over the next 20 years. The strategies for better using the existing hydropower system are needed beginning in 1997, and by 1999 all 714 megawatts are installed. The region is assumed to develop the available hydropower at developed sites beginning in 1996, and by 2005 all 200 megawatts are built. The requirements of the medium-high scenario have the region acquiring the 190 megawatts of available cogeneration facilities by about 2000. The region begins to acquire additional coal plants in 2001 and adds three plants to meet the requirements of the medium-high scenario.

The **medium-low load scenario** calls for substantially fewer new resources. The current regional surplus is exhausted by about 1996, with conservation programs beginning at a relatively slow pace in 1993. Again, because this load scenario assumes less new construction will take place in the region, the overall conservation opportunity in the medium-low is reduced to about 2,400 megawatts. In the period 2003 through 2005, the region would acquire only 100 megawatts of the 200 megawatts of available hydropower at developed sites and would acquire only about 360 megawatts of the 714 megawatts of nonfirm strategies available.

Finally, if **low loads** occur, the region is surplus throughout the next 20 years. For this reason, no additional resources are needed and only the savings that accrue as a result of the region implementing the model conservation standards are shown. These savings contribute slightly to the regional surplus but, due to the extremely low rate of new building construction, they add little to the region's resource mix.

Bonneville's Resource Strategy

The Northwest Power Act requires the Council to develop a regional electric power plan. In addition to development of this regional plan, the Act also requires the Council to plan resources to reduce or meet the Administrator's load obligations and requires Bonneville to acquire resources needed to meet its contractual obligations. This plan recognizes that the obligations of the Bonneville Power Administrator will not be the entire region's load growth, unless all utilities choose in the future to place their load growth on Bonneville.

In developing this 1986 Power Plan, the Council focused on both the needs of the region and the substantial uncertainties that exist with respect to the Administrator's obligations. Current Bonneville customers, primarily public utilities and direct service industries, represent substantial uncertainty in themselves. The total range of load uncertainty for Bonneville, even assuming no additional loads from customers other than the public utilities and direct service industries, is 4,800 megawatts over the next 20 years.

If the Council assumes that all investor-owned utility load growth becomes a part of the Administrator's load obligations, the range of uncertainty for Bonneville adds to the region's load uncertainty of almost 12,000 megawatts in 20 years. This substantial increase in uncertainty poses a particular dilemma to the Council and Bonneville. This dilemma is whether or not to undertake actions at this time that will prepare Bonneville for the total region's load growth, even though the cost of these actions will be borne by Bonneville's current customers. In developing this power plan, the Council sought to strike an appropriate balance between the risk represented by Bonneville's load uncertainty, and the cost to Bonneville's customers of securing sufficient options to manage this uncertainty effectively.

Balancing Bonneville's uncertainty and the cost of insurance, the Council chose to follow a two-step planning strategy. The first step is for Bonneville to lead the region in developing the capability to secure resource options and to build conservation capability so the region can meet rapid load growth. This strategy recognizes the importance of being able to option to high levels of load growth, since the cost of options is small when compared to either not having sufficient resources or to overbuilding resources and thus creating surplus. At the same time, the Council expects that Bonneville will not be responsible for securing all options, since some utilities will undertake independent actions. It is important to note again that securing resource options and developing conservation capability does not necessarily mean that resources will be developed.

The second step identifies the resources Bonneville should acquire. Because Bonneville faces considerable uncertainty with respect to future investor-owned utility loads, the plan expects Bonneville to actually decide to build and acquire sufficient new resources to meet the median or 50 percentile load of Bonneville's known customers. The plan recognizes that even the loads of Bonneville's customers are quite uncertain. However, the costs of overbuilding or underbuilding are borne only by Bonneville's actual customers. Accordingly, this strategy will help minimize Bonneville's cost of serving its customers and will thereby help hold down Bonneville's rates.

Schedule for Acquiring Resources to Meet Bonneville's Obligations

Figure 8-6 illustrates the overall schedule of resource acquisition for Bonneville if Bonneville continues to represent only its current customers and does not have to serve substantial investor-owned utility loads. In this scenario, Bonneville can wait until 1991 to begin discretionary conservation acquisition even in the highest load forecast. In half of the load cases, Bonneville does not need to begin conservation program activity until after the year 2000.

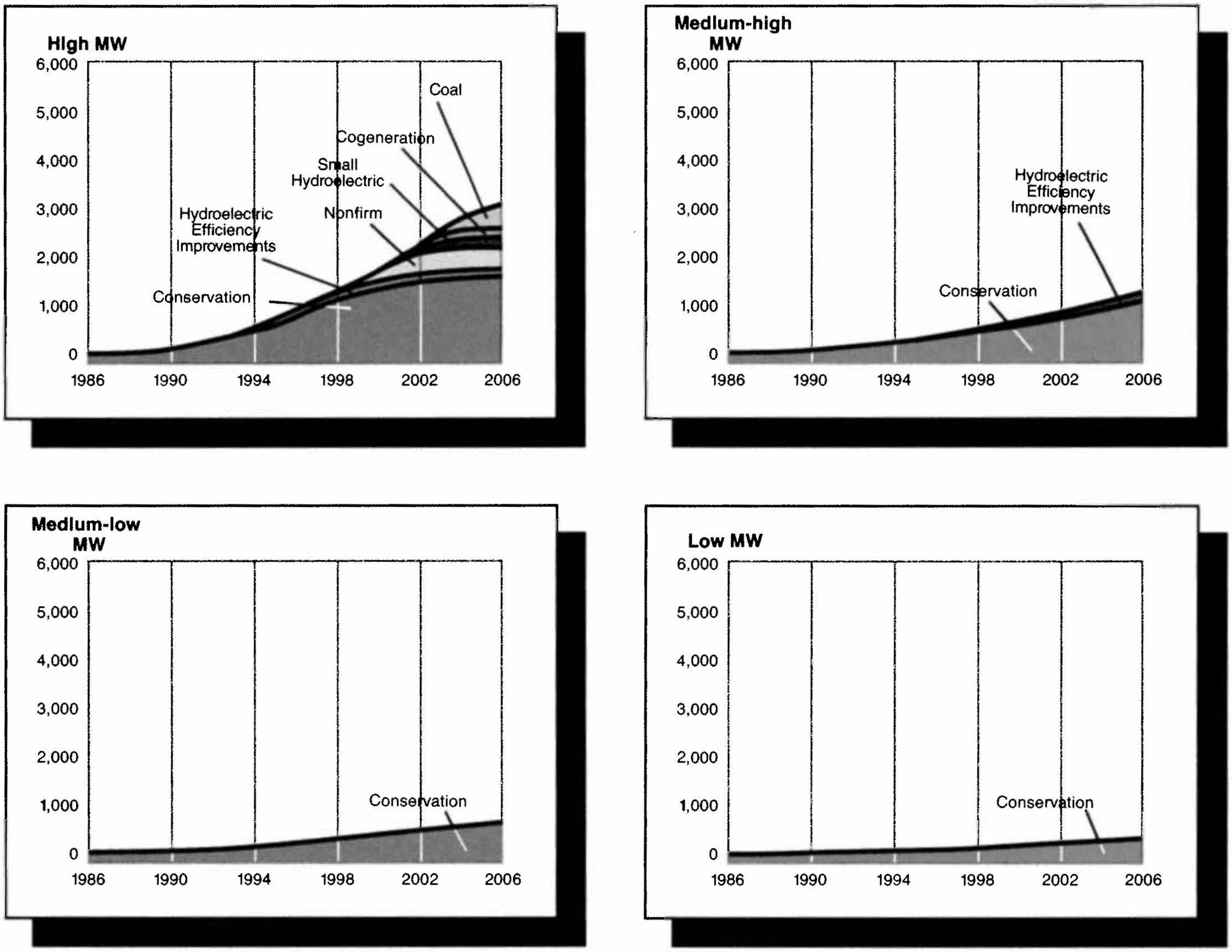


Figure 8-6
BPA Resource Schedule (High, Medium-High, Medium-Low, Low)

Figure 8-6 illustrates that Bonneville will begin discretionary conservation programs in 1991, assuming it experiences the high load growth. Bonneville will increase the rate of activity in these programs, achieving approximately 1,700 megawatts of savings by the end of the planning period. In addition to this conservation, Bonneville will add its available system efficiency improvements, new hydropower at existing projects, available cogeneration opportunities, and about 400 megawatts of energy made available by new uses of the hydropower system (called nonfirm strategies). If high loads develop, Bonneville will need one coal plant in 2004.

Figure 8-6 also shows that, for the medium-high, medium-low, and low load scenarios, conservation and a small amount of system efficiency improvements are sufficient to meet the needs of Bonneville's current customers, who are primarily the public utilities and the direct service industries.

Near-Term Decisions

The resource portfolio not only determines the schedule for resources to be put on-line, but also determines the resource option and build decision points necessary to achieve the schedule. The Council has extracted from the portfolio the resource targets that are necessary to meet the region's resource requirements. Table 8-4 shows resource acquisitions the region's utilities will have to make over the next ten years in order to meet the region's requirements in the high scenario. The responsibility for these actions if high loads occur may fall either on Bonneville or on utilities that do not place loads on Bonneville.

To illustrate the impact of load uncertainty, Table 8-5 shows the region's resource requirements for the medium-high load scenario. If medium-high loads materialize over the next ten years, the region will need to

Table 8-4
Resource Requirements—Region's High

RESOURCE	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Residential MCS	8	19	20	27	30	33	35	35	38	42
Commercial MCS	0	15	22	21	20	20	20	21	22	22
Refrigerators & Freezers	0	0	0	0	0	0	11	16	22	24
Water Heat	0	0	0	0	0	0	11	18	24	26
Manufactured Homes	0	1	1	1	1	2	1	2	2	2
Agriculture	0	3	7	10	10	10	10	10	10	10
Existing Commercial	0	15	45	65	70	70	70	70	70	70
Transmission & Distribution Efficiency Improvement	0	1	3	5	5	5	5	5	5	0
Existing Space Heat	0	8	18	30	45	50	50	50	50	50
Existing Industrial	0	0	20	60	90	100	100	81	0	0
Hydropower Efficiency Improvement	0	0	0	0	0	60	15	10	15	10
Nonfirm Strategies	0	0	0	0	0	0	0	0	714	0
New Hydropower	0	0	0	0	0	0	0	52	7	140
Cogeneration	0	0	0	0	0	0	0	0	0	255
New Thermal	0	0	0	0	0	0	0	0	0	0

Table 8-5
Resource Requirements—Region's Medium-High

RESOURCE	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Residential MCS	8	14	17	20	23	25	25	27	26	28
Commercial MCS	0	7	11	10	11	12	11	11	12	12
Refrigerators & Freezers	0	0	0	0	0	0	10	16	21	22
Water Heat	0	0	0	0	0	0	11	16	22	23
Manufactured Homes	0	1	1	2	2	1	2	2	2	2
Agriculture	0	0	0	3	7	10	10	10	10	10
Existing Commercial	0	0	0	15	45	65	70	70	70	70
Transmission & Distribution Efficiency Improvement	0	0	0	1	3	5	5	5	5	5
Existing Space Heat	0	8	12	13	28	44	50	50	50	50
Existing Industrial	0	0	0	0	0	20	60	90	100	100
Hydropower Efficiency Improvement	0	0	0	0	0	0	0	0	55	5
Nonfirm Strategies	0	0	0	0	0	0	0	0	0	0
New Hydropower	0	0	0	0	0	0	0	0	0	0
Cogeneration	0	0	0	0	0	0	0	0	0	0
New Thermal	0	0	0	0	0	0	0	0	0	0

begin discretionary conservation programs in about 1990 and will need only a small amount of hydropower efficiency improvements in 1994-95. Comparing this table with the region's requirements in the high scenario shows how sensitive future actions are to the load scenario that actually develops.

Building Capability

The federal government requires Bonneville's budget planning to be done up to seven years in advance of actual expenditures. No one knows how loads will grow over the next seven to ten years; however, the Council believes that Bonneville should build the capability to implement conservation programs that can meet the needs of the region's medium-high load scenario. Table 8-5 is provided as the basis for setting conservation budgets and targets and developing capability to develop conservation and secure options. The Council has selected regional medium-high loads for budget planning so that Bonneville will be prepared to meet the requirements of the Council's most likely range of load growth. If loads grow slowly, however, capability should be built and then maintained, and very little resource acquisition would be required.

Securing Options

Table 8-6 shows the time periods when options on new resources must be initiated in order to meet the region's requirements in the high load scenario. Table 8-6 also illustrates the needs of Bonneville's current customers for options if high loads develop. The region as a whole needs substantial amounts of options for all available resource types during the 1988 to 1991 time period in order to ensure that the requirements of high load growth can be met. Bonneville alone would need resource options much later if high loads develop, but investor-owned utilities do not place their load requirements on Bonneville.

To ensure that high load growth can be met, the region may need to secure options on a large number of megawatts by 1988. Figure 8-7 shows the frequency of need for the first coal option in each year. This shows that there is about a 70 percent chance of needing an option on a new thermal resource by 1995 and about a 30 percent chance of needing that option by 1990. The Council and the region will have to see how actual loads develop over the next several years, but it is clear that the resource portfolio analysis indicates that the region should be developing the policies, procedures and capability to secure an option inventory before the current surplus is exhausted.

The region currently has initiated siting and licensing for several thermal resources. These sites could be lost if not properly maintained. Bonneville also needs to develop experience with the legal, institutional and financial issues surrounding securing options. For this reason, and because an option could be low cost if secured at this time, Bonneville should work with resource developers to further demonstrate the workability of the options concept.

It is not possible for the Council to know exactly the Administrator's load obligations over the next ten years. Substantial uncertainties remain with respect to the basic level of load growth, the amount and timing of investor-owned utility loads that will be placed on Bonneville, the availability in the future of additional resources not included in this plan, and the independent actions of utilities that are not placing loads on Bonneville.

Table 8-6
Options Requirements
(Average Megawatts)

RESOURCE	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
REGION'S HIGH										
Hydropower Efficiency Improvements	60	15	10	15	10	0	0	0	0	0
Nonfirm Strategies	0	0	0	714	0	0	0	0	0	0
New Hydropower	0	0	0	53	8	140	0	0	0	0
Cogeneration	0	0	0	0	0	255	0	0	5	40
New Thermal Resources	0	0	452	905	1,357	452	452	452	905	452
BONNEVILLE HIGH										
Hydropower Efficiency Improvements	0	0	0	65	5	0	0	0	0	0
Nonfirm Strategies	0	0	0	0	0	0	0	0	0	357
New Hydropower	0	0	0	0	0	0	0	0	0	5
Cogeneration	0	0	0	0	0	0	0	0	0	0
New Thermal Resources	0	0	0	0	0	0	0	0	0	0

In the future, the Council will evaluate the region's need for and appropriate level of an option inventory. The current surplus provides a de facto option inventory that is sufficient to meet even high load growth for the next several years. As the current surplus is reduced, the region will have to begin to option new resources. There is currently no consensus as to how big the option inventory should be, nor whose responsibility it is to pay for options. For this reason, the Council will continue to work with all regional entities to try to resolve these questions. In the meantime, if the current surplus is reduced by

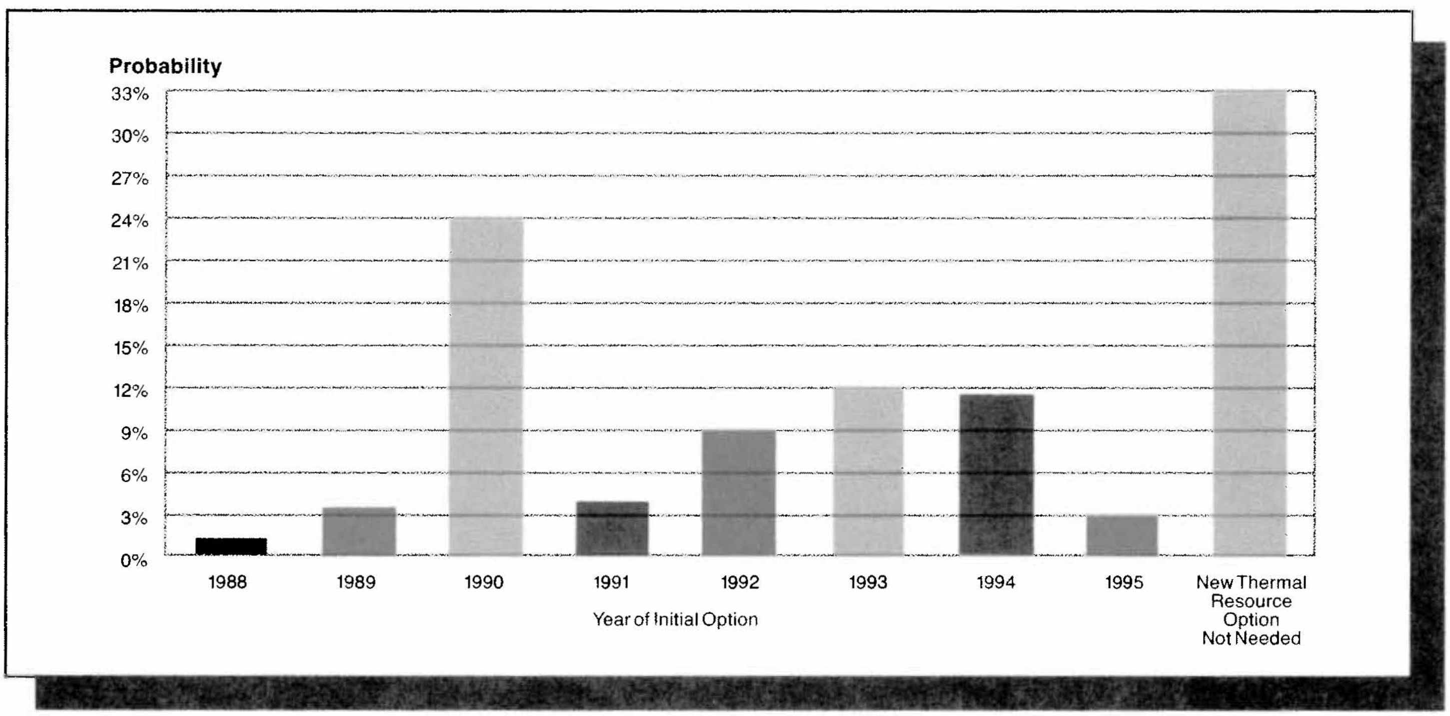


Figure 8-7
Region's Need for a New Thermal Resource Option in the Next Ten Years

1,000 megawatts or more, the Council calls for the region to secure options on 500 megawatts. In this way the region will phase in the necessary option inventory as the region's surplus declines. At the same time, the Council calls on Bonneville to develop a policy to allocate the cost of options.

Portfolio Uncertainty

The Council believes that producing an effective and adaptive power plan requires recognition of the large uncertainties inherent in long range resource planning. Most of the uncertainty directly included in the analysis leading to the final portfolio concerns future load and the large impact this will have on the types and amounts of resources that might be needed. Resource uncertainty has been included in the analysis to the extent that conservation and generating resource supply can vary with the economics and demographics across changing load forecasts (e.g., more energy is available from the model conservation standards in high load growth than in low load growth). However, the planning models do not explicitly incorporate resource supply uncertainty on each specific load path. While the Council feels that the data development process has produced reasonable and balanced estimates of future resource supply, there is no question that a range of uncertainty exists around these values as well.

Based on the public comment received on the draft plan, the Council performed a number of sensitivity analyses on the resource portfolio. These studies were designed primarily to investigate how costs and schedules in the resource portfolio would be affected by higher or lower levels of conservation or generating resource supply than are projected in the final portfolio, or by less flexibility in the process of developing resources. An additional study was performed to estimate the impact of greater uncertainty in direct service industry load than is assumed in the base portfolio.

These studies were all performed using the Decision Model and, except as noted, used the same data, resource priorities, and decision rules that were used in the final resource portfolio. The parameters of interest in each study were the changes in cost from the base portfolio and the changes in the timing of resource decisions. Because an option on a coal unit may be required in the relatively near future, the impact of resource uncertainty on the frequency and timing of initial coal options was used as the critical indicator of impact on timing of resource decisions. The following sections describe these sensitivity analyses in more detail.

Impact of Lower Conservation Supply

One analysis was performed under the assumption that one-third less energy would be available in all of the conservation programs in the resource portfolio. The study changed only the total energy supply; it did not affect the cost effectiveness of individual conservation programs. This drop in conservation supply has an expected present value cost of $2 billion to the region.

Figure 8-8 shows a frequency histogram for the timing of the first options taken on a new thermal resource in a resource portfolio with one-third less conservation. Figure 8-8 is based only on the timing of the first thermal resource option taken, if any, in all of the load paths analyzed. The last period in which ther-

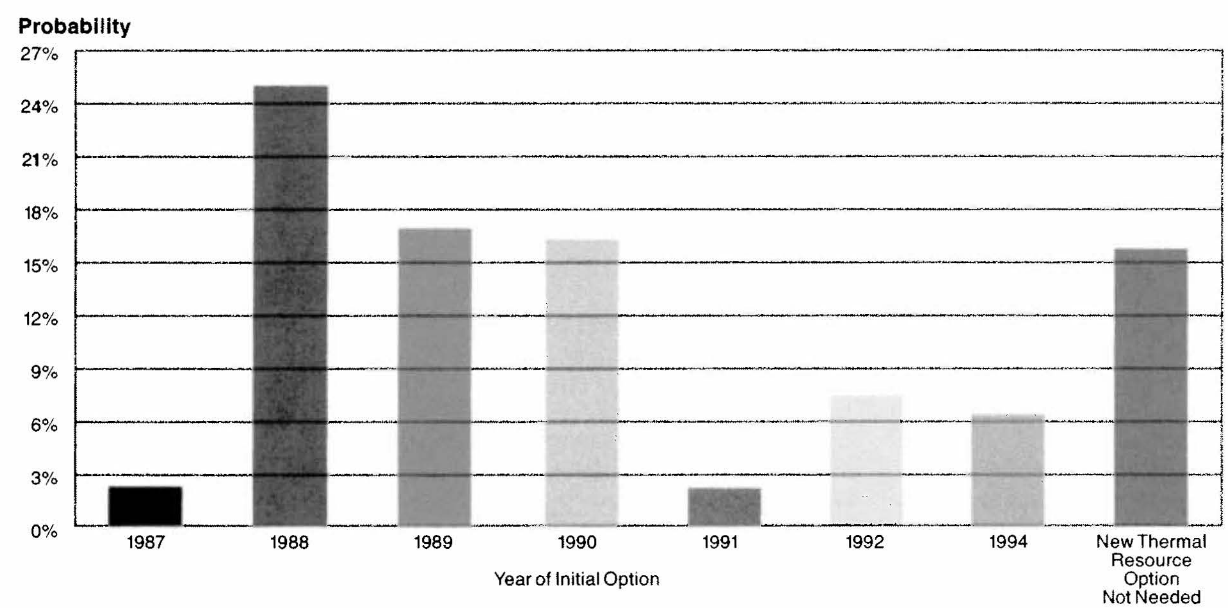


Figure 8-8
Region's Need for a New Thermal Resource Option if There Is One-Third Less Conservation Available

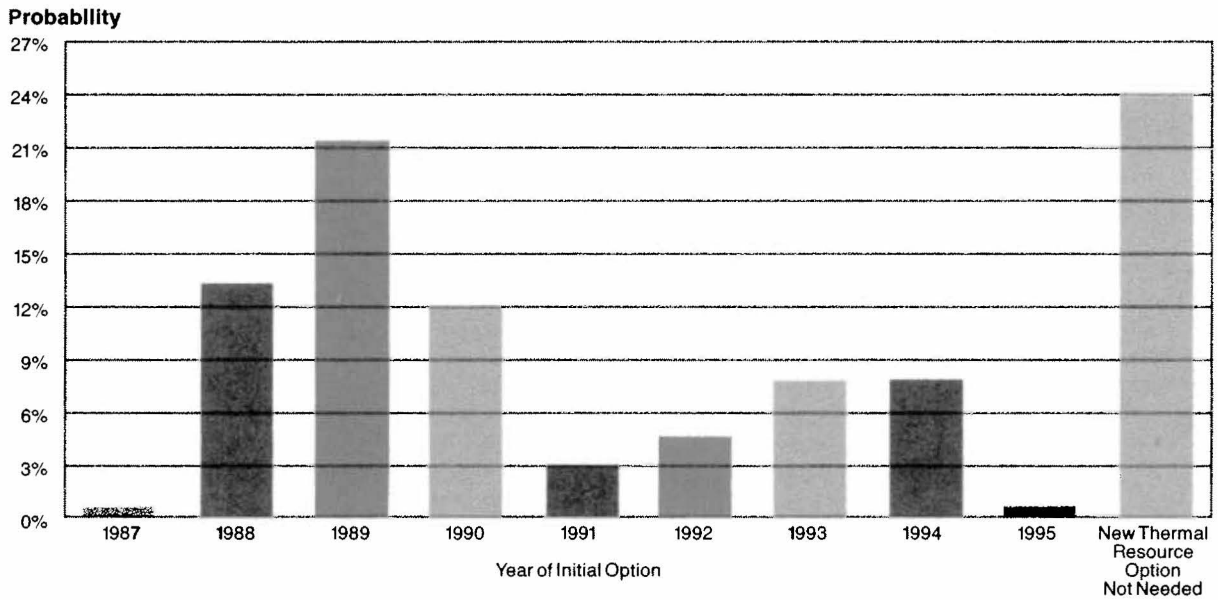


Figure 8-9
Region's Need for a New Thermal Resource Option if It Takes Twice as Long to Achieve Conservation Savings

mal option decisions occur is 1995 because, with a ten-year total lead time, decisions made after this point would have on-line dates outside the planning horizon. The size of the bar to the far right represents the probability that no new thermal resource options are taken in the planning horizon. The sum of the probabilities between 1986 and 1990 yield an estimate of the probability that at least one thermal option is needed by 1990. For this case, with one-third less conservation supply, the probability jumps to about 65 percent. For the base case portfolio, the same value is about 30 percent.

Impact of Slower Conservation Ramp Rates

About ten years of total development time would be needed for conservation programs to capture the bulk of the energy available in the existing sectors, based on the Council's assumptions for the maximum activity levels of conservation programs and the maximum rates at which the programs can be accelerated to those activity levels. While there is very little data available on this subject, some commentors felt that this assumption was optimistic and that total lead times of 15 to 20 years were more reasonable. A sensitivity analysis was conducted by dropping the existing sector program ramp rates by 50 percent, which would yield total program lead times of about 20 years. As a result, the expected present value cost increased by about $340 million. The impact on the frequency for the first new thermal resource option is shown in Figure 8-9, and indicates a probability of about 50 percent that an option will be needed by 1990.

Impact of Less Conservation Combined with Slower Ramp Rates

The assumptions in the two previous sensitivity analyses were combined to determine the impact of having both one-third less conservation supply available and 20-year ramp rates. Impacts of the previous two sensitivities are not directly additive, because in this case the reduced ramp rates act on a reduced conservation supply. The expected cost increases about $2.25 billion and the probability of needing a thermal option by 1990 increases to 85 percent.

Impact of Higher Conservation Supply

It is also possible that the Council has underestimated the amounts of cost-effective conservation supply available over the study horizon. A study was performed under the assumption that one-third more energy was available in each of the programs in the portfolio, at their current average cost. This increase reduces the expected value cost of the portfolio by about $1.7 billion, and the probability of need for a thermal option by 1990 drops to under 5 percent.

Impact of Losing the Model Conservation Standards

Another sensitivity was performed by eliminating from the portfolio the energy savings of both the residential and commercial model conservation standards. The expected cost of the portfolio increased by about $620 million. This clearly indicates the cost effectiveness of the model conservation standards to the region. Without the standards, the likelihood of needing a thermal option by 1990 is about 40 percent.

Impact of Being Unable to Option Generating Resources

One important attribute of the resource portfolio is its reliance on the ability to obtain resource options. The option process provides the opportunity for two-stage decision making on resources. Options enhance flexibility and improve the ability to match capital-intensive generating resource construction decisions to load growth. The ability to option resources reliably should reduce the probability and magnitude of errors likely to occur in the planning process. The Council believes the optioning process can be a workable and reliable one. However, the option concept is still largely unproven.

A sensitivity study was performed to evaluate the impact of not being able to option resources. This was done by setting the construction lead times for the generating resources in the portfolio equal to the sum of their option and construction lead times in the base case, and eliminating the option lead time. The result is a significantly earlier decision to build resources, resulting in a greater tendency to over- and underbuild resources. If options are not possible, present value cost of the resource portfolio increases by about $710 million over the base portfolio. This impact is caused mostly by overbuilding resources. Much of this impact can be avoided by recognizing that there are several opportunities to decide on whether or not to continue resource development after the initial stages. Even if the option concept is not fully functional, recognizing the significance of the decision to enter construction and making that decision based on the latest information will allow the region to substantially avoid the $710 million impact.

Impact of Increased Direct Service Industry Uncertainty

The Council's base planning assumptions for direct service industry (DSI) load are that at least 50 percent of the DSIs will remain as power customers in the region throughout the planning horizon. For DSI loads above 50 percent the Council has assumed that each load level is equally likely and randomly distributed.

A sensitivity study was conducted with 100 percent of DSI load uncertain, rather than only 50 percent uncertain, with each level of DSI load equally likely across the entire load range. This has the effect of reducing the expected value of DSI load remaining at the end of the study horizon from 75 percent of current contract demand to 50 percent, and produces a significant number of load cases where DSI loads are much lower than in the base portfolio. The expected value impact is a reduction in the cost of the portfolio by about $5.8 billion. Note that these values are from a regional generating system perspective. They do not include any effects of short-term lost revenue as DSI load falls off before other regional loads can grow to replace it, or any of the primary and secondary economic effects due to the loss of jobs these industries represent.

The impact on timing of a coal option is depicted in Figure 8-10. Under this scenario, the probability of needing an option by 1990 is about 10 percent.

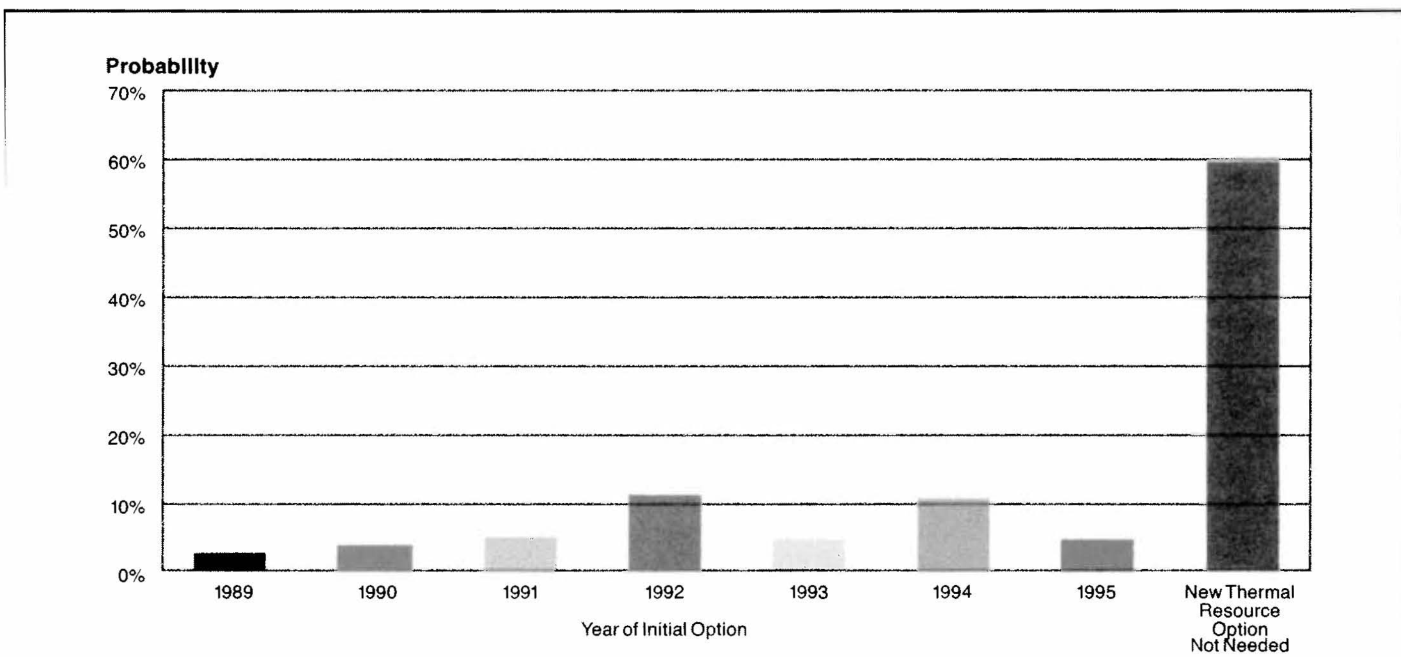


Figure 8-10
Region's Need for a New Thermal Resource Option if There Is Greater Uncertainty in DSI Load

Value of Resources Acquired During Surplus

Early development of resources that could be developed later depends on the cost effectiveness and the lifetime of those resources. It may be cost effective to develop some resources earlier than they would otherwise be needed, but generally only those resources that would otherwise be lost to the region should be acquired during the surplus. Further, early development of lost opportunity resources should involve only the ones that are environmentally acceptable.

This analysis evaluates the expected value of lost opportunity resources based on the needs of the region as a whole. The region's utilities and public utility commissions need to evaluate the specific conditions of their ratepayers and decide on the appropriate resource acquisition actions. The Council provides the following analysis as a general indication of the value of lost opportunity resources to the entire region. The Council will conduct additional analysis of the region's need for new resources and is prepared to assist others to assess individual circumstances that differ from the region as a whole.

The expected value of deferring all resources in the plan was used to evaluate the value of lost opportunity resources acquired in 1986 and, alternatively, in 1990. Using the Decision Model, a lost opportunity resource was added in 1986 and, to bound the range of value over the next five years, a second case assumed the resource was added in 1990. These lost opportunity resources were added to every load path, independent of the need for new resources. The result is to contribute additional surplus for the entire 20 years in low load paths. In high load paths, the lost opportunity resource displaces high-cost coal plants. In medium loads, the acquisition of a lost opportunity resource in 1986 displaces conservation.

The region is expected to benefit from acquiring lost opportunity resources if they are less costly than a certain amount. Figure 8-11 illustrates the resulting value of lost opportunity resources acquired in 1986 or 1990. Since the value depends on the resource's lifetime, along with many other factors, Figure 8-11 shows the relationship of avoided cost to various lifetimes. This analysis shows that, for extremely short-lived resources of ten years or less, the region gains little benefit from their early development because the region is surplus during most of their life. For resources that are longer lived, the benefits to the region from acquisition in 1986 increase up to a maximum of approximately 3.0 cents per kilowatt-hour. Based on this analysis, during 1986 the region should not acquire lost opportunity generating resources earlier than they are needed to meet regional load requirements, unless the cost of the resource is less than 3.0 cents per kilowatt-hour. The maximum value for the same resource in 1990 would be about 3.2 cents per kilowatt-hour. These estimates will need to be revised as regional conditions change and the region approaches the point of needing higher cost resources.

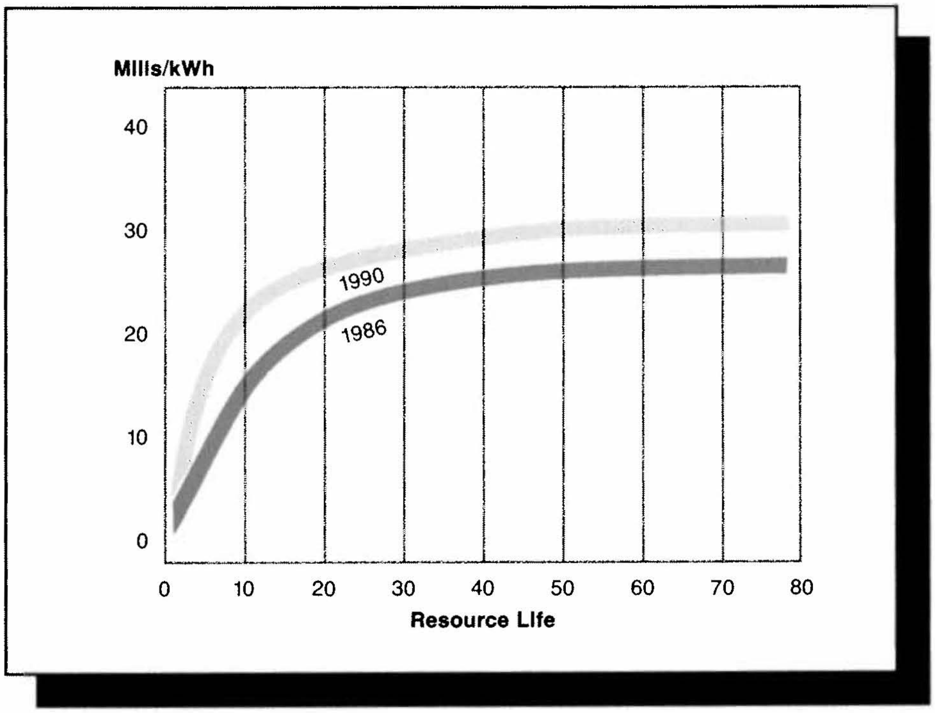
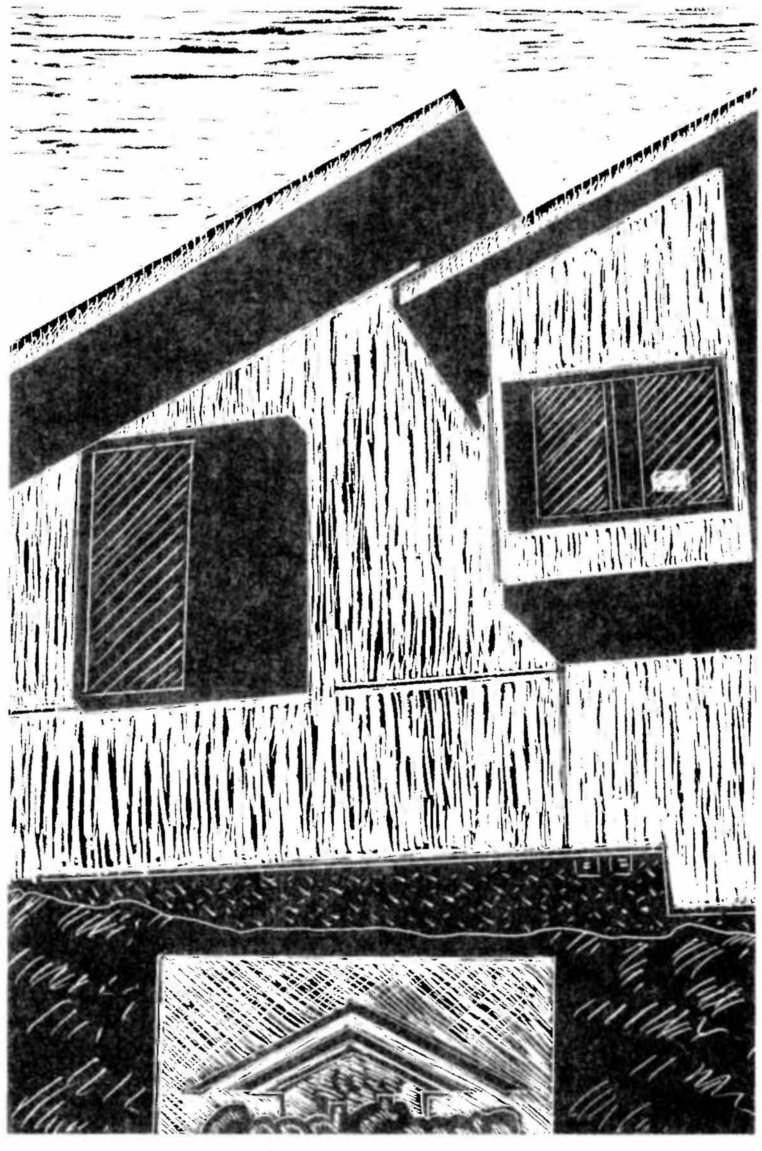


Figure 8-11
Value of Lost Opportunity Resources in the Portfolio

These estimates of the value of a lost opportunity resource have been based on the addition of a single resource with a uniform contribution to the system across the year. Further, the resource's contribution does not vary as a function of the region's future load path. In order to use these estimates for the evaluation of conservation resources, the analysis must be modified to take into account both the seasonal load shape of conservation programs and the ability of some conservation activity, such as the model conservation standards, to adjust their savings as a function of the load path the region experiences. In addition, for conservation programs, several other adjustments are necessary to correct for this analysis having been done at the point of generation in the region's power system. Because conservation programs affect savings at the load centers, these estimates of the value of a lost opportunity resource need to be adjusted for transmission system losses and costs before they are applied to evaluating conservation programs. Further, conservation programs are awarded a 10 percent cost advantage under the Northwest Power Act. Therefore, the values of lost opportunity resources shown on Figure 8-11 need to be increased by 20 percent for evaluating a lost opportunity conservation program.

1./System cost is defined as an estimate of all direct costs of a measure or resource over its effective life, including, if applicable, distribution and transmission costs, waste disposal costs, end-of-cycle costs, fuel costs and quantifiable environmental costs. System cost also takes into account projected resource operations based on appropriate historical experience with similar measures or resources.



Chapter 9

Chapter 9
1986 Action Plan

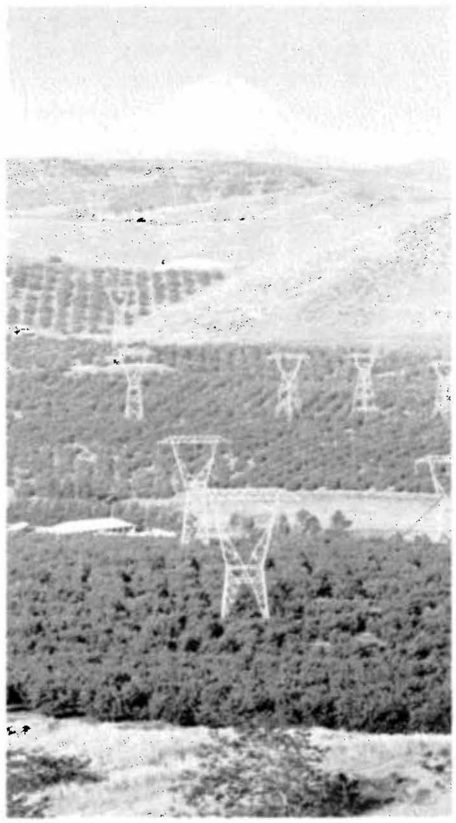
Introduction

The Action Plan describes the actions that must be taken in the near term if the region is to achieve the goals of this 20-year power plan. This Action Plan supersedes the 1983 Action Plan and should guide the region's actions until conditions require substantive change, at which time the Action Plan will be amended. Activities that are being conducted to implement the 1983 plan should be completed, except as specifically stated in this Action Plan. The Action Plan also provides a standard against which to measure the region's progress toward the long-term goals of the plan, and summarizes progress made in achieving the goals that were set for the region in the 1983 Action Plan.

The 1986 Action Plan differs in approach 'rom the 1983 Action Plan in two important ways. First, the actions that the Bonneville Power Administration needs to take are described in many cases as objectives to be met, rather than as detailed tasks. Bonneville will thus have more flexibility in determining exactly how to achieve the objectives of the Action Plan. Bonneville has agreed to develop detailed work plans for achieving the objectives of this Action Plan. Bonneville will develop the work plans through a public process and in consultation with the Council and other interested parties. In addition, the Council will review the work plans in open public meetings for consistency with the objectives of the plan.

The second way this Action Plan differs from the 1983 Action Plan is that it recognizes explicitly that other organizations besides Bonneville and the Council will need to be involved if the region is to realize the benefits of the 20-year plan. In the 1983 plan, the Council did not distinguish Bonneville's obligation from the total needs of the region's electrical system. The 1986 plan does make distinctions in the actions needed by various groups in the region.

Like the 1983 Action Plan, the 1986 Action Plan emphasizes building the capability to acquire conservation and calls for no near-term development of resources except those that are cost effective and that could be lost to the region if they are not secured right away.



This plan emphasizes the following priorities:
1) a stronger regional role for Bonneville;
2) development of the capability to acquire conservation on a regional basis;
3) strategies to make better use of the hydropower system;
4) building conservation capability in all sectors;
5) demonstrating the cost effectiveness of renewable resources so they are available before the region has to build new generating resources;
6) allocation of costs for two unfinished nuclear plants and elimination of barriers to their completion; and
7) a study of electric power sales and purchases between regions.

The key to most of these priorities is cooperation among power organizations, both publicly-owned and investor-owned, and cooperation is a theme that runs throughout the 1986 Action Plan.

The objectives and specific activities expressed in this Action Plan are those that the Council believes are necessary in light of the current surplus and the range of forecasted energy needs facing Bonneville and the region. The Council believes that if the objectives of this Action Plan are achieved, the goals of the plan, set forth on page 3-1, will be realized.

Activities to Promote Regional Cooperation

Bonneville's present firm power customers, primarily the public utilities and direct service industries, represent only about half the regional load. The region's investor-owned utilities and generating public utilities represent the other half. Although they have signed power sales contracts giving them the rights to power from Bonneville with seven years' notice, the investor-owned utilities have not yet chosen to place significant loads on Bonneville. The result is that Bonneville faces considerably more uncertainty about its future load requirements than was envisioned by the Council when it adopted the 1983 plan.

The current status of regional utilities' loads and resources only exacerbates the difficulties in managing the uncertainty of future loads. The public utilities and other customers served by Bonneville could have sufficient resources to meet their needs through the end of the century if energy demand remains relatively stable. The public utilities also have ownership of the Washington Public Power Supply System's mothballed Nuclear Project 1 (WNP-1) and 70 percent ownership of WNP-3, representing over 1,300 megawatts of power that they probably will not need until after the year 2000. Furthermore, as the result of settlement of a lawsuit over the mothballing of WNP-3, Bonneville has obtained a contractual right to acquire, in accordance with the provisions of section 6(c) of the Northwest Power Act, the remaining 30 percent of that plant.

Further, the Council analysis indicates that some of the investor-owned utilities may need additional resources in the near future. From a regional perspective, the lowest cost resources to serve the investor-owned utilities' needs are resources currently surplus to the region's needs; conservation in their own service territories; conservation in public utility service territories; and strategies to better use existing nonfirm hydropower. Additional potentially low-cost resources could be obtained by the completion of the two mothballed nuclear plants, WNP-1 and WNP-3.

The fact that the region is more decentralized than was assumed in the first plan presents the Council with new questions to address in its Action Plan for the region. Should the Council plan only to meet Bonneville's current obligations and its attendant load growth? If so, what are the implications for current conservation, and for research, development and demonstration? How should the regional plan treat Bonneville's potential obligations to serve future load growth of investor-owned utilities? Given that conservation in public utilities' service territories is part of the lowest cost regional mix of resources to meet load growth of investor-owned utilities, what institutional arrangements could lead to a sale of this resource from public to investor-owned utilities? And, what actions should other entities take, independently from Bonneville, to promote the lowest cost energy future for the region?

The Council has addressed these questions in developing this 1986 Power Plan for the region. The activities called for in this Action Plan are intended to facilitate achieving the regional goals identified in the 20-year plan.

The goals of this plan can only be achieved if the Council, Bonneville, the region's utilities, and state utility regulatory commissions work to promote cooperative regional actions. Cooperative actions will ensure that the region can achieve the least-cost resource mix, minimize uncertainties in Bonneville's load obligations, and enhance the region's ability to meet the uncertainties of the future. The Action Plan includes activities that need to be pursued to initiate this effort.

Actions by regional entities to help promote regional cooperation should accomplish the following:

- Assure that Bonneville's new resource (7f) rate be a predictable and cost-effective source for utilities that might require new resources. Regional power entities should work toward specific policies for the allocation of new resource costs, including the transfer of conservation and nonfirm power based on mutually agreeable terms and conditions. Bonneville should develop projections and procedures that will enhance predictability in the forecast of new resource costs. Bonneville should consult with public utility commissions and investor-owned utilities in the development of such policies so that these entities can reliably plan on acquiring energy through Bonneville power sales contracts.

- Develop mechanisms that will allow surplus utilities to make available their conservation resources to utilities in need of additional resources. These mechanisms should be explored cooperatively with the region's utilities to ensure that affected utilities will be able to use the mechanisms that are developed. The Council believes there may be a number of ways to pursue the sale of conservation. The Public Generating Pool, for example, has expressed a willingness to explore bilateral sales. The Bonneville new resource pool could also prove to be an acceptable means of achieving this goal.

- To the degree permitted by law, develop an allocation policy for the costs of options and potential options such as WNP-1 and 3. In developing such a policy, Bonneville should pursue a vigorous program of public involvement to ensure that the final policy is a mutually acceptable one that will promote regional flexibility in meeting future resource needs and will assist in the management of the risks of overbuilding or underbuilding.

- Explore the opportunities and difficulties of making better use of the region's nonfirm energy resources. Currently, much of the region's nonfirm energy resource is controlled by Bonneville. Better use of nonfirm energy for meeting firm loads could significantly benefit the region's ratepayers by avoiding the development of new, more expensive resources. These strategies may include appropriate rate treatment and fuel adjustments for combustion turbines used to firm secondary hydropower. Any such use of nonfirm resources must be consistent with the Council's Columbia River Basin Fish and Wildlife Program and should be preceded by careful evaluation of the costs and benefits of nonfirm reallocation, including fish and wildlife and environmental effects. The Council will follow closely the development of the policy, to ensure that this plan and the fish and wildlife program are effectively pursued in the study effort.

- Include in Bonneville's environmental review of the long-term power sales contracts an examination of the opportunities presented by the contracts for enhanced regional cooperation, through such actions as are described in this Action Plan.

- Design policies to develop and preserve cost-effective resources.

- Jointly sponsor research, development and demonstration activities whenever possible. Where investor-owned utilities are involved, the Council recommends that the public utility commissions consider appropriate rate treatment for funds expended in regional research and development activities.

Status of Conservation Resources

The region has made substantial progress toward understanding and achieving conservation in the nearly three years since the Council's first power plan. Five communities have participated in the early adopter program for the Council's model conservation standards for new buildings. Washington and Oregon have adopted statewide codes that will raise the energy efficiency of new buildings, and Bonneville has developed and implemented the Super Good Cents program to encourage building new homes to the model conservation standards level. Bonneville has developed and implemented programs in each sector to gather additional information on conservation potential and methods of achieving that potential. Finally, several of the region's investor-owned utilities have implemented programs to market efficient construction of electrically heated residences in their service territories.

This Action Plan continues the process, begun in the 1983 plan, of building the capability to secure conservation as a regional resource. The vast majority of action items in the 1983 plan were the responsibility of Bonneville's Office of Conservation. Because that office was new when the 1983 plan was adopted, there were a number of problems that are typical for a new and rapidly growing organization. These start-up problems have delayed implementation of some aspects of the plan.

It appears that many of the start-up problems have been resolved. Staffing levels have been increased in the commercial, industrial and irrigation sectors, and staff has gained valuable experience in a number of areas. In addition, Bonneville has established an ongoing consultation program with the states, local governments and Indian tribes on substantive matters of policy and program design.

In spite of the progress made since adoption of the first plan, uncertainty remains about the region's ability to meet its future energy needs through conservation. Bonneville has gained only limited information and experience in the commercial, agricultural and industrial sectors regarding the costs, incentives, market penetration rates and lead times needed to expand programs to the regional level.

Concern still remains over Bonneville's slow response to the Council's repeated call to achieve a representative number of low income and renter households in the service territories of utilities participating in its residential weatherization program, and with Bonneville's allowing partial weatherization of houses within its residential weatherization program.

The Council believes it may take several years and several program cycles to gain the experience that assures the conservation resource can be acquired when needed.

Status of Generating Resources

With respect to generating resources, the central feature of the 1983 Action Plan was the options concept. The plan placed strong emphasis on developing and testing optioning capability, because the concept offers a significant opportunity for dealing with planning uncertainty. Other actions in the 1983 Two-Year Action Plan concerning generating resources included development of an inventory of lost opportunity resources; development of improved information concerning the availability, cost and constraints to development of generation resources, including system efficiency improvements; confirmation of the availability of geothermal resources and of combustion turbines for meeting unexpected load growth; and further development of methods for determining environmental costs and benefits.

Some significant advances have been made since the 1983 plan was adopted. Through the work of the Council's Options Steering Committee, its option task forces and Bonneville staff, the region has gained a better understanding of potential barriers to the options concept, and advances have been made towards resolving important concerns. The State of Montana has taken legislative action to accommodate the options process. The State of Oregon can accommodate options when siting and licensing generating resources. The process in Washington appears to be receptive to optioning resources, but regulatory changes would probably be needed. Bonneville is proceeding with the action item to acquire several hydropower sites to test whether the options concept could be accommodated by the Federal Energy Regulatory Commission (FERC) in its licensing process. Bonneville has begun negotiating with sponsors of hydropower sites chosen from responses to its request to purchase options. FERC staff has responded positively to an approach that would have them hold a request for a license until Bonneville indicates a desire to begin construction. At that point, final need for power and environmental issues would be considered. A license could be granted within a few months of Bonneville's signal to proceed with development of the site. Bonneville's attempts to secure options on hydropower facilities will provide a test of this approach.

The Council has also developed a model process for securing resources that incorporates the options concept. That process appears as Appendix I-A of this plan.

Bonneville has developed a list of potential lost opportunity resources and a process for monitoring them.

Data bases used in the planning process have been improved to provide better information on the availability, cost, and constraints to development of generation resources.

A major cooperative effort among the Council, Bonneville, and the U.S. Army Corps of Engineers to update the region's hydropower data base is nearing completion. The improved hydropower data base and the results of the Council's hydropower assessment efforts will help the Council refine its estimates of the potential for new hydropower development in the region.

Studies to gain a better understanding of the availability and cost of potential improvements in hydropower system efficiency are continuing.

Bonneville has made no progress on acquiring a combustion turbine. Nor has it requested approval from the Economic Regulatory Administration for a waiver from the Powerplant and Industrial Fuel Use Act to use combustion turbines in the region as a hedge against rapid electrical load growth and as part of a strategy to make more efficient use of the region's hydropower. Because the region needs to evaluate further several strategies for better utilizing our hydropower system, the Council concluded that acquisition of a combustion turbine is not necessary at this time. However, before a decision can be made on the appropriateness of building new combustion turbines, additional work should be undertaken to clarify whether the Fuel Use Act will constrain the region's use of combustion turbines.

Action Plan

This Action Plan presents key activities that should be part of any work plan designed to meet goals and objectives of the power plan. The Council intends that Bonneville consult with the Council and other interested parties to develop work plans designed to meet the stated goals and objectives, and that Bonneville provide the Council with periodic briefings on the progress of its activities. Specific details of what the Council expects to be in work plans and the public process for Council review are presented at the beginning of Section I of this Action Plan, concerning Bonneville Activities.

The Council has determined that the actions in this Action Plan are cost effective, prudent, and necessary in order for Bonneville to acquire the lowest cost resources consistent with the priorities, considerations, and other requirements of the Northwest Power Act. The Council will consider Bonneville's record in implementing these actions as a part of any Council proceedings under section 6(c)(2) of the Act, which requires a Council determination of consistency or inconsistency with this plan prior to Bonneville's acquisition of any major resource. A major resource is a resource with a planned capability greater than 50 average megawatts that is acquired for a period of more than five years. If significant changes in circumstances occur, this plan can be revised at any time by Council action.

The Council has considered the financial effect these actions may have on Bonneville and the region's ratepayers and has found them to be negligible. Because of the size and expected duration of the surplus, there are no actions included for the sole purpose of acquiring electrical energy, and the activities included in this Action Plan to position the region to meet its future needs for electricity represent a very small part of Bonneville's budget.

Some of the activities contained in the Action Plan, if not designed carefully, could affect consumer choices between electricity and other fuels. Every care should be taken when implementing this power plan to avoid affecting consumers' choices of electricity over another fuel type. The Council will continue to monitor this aspect of plan implementation; if significant changes in fuel choice occur, the Council will consider modifying the power plan. In addition, the Council plans to do economic analysis of heating with gas and other fuels compared to heating with electricity. These analyses will be made available to interested parties.

The Council believes that the benefits envisioned in the Act can be realized if utilities, public utility commissions and other regional entities cooperate in implementing this Action Plan.

The Action Plan is structured as follows:

I. Bonneville Activities

1.0 New Residential (site-built) and New Commercial Buildings

2.0 New Manufactured Houses

3.0 Existing Residential Buildings

4.0 Existing Commercial Buildings, Industry, Irrigated Agriculture, and Institutional Buildings

5.0 Residential Appliances

6.0 State and Local Government Programs

7.0 The Resource Acquisition Process and Supporting Activities

8.0 Management of the Resource Option Inventory

9.0 Confirmation of Resources

10.0 Intertie Access Policy

11.0 Data Development

II. Council Activities

1.0 Information and Methods for Planning

2.0 Research and Development Agenda

3.0 Monitoring and Review of Plan Implementation

4.0 West Coast Energy Study

III. Recommended Activities for the Region's Public Utility Commissions and Investor-owned Utilities

I. Bonneville Activities

This section of the Action Plan describes objectives and key elements of work plans to be developed and implemented by Bonneville. Bonneville's conservation and generating resource activities are funded in general accordance with an annual budget. Budget development for a given fiscal year is initiated more than two years before the beginning of the fiscal year in which the funds are actually expended. In addition, the agency's overall spending levels are set in individual rate cases that can cover periods from one year to in excess of two years.

Nonetheless, Bonneville has considerable budgeting flexibility compared to other federal agencies. Although Bonneville's budget is reviewed by Congress, it is considered approved unless Congress specifically disapproves it. In granting Bonneville this special status, Congress recognizes that the agency's expenditures and repayment of debt are funded by the ratepayers of the region.

Some of the Action Items contained in the Action Plan could entail modification of Bonneville's budget plans in the current and subsequent fiscal years. The Council believes Bonneville has sufficient budget flexibility to accommodate needed changes.

The Council's expectations concerning implementation of the 1986 Action Plan are based on the policy of the Bonneville Administrator, which was stated in Bonneville's August 1983 response to the Council's 1983 Action Plan. That policy stated:

> *"... in areas where [Bonneville] and the Council disagree over the appropriateness of implementing a particular action item and where it is one party's opinion against the other's, where a mutually acceptable resolution is not reached, and where there are no legal constraints, financial or budgetary limitations of the U.S. Government, or breaches of prudent utility practice confronting [Bonneville], the Council's approach will be followed."*

Rather than specifying action items in great detail, as it did in the 1983 plan, the Council is providing Bonneville more flexibility in designing programs to achieve the objectives set forth in the Action Plan. Bonneville is expected to develop work plans that contain schedules and descriptions of tasks and activities to be undertaken to achieve the objectives set forth in the Action Plan and to implement those work plans.

Each work plan should contain the following information:

1. A statement of the objective(s) of the work plan and its relationship to the Action Plan.

2. A description of the tasks or activities which will be undertaken to meet the objective(s), including 1) scope of work, 2) major tasks to be completed, 3) research and development requirements, and 4) a method for measuring and evaluating progress toward the objective.

3. Key decision points, schedules of expected research findings, and major task objectives.

4. A statement by Bonneville of the relative level of effort to be expended on each of the major parts of plan implementation. Level of effort can be described using estimated staffing and funding requirements, which are an integral part of all work plans, or any other measure which Bonneville believes will more appropriately define the relative level of effort being expended on implementing the plan.

In developing and implementing its work plans, Bonneville should consult, as appropriate, with at least the following groups: the Council, Bonneville's customers, state governments (energy offices, utility regulatory commissions, siting agencies), local governments, private utilities, fish and wildlife agencies, Indian tribes, and other interested parties.

The Council will conduct a review of the work plans, including an opportunity for public comment, to determine consistency with the Council's plan and the Northwest Power Act. If significant unresolved differences exist after Bonneville's consideration of the Council's comments, the Council may begin rulemaking for a formal amendment to the plan, which will specify in detail the activities needed to meet the objectives of the plan.

Sixty days past the date of adoption of this plan, Bonneville should publish a schedule for development of work plans. The Council expects that Bonneville will develop draft work plans and complete its public involvement process in order to begin implementing its approved work plans at the beginning of Fiscal Year 1987.

1.0 New Residential (Site-built) and New Commercial Buildings

As directed by the Northwest Power Act, the Council designed the model conservation standards (MCS) to produce electricity savings that are both cost effective for the region and economically feasible for consumers. Since most residential and commercial buildings constructed today are likely to last considerably longer than the current surplus of electricity, all cost-effective conservation should be captured at the time the buildings are constructed. Where such cost-effective measures are not installed at the time of construction, it can be prohibitively expensive if not impossible to return to the structure and add the measures later. The result is that a cost-effective resource is lost to the region forever.

Objective

To improve the efficiency with which new residential and commercial buildings use electricity and to ensure that buildings converting from other fuels also use electricity efficiently.

Status and Review: Model Conservation Standards

Since the Council's first regional power plan was adopted on April 27, 1983, the Council and Bonneville have made substantial progress in their efforts to improve the energy efficiency of new buildings. Several local jurisdictions in Washington State have adopted the model conservation standards (MCS) as codes. In addition, statewide code improvements have been achieved in Oregon and Washington, although not to the full levels of the MCS. Over 400 houses have been built to the MCS through the Residential Standards Demonstration Program (RSDP), a training program for builders, code officials, and other interested parties in the shelter industry. Even though the data from the RSDP have statistical limitations, the Council is encouraged by the fact that costs reported by the majority of RSDP builders were in accord with the Council's 1983 cost estimates. This result is remarkable in that most RSDP builders were constructing an MCS home for the first time.

Bonneville has initiated a marketing program, Super Good Cents, aimed at achieving 5,000 houses built to the MCS in fiscal year 1986. Houses built and marketed through the Super Good Cents program will be certified energy efficient by electrical utilities. The goal of certification is to get lenders, sellers and buyers to recognize the added value of an MCS home because it is less expensive to own and heat. Bonneville also has a continuing program to help train and educate the shelter industry, including lenders, about the advantages of building more efficient buildings. In addition, several investor-owned utilities in the region have established a program to market efficient building practices in their service territories.

The Council adopted the MCS in its 1983 Power Plan for the region (48 Fed. Reg. 24493). On July 26, 1985, the Council published proposed amendments to those standards (50 Fed. Reg. 30654). Hearings were held in the four Northwest states to receive oral public comment on the proposed amendments. Consultations were held with interested persons and groups. Extensive written public comments were also received. After review of the comments received, the Council published a reformulated version of the proposed rule and reopened the comment period (50 Fed. Reg. 40091, Oct. 1, 1985). Additional consultations and hearings were held in each of the Northwest states. The revised MCS in Appendix I-B are the result of that process.

The MCS savings levels for both new residential and commercial buildings are equivalent to the MCS set forth and as amended by the Council in its 1983 plan. The savings resulting from the MCS will help the region avoid the construction of more expensive resources.

The MCS protect indoor air quality by including requirements to maintain air quality at levels common in 1983 in new non-MCS residential buildings. The Council also has included action items in this plan for the development by Bonneville of design, installation, and inspection standards for mechanical ventilation.

The MCS are also designed to meet the Northwest Power Act's requirements that they produce all electrical energy savings that are cost effective for the region and economically feasible for consumers, taking into account financial assistance made available pursuant to the Act. The Council will continue to monitor the cost and performance of all the model conservation standards and will revise the MCS as appropriate.

The Council's 1983 approach to the MCS emphasized the use of building codes as the least expensive way for the regional power system to acquire cost-effective conservation. State and local jurisdictions are still strongly encouraged to adopt the MCS for new residential and commercial buildings and conversions as building codes. This reformulation of the MCS, however, also focuses on utility residential and commercial conservation programs. The new MCS for utility programs are designed to encourage through marketing and financial assistance improved building practice and ultimate adoption of building codes at MCS levels by reducing the cost of the MCS.

Compliance with the MCS for utility programs is determined by an annual evaluation of the performance of all utilities. The poorest performing utilities will be subject to a surcharge as detailed below.

To help jurisdictions and utilities prevent inefficient buildings from being converted to electricity for space heating and/or conditioning, the Council has included an MCS for conversions that calls upon state and local jurisdictions and utilities to require all regionally cost-effective conservation measures to be installed at the time of conversion.

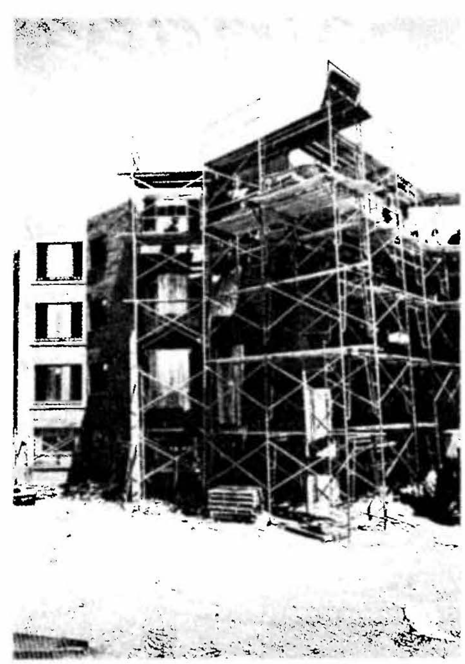
The model conservation standards are contained in Appendix I-B.

Activities: Model Conservation Standards

Achieving the improved levels of building efficiency represented by the MCS is the goal of the Council. This goal can be achieved in a variety of ways. Bonneville has a key leadership role in achieving the goal of constructing more efficient buildings in the region.

Even though the benefits of building to the MCS are clear, homebuyers, builders, lenders, state and local governments and utilities need technical and financial assistance to make the transition to energy efficient buildings constructed at the level of the standards. Bonneville should continue activities to assist homebuyers, state and local governments, homebuilders, utilities, realtors, lenders, and appraisers to accurately evaluate building techniques that will achieve improved levels of electrical energy efficiency. This training and technical information is needed so that all of the decision makers involved in constructing and purchasing new buildings can make an informed decision that recognizes the importance of energy efficient measures in the total costs of owning and heating or cooling the building. Bonneville activities listed below are those that the Council has determined are important in achieving its goal.

Bonneville activities are discussed in four sections below: 1) new site-built electrically heated residences; 2) new commercial buildings; 3) conversions of buildings to electric space conditioning; and 4) general activities that relate to more than one of the building sectors.



1. New Electrically Heated Residential Buildings

Bonneville should develop and implement a work plan which includes the following actions:

- Assist states, local governments and/or utilities in their efforts to comply with the Council's residential model conservation standards (MCS), described in Appendix I-B.
- Maintain an aggressive energy efficient new home marketing program (e.g., Super Good Cents). This program should include, as a condition of participation in the program, monitoring of indoor air quality and employment of specific pollutant source control measures in residential buildings constructed under the program. When the commercial marketing program development (described below) is complete, make the marketing program a comprehensive one to market electrically efficient residential and commercial buildings.
- Establish by July 1, 1986, a program to share financial assistance with local utilities for both single family and multifamily dwellings. Bonneville should establish the financial assistance for calendar years 1987 and 1988 at the levels stated in Table I-B-2 of Appendix I-B for average size single family houses (about 1,850 square feet), and establish a procedure to adjust the financial assistance as appropriate beyond January 1, 1989. Financial assistance to multifamily residences and other than average size single family houses should be based on the square footage of the residences. The financial assistance and/or marketing effort should be adjusted if compliance with the MCS is not being achieved. In any case, beginning January 1, 1989, the financial assistance should be established by Bonneville within the range set forth in Table I-B-3 of Appendix I-B. The minimum value is the difference in net present value life cycle costs to the consumer between a house built to the minimum life cycle cost level and a house built to the full residential MCS level. The maximum value is the median builders' costs in the previous year or years for conservation measures more efficient than the level of the 1983 building practice. The Council's current calculation of the minimum and maximum values is shown in Table I-B-3 of Appendix I-B.

The financial assistance beyond January 1, 1989, should be provided by Bonneville and local utilities[1] based on shares established in Table I-B-4 of Appendix I-B. The cost-sharing ratios will be determined by the level of current building practices in each state by climate zone compared to the residential MCS. As local building practice improves through codes or by other means, the local utility's share of the total financial assistance payment would be decreased until such time as the code reached or exceeded the minimum life cycle cost level for homebuyers. At that time, the local utility's share of the financial assistance could drop to zero, and Bonneville would make the entire payment, up to the maximum level described above. The Council may revise these tables based on new information, including, but not limited to, that made available by early adopter jurisdictions and by utilities participating in the Bonneville/utility residential MCS program.

Bonneville financial assistance should be offered regionwide—including to utilities not currently exchanging with Bonneville or purchasing power from Bonneville. There are several reasons for this. First, Bonneville could find itself obligated to meet future investor-owned utility loads under its current power sales contracts. Avoiding unnecessary increases in investor-owned utility load requirements would reduce future rate increases as well as other risks associated with expensive thermal plant construction. Second, when an investor-owned utility acquires new resources, its acquisition costs are not paid solely by that utility's customers. In significant part, the costs are paid by Bonneville and its customers. This occurs when these costs are included in an investor-owned utility's average system cost and are spread to all Bonneville customers through the exchange. This exchange was authorized by the Northwest Power Act and is designed to provide lower rates for the residential and small farm customers of investor-owned utilities. Energy efficient construction will help hold down the size and cost of the exchange. Third, it is important for the ultimate adoption of MCS building codes and reduction of MCS costs to pursue MCS construction and market development regionwide. Improving building practice is key to achieving MCS construction. This may not occur if the focus is solely on that portion of the region (approximately 40 percent) currently purchasing power from Bonneville.

Bonneville financial assistance to partial requirements customers and potential customers not currently purchasing from Bonneville should vary to reflect the benefits Bonneville is expected to receive in reduced load requirements, reduced exchange requirements, and improved building practice. The payments should take into consideration Bonneville's "Final Conservation Cost-Sharing Principles" (Office of Conservation, Bonneville Power Administration, January 21, 1985), which allow cost sharing with all Bonneville customers, including those with no load requirements on Bonneville.

The Council expects that costs of conservation measures beyond the current minimum life cycle cost level for homebuyers will decline as the market for heat recovery ventilators matures, builders gain experience in using high R-value exterior walls, and lower cost infiltration techniques come into practice. As this occurs, Bonneville's share of the financial assistance would decrease. It could become zero when the full residential standard results in the minimum life cycle cost level for homebuyers. The Council will review annually the allocation shares as codes improve, relative costs and performance of conservation measures change, or as building practice changes, and will adjust them as appropriate.

Based on costs reported by builders participating in the Residential Standards Demonstration Program (RSDP), the Council has established the minimum share of the total financial assistance to be provided by the local utility. This share is based on a Council judgment after considering: 1) the RSDP costs of measures that would be required to go from current (October 1985) building practice (or 1986 state building codes) to a house which has the minimum life cycle costs for homebuyers; and 2) the RSDP costs of measures that would be required to go from current building practice to the full residential MCS. The local share of the financial assistance is based on the ratio of these two costs. The financial assistance per single family dwelling for an average sized home should be as shown in Table I-B-2 of Appendix I-B and should remain in effect for calendar years 1987 and 1988.

- Refine the point system used in the Residential Standards Demonstration Program, using the generalized paths shown in Table I-B-1 of Appendix I-B as the basis. At a minimum, component trade-offs should be included to account for variations in building thermal mass, heating system efficiency, solar orientation, envelope thermal efficiency, and mechanical ventilation without heat recovery. The point system is required to give builders the flexibility they need to meet the wide range of characteristics desired by homebuyers.

- Develop and implement in consultation with the region's electric utilities, other fuel providers (such as the natural gas industry), state and local governments, utility regulatory commissions, and others, a method to monitor the effects of financial assistance on heating system choice of new homebuyers. The Council does not believe that consumer choice between competing fuel sources will be significantly affected by financial assistance offered by Bonneville and/or utilities. If the Council determines that significant fuel switching does occur, then the Council may determine that appropriate adjustments should be made to the financial assistance levels and/or marketing program. The Council will also analyze how the life cycle cost of gas-heated homes compares to electrically heated homes and will make that information available to interested parties.

- Request utilities to submit to Bonneville by September 1, 1986, a plan declaring how they intend to comply with the MCS for utility residential conservation programs beginning on January 1, 1987.

- Continue research on technology that improves indoor air quality beyond the level attained in homes built to current practice, which is estimated to be approximately 0.5 air changes per hour.

- Expand Bonneville's existing Indoor Air Quality Research Program to:

  - Assess the relative effectiveness of alternative source reduction and mechanical ventilation systems and strategies for minimizing potential pollutant build-up, including but not limited to spot ventilation, whole house exhaust-only ventilation, ductless heat recovery ventilation, and whole house heat recovery ventilation.

  - Monitor indoor air quality in a sample of all new electrically heated homes and evaluate the effectiveness of natural ventilation (i.e., infiltration) compared to mechanical ventilation in maintaining clean air, given the same source strength and whole house ventilation rate.

  - Identify the major indoor pollutants that may be significantly reduced or eliminated through source reduction actions that might be effected through building codes and product standards.

  - Provide findings from indoor air quality research to local and state building code and public health agencies for their consideration.

- Heat recovery ventilation systems and/or ventilation systems without heat recovery installed in all programs used to achieve the MCS should be designed and certified to result in 0.5 air changes per hour to the conditioned space under typical installation and design weather conditions. Interim standards for the design, installation and performance of heat recovery ventilation systems should be promulgated by April 1, 1986. Final standards for the design, installation, and performance of heat recovery ventilation systems should be established by January 1, 1987. The Council intends to review and approve the standards at that time.

- Inspect heat recovery ventilators installed before the standards have been established and repair those units that are not meeting the certification standard. Heat recovery ventilation systems installed prior to January 1, 1987, which satisfy the interim standards but fail to meet the final standard should be replaced or upgraded at no cost to the homeowner or homebuilder, as appropriate.

- Require that all houses built to the residential MCS under the Bonneville/utility residential MCS program or an alternative program being used to comply with the residential standard have a mechanical ventilator capable of providing 0.5 air changes per hour installed if natural ventilation has been reduced below that level. Existing early adopter programs which do not require mechanical ventilators are exempted from this restriction.

- Continue to provide technical and financial assistance to builders, insulation contractors, architects, designers, real estate appraisers, lenders, salespersons and code officials for the implementation of a uniform, regionwide energy efficiency certification system for new residential buildings.

- Provide information to homebuyers on energy efficient housing, including publications on how to operate an energy efficient house and equipment such as heat recovery ventilators.

- Design and implement a program to collect and analyze cost and energy data from homes built to the MCS. This program should be similar to the Residential Standards Demonstration Program, but with buildings concentrated in a few jurisdictions rather than spread sparsely throughout the region. The jurisdictions should be selected based on how well they represent larger parts of the region. The intent of this activity is to gain information on the effect that the number of buildings constructed in a jurisdiction has on the cost and cost effectiveness of building to the MCS.

2. New Commercial Buildings

Bonneville should develop and implement a work plan which includes the following activities:

- Assist states, local governments and/or utilities in their efforts to take actions through codes, a Bonneville/utility commercial MCS program, alternative programs, or a combination thereof which will result in compliance with the commercial buildings MCS.

- Request utilities or local jurisdictions to submit to Bonneville by September 1, 1986, their plans for complying with the MCS for utility conservation programs for commercial buildings.

- Develop and implement an aggressive energy efficient new commercial buildings marketing program similar to the Super Good Cents program for residential buildings. This should be made part of a comprehensive package to market efficient buildings, both residential and commercial. Evaluate the need for financial assistance to promote commercial buildings built to the MCS.

- Collect and evaluate data on new energy efficient commercial buildings built under the "early adopter" program or elsewhere. These data should be maintained and updated as necessary so they can be used in future planning and be used in information brochures on efficient building techniques.

- Continue the New Commercial Buildings Field Test Demonstration program conducted pursuant to the Council's 1983 plan. This program is designed to achieve approximately 30 new commercial buildings constructed to be approximately 30 percent more efficient than the Council's standard.

- Develop for commercial buildings an energy efficiency certification program focusing on lighting. This program should be available by January 1, 1987, and be designed to influence the financing terms available to developers of energy efficient commercial buildings.

3. Residential and Commercial Buildings Converting to Electric Space Conditioning

Bonneville should develop and implement a workplan which includes the following activities:

- Encourage and assist states, local governments or utilities to take actions through codes, alternative programs or a combination thereof to achieve electric power savings from buildings which convert to electrical space conditioning comparable to those savings that would be achieved by incorporating all efficiency improvements that could be installed up to the regionally cost-effective level. The Council will work with Bonneville in consultation with the interested regional parties to define the measures that are regionally cost effective.

4. General Activities for Both Residential and Commercial Buildings

Bonneville should develop and implement a work plan which includes the following activities:

- Refine the Code Adoption Demonstration Program, which encourages utilities, states and local governments to achieve the MCS through adoption of equivalent codes prior to January 1, 1989. If codes adopted in a utility's jurisdiction vary in specifics from those stated above but result in equivalent electricity savings, the utility should be eligible for inclusion in the Code Adoption Demonstration Program. This 'early adopter' program should be available throughout the region to jurisdictions which comply in aggregate with the MCS for new residential and commercial buildings through improvements in their building codes and should include the following elements:

  - Financial assistance sufficient to cover the incremental cost of electrically heated residential building construction between 1983 practice and the MCS. This financial assistance should be available through January 1, 1989, to any jurisdiction that adopts the MCS through codes before January 1, 1989. Beyond January 1, 1989, financial assistance to early adopters should be set at or above financial assistance given to utilities participating in the Bonneville/utility MCS program.

  - Inclusion of financial assistance to commercial building developers in 'early adopter' jurisdictions.

  - Reimbursement to utilities and states or local governments for the costs of MCS-level code adoption and enforcement.

  - Systematic evaluation of construction cost, fuel share impacts, thermal performance, occupant satisfaction, indoor air quality, overall compliance with code targets, and enforcement costs for both residential and commercial buildings.

  - Education and training programs for builders, consumers, architects, designers, energy code enforcement officials, mechanical ventilation system designers, installers and servicing contractors, realtors, lenders and appraisers, and other appropriate participants in the design, purchase, and construction of new buildings.

- Shelter industry training which focuses on the most cost efficient means of achieving the MCS.

- Implement the Model Conservation Standards Implementation Program (MCSIP) to reimburse state and local governments throughout the region for the incremental costs of adopting and enforcing model conservation standards as codes. Reimbursement should be made available throughout the region and should continue as long as enforcement of the standards remains regionally cost effective.

- Establish and maintain a program to reimburse states or local governments for the incremental costs of adopting and enforcing codes that are designed to achieve part of the savings represented by the MCS if the inspection and enforcement activities are undertaken as part of an overall program designed to meet the MCS. Code enforcement reimbursement should be provided for the cost of at least one inspection per building in such jurisdictions. This reimbursement should be provided throughout the region so long as regionally cost effective.

- By December 1, 1986, design and implement a method or process for estimating costs, over and above the costs of building to current practice, of building to the MCS throughout the region. This activity should be aimed at producing annual reports beginning in 1987 on the estimated costs experienced by builders in early adopter jurisdictions, and by builders in the Bonneville/utility MCS programs throughout the region. These cost estimates will be used by Bonneville and the Council to evaluate all aspects of the MCS, including a determination of the amount of and responsibility for the financial assistance offered in the next building season.

- As soon as possible in 1986, design a process to collect utility-specific data on the achievement of electricity savings as a percentage of the total savings, based on 1983 building practice, that would be expected if all buildings were constructed to MCS levels. The data should be the basis for a report published every year to notify utilities of their progress towards achieving the MCS in the previous year and the annual minimum performance standard and equivalence standard, where applicable, which will have to be met in the following year to avoid a surcharge.

- Continue development of and implement a procedure to measure compliance with the MCS and to review alternative plans for achieving compliance with the MCS for utility conservation programs. This procedure should be incorporated into Bonneville's surcharge policy scheduled for completion early in 1986. The surcharge policy should be modified to incorporate changes to the MCS made by the Council in this plan.

- Continue to collect and analyze data regarding energy use, structural specifications and operation of residences and commercial buildings through the existing End-use Load and Conservation Assessment Project (ELCAP).

- Establish, maintain and disseminate the results of an ongoing research and demonstration effort which focuses on the refinement of new residential and commercial building conservation technologies, construction techniques and products. This program should initially concentrate in the residential sector, identifying and/or developing better information on:

  - Reducing uncontrolled air leakage.

  - Providing more reliable ventilation both with and without heat recovery.

  - Constructing highly insulated exterior walls.

- Develop the surcharge policy and impose a 10 percent surcharge on any utility that has not met all of the requirements of the MCS for utility conservation programs for new residential and new commercial buildings. The surcharge policy should be developed and the surcharge should be imposed pursuant to the Council's model conservation standards and surcharge recommendation included in Appendix I-B.

2.0 New Manufactured Houses

A large number of new homes purchased in the Northwest are manufactured houses subject to standards adopted by the U.S. Department of Housing and Urban Development (HUD). Neither the Council nor state and local governments can mandate energy efficiency standards for these HUD code homes, since HUD regulates their construction. Inefficient manufactured houses are a lost opportunity resource to the regional power system. However, steps can be taken to encourage consumers to purchase the most efficient manufactured homes available. The Council intends to give more of its attention to achieving more efficient manufactured housing after the adoption of this plan. (Non-HUD code manufactured homes include those manufactured in modular and panel form that are subject to local or state building codes but not to the HUD standards.)

Objective

Work with the U.S. Department of Housing and Urban Development, manufacturers and consumers to foster the construction and purchase of manufactured houses that incorporate all regionally cost-effective conservation measures.

Status and Review: New Manufactured Housing

Bonneville is implementing a demonstration program to construct five HUD code manufactured homes to the model conservation standards. Bonneville will test the actual energy consumption of these homes when they are completed, and will estimate what the costs of these homes would be if built in greater numbers. Bonneville is also providing financial support for the construction of 34 HUD code manufactured housing units built to the model conservation standards, which will also be monitored over several years to determine energy performance. Energy efficiency in all new manufactured housing will be marketed as part of the Super Good Cents program. Although HUD has cooperated with Bonneville at the regional level, there is little likelihood of action being taken on new efficiency standards at the national level in the foreseeable future.

Activities: New Manufactured Housing

A work plan should be developed which includes the following actions:

- Provide marketing or financial incentives, or both, to the producers or consumers of HUD code and non-HUD code manufactured houses that incorporate all regionally cost-effective conservation measures. This program should be established by October 1, 1986, and be designed so that a majority of new manufactured housing is built to the regionally cost-effective limit by July 1, 1990.

- Collect the data necessary to make more reliable estimates of the cost and performance of conservation measures in new HUD code manufactured housing. As an integral part of this activity, conduct research, development and demonstrations for conservation measures that have the potential to be more cost effective than measures currently installed in manufactured housing. An improvement of 60 percent savings in the heating of new HUD code homes over current practice should be the goal of this effort.

3.0 Existing Residential Buildings

The rate of conservation acquisition must reflect the need for power in the region. Unlike new homes, the purchase of efficiency improvements in existing houses can be deferred until the power is needed to meet loads without creating lost opportunities. The Council's current load forecast and draft resource portfolio do not indicate any current need to acquire resources from the existing residential building sector. To hold down costs to the ratepayers served by public utilities and to minimize increases to the regional electricity surplus, Bonneville, in consultation with its utility program operators and the Council, should reduce the size of the residential weatherization program to a minimum viable level by FY 88. This program should be consistent with achieving the Council's objectives of meeting future load growth with residential conservation. This level should hold until a subsequent revision of the Council's plan indicates a need for increased resource acquisition.

Conservation, like other resources, should only be purchased when needed. However, it is beneficial to the region's ratepayers and utilities for Bonneville to continue to offer a residential weatherization program at a low level and to refine the program so that conservation savings are not lost through partial weatherization of residences. A primary benefit would be to maintain the conservation expertise that has been developed within many utilities. Preserving an active utility conservation role can improve the effectiveness of new programs the utilities could offer in support of the Council's model conservation standards for new residential and commercial buildings. In addition, Bonneville should continue to build the capability to acquire resources from low income and renter occupied dwellings.

Bonneville should use this time of surplus energy to gain information on various ways to acquire conservation, and ways to test alternative means of financing conservation. The residential weatherization program, as well as all other programs, should include data gathering and evaluation components, both structured to gain statistically reliable information the region can use to fashion an aggressive and effective conservation acquisition program[2] when additional power is needed. The resulting program should provide a model of an effective resource acquisition program that can be slowed or accelerated to meet regional needs as required. More information is needed to determine how flexible individual conservation acquisition programs can be, since flexibility adds to the value of conservation to the region.

Although operating at a minimum level, the programs should install all cost-effective measures at the time a house is weatherized. The region should seek to avoid partial retrofitting now which results in unnecessary administrative costs later, when increased levels of regional acquisition are needed. In addition, partial retrofitting can create lost opportunity resources that can not be cost effectively secured if an additional visit to the house is required.

Objectives

1. **Operate the weatherization program at a minimum viable level.**

2 **Ensure that the residential weatherization program operates reliably across all segments of the existing residential sector, including achieving penetration rates into low income and rental housing at least in proportion to their share in the service territory of each utility operating the Bonneville program. Bonneville should provide assistance to utilities to achieve and maintain proportional penetration.**

Status and Review: Existing Residential Buildings

The residential weatherization program is a viable program that should be maintained at the lowest possible level that still assures availability of the program when needed, including the utility and private sector infrastructures that support conservation activities.

In the 1983 Action Plan, the Council noted that utility conservation programs were not reaching low income or rental housing. Experience over the past two years indicates that Bonneville is still not succeeding in reaching these two target groups in proportionate shares to their presence in the population in many of the service territories of utilities operating the Bonneville program. There appears to be difficulty in identifying eligible low income households in some service territories. The reasons include lack of information on the penetration of previous Bonneville or other federal programs, the limited accuracy of census data, and the reluctance of individuals to identify themselves as being eligible for the program. In addition, some utilities do not appear to support the program.

The Council stated, in the 1983 plan, that Bonneville should provide for 100 percent of the costs of all measures installed in low income homes. Data indicate that many low income home weatherizations funded by Bonneville in the State of Washington require financial supplements from other federal programs. These other federal programs, with limited budgets, are required to serve homes using all fuels. The Council believes that these tax supported programs should not have to bear costs that the region's electric power system should be assuming for the purchase of conservation resources.

Nearly 60 percent of rental housing in the region is electrically heated. In multifamily units of ten or more, nearly 75 percent are electrically heated. Because of a number of market imperfections, sufficient incentives do not exist for tenants and owners, who range from individuals to corporations, to avail themselves of the weatherization program. There should be additional effort made to develop mechanisms to attract this segment of the population to weatherization programs. Bonneville has made little progress in collecting data on the share of renters being served through the program or in establishing mechanisms to identify proportionate shares of renters in each utility's service area. However, Bonneville has begun to explore different approaches to increasing low income and renter penetration rates.

Bonneville has not required that all cost-effective measures be installed when a residence is weatherized. In an effort to increase the number of measures selected by program participants, Bonneville is developing a program to market all cost-effective measures to homeowners. The Hood River Program, a program to demonstrate the penetration levels that can be achieved when all costs are paid by a utility, is nearing completion and will provide a great deal of information on what to expect when the region implements conservation acquisition programs on a large scale.

Bonneville has initiated a program to address the problems related to indoor air quality. This study will examine sources of pollution and effective ways to mitigate them, including source reduction, informed consent, and the provision of adequate ventilation in existing and new energy-efficient dwellings.

Programs to provide information to individuals about energy saving measures are continuing through the Energy Extension Service.

Activities: Existing Residential Buildings

A work plan should be developed which includes the following actions:

- Conduct additional assessments of the minimum viable level for operation of the residential weatherization program, with the goal of reducing the size of this program. This revision to the weatherization program should be made by October 1, 1987.

- Require, as a condition of receiving acquisition payments from Bonneville, that full levels of all structurally feasible measures costing less than or equal to 5.0 cents per kilowatt-hour (levelized 1985 dollars) be installed when a dwelling in the residential weatherization program is weatherized. Provide a level of financial assistance not to exceed the regional cost-effective limit of 5.0 cents per kilowatt-hour (levelized 1985 dollars) for any installed measure.

- Conduct an ongoing analysis of the weatherization records with periodic reporting of program effectiveness, including an assessment of the administrative costs incurred by Bonneville and utility operators.

- Continue research into housing characteristics and effects of occupant behavior (thermostat settings, door and window opening, wood heating, etc.) leading to more accurate thermal analysis and better estimates of electrical space heat consumption.

- Implement a program which establishes an acquisition payment of no less than 100 percent of the actual cost of full levels of all structurally feasible and cost-effective conservation measures in owner-occupied and rental housing inhabited by persons identified as low income. The program should not require the use of financial supplements from any other source. 'Low income' is as defined by federal guidelines.

- Assure that the weatherization program achieves penetration rates for low income households, in both owner-occupied and rental housing, at least in proportion to their share of all electrically heated households in the service territory of each utility that offers the Bonneville program. By FY 88, adjust the overall weatherization budget to increase low income and renter budget shares to account for any shortfall in penetration rates for the FY 84- 87 program years. Continue this adjustment until the low income and renter program has cumulatively met its proportionate share objectives. Bonneville should report, on a quarterly basis, each utility's progress toward meeting its budget and unit goals for low income and rental weatherization. In order to develop more accurate estimates of proportionate share, Bonneville, in cooperation with its utility program operators, should undertake further analysis of available data on low income and rental populations, including the results of their earlier participation in federal weatherization programs.

- Develop, test and evaluate options for alternative service providers for part or all of the low income weatherization program. Recommendations should be made and implemented no later than the start of the FY 87 program year.

- In FY 87, implement administrative actions and marketing approaches that can be used successfully to reach low income consumers. Such actions include the elimination of budgets for non-low income weatherization from utility operators that fail to achieve their low income target shares.

- Test the feasibility, effect on market penetration, and cost effectiveness of a variety of program approaches in the rental sector. Such activities should focus on programs that have been successful elsewhere or other innovative means that Bonneville expects will be successful. These demonstration programs should be designed to address the diverse range of housing types, ownership patterns and location of existing rental housing.

- Monitor weatherization in rental units in the region, keeping information on participation, measures installed, costs and appropriate demographic information on participants and nonparticipants.

- Determine whether state or local governments can help increase the share of rental housing in the residential weatherization program.

- Monitor and evaluate incentive and regulatory approaches to rental weatherization being used throughout the United States.

- Provide a program that certifies the energy efficiency of owner-occupied and rental units that have been weatherized to regionally cost-effective levels.

1.0 Existing Commercial Buildings, Industry, Irrigated Agriculture, and Institutional Buildings

To hold down costs for ratepayers served by public utilities and to minimize increases to the regional electricity surplus, Bonneville should not offer financial incentives for the sole purpose of acquiring conservation resources in the existing commercial, industrial or irrigated agricultural sectors.

The actions listed below are designed to gain experience which will enable the region to achieve conservation from these sectors when the region looks to new sources of power. In implementing programs to achieve the objectives listed below, there may be energy savings that are incidental to this purpose. Care should be taken, at the time a conservation demonstration program is initiated, not to lose part of the future potential of the resources. All cost-effective measures should be installed at the time a commercial building is modified if these measures do not change the amenity level or function of the building. In industrial facilities, opportunities for increasing process efficiencies should be fully explored, with care taken not to create lost opportunities. Since these programs are intended to test the long-term viability of conservation resources, the cost-effective limit is set at 5.0 cents per kilowatt-hour. This principle should be taken into account by all entities implementing conservation programs.

Objective

Gain information on the size, cost, and availability of the conservation resource in each of the sectors, and determine the lead time and delivery mechanisms to acquire all cost-effective, structurally feasible conservation resources. Do not convert programs developed to meet this objective into acquisition programs until called for in a subsequent modification to this plan.

Status and Review: Existing Commercial Buildings, Industry, Irrigated Agriculture, and Institutional Buildings

Progress has been slow in the existing commercial buildings sector, but a number of activities are underway. Bonneville is developing a standard procedure to audit commercial buildings' use of energy. In the Commercial Audit Program, 4,000 buildings will be audited in the service territories of 26 utilities that have signed long-term contracts with Bonneville. A Commercial Incentive Pilot Program involving rebates for retrofit is being implemented through six public utilities. Bonneville is testing off-budget financing and shared savings arrangements through the Purchase of Energy Savings pilot program. In the first round of this program, contracts were signed with sponsors to retrofit up to 29 commercial buildings. It is now expected that eight to ten buildings will be retrofitted. A second Purchase of Energy Savings Field Test Program to retrofit up to 200 buildings is being negotiated with potential sponsors. Bonneville has begun design work on a program to market conservation measures and to provide technical assistance to owners of commercial buildings. This program will not include any direct financial incentives. Finally, Bonneville is scoping the design of a training program directed at the operation and maintenance of commercial buildings. It appears the region is beginning efforts to develop capability to measure and acquire conservation in the commercial sector, albeit more slowly than the Council anticipated in April 1983. In addition, more information is needed about the costs, savings and availability of efficient commercial appliances such as large coolers and freezers, hot water heating systems and cooking equipment.

Little progress has been made in the industrial sector. Until recently, Bonneville had only signed a shared-cost contract for efficiency improvements with two industrial sponsors. Bonneville is now negotiating contracts with ten industrial firms that responded to the second solicitation of conservation proposals from industrial firms. Bonneville plans to initiate a public involvement process to further refine its process for soliciting industrial conservation proposals and is planning to test the effectiveness of innovative technologies in saving electricity. In the Industrial Test Program, 25 firms were audited to determine if there is a systematic way to estimate savings in three standard industrial classifications: 1) food and food processing, 2) wood products, and 3) pulp and paper. Finally, two research and development projects are being conducted that could have broader application in the region. The Council expects that the additional experience gained through increasing the number of contracts with industrial facilities will lead to a simpler and more streamlined approach to acquiring conservation when needed.

Bonneville is currently designing an aluminum smelter conservation/modernization proposal. The Council did not have an opportunity to review and evaluate this proposal prior to adoption of the 1986 Power Plan. When Bonneville completes the study, the Council will review it for consistency with the Council's plan and the Northwest Power Act.

The main pilot program effort in irrigated agriculture is the Inspection/Hardware Incentive Program. Initially, a large number of utilities conducted inspections of their customers' irrigation systems, but relatively few followed up with hardware retrofits. As an alternative to utilities, the U.S. Bureau of Reclamation is now under contract to Bonneville to achieve hardware retrofits. The main pilot program has focused primarily on small to medium-sized farms with center pivot irrigation systems. This program offers comprehensive inspection of a farm's irrigation systems and administrative incentives to encourage installation of all recommended measures. Two levels of incentives are offered to irrigators: 1) immediate payment of 50 percent of the cost of the measures, or 2) full payment over a five-year period. In addition, a number of research and development projects specified in the 1983 Council plan are underway, including irrigation scheduling, very low pressure sprinklers, and deficit irrigation. Bonneville has implemented these programs in cooperation with the U.S. Bureau of Reclamation, Agriculture Extension Service, Soil Conservation Service, Energy Extension Services, universities and private consultants. It appears that the capability is being slowly developed to acquire conservation in this sector when need dictates.

Activities: Existing Commercial Buildings, Industry, Irrigated Agriculture, and Institutional Buildings

Work plans should be developed to include the following provisions:

Provisions Related to All of the Sector Work Plans

- Conduct an evaluation of the alternative financing mechanisms that have been used in programs in these sectors. This study should be concluded by January 1, 1987, and a report on the results made available to the public.
- Ensure that no cost-effective resources are lost in any pilot program that may be undertaken to achieve the above objective.

Provisions in the Existing Commercial Sector Work Plan

- Use Bonneville's Institutional Buildings Program as one vehicle to gain information and experience with commercial building retrofits. See discussion of the Institutional Buildings Program in Section 6.0 of this Action Plan.
- Analyze data collected by the End-Use Load and Conservation Assessment Program (ELCAP) to help refine estimates of electrical end-use consumption in commercial buildings.
- Research and demonstrate technologies which may improve building energy efficiency, including energy management control systems, lighting technologies, and ventilation equipment.
- Implement a technical assistance program for commercial building owners, operators and tenants, focusing on the efficient operation of buildings.
- Estimate costs and savings from efficiency improvements to appliances in commercial use. Include in this research an estimate of the amount of savings available from appliances in the commercial sector.
- Develop and implement strategies to promote the purchase of energy efficient appliances by commercial and industrial customers at the time of normal replacement.

Provisions in the Existing Industrial Sector Work Plan

- Continue to build capability to acquire conservation from industry when needed by entering into contracts by January 1, 1987, with at least 20 industrial facilities that represent a substantial variety of industrial processes, to purchase conservation efficiency improvements. Several of the contracts should be dedicated to cost-effective projects in "small" firms. This contracting activity should remain active beyond January 1, 1987, at a minimum viable level to maintain the capability.
- Operate a research and development program in conjunction with industry to determine the potential costs and savings from efficiency improvements in industrial processes that apply to a wide array of industrial firms.
- Maintain a program that provides technical and/or financial assistance to industrial firms to conduct audits of their processes to identify conservation opportunities.
- Establish a program, including technical and financial assistance, in conjunction with utilities and the state energy agencies to address energy efficiency in new industrial facilities.

Provisions in Existing Irrigated Agriculture Work Plan

- Maintain programs that offer technical and financial assistance to irrigators to make cost-effective efficiency improvements. Do not convert the financial assistance program to an acquisition program until there is a need for power.
- Monitor irrigation systems being installed on newly irrigated land to establish the efficiency of these systems.
- Conduct an evaluation of incentive rate designs that promote conservation through lower retail rates for irrigators that install conservation measures. This evaluation should be completed by January 1, 1988.

5.0 Residential Appliances

Energy efficient appliances, especially residential refrigerators, freezers and hot water heaters, represent a significant source of low-cost conservation potential in the region. On average, these residential appliances can be made to operate much more efficiently. Council and Bonneville analysis has shown that efficiency improvements in residential appliances are cost effective from the regional and consumer perspective. It is important that consumers purchase efficient appliances when old ones are replaced; otherwise, inexpensive resources are lost to the electric power system for the life of the appliance.

Objectives

1. **Encourage the states to establish residential appliance standards equivalent to those adopted by California for refrigerators/freezers, freezers and electric hot water heaters.**

2. **Conduct additional analysis to determine the costs and performance of appliances with efficiencies higher than the California standard, to refine estimates of the total amount of savings available from all appliances in the residential sector, and to assess marketing programs to promote energy efficient appliances that exceed current and proposed standards.**

Status and Review: Residential Appliances

Bonneville has sponsored the Solar/Heat Pump Market Test, which will evaluate the effectiveness of incentives and promotions to encourage the purchase of solar or heat pump hot water heaters. Sales have been slow in the first year, but the program is likely to continue for an additional two years.

Bonneville staff held discussions with staff from the U.S. Department of Housing and Urban Development (HUD) about a HUD requirement that housing authorities review life cycle costs of appliances they purchase. Bonneville is planning to supply HUD with information to use in enforcing the regulation.

Bonneville has awarded a contract to implement a regionwide campaign promoting energy efficient appliances and has established a work group to advise on the direction of the overall program.

Through its Sponsor-designed conservation program, Bonneville has agreed to pay incentives for the purchase and installation of up to 1,500 energy efficient refrigerators. A review of the program is being conducted.

The Council, in action item 4.5 of the 1983 Power Plan, committed itself to assessing the feasibility of establishing uniform appliance efficiency standards in the region. The California Energy Commission has established new efficiency standards for refrigerators and freezers to be fully implemented in 1992. Analysis by the Council and Bonneville concludes that the California standards are cost effective for the region's ratepayers. The Council has determined that these standards should be adopted in the region on a schedule consistent with California's, to support a smooth transition in the marketplace.

The State of Oregon considered, but did not act upon, legislation that would have established standards for refrigerators and freezers equivalent to those adopted by the California Energy Commission. The Oregon legislature also considered standards for hot water heaters, and again took no action.

Activities: Residential Appliances

A work plan should be developed to include the following actions:

- Provide technical assistance to each state requesting such assistance for the development of cost-effective appliance efficiency standards. This assistance should at least cover refrigerators, freezers, and hot water heaters.

- Assess the effectiveness of various marketing strategies and incentives in promoting the purchase of the most efficient appliances that are available. These strategies should promote purchases of more efficient appliances at the time of normal replacement. Early retirement of existing appliances should not be encouraged. Evaluate the existing Sponsor-Designed program to market energy efficient refrigerators to determine if the project should be extended.

- Purchase, install and monitor the performance of refrigerator/freezers, freezers and electric hot water heaters. Compare several different efficiency levels for each appliance, including very efficient appliances that exceed the 1992 California standard.

6.0 State and Local Government Programs

The four states and more than 900 cities, towns and counties in the region have a direct interest in and, in many cases, exercise direct legal authority over many elements of the regional power plan. State and local governments have unique capabilities to support implementation of many of the activities in this Action Plan. In particular, state and local governments can be instrumental in implementing the Council's model conservation standards, and they are alone in their ability to achieve solar access ordinances across the region. The state and local government actions are included to support the essential partnership between the region's governments and the electrical power system.

Objective

Continue and maintain regionwide programs, through state and local governments, that strengthen state and local participation in the full implementation of the regional power plan.

Status and Review: State and Local Government Programs

Bonneville made significant progress in building relationships with state and local governments through the establishment of the State, Local and Tribal Government Consultation Group. Bonneville restored the financial assistance program for local governments; developed guidelines which permitted facilities to be included in the Institutional Buildings Program; and created a Model Conservation Standards Adoption/Enforcement Task Force to assist in the development of the Code Adoption Demonstration Program (early adopters program) and long-term Model Conservation Standards Implementation Program. Bonneville also provided the necessary technical and financial resources for states and a number of local governments to begin consideration of adopting the model conservation standards as building codes. Bonneville provided limited support for solar access protection through the State Technical Assistance Program and the Local Government Financial Assistance Program.

Activities: State and Local Government Programs

In developing work plans, particular attention should be paid to capturing lost opportunity resources in the governmental sector. Some services performed by the region's governments are unique to the public sector; therefore, findings in existing commercial conservation programs cannot be applied easily to the public sector. Two examples are jails and municipal solid waste disposal. Conservation and generating opportunities in providing these services are different from typical opportunities in commercial buildings. For example, new jails are being constructed which must meet federal standards that may be in conflict with the energy efficiency goals of the region. Thus, opportunities to save electricity in jails could be lost if action is not taken at the time of construction. Local governments are facing growing difficulty finding and licensing landfill sites, and many have only one choice remaining for solid waste disposal—incineration. As part of an overall resource acquisition process (see Section 7 of this Action Plan), the region should evaluate whether opportunities such as these represent cost-effective resources when they are being planned.

There has been considerable discussion about solar access protection. Further analysis is necessary to better define the importance of solar access savings to the region's electric power system. Also, additional assessment should be done of the value of potentially cost-effective solar technologies for residential and commercial buildings. In order to avoid losing potentially valuable resources and to support flexibility in building design for the model conservation standards, solar access should be provided and protected when land is platted for development and when improvements to land and buildings are made.

Bonneville's ongoing work plan should maintain programs to achieve the above objective and should include at least the following activities:

- Continue consultation with state and local governments and local government associations regarding the most appropriate mechanisms to provide for implementation of model conservation standards, technical and financial assistance, the development of conservation programs, and acquisition of governmental resources, including those which affect governmental buildings and facilities.

Technical and Financial Assistance to State and Local Governments

- Offer technical and financial assistance for 1) identifying cost-effective conservation and resource development opportunities in state and local government building and facilities, and 2) developing internal energy management programs, including preliminary energy audits of public buildings and facilities, efficient operation and maintenance, and financing strategies.
- Offer a regionwide program of technical and financial assistance for the period FY 86-94, for revising and adopting land-use plans, zoning and subdivision ordinances which affect onsite energy use, solar access protection, solar orientation, and local permitting processes for energy facility development. Under this program, all local governments should be offered technical and financial assistance to address solar access protection through regulatory or voluntary approaches.
- Develop a program component for supporting further research on technical issues related to solar access.
- Disseminate information to the region's state and local governments on the findings and experiences of relevant research, demonstration and implementation efforts, both within and outside the region.
- Continue to offer the Local Financial Assistance Program to local governments, to identify innovative approaches for acquiring cost-effective resources in their jurisdictions.
- Educate and train state and local governments on how to achieve the objectives of the Council's model conservation standards.

Education, Training and Technical Assistance Provided by State and Local Governments

- Maintain programs, such as the existing state Energy Extension Service programs, that provide skilled trainers and training materials to transfer knowledge gained in pilot programs and demonstrations to residential consumers of electricity. These programs will minimize the loss of resource opportunities due to inappropriate installation of measures in the near term.
- Offer training programs to building contractors, architects, designers, realtors, appraisers, code officials, building inspectors and lending institutions regarding provisions of the residential model conservation standards or alternative plans.
- Train and educate contractors, building owners, architects, designers, realtors, appraisers, code officials, inspectors and lending institutions in techniques and strategies for achieving the commercial model conservation standards.
- Train and educate consumers regarding energy efficient manufactured housing, energy efficient mobile homes (regulated by the HUD code) and energy efficient appliances.
- Educate and train commercial and institutional building operators and occupants regarding energy efficient operations, maintenance practices, and the identification of cost-effective resource opportunities when retrofitting buildings and when replacing appliances.
- Train and educate irrigators, investors, irrigation specialists, and equipment dealers regarding energy efficient irrigation technologies and strategies.
- Provide technical assistance in pump efficiency testing and system analysis.
- For jurisdictions served by electrical utilities that do not place a load on Bonneville and who are not participating in Bonneville's conservation programs, encourage independent activities which parallel those called for in this plan.
- Support the development of mechanisms to help state and local governments, utilities, and the private sector cooperate in conservation and resource acquisitions and to share energy management information, technical expertise, and experience.

ıstitutional Buildings and Facilities

ı Redesign the Institutional Buildings Program as soon as possible. The following elements should be addressed:

- Complete current technical assistance studies, and install the cost-effective energy conservation identified by all the studies that have been completed.

- Integrate the program more fully into Bonneville's existing commercial sector programs. Place programmatic focus on those institutional buildings that most closely resemble commercial buildings, in order to increase technical knowledge of commercial building conservation. Continued evaluation of the program should consider the transferability of results to the entire commercial building sector and the effectiveness over time of the conservation measures installed in the buildings and facilities.

- Develop the capability in municipal facilities, including information on the size, cost, and availability of the conservation resource, and determine the lead time and delivery mechanisms to acquire all cost-effective, structurally feasible conservation resources. Do not convert this program into an acquisition program until called for in the Council's plan.

- Identify and evaluate lost opportunities in buildings and facilities. This information should be used in the Resource Acquisition Process activities described below.

- Train and educate building operators and managers, architects, engineers and contractors regarding energy efficient retrofit and design, operation and maintenance practices, and energy accounting as a management tool.

- Assess alternative financing strategies, including targeted testing of alternative incentive levels, revolving loan funds, and third party and performance-based contracting.

- After the above elements have been incorporated into the Institutional Buildings Program, any funds that remain in the budget for the Institutional Buildings Program through FY 87 should be made available for purposes consistent with the original program.

7.0 The Resource Acquisition Process and Supporting Activities

Because of the current surplus, this Action Plan does not call for the acquisition of additional resources to meet load. However, in the last decade, the region has learned at great cost that the future is highly uncertain and expectations can change dramatically in a short period. If loads grow rapidly over the next two to five years there may be a need at some point in the not too distant future for Bonneville to secure an option on a major generating resource. In addition, the Council may find other resource acquisitions to be desirable. These could include: 1) acquisition of resources to test elements of the resource acquisition process, including the ability to secure options; 2) acquisition of certain very low-cost resources, costing less than the value of nonfirm power, that have value even during conditions of surplus; 3) acquisition of options on lost opportunity[3] resources; and 4) acquisition to develop or demonstrate new resource types.

Thus, the Council views as very important the development of policies and procedures now that will enable Bonneville to secure options and acquire the capabilities of conservation and generating resources, when needed. A key element of future resource acquisitions will be the ability to secure options on these resources. Efforts initiated in the 1983 Power Plan to identify and resolve potential constraints to implementing the options concept have been positive and provide a sound foundation from which further improvements can evolve. As a first step, the Council, with the help of its Options Steering Committee, has adopted a model process for acquiring resources, including the stage of securing options. This model process is described in Appendix I-A of this plan. The resource acquisition process developed in response to this action item should be based on that model process.

Development of specific elements of the model process for securing lost opportunity resources remains a high priority. In addition, this Action Plan calls for Bonneville to establish a standard power purchase offer to encourage the development of higher priority resources to the extent that these are cost effective and environmentally acceptable. The standard power purchase offer should be designed to facilitate the identification and acquisition of decentralized and non-utility resources.

Regional cooperation is stressed throughout this plan. To achieve the objectives of this action item, in particular, regional cooperation is most important. The Council, Bonneville, utilities, state siting and regulatory commissions, environmental groups, state energy offices, and other state and local government agencies will all be important actors in developing a process for acquiring resources to serve regional needs.

Objective

Develop an acquisition process and supporting activities designed to encourage the development of cost-effective priority resources, including conservation, renewables and high-efficiency resources, and lost opportunity resources, while also developing the capability to acquire conventional resources, when and if needed.

Status and Review: The Resource Acquisition Process and Supporting Activities

Because there was no need to acquire additional generating resources to meet load, resource acquisition activities in the 1983

Power Plan were limited to lost opportunity conservation resources that were cost effective and consistent with the plan. The availability and cost effectiveness of lost opportunity conservation resources in the residential and commercial sectors were well understood at the time of the 1983 plan. This led the Council to call for the acquisition of these resources, where cost effective, through adoption and implementation of conservation standards. In contrast, the extent and cost effectiveness, and best means of securing lost opportunity generating resources were, and continue to be, less well understood.

The 1983 plan contained two action items leading to the development of programs for identifying and securing options on lost opportunity resources. The inventory of lost opportunity resources called for in Action Item 13.3 is described in Volume II, Chapter 7, of this plan. Action Item 20.3 called for Bonneville to develop a program that would assist potential cogenerators to make investments that would allow adding generating equipment at a later date, thus securing an option on a cogeneration resource that would otherwise have been lost. Bonneville has prepared a work plan for implementation of this action item; however, no substantive work has been accomplished to date.

The 1983 plan emphasized identification and resolution of constraints to the optioning concept. Several task forces were created by the Council and Bonneville pursuant to Action Item 13.2 and 13.5 of the 1983 plan to consider the process questions that might arise in the acquisition of resources. The task forces looked specifically at hydropower, cogeneration and coal and evaluated the potentially inhibiting effect of state and local regulations on the options process. Bonneville and the states exchanged information regarding energy resources and energy facility siting to promote consistent state and federal policies for resource acquisitions. Each state produced a report detailing the constraints to the options concept presented by that state's laws and regulations. This effort is leading to modifications of state regulations, in some cases, to better accommodate the options concept.

The Hydropower Task Force has identified and assessed various approaches to deal with the Federal Energy Regulatory Commission (FERC) licensing process. Based on the task force deliberations and discussions between the Council and FERC staff, the Council has recommended the approach of "hold prior to licensing" that is being tested by Bonneville. The Cogeneration Options Task Force identified bid procedures and contract provisions as the most significant impediments to optioning of cogeneration resources. A prototypical Request for Proposals developed by this task force was used by Bonneville to develop its solicitation of hydropower options. The Coal Options Task Force found no major constraints to the development of coal options.

These task forces and others concluded that the only certain means of validating the options concept is to demonstrate the ability to secure options. This need was recognized in the 1983 plan, which, in Action Item 14.1, called for acquisition of several hydropower options for the purpose of identifying and resolving constraints to the optioning concept. Hydropower was chosen for this test because it was believed that hydropower projects would encounter as severe a set of constraints as any resource, including constraints common to other resource options. In response to Action Item 14.1, Bonneville issued a Notice of Program Interest (NOPI), requesting proposals for hydropower options. Five qualifying candidates were selected. Contract negotiations on the first of these were discontinued when agreement could not be reached on principles for power purchase prices should the option be exercised. Contract negotiations on the remaining projects will resume once Bonneville has reassessed alternative methods of establishing power purchase prices.

Based on Action Items 1.11 and 1.12 of the 1983 plan, the Council sponsored a study of existing programs to acquire electrical energy conservation in the residential, commercial, industrial and agricultural sectors. Cooperative efforts are underway among Bonneville, utilities, utility associations, state energy offices, and private firms to develop useful criteria for evaluating the conservation acquisition programs operated by entities in the region. Efforts should continue to further develop effective methods of acquiring conservation.

This plan continues to emphasize development of the capability to option resources and to secure lost opportunity resources. Bonneville's activities are broadened to include 1) development of a clear and concise process for establishing the price of power purchased from the new resources pool, 7(f), 2) development of a process to acquire resources from utility and non-utility resource developers, and 3) refinements of methods for assessing the effectiveness of conservation acquisition programs.

Activities: The Resource Acquisition Process and Supporting Activities

A work plan should be developed which includes the following actions:

- Based on the model process for acquiring resources set forth in Appendix I-A, develop a comprehensive acquisition process. An important part of any process to acquire resources is the purchase price of the resource. The concept, embodied in the Public Utility Regulatory Policies Act, of offering to pay the "avoided cost" (or what would have been paid for the development of the next planned resource), for qualified resources has been effective at encouraging the development of dispersed and renewable resources. Bonneville's acquisition process should embody this concept. Offering prices should be based upon the present value of these resources to Bonneville, including the effects of expected loads put on Bonneville by investor-owned utilities, and should consider characteristics of prospective resources which affect this value, such as dispatchability, and whether acquisition is constrained to a certain time period (a lost opportunity resource). Offering prices should be periodically adjusted to reflect changing demand forecasts, contracted loads and other conditions. The offer should include conditions to ensure that resource development is consistent with requirements of the plan and the Northwest Power Act. Several activities, listed below, should take place before this process is implemented. This comprehensive acquisition policy should not be implemented prior to a Council determination that an acquisition is consistent with the plan.

- Develop the capability to secure options on major resources. As part of this activity, Bonneville, in consultation with its customers, public utility commissioners and investor-owned utilities, should establish principles for allocating the costs of options and should develop the language of a contract for securing options on major resources. Should the annual regional firm surplus[4] decrease by 1,000 average megawatts or more from its January 1, 1986, level—because of load growth, the loss or long-term sale of regional resources, or any combination of these events— Bonneville should secure options on a facility or facilities representing at least 500 average megawatts of energy.

- Develop and test a program for securing potential lost opportunity resources. This program should incorporate the objectives of Action Item 20.3 of the 1983 Power Plan with respect to potential lost opportunity cogeneration resources. In addition, this program should address the unique characteristics of the other types of potential lost opportunity resources.

- Develop and demonstrate general approaches to contracting with utilities and independent power developers. When the region needs power, it is quite likely that utilities will not be the only developers of resources. Independent developers will likely sponsor many dispersed generating resources, conservation resources and, possibly, central station power plants. The intent of this activity is to encourage the orderly development of small-scale and high priority resources and to identify and acquire lost opportunity resources as these become cost effective.

- Complete the development of, and demonstrate, a procedure for assessing the cost effectiveness of resource acquisitions. The intent is for Bonneville to establish a method of assessing resource cost effectiveness that is consistent with the Council's planning efforts and can be used in assessing resource option acquisitions, continuing cost effectiveness of options in inventory, decisions to build resources, and decisions regarding the acquisition of lost opportunity resources. This procedure should be consistent with the Council's plan, and should incorporate methods for the quantification of environmental effects developed in response to Action Items 24.1 and 24.2 of the 1983 plan.

- Develop and test programs for acquiring hydropower efficiency improvements and secondary hydropower firming alternatives. These programs should be available for implementation when the development of these resources becomes cost effective.

- Develop and demonstrate methods for buying and selling key resources between utilities. Such resources include conservation, hydropower firming strategies and system efficiency improvements. The ability to contract for the transfer of these resources between utilities will promote the development of resources from a regional perspective in their order of cost effectiveness.

- In consultation with Bonneville's customers, the public utility commissions, and investor-owned utilities, develop a clear and concise policy to establish rates for the new resources (7f) pool. The policy should incorporate the formula for allocation of option costs called for in Bonneville Activity 8.0. With the development of this policy, Bonneville should provide the investor-owned utilities and public utility commissions with a prediction of the availability and cost of power from this pool.

- Continue efforts to identify and to resolve barriers and uncertainties to the optioning process. This activity should include continuation of efforts to test hydropower optioning capability in response to Action Item 14.1 of the 1983 plan.

- Work with conservation program analysts to develop methods to evaluate the effectiveness of conservation programs. The purpose of this activity is to improve the design of programs to acquire conservation and other dispersed resources. In general, program evaluation should provide a rigorous basis for determining market acceptance, economic impacts, and load impacts associated with conservation programs when compared to baseline conditions.

8.0 Management of the Resource Options Inventory

Resources that have been secured as options are valuable to the region and require care to preserve their availability and/or cost effectiveness. These actions may include physical asset preservation, renewal of licenses and permits, collection of environmental baseline data and maintenance of land options. Technological advances, improved information, changing resource requirements and other factors may affect the option's cost effectiveness. Therefore, periodic review of the option inventory is desirable to determine whether each option continues to be cost effective and needed.

Objectives

1. **Develop and implement a general policy that allows the region to maintain options so that they can be developed as cost-effective resources when needed.**

2. **Continue to implement actions leading to resolution of the uncertainties affecting the long-term availability of WNP-1 and WNP-3.**

Status and Review: Management of the Resource Options Inventory

Pursuant to Action Item 14.1 in the 1983 plan, Bonneville is negotiating the purchase of options on several hydropower facilities. If these options are successfully secured, they will become part of the options inventory. Bonneville needs to implement policies and procedures for the management of these options and any other options secured to protect against losing resources or to test Bonneville's ability to acquire resources.

Washington Public Power Supply System Nuclear Projects (WNP) 1 and 3 are potential options to meet future load growth requirements of the region. However, there are questions about the reliability of an option on these plants because of uncertainties associated with the ability to continue financing preservation and to finance completion of them when needed. These questions have caused the Council to leave WNP-1 and WNP-3 out of the portfolio of resources in the plan. It currently appears that preservation, completion and operation of the plants is physically feasible and would be cost effective if the region were to experience relatively high load growth. Furthermore, there appear to be no insurmountable regulatory obstacles to satisfactory completion or operation of these projects. There remain, however, serious financial, institutional and legal concerns that could prevent the projects from being completed. These concerns include the inability to finance construction, the imbalance between likely need and resource ownership, questions about financing a long-term preservation, and the potential claims resulting from the WNP-4 and WNP-5 default. It will be necessary to maintain the physical assets and resolve the legal and institutional problems if these projects are to be available when and if they are needed. If the legal and institutional problems are not resolved, these plants can not be built.

Activities: Management of the Resource Options Inventory

A work plan should be developed containing the following specific provisions:

- Develop and implement a program to establish and preserve WNP-1 and WNP-3 as options for the region, and establish an order of priority for the two projects. Council analysis has shown that these two plants have the highest expected benefit to the region if they can be preserved for a 15-year period or longer. Since most of the expected benefits derive from the ability to preserve, construct, and operate only one of the plants, the preservation program should emphasize the plant with the highest priority. A reassessment of the preservation program for each project should be conducted to assure that the most cost-effective approach consistent with these findings is being followed for each of the plants. This reassessment should be completed by July 1, 1986. The purpose of this activity is to provide a basis for preservation planning that is consistent with current forecasts of need for these projects.

- Develop and implement a plan to resolve the financial, institutional and legal uncertainties which threaten preservation and completion of WNP-1 and WNP-3. The intent of this activity is to facilitate resolution of the uncertainties affecting these projects so that they may be reinstated into the resource portfolio. This activity should begin immediately and be completed as soon as possible.

- Develop a policy to allocate the costs of securing and maintaining optioned resources. The intent of this activity is to ensure that the viability of the option concept is not compromised by the lack of funds. Recognizing that options are valuable to all of Bonneville's customers, the policy should contain a formula for allocating these costs.

- Develop a procedure to periodically evaluate resources being held in the options inventory, to determine the viability and cost effectiveness of each of the options. Models developed to achieve the objectives of the Resource Acquisitions Process and Supporting Activities, Section 7.0 of this Action Plan, should be used in this procedure.

9.0 Confirmation of Resources

Although the Council estimates that all resources in the portfolio can be developed when needed, additional work is needed to confirm this assumption for several resources. These resources include alternatives for firming secondary hydropower, the use of combustion turbines for meeting unexpected load growth, and hydropower efficiency improvements. One additional resource, geothermal, is potentially cost effective, but has been excluded from the portfolio because of great uncertainties regarding its availability and cost. Although promising, further confirmation of the availability and cost of geothermal is required before it can be included in the portfolio.

The activities called for in this section are intended to resolve implementation issues associated with resources presently included in the portfolio and resources that are apparently cost effective but presently excluded from the portfolio due to uncertainties associated with cost and availability. The timing of the activities called for in this section should be chosen to ensure that these resources are available for development when needed to meet load.

Objective

Confirm resources through analysis and research, development and demonstration activities, where appropriate.

Status and Review: Confirmation of Resources

Strategies for firming secondary hydropower are a key resource in the Council's plan. The firming strategies have very low capital costs and short lead times. Combustion turbines, for example, can be sited, licensed and built relatively quickly, and are a cost-effective way to firm secondary hydropower. Combustion turbines can also be used to verify that load increases are permanent. If combustion turbines installed for secondary hydropower firming are operated in several average or good water years to meet firm load, it would verify permanent load growth. A need for more cost-effective base load resources would be indicated. As new, more cost-effective base load resources were acquired, the combustion turbines would revert to the role of firming secondary hydropower.

The concepts of using combustion turbines in these ways were first advanced in the 1983 Power Plan. A number of important concerns have been raised with respect to the feasibility of using generating resources, and combustion turbines in particular, to firm secondary hydropower. Among these concerns are operational restraints of the Powerplant and Industrial Fuel Use Act on plants using oil or natural gas, the cost effectiveness of combustion turbines as a resource for firming secondary hydropower, the availability of sites for new combustion turbine units, and the cost and availability of fuel.

Combustion turbines clearly have the potential to be a cost-effective and significant component of the resource portfolio. Furthermore, it appears that several other alternatives discussed in this plan are available to achieve the objective of firming secondary hydropower. The feasibility and relative merits of each of the alternative approaches to firming secondary hydropower must be determined. The intent is to have one or more alternatives ready for implementation when this resource is needed.

Action Item 19.1 in the 1983 plan called on Bonneville to acquire the output of an existing combustion turbine in the region and to then petition the Economic Regulatory Administration for an exemption under the Fuel Use Act to allow use of the turbines to meet rapid load growth. Bonneville has declined to respond to this action item until additional analysis confirms that combustion turbines are an appropriate component of the resource portfolio. Given the potential benefits to the regional system from using combustion turbines in this way, the Council reiterates its desire for clarification of this issue.

Action Item 19.3 called for the Council to study regulatory requirements, including state siting standards, that would apply to new combustion turbines. Information to support this study has been compiled in reports submitted by the State Options Task Force; however, the analysis has not yet been completed.

Action Item 19.4 called for the Council to study the potential contribution of existing combustion turbines and to evaluate the effect of the Fuel Use Act on their use. The study, performed in response to Action Item 19.2, indicated that certain existing units would likely be exempt from Fuel Use Act restrictions. Because the owners of the existing units have not committed about 615 megawatts of the turbines as firm resources, the existing units are available for hydropower firming, to the extent that fuel availability can be confirmed and institutional problems resolved.

Action Item 19.5 called for the Council to study the cost effectiveness of combustion turbines as a resource for firming the nonfirm energy from the regional hydropower system. The findings of this study, based on the latest load forecasts and resource cost and performance information, have been incorporated into the resource portfolio for this 1986 Power Plan.

Action Item 19.2 called for the Council to study the likelihood of obtaining exemptions under the Fuel Use Act for the use of combustion turbines to meet rapid load growth. This analysis, completed in November 1983, concluded that the Fuel Use Act generally prohibits the use of oil or natural gas in new power plants, but that regulations under the Fuel Use Act provide for various exemptions from the general prohibition. It is unclear whether any of the types of exemptions would allow combustion turbines to be operated to meet unanticipated load growth. Exemptions are available only for specific plants actually proposed and designed, although it appears that interpretations or rulings may be issued upon request regarding application of Fuel Use Act regulations.

Strategies for firming of secondary hydropower with existing combustion turbines and the use of combustion turbines as a load verification resource continue to be important elements of this plan. However, a number of implementation issues must be resolved before combustion turbines are needed to meet load growth. The objective of several of the activities appearing below is to ensure that these resources are available when needed and to ensure consistency with the fish and wildlife program.

Confirmation of geothermal was also called for in the 1983 plan. The cost and availability of this resource can be confirmed only by drilling and testing production-scale wells. The problem, therefore, is how to confirm this resource without premature expenditure of the substantial funding required for its full development. The approach called for in Action Item 17.1 of the 1983 plan is to selectively develop small-scale geothermal plants at promising resource areas. Other approaches might include development of wellhead scale plants at selected sites, regional and federal funding of additional exploratory activities and development at selected sites for interim sale to the California market. Bonneville has prepared an offer for acquisition of geothermal demonstration projects in response to Action Item 17.1. However, objections have been raised that the process envisioned in Action Item 17.1 of the 1983 plan is too costly for the region to subsidize. Action Item 17.1 called on Bonneville to purchase 10 megawatts of capacity at a geothermal site capable of supporting 100 megawatts. The Council now believes that there may be cheaper ways of confirming a geothermal site.

Substantial progress in the assessment of system efficiency improvement potential was made in response to Action Items 11.1 and 11.2 of the 1983 plan. This is one of the most cost-effective resources appearing in the portfolio. Activities called for below will lead to further confirmation of the cost and availability of this resource.

Activities: Confirmation of Resources

A work plan should be developed which includes the following actions:

- Test and confirm strategies for firming secondary hydropower.
  - Conduct additional studies to determine the best and lowest cost energy-firming alternative. Alternatives considered should include construction of new combustion turbines, use of existing combustion turbines and combined cycle plants in the region, use of surplus or reserve units outside the region, load management, and use of cogeneration units with backup electric boilers. These studies should be completed by January 1, 1987.
  - Study the cost effectiveness of increasing the flexibility of the Northwest hydropower system. Some constraints on the flexibility of the U.S. and Canadian reservoirs may be subject to relaxation if appropriate agreements among the affected parties can be reached. Relaxation can be expected to increase the cost effectiveness of various nonfirm energy strategies.
  - Develop, analyze and test approaches to resolve the constraints to development for each of the more promising energy-firming alternatives. Among the possible constraints to analyze is the inability of Bonneville or utilities to smooth out rate fluctuations associated with several of the energy-firming strategies. This task should be completed by 1989, well before hydropower firming options are required in the high growth forecast.

- Develop a strategy to gain definitive resolution of the effects of the Fuel Use Act on the ability of the region to plan on using new and existing combustion turbines in regional planning. Two specific questions should be resolved: 1) Can the region plan on using combustion turbines to firm nonfirm hydropower, and 2) Can the region plan to use combustion turbines as a resource that meets unexpected load and verifies load prior to beginning the construction of large capital-intensive generating resources.

- Complete design of the geothermal demonstration program called for in Action Item 17.1 of the 1983 Power Plan, modifying that program to eliminate purchase of 10 megawatts of capacity but proceeding to confirm a geothermal site capable of supporting 100 megawatts, at a cost not to exceed $10 million over several years.

- Design and implement a program to demonstrate the costs and efficiency gains possible from hydropower efficiency improvements, including upgrade of turbine runners and Kaplan turbine governors. These measures are among the most promising hydropower efficiency improvement measures and may be cost effective even during the current surplus.

- Promote participation of the Electric Power Research Institute in resource confirmation activities where Pacific Northwest and national interests coincide.

- Implement additional resource confirmation activities as recommended by the Research, Development and Demonstration Advisory Committee and approved by the Council.

10.0 Intertie Access Policy

Bonneville's transmission system is a regional resource of enormous value. For this reason, the Council has included the Intertie Access Policy as a separate item in the Action Plan.

Objective

Design Bonneville's long-term intertie policy to provide an important mechanism for encouraging regional cooperation.

Status and Review: Intertie Access Policy

Bonneville developed and implemented an interim near-term policy on September 7, 1984, and a near-term policy on June 1, 1985, that significantly altered access to Bonneville's interties. Bonneville is scheduled to develop a long-term policy by September 1986.

Many aspects of Bonneville's current Intertie Access Policy are working well, and current provisions should generally be maintained. The allocation of available tieline capacity to all parties of the Pacific Northwest that have surplus resources to sell has greatly facilitated the use of Bonneville's transmission as a regional resource benefiting all the Northwest.

Activities: Intertie Access Policy

Bonneville should include the following provisions in the long-term intertie access policy:

- Allow longer-term sales, if the sales are made consistent with the following provisions.

- Use Bonneville's transmission to assure that the region has the ability to acquire the lowest cost resources first. Access to Bonneville's interties should not encourage resource development that is counter to cost-effective implementation of the plan.

- Include measures that enhance the region's ability to plan for and serve the region's customers at the lowest possible cost. To accomplish this, priority should be given to transactions that provide the greatest flexibility for meeting future planning uncertainties. Examples of flexible transactions include firm sales with a callback provision and seasonal exchanges.

- Grant access to parties outside of the region only if the following two conditions are met: 1) No firm transactions will be granted access unless economic benefits are provided to Pacific Northwest ratepayers; and, 2) If firm transactions are granted to extra-regional parties, Bonneville should seek comments from all Northwest entities concerning the impact of the extra-regional transactions on their ability to market the region's surplus. If entities in the region are adversely affected by the proposed transaction, Bonneville and the extra-regional parties should assure that compensation for those impacts is sufficient to mitigate the costs imposed on the region by the extra-regional transaction.

- While assisting with the current surplus, the federal interties should not encourage overcommitting to sales of existing resources to the point where the Northwest becomes an 'energy farm' for others. Bonneville should be guided by sections 9(c) and 9(d) of the Act in cases where long-term commitments by utilities might result in increased future costs for the region. The Council believes that both the language and intent of sections 9(c) and 9(d) of the Northwest Power Act do not allow Bonneville to serve any regional load that was served by firm resources later sold outside the region, unless the Administrator determines that the energy from the resources could not be reasonably conserved or retained for service to regional loads.

11.0 Data Development

Good basic data is fundamental to power planning. Bonneville has both the staff and budget necessary to construct and maintain large data bases in consultation with the Council and to work with the Council to continue with the refinements of analytical methods used in power planning. The Council intends to rely on Bonneville and others in the region with known expertise for collection, maintenance and dissemination of basic data for regional power planning. This Action Plan's allocation of responsibilities between Bonneville and the Council reflects this intent.

Bonneville is encouraged to identify and employ regional expertise, where available, for data acquisition, review and maintenance. Many organizations in the region, including the Pacific Northwest Utilities Conference Committee, utilities, state and federal agencies, advocacy groups, private contractors and others have demonstrated the ability to develop excellent planning data. The participation of these organizations in the data development and review process will ensure that the best regional expertise is employed in data base development and naintenance. This will also help develop egionwide endorsement of the resulting planning information.

Objectives

1. **In consultation with the Council and other regional interests, develop and maintain basic data required to support regional power planning.**

2. **Work with the Council and others to develop improved methods and tools to support regional power planning.**

Status and Review: Data Development

\ number of action items of the 1983 plan alled for activities leading to improved inforation for regional power planning.

ı response to Action Item 11.1, Bonneville's oss Savings Task Force has continued peridically to assess loss-saving potential on ie Bonneville transmission system. An ıventory of potentially cost-effective projects as been identified.

'reliminary studies by Bonneville in esponse to Action Item 11.2 indicate that iere may be a cost-effective resource of sevral hundred megawatts available through nprovements in the efficiency of the transiission and distribution systems of the egion's utilities. Because these conclusions re very preliminary, this resource has not een included in the 1986 resource portfolio.

dditional studies by Bonneville in response ı Action Item 11.2 indicate that improveıents in the efficiency of existing hydroectric generation may offer several hundred ıegawatts of new energy at very low cost. he Council has included 110 megawatts of ıergy from turbine runner replacement and overnor improvements in the 1986 resource ortfolio. There are additional efficiency ıprovement measures that require further ssessment. Thermal plant efficiency ıprovements offer the potential for addiınal cost-effective energy, and should be ssessed.

Bonneville has compiled all information in the public domain concerning the region's geothermal resources. This assessment could serve as the nucleus of an ongoing regional geothermal resource data base.

In response to Action Item 18.1, Bonneville has continued to monitor the Whisky Run Wind Park (Oregon) and the Goodnoe Hills large wind turbine test facility in Washington. Bonneville has also sponsored a feasibility study of a proposed wind farm at Cape Blanco, Oregon, and has monitored cost, technical performance, environmental and utility integration issues through on-site evaluation of California developments.

In response to Action Item 21.1, Bonneville has maintained its solar insolation monitoring network and has recently published a compilation of Pacific Northwest solar radiation data. Bonneville has indicated to Council staff that it intends to discontinue this activity in the future. The Council has received comment during preparation of this plan and the 1983 plan that the development of a long-term (up to 15-year) record of solar insolation is important in assessing the potential of the solar resource. For this reason, this plan calls for continuation of monitoring at existing sites until the adequacy of insolation data can be assessed by the Council based on the findings of the Research, Development and Demonstration Advisory Committee to be established in response to Council Activity 2.0.

In response to Action Item 22.1, Bonneville has continued to manage the Pacific Northwest and Alaska Bioenergy Program. Through this program, federal funding for energy research is being applied to regional needs.

Bonneville has sponsored a series of engineering case studies of potential regional applications of conventional and advanced generation technologies. These studies have provided the basis for the assumptions regarding the cost and performance of conventional coal plants used in the development of this plan. Because coal is the marginal resource, the coal cost-effectiveness resulting from these cost and performance data establishes the resource cost-effectiveness limit, and consequently the availability of cost-effective conservation, renewable and cogeneration resources. For this reason, it is important that these studies be maintained and updated regularly.

Activities: Data Development

Expand the data base of information to include the following resources and data elements:

- Maintain and refine the lost opportunity resource data base. The purpose of this activity is to ensure that lost opportunity resources including conservation resources are identified, and secured if determined by the Council to be cost effective. Information appearing on the data base would be used in structuring and implementing a lost opportunity resource acquisition effort. The data base should be refined to include additional resource types identified as lost opportunity resources during the development of this plan, the information required to assess the cost effectiveness of these resources, and the information required to design cost-effective approaches to securing these resources.

- Conduct an assessment of the relative shares of the conservation resource potential in public and private utility service territories.

- Continue the development and implementation of a regional survey of the residential and commercial sector use of electricity.

- Complete the current assessment of the cost and availability of efficiency improvements in the transmission and distribution systems of the region's utilities. Extend this work to include an assessment of the loss reduction potential through improved voltage regulation. Conduct periodic assessment of loss reduction potential on the transmission and distribution systems of Bonneville and the region's utilities.

- Extend the assessment of the cost and availability of efficiency improvements in the region's hydroelectric projects to include improvements in addition to turbine runner replacement and Kaplan governor replacement. Measures that might be assessed include Kaplan governors with automatic indexing, windage loss reduction, powerhouse conservation measures, loss reduction and energy recovery in navigational facilities and in fish protection and passage facilities. Possible efficiencies available from improved operational procedures might also be investigated.

- Conduct a case study of the cost and availability of efficiency improvements in a coal-fired generating unit representative of those in use in the region. This study should be completed by July 1987. Participants should evaluate the need for further work based on results obtained from the pilot study.

- In conjunction with the Council and the Corps of Engineers, complete, maintain and refine the Pacific Northwest Hydropower Data Base and Analysis System.

- In cooperation with the Council, interested state and federal agencies and the tribes, complete the Pacific Northwest Rivers Study. Develop and maintain Rivers Study Data Bases in each state to be incorporated into the Council's Hydro Assessment Data Base. In cooperation with the Council and Corps of Engineers, assure that the linkage between the Pacific Northwest Hydropower Data Bases and the Pacific Northwest Hydro Assessment Data Base is completed.

- Continue the collection and maintenance of regional wind resource data. Until superseded by the agenda for regional research, development and demonstration called for in Council Activity 2.0, this effort shall include: 1) maintenance of a network of stations for collection of long-term wind resource data; 2) initiation of a series of assessments of the most promising wind resource areas, including data on turbulence, spatial extent, climatological factors, access, environmental considerations and constraints to development; and 3) initiation of data collection at new sites that are likely to be cost effective and have significant development potential.

- Maintain and refine the Regional Geothermal Resource Data Base resulting from the Four-State Geothermal Study.

- Continue the collection and maintenance of long-term direct and global insolation data at a network of promising sites within the region. Review these activities for consistency with the regional research, development, and demonstration agenda called for in Council Activity 2.0 when it is approved by the Council.

- Continue participation in the Pacific Northwest and Alaska Bioenergy Program. Activities sponsored under this program (excepting Alaskan activities) should support the objectives of this Action Plan. Activities should include at least the development of information concerning the cost and availability of biomass fuels and assessment of generation technologies using biomass fuels.

- Continue the development, maintenance and refinement of information concerning the technical performance, cost, environmental characteristics, and constraints to development of generating technologies. This effort should include maintenance and refinement of the Comparative Electric Generation Study, and monitoring of technology research, development, and demonstration. Also included should be the development of a wind farm cost and performance algorithm that can be used in conjunction with wind resource area data to estimate the energy characteristics and costs of prospective wind developments. In this task, priority should be given to generating resources that currently establish the cost-effectiveness limit (conventional coal), other resources in the resource portfolio, and promising technologies such as wind, geothermal, fluidized bed combustion coal, steam-injected combustion turbines and integrated coal gasification-combined cycle plants.

- Initiate a program to assess the regional availability and cost of fuels for generating plants. Included should be coal, natural gas, petroleum products and biomass fuels. Estimates should be updated periodically.

- Determine the feasibility of a survey of industrial uses of energy in the region. This survey should have the objective of identifying uses of electricity and other fuels at the two-digit SIC level, with substantially more detail for key electricity-consuming sectors.

- Continue to work with the Council and others in the region to improve and maintain the demand analysis and forecasting tools needed for regional planning. This effort should include continuing analysis of data currently being collected, including data from Hood River and data being collected through ELCAP.

- Work with the Council to establish the Research, Development and Demonstration Advisory Committee described in Council Activity 2.0. The Research, Development and Demonstration Advisory Committee is expected to recommend activities that may be included in future amendments to the Council's plan.

- Develop a planning tool to assess the value to the region's power system of intermittent resources such as wind and solar. Assess the value of building a model that simulates intermittent resources operating within the region's electrical system. This effort should be complete by January 1, 1987.

II. Council Activities

The Council will continue its responsibilities related to regional energy planning and monitoring the implementation of the plan. This means that the Council will be closely involved in the cooperative development and refinement of regional data bases and improved planning methods, and will be watching for changing conditions that might dictate modifications to this plan.

In addition, in this plan the Council has dedicated itself to promoting regional cooperation. Two new tasks in which the Council will be seeking the cooperation of regional entities are: 1) assessing the research, development and demonstration (RD&D) needs in the region, with a goal of setting a regional agenda for RD&D, in which all power entities in the region are involved; and 2) conducting a West Coast energy study to examine costs and benefits of potential cooperative efforts among the Pacific Northwest, the Pacific Southwest, and Western Canada.

1.0 Information and Methods for Planning

Decisions made in power planning can only be as good as the basic information from which power planning proceeds. This section defines basic data needs and activities to gather and manage the data, concentrating on those areas where the current base of experience is limited and on the development or refinement of basic planning tools and methods.

Continued refinements to the data base are needed. The Council will work closely with Bonneville and others in the region with expertise to refine estimates of cost, performance and environmental characteristics of the various resources and technologies. Together, the resource and technology data bases support the estimates of resource availability, reliability and cost effectiveness required for power planning. The most current forecasts of fuel availability and cost are needed for assessing the cost effectiveness of resources using coal, fuel oil, natural gas and nuclear fuel.

Objectives

1. **Work with all power entities in the region to develop improved methods and tools for regional power planning.**

2. **Conduct studies of regional power planning issues found to require additional analysis as a result of the development of this plan.**

3. **Consult with all entities in the region in the maintenance of an up-to-date data base.**

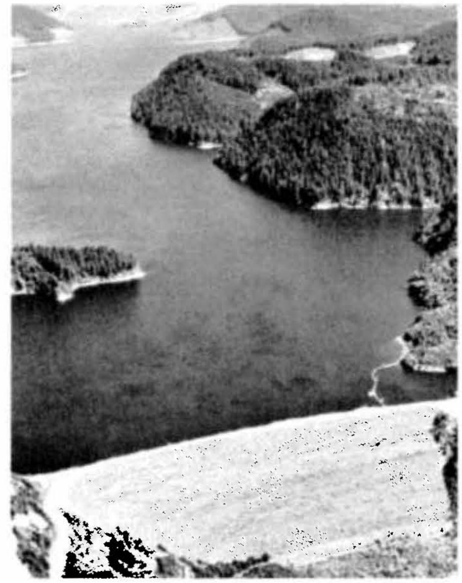
Status and Review: Information and Methods for Planning

Action Item 28.1 in the Council's 1983 Power Plan called for the Council to seek additional and better resource information. In response, the Council has continued to improve the quality and extent of its resource data base as additional information has become available.

In particular, the Council has worked to develop a renewable resources data base. For development of the 1983 plan, the Council assembled initial renewable resource data bases, using the most current information compiled from a number of studies. In response to Action Item 14.2 of the 1983 plan, the Council and Bonneville, with the assistance of a number of state and federal agencies and the tribes, initiated the Rivers Assessment Study, currently underway, to identify and evaluate stream characteristics affecting development of hydropower facilities. In response to Action Item 14.3 of the 1983 plan, the Council, Bonneville and the Corps of Engineers have upgraded the regional hydropower data base and associated computer programs for estimating the cost and energy production of potential hydropower sites.

The Council regards the continued development and maintenance of resource and consumption data as essential to successful regional power planning and important to the implementation of the Columbia River Basin Fish and Wildlife Program. The Council believes that the quality, extent, credibility and usefulness of regional power planning data can be enhanced by the development of centralized regional data bases. The credibility of such data bases can be ensured by broad participation in the assembly and review of the data included in these data bases. This approach to compiling and maintaining regional planning data should also lead to economies of scale through eliminating duplicate efforts.

In the future, the Council expects Bonneville to fund and manage the collection and maintenance of basic regional power planning data. For this reason, most basic data collection and maintenance activities called for in this plan are included under Bonneville activities. The Council will work with Bonneville to ensure that the regional planning data bases contain the information needed by the Council for future planning activities and to coordinate the schedule of data collection and format of data such that the Council's needs are met. The Council will assist Bonneville in data acquisition and review, as appropriate. The Council encourages Bonneville to use regional expertise wherever available in the acquisition of data, and to seek broad review and consensus on the resulting data bases.



Future work of the Council will focus on the analysis of planning issues. The Council will also seek to achieve technical equivalence between the planning models used by Bonneville and those used by the Council. And, as described above, the Council will work with Bonneville to promote regional endorsement of the region's planning data.

Both the Council and Bonneville have developed decision models to provide strategic analysis of resource alternatives. These models, while incorporating similar characteristics, have different strengths and weaknesses. A better decision analysis model can be developed by incorporating the best features of both models. The Council and Bonneville need to work together to evaluate both models and to design an improved decision model. The joint development of a single System Analysis Model (SAM) has helped the region focus on policy alternatives that are analyzed in a consistent framework. The process used to develop SAM needs to be duplicated to develop a more consistent decision model.

Activities: Information and Methods for Planning

This work plan will include the following specific activities:

- Work with Bonneville and others to ensure the consistency of the resource data bases used for regional power planning. To the extent feasible, the Council will seek to use centralized regional resource data bases in future planning.

- Work with Bonneville and others to develop a more uniform decision model for regional resource planning.

- Work with Bonneville and others in Bonneville's efforts to develop a planning tool to assess the value to the region's power system of intermittent resources such as wind and solar. Assess the value of building a model that simulates intermittent resources operating within the region's electrical system. This effort should be complete by January 1, 1987.

- Conduct a survey to determine the net effect on the availability of cogenerated electricity if utility or regional capital is made available, instead of requiring industrial financing of the cogeneration facility.

- Work with Bonneville and others in refining the heat loss models used to estimate annual space heating use in residential buildings.

2.0 Research, Development and Demonstration Agenda

Confirming the availability, cost and performance of promising resources typically requires a series of research, development and demonstration activities. The region does not currently have an open process to address decisions about what projects are considered for research and development funding. This action item calls for developing that process.

The allocation of the region's research and development expenditures should be reviewed and adjusted if necessary. Much of the region's research and development expenditures currently go to the Electric Power Research Institute (EPRI). It is not clear that EPRI's research is focused appropriately for the needs of the Pacific Northwest, given both the nature of this region's resource base and the region's schedule and priority for new resources. The Council will work with Bonneville, the region's utilities, state energy offices, and public utility commissions to coordinate the region's research and development expenditures. Coordinated action should refocus and reprioritize all these expenditures to be consistent with the future needs of the region and to ensure that the costs of the research and development programs are fairly shared among the utilities. This action should include a thorough review of resource research, development and demonstration (RD&D) needs, development of a consistent regionwide RD&D policy, and development and implementation of RD&D agendas for promising resources.

In medium-high and high forecasts, the region may have to turn to new coal plants. The Council expects that before the region actually commits to coal generation it will open a 'window of opportunity' for any other higher priority, cheaper, environmentally preferable resource. Research, development and demonstration need to be done in order to demonstrate whether renewable resources will be available and cost effective in time to displace coal plants.

Objectives

1. **To determine the best allocation of regional funding for resource research, development and demonstration activities.**

2. **To coordinate the research, development and demonstration necessary to confirm the cost effectiveness of conservation, renewable, and high efficiency resources before commitments must be made to acquire conventional thermal resources. Without this effort, potentially cost-effective priority resources may not be able to help the region avoid construction of new conventional thermal resources.**

Status and Review: Research, Development and Demonstration Agenda

Research, development and demonstration are not currently coordinated in the region. Although Bonneville has an internal process for allocating its own research and development budgets, it relies on the Electric Power Research Institute for much of its information. However, because of the unique system in the Northwest, that information is not always applicable. Investor-owned utilities and larger generating utilities in the region conduct their own research and development activities. It is in this context that the Council has included the following activities that should lead to a coordinated research, development and demonstration program for the region.

Activities: Research, Development and Demonstration Agenda

- Organize a Research, Development and Demonstration Advisory Committee to recommend to the Council an agenda for resource research, development and demonstration needs. This committee, when formed, should focus its attention initially on renewable resources.

- The Committee will deliver recommendations to the Council, describing the necessary actions to resolve uncertainties affecting resource planning and to improve the cost effectiveness and environmental acceptability of specific resources. Each recommendation should include a description of the action, its justification and relationship to the plan, its priority, estimated cost and schedule, and how the recommendation fits into the context of all regional research, development and demonstration.

- The Council will review the recommendations of the committee and take actions as necessary.

3.0 Monitoring and Review of Plan Implementation

As with any plan, it is important that the Council be aware of how this plan is being implemented and how the region's energy future is unfolding. Without this process, the Council would be unable to respond to changing conditions.

A major objective of the Council in developing the plan was to deal effectively with the obvious uncertainties facing the region. The Council has developed a program to monitor implementation of the plan and to evaluate the plan's continuing suitability for the region's energy future. With this information, the Council can take corrective actions quickly. As a result, the plan is not a document to be placed on a shelf; it establishes a continuing and adaptive process. The Council will modify specific parts of the plan, or the entire plan, if such changes are warranted by any changes in the conditions and assumptions on which the plan depends. Plan modifications may also be needed as the region's progress toward the objectives of the plan is evaluated and as experience is gained from the operation of various programs.

As required by section 4(k) of the Act, the Council will, by October 1, 1987, complete a thorough analysis of conservation measures and conservation resources implemented pursuant to the Act during the first five years of the Council's existence. This analysis will determine whether conservation measures or conservation resources:

a) have resulted or are likely to result in costs to consumers in the region greater than the costs of additional generating resources or additional fuel which the Council determines would be necessary in the absence of such measures or resources;

b) have not been or are likely not to be generally equitable to all consumers in the region; or

c) have impaired or are likely to impair the ability of the Administrator to carry out his obligations under this Act and other laws, consistent with sound business practices.

If the Bonneville Administrator finds, after the receipt of this analysis from the Council, that such a measure or resource would have any of these effects, he may determine that the Act's 10 percent credit for conservation will not apply.

In the first planning period, the Council focused on the actions of Bonneville through a periodic monitoring report which was based on the action items in the 1983 Action Plan. In this second planning period, while the emphasis will continue to be on monitoring the response of Bonneville to the objectives outlined in the plan, the Council also will work more closely with other institutions in the region.

Objectives

1. **Promote regional cooperation.**

2. **Monitor Bonneville's consistency with the objectives of the plan.**

3. **Enable the Council to make corrective changes to the plan, if needed, by providing the Council with the information necessary to determine whether or not the forecasts, assumptions, analysis and recommendations contained in the power plan are developing or evolving as anticipated.**

Status and Review: Monitoring and Review of Plan Implementation

The Council has closely monitored the status of all conservation and generating resource action items from the 1983 plan. A monitoring status report has been developed outlining the monitoring process to be followed for each objective and action contained in the plan.

In addition, the Council evaluates the status of the regional economy and loads on a regular basis. The Pacific Northwest Utilities Conference Committee developed a monthly publication, *The Regional Load Monitor,* to help track current trends in regional loads.

Activities: Monitoring and Review of Plan Implementation

- Continue to implement the monitoring system and report quarterly on progress being made in implementing the plan.

- Prepare by October 1, 1987, a thorough analysis of conservation measures and conservation resources implemented pursuant to the Act and the Council's plan.

- Report regularly on the status of the regional economy and the demand for electricity.

- Initiate modifications to the Council's plan as required by changing conditions or information.

- Represent the regional perspective in the U. S. Department of Energy proceeding to set national appliance efficiency standards, in amendments to update standards set forth by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, and in any proceedings that would result in significant conservation opportunities for the Northwest, including those proceedings dealing with appliances, buildings and manufactured homes.

- Work with legislatures of the four states and with state and local governments to facilitate adoption of cost-effective building and appliance efficiency codes.

- Monitor work done by others who are examining efficiency improvements in residential appliances. Study the feasibility of a higher level of efficiency than the 1992 California standard.

- Consult with Bonneville, utilities, state and local governments, public utility commissions, and others as needed to facilitate regional cooperation in meeting the objectives of this plan.

4.0 West Coast Energy Study

As the regional planning body, the Council should play a significant role in analysis of out-of-region purchases and sales, a major element of utility planning. The Council will conduct a West Coast energy study to examine costs and benefits of potential cooperative efforts among the Pacific Northwest, the Pacific Southwest, and Western Canada. This action will ensure that the Council is kept informed about current and future opportunities for interregional cooperative planning. With information provided through this study, the Council can factor import/export opportunities into its planning, rather than having to react to activities that are outside of its planning process. The Council will take no part, other than supplying information to interested parties, in financial negotiations among parties.

Objective

Design and implement an energy study to explore mutually beneficial cooperative agreements among utilities in the Northwest and in connected regions.

Status and Review: West Coast Energy Study

The Council has adopted West Coast cooperative planning as a major activity for the next several years. This activity will begin immediately. For background and additional details of the Council's proposed activities, see the staff issue paper "Out of Region Imports/Exports," March 27, 1985. While the Council has consulted with some of the organizations that will be involved in the study, no specific activities have taken place to date.

Activities: West Coast Energy Study

- Develop a work plan by April 1986 that includes the following elements:
  - Initiate the formation of a technical committee of representatives of interested West Coast utilities, planning agencies and utility commissions in the 11 Western states, and Canadian utilities in British Columbia and Alberta. The primary objectives of the technical committee would be to work with the Council to identify promising cooperative actions that can be taken by interested parties and to assess the benefits of those cooperative actions. The analysis would include all resources that might be available for cooperative sales or exchange of power and associated transmission issues.
  - Consult at the staff and Council level with all interested regional parties, including fish and wildlife agencies and tribes, affected utilities, state energy and regulatory agencies, environmental and ratepayer groups, and other interested members of the public.
  - Report periodically on the results of studies conducted by the technical committee and take action as necessary to promote cooperative arrangements that further the goals of this plan. The Council would not be part of any negotiations of financial terms of contracts between or among interested parties. The Council would consult with technical and planning bodies in this and other regions, as necessary, to evaluate policy considerations that might affect beneficial agreements.
- In order to be most effective, a draft study should be completed within about a year after the adoption of this Action Plan, and a final study should be completed by April 1987.

III. Recommended Activities for the Region's Public Utility Commissions and Investor-Owned Utilities

Throughout the development of this power plan, the Council has assumed that the region as a whole would cooperate in the process of developing the most cost-effective resources first. In developing this plan, the Council conducted studies that illustrate the difference between the power needs of some of the investor-owned utilities and those of the Bonneville Power Administration. Since the Act requires the Council to review Bonneville acquisition of resources sufficient to meet Bonneville's obligations, the Council has focused on action items for Bonneville that recognized Bonneville's current surplus, the uncertainty in investor-owned utility loads potentially being placed on Bonneville, and Bonneville's current load obligations.

At this time, only small loads are being placed on Bonneville by investor-owned utilities. Until investor-owned utilities place loads on Bonneville, there will be considerable uncertainty with respect to Bonneville's obligations through the power sales contracts. As the investor-owned utilities plan their most cost-effective strategy for meeting the needs of their consumers, there are several actions that will help to coordinate regional planning and thereby prepare the region for securing the lowest cost resources. Specific suggested actions involving cooperative planning among public utility commissions, investor-owned utilities and others are described in the introduction to this Action Plan. Other recommended activities that the region's public utility commissions and investor-owned utilities should consider in order to facilitate coordinated implementation of the plan are presented below.

The Council recognizes that public utility commissions will need to balance the interests of both gas and electric ratepayers when implementing the following actions. The Council is concerned that the benefits of conservation could be negated if substantial fuel switching occurs. Also, the Council recognizes that the needs of each utility may be different. These differences need to be considered in addressing these recommendations.

1.0 Lost Opportunity Conservation

The size and expected duration of the surplus require a reevaluation of the region's conservation programs. For most of the region's utilities, conservation actions should not be taken to acquire megawatts unless those megawatts represent a lost opportunity to the region. The model conservation standards represent such a lost opportunity, because if buildings being built in the next several years are not built efficiently, retrofitting those buildings to a level comparable to the standards will not be cost effective. The region should capitalize on the opportunity during the period of current surplus to modify building practices so that more efficient residential and commercial buildings are constructed in the future.

To implement the standards regionwide, the Council recommends that the region's public utility commissioners and investor-owned utilities consider providing incentives to builders of new buildings in investor-owned utilities' service territories. These incentives would help to achieve regionwide new residential and commercial construction levels that are consistent with the standards. The following incentives are recommended:

- Marketing assistance through programs similar to Super Good Cents to provide technical information and advertising for homes and commercial structures built to the standards' levels of efficiency.

- Public utility commissions and investor-owned utilities may wish to offer financial assistance in order to encourage construction to the standards' level. The Council recommends that the region's public utility commissions consider providing appropriate rate treatment for investor-owned utility expenditures.

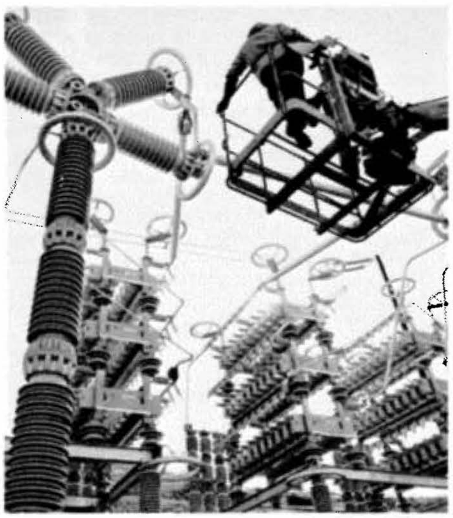
- The investor-owned utilities should participate in Bonneville's research on more efficient buildings. The investor-owned utilities may bear some costs from participating in this research and, since these expenditures would benefit both the investor-owned utilities' ratepayers and the region, the Council recommends that the public utility commissions consider providing appropriate rate treatment for these costs.

2.0 Acquisition of New Generating Resources

The current regional surplus will probably last from five to 20 years. Because of the current availability of relatively low-cost surplus power, aggressive acquisition of Public Utility Regulatory Policies Act (PURPA) resources is not needed at this time. The Council recognizes that existing statutory requirements may require a certain level of PURPA acquisition in spite of the region's current surplus. Given these considerations, the Council recommends that the public utility commissions and investor-owned utilities consider developing an acquisition policy for PURPA resources that includes the following elements:

- PURPA acquisitions should emphasize lost opportunity resources. These are resources the region would lose forever unless they are acquired now. For this reason, immediate acquisition of some lost opportunity resources may be justifiable on the basis of cost.

- The region's public utility commissions should consider establishing a consistent avoided cost policy for pricing PURPA resource acquisitions during the current surplus. Because each utility is unique in the resources it has access to and in its access to capital, the Council does not assert that the same avoided cost figure should be used by all jurisdictions for all



utilities. However, the Council does recommend that the region's public utility commissions develop a consistent avoided cost policy so that future PURPA resource acquisitions within the region are consistent to the extent feasible for each utility and across state boundaries. The Council recommends that the basis for such an avoided cost policy be the forecasted new resources pool rate that Bonneville will be developing. That is, in the event that lost opportunity PURPA resources are acquired, only those that are cost effective when compared to Bonneville purchase should be acquired.

3.0 Sale of Existing Resources and Maintenance of Options

Considerable uncertainty exists concerning the duration of the current surplus. Because of this uncertainty, the region's investor-owned utilities and public utility commissions should exercise care in not over-committing to long-term sales of existing resources outside the region. The long-term sale of the region's existing resources could necessitate the development of higher cost new resources to meet the region's needs. If this occurs, the region could bear significant added costs.

In addition, it is important to recognize that utilities will not be able to exactly match resources to loads, yet they need the ability to maintain an inventory of options or resources. Given the uncertainty of projecting and meeting load growth, the Council recommends that the region's public utility commissions consider ways to provide rate treatment for the costs of developing and holding an inventory of options or resources.

The current regional surplus is not uniformly distributed to all utilities within the region. For this reason, the public utility commissions and the investor-owned utilities need to continue to facilitate the transaction of existing surplus resources to those entities within the region that currently have need for them. These kinds of transactions will help to alleviate the cost impacts of the current surplus on the region's utilities that have surpluses and at the same time maintain the regional benefits of the existing resource base.

4.0 Existing Residential Weatherization Program

During the current surplus, conservation program savings from existing residential weatherization are not needed in most utility service areas. For this reason, the Council recommends that existing weatherization programs should be operated at the minimum viable level. In addition, they should be modified to achieve the following characteristics:

- The programs should avoid creating lost opportunity resources. Lost opportunities are created by partially weatherizing homes. To avoid this, weatherization programs that are operative should take care to install all conservation measures that are cost effective. The Council estimates these measures to be all measures that can be purchased for less than 5.0 cents per kilowatt-hour on a levelized life cycle cost basis.

- Weatherization programs have yet to reach and include sufficient numbers of low income households. Because low income households cannot contribute to the cost of weatherizing their homes, the Council recommends that utilities should continue to encourage low income participation in weatherization programs and pay the full cost of all cost-effective measures installed.

- The existing weatherization programs have had only limited success at weatherizing rental property. For this reason, the weatherization programs should focus efforts on achieving a substantial proportion of participants from rental properties.

5.0 Conservation Capability Building

The Council recommends that the region's public utility commissions and investor-owned utilities consider participating with Bonneville in regional demonstrations of the technical feasibility and economic cost effectiveness of new conservation opportunities. Sectors in which Bonneville will be developing capability include the existing commercial and industrial sectors. The investor-owned utilities should participate in Bonneville's demonstration projects in both the commercial and industrial sector. To the extent the investor-owned utilities incur costs through their participation in these demonstration projects, the Council recommends that the utility regulatory commissions consider providing them appropriate rate treatment. These activities are important for the region at this time, since they will help develop the region's capability to cost effectively secure conservation savings from these sectors. At this point, the region has little conservation experience in either commercial or industrial conservation opportunities, and utilities should take the opportunity during the current surplus to develop this capability.

6.0 New Manufactured Housing

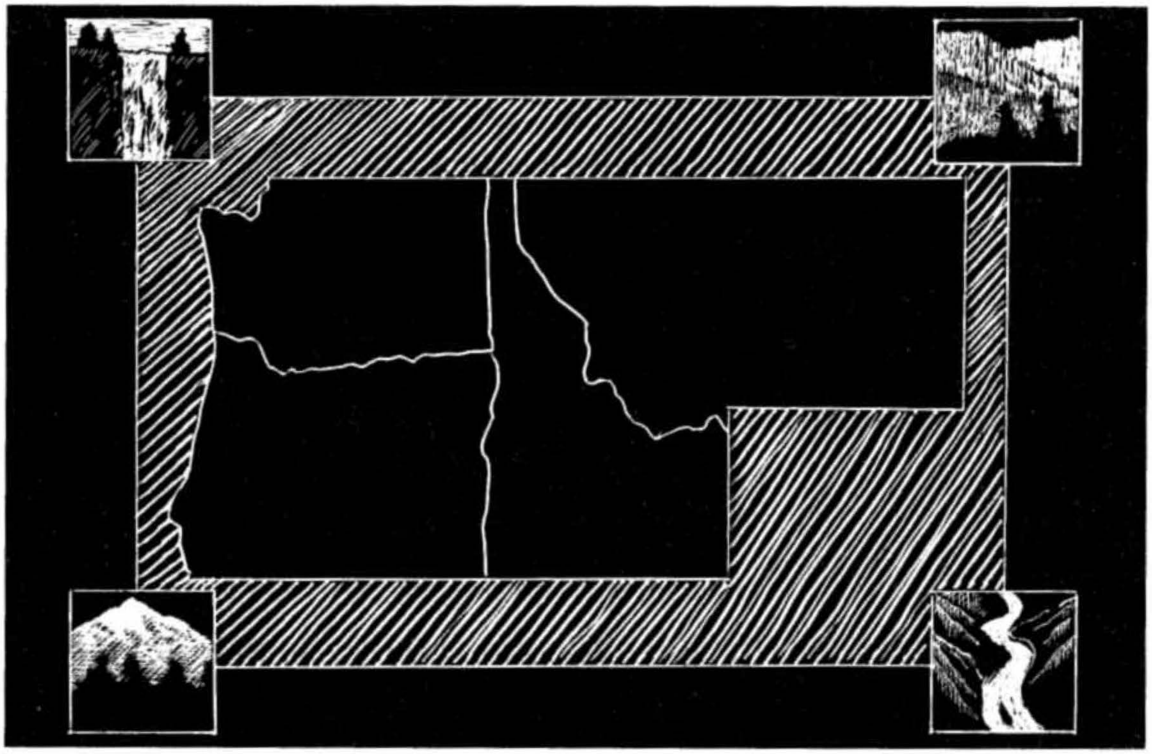
Significant numbers of new manufactured houses are being built and sold in this region. Many of these homes are heated electrically and are built much less efficiently than the model conservation standards would require. Therefore, the Council recommends that the investor-owned utilities and public utility commissions consider working with Bonneville in providing information and technical assistance to owners and builders of new manufactured housing. In order to achieve a change in building practice in the manufactured housing industry, it may be necessary to offer incentives to either manufacturers or owners. The Council recommends that public utility commissions and investor-owned utilities consider participating with the Council and Bonneville in developing consistent incentive-based programs for new manufactured housing.

1./ If local utilities determine that higher levels of financial assistance are required to achieve compliance, they should adjust their assistance level as appropriate.

2./ Acquisition programs are programs designed and intended to acquire electric generating resources or conservation savings for the sole purpose of meeting electric loads. Programs designed or intended merely to build or maintain capability or to confirm the availability or reliability of resources or savings are not acquisition programs. Acquisition programs for a major resource as defined in the Northwest Power Act must undergo the process provided in section 6(c) of the Act.

3./ A lost opportunity resource is a potential electric power generating resource or a potential electric power conservation measure that is currently available to the region and that, if not acquired or otherwise secured now, will no longer be available and cost effective to the region. If a lost opportunity resource is not secured, it will have to be replaced in the future by a less cost-effective resource. A lost opportunity resource is cost effective and should be secured if the present value system cost of the investment to secure and maintain the resource, as determined by the Council, is less than the expected present value system cost of other resources included in the Council's resource portfolio that might have to replace it.

4./ The Council and Bonneville will develop the precise definition of, and a plan for monitoring changes in, the annual regional firm surplus.



Chapter 10

Chapter 10
Conclusion

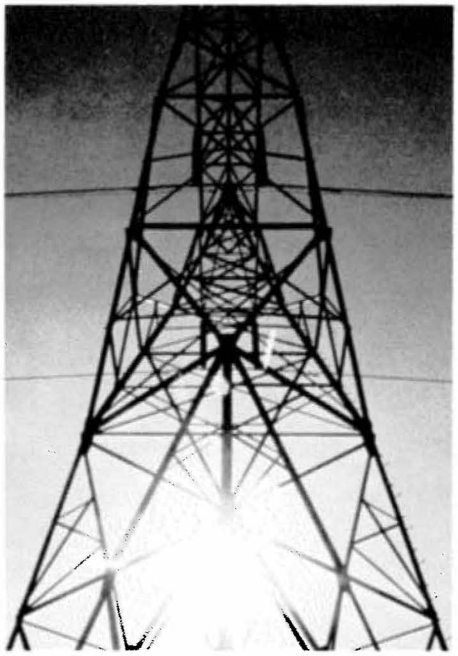
The 1986 Power Plan is a positive response to the uncertain events in the Northwest's electrical energy future. The information and strategies in this plan are intended to ensure that the region has access to the lowest cost and most reliable resources when they are needed.

Decisions the region makes about what resources to acquire and when to acquire them will have a critical effect on the health of the Pacific Northwest economy and its environment.

During the present surplus of electricity, the plan calls for securing lost opportunity resources, such as conservation in new buildings, which represent one-time chances to gain benefits that will long outlast the surplus. But the plan minimizes acquisition of other resources that would add to the surplus and to regional power rates.

The Council's plan provides the means for an ongoing re-evaluation of need. By calling for development of conservation when new resources are needed, the plan embodies its principle of choosing the most flexible resources first—the ones with the shortest lead times, smallest units and least cost. This approach allows the region to reduce the cost and likelihood of making mistakes.

The plan concentrates on making better use of existing resources, not only with conservation measures but through strategies for making nonfirm hydropower more reliable and useful, so it can meet part of the future energy demand far more cheaply than by building new generating resources.



A central purpose of the Council's plan is to provide the lowest cost energy future for the Northwest. Average retail rates for all Northwest consumers rose from 1.7 cents per kilowatt-hour in 1979 to an estimated 3.4 cents in 1984—a 100 percent increase. The increase in Bonneville's wholesale power rates to preference customers has been more dramatic, increasing by over 500 percent, from .35 cents to 2.2 cents per kilowatt-hour. If the provisions of this plan are implemented, the Council forecasts that average retail rates over the next 20 years will be stable or decrease (adjusting for inflation) in all but the highest growth scenario. The medium-high and medium-low forecasts for the year 2005 anticipate average retail rates for all consumers of 3.8 cents and 3.1 cents respectively (1985 dollars). Low growth would produce a forecasted rate of 2.8 cents. High case rates would increase to 4.5 cents. Reduced demand growth and the current surplus account for much of the expected decline in rates. Decision strategies in this plan contribute to the rate stability through reliance on least-cost resources and by preventing over- and underbuilding of resources.

A fuller account of the methods and conclusions of this planning process will be found in Volume II. It describes the analytical work and technical details that support the policy decisions.

Achieving the least-cost energy future described in this plan will require new forms of cooperative effort in the Pacific Northwest. The Council has identified substantial benefits achievable through a regional approach to developing the lowest cost resources first. The Council has also described actions that would produce shared advantages if they are taken by all the organizations involved in making energy decisions.

The plan's resource mix and schedules, its planning strategy, and the opportunities it identifies for cooperative regional development of resources could potentially save the region's economy billions of dollars that would not otherwise be available for investments, purchases and employment. They can reduce the development of resources that would damage the region's environment.

The Northwest's inexpensive electricity, due largely to an abundant hydropower base, has been a cornerstone of the region's economy. The goal of this 1986 Power Plan is to stretch that great resource and, by using it more efficiently, to ensure continuing inexpensive electricity in the future.

administrative costs
Certain overhead costs related to conservation or generating resources, such as project management and accounting.

anadromous
Fish that hatch in fresh water, migrate to the ocean, mature there, and return to fresh water to spawn. For example, salmon or steelhead trout.

available technology
The range of efficiency choices for electrical appliances or other equipment that are currently known technologies and are expected to be generally available in the marketplace at some time during the 20-year planning period.

average cost pricing
A concept used in pricing of electricity. The average cost price is derived by dividing the total cost of production by the total number of units sold in the same period to obtain an average unit cost. This unit cost is then directly applied as a price.

average annual megawatt or average megawatt
A unit of energy output over a year. It is equivalent to the energy produced by the continuous operation of one megawatt of capacity over a period of one year. (Equivalent to 8,760 megawatt-hours or 8,760,000 kilowatt-hours.)

avoided cost
An investment guideline, describing the value of conservation and generation resource investments in terms of the cost of more expensive resources that would otherwise have to be acquired.

base load
The minimum load in a power system over a given period of time. Base load resources run continually except for maintenance and scheduled or unscheduled outages.

billing credit
Under the Northwest Power Act, a payment by Bonneville to a customer (in cash or offsets against billings) for actions taken by that customer to reduce Bonneville's obligations to acquire new resources.

binary-cycle
A generation system that, rather than using steam directly to drive a turbine, uses secondary working fluids. These systems pipe the resource (e.g., geothermally heated water) to a heat exchanger, vaporizing a secondary fluid which then drives a turbine.

Bonneville Power Administration (Bonneville)
A federal agency that markets the power produced by Federal Base System resources and resources acquired under the provisions of the Northwest Power Act of 1980. Bonneville sells power to public and private utilities, direct service industrial customers, and various public agencies. The Northwest Power Act charges Bonneville with other duties, including pursuing conservation, acquiring sufficient resources to meet its contract obligations, and implementing the Council's plan.

Btu (British thermal unit)
The amount of heat energy necessary to raise the temperature of one pound of water one degree Fahrenheit (3,413 Btus are equal to one kilowatt-hour).

buyback
A conservation program that, in effect, purchases electrical energy in the form of conservation measures installed by a consumer. The consumer is paid a certain amount per kilowatt-hour of energy saved.

callback
A power sale contract provision that gives the seller the right to stop delivery of power to the buyer when it is needed to meet other specified obligations of the seller.

capacity
The maximum power that a machine or system can produce or carry under specified conditions. The capacity of generating equipment is generally expressed in kilowatts or megawatts. In terms of transmission lines, capacity refers to the maximum load a line is capable of carrying under specified conditions.

climate zone
As part of its model conservation standards, the Council has established climate zones for the region based on the number of heating degree days, as follows: Zone 1: 4,000-6,000 heating degree days (the mild maritime climate west of the Cascades and other temperate areas); Zone 2: 6,000-8,000 heating degree days (the somewhat harsher eastern parts of the region); and Zone 3: over 8,000 heating degree days (western Montana and the severe higher elevations throughout the region).

cogeneration
The simultaneous production of electricity and useful heat energy from a fuel source. Often, this is accomplished by the recovery of excess 'waste' energy created by various industrial and commercial applications. This energy is typically used for industrial processes or space heating applications.

combined cycle
The combination of a gas turbine and a steam turbine in an electric generation plant. The waste heat from the gas turbine cycle provides the heat energy for the steam turbine cycle.

combustion turbine
A turbine engine generator, often fired by natural gas or fuel oil, used to generate electricity. The generator is turned by the exhaust gases rather than heat-created steam.

conservation
According to the Northwest Power Act, any reduction in electric power consumption as a result of increases in the efficiency of energy use, production, or distribution.

cost effective
According to the Northwest Power Act, a cost-effective measure or resource must be forecast to be reliable and available within the time it is needed and to meet or reduce electrical power demand of consumers at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative or combination of alternatives.

critical period
The sequence of low water conditions during which the region's hydropower system's lowest amount of energy can be generated while drafting storage reservoirs from full to empty. Under the Pacific Northwest Coordination Agreement, it is based on the lowest multi-month streamflow observed since 1928. Based on analysis of streamflows at

The Dalles, this is also the lowest streamflow since recordkeeping began in 1879.

critical water
The sequence of streamflows in the critical period, under which the hydropower system will generate about 12,300 average megawatts. In an average year, the Northwest hydropower system will produce about 16,400 average megawatts.

curtailment
An externally imposed reduction of energy consumption. Does not include response to price.

debt/equity ratio
The ratio of debt financing to equity financing used for capital investment.

Decision Model
A computer model which simulates decisions to option and build resources across a large number of possible load paths. It shows the effects of uncertainty of the load forecast and variations in hydropower availability on various resource strategies. The Council uses the model to help choose the best strategy.

demand forecast
An estimate of the level of energy that is likely to be needed at the point of use at some time in the future.

direct application renewable resource
Technologies that use renewable energy forms to perform the same task as electricity. These energy forms and their functions include wood, solar, and geothermal space and water heating, and wind machines used for mechanical drive (such as pumping).

direct service industry
An industrial customer that buys power directly from the Bonneville Power Administration. Most direct service industries are aluminum smelting plants.

discount rate
The rate used in comparing values observed at different points in time. Discount rates are used to compute such measures as present value and levelized cost.

drawdown
Release of water from a reservoir for purposes of power generation, flood control, irrigation, or other water management activity.

energy
That which does, or is capable of doing, work. Energy is measured in terms of the work it is capable of doing. Electrical energy is commonly measured in kilowatt-hours, or in average megawatts.

Average annual energy is the total kilowatt-hours generated over a period of a year, divided by the number of hours in one year.

equivalent availability
The ratio of the maximum amount of energy a generating unit can produce, after adjustment for maintenance and forced outage, to the capacity of the unit. It also represents an upper limit for a long-run (annual or longer) capacity factor for a generating unit. For example, a unit with an equivalent availability of 70 percent and a capacity of 500 megawatts could be relied on to produce 350 average megawatts of energy over the long term, if required.

Federal Base System
The system includes the Federal Columbia River Power System hydroelectric projects, resources acquired by the Bonneville Power Administration under long-term contracts prior to the Northwest Power Act, and resources acquired to replace reductions in the capability of existing resources subsequent to the Act.

Federal Energy Regulatory Commission (FERC)
A federal agency which regulates interstate aspects of electric power and natural gas industries. It has jurisdiction over the licensing of hydropower projects and the setting of some rates. The FERC was formerly the Federal Power Commission.

firm energy
Electric energy which is considered assurable to the customers to meet all agreed upon portions of the customers' load requirements over a defined period.

firm energy load carrying capability (FELCC)
The amount of firm energy that can be produced from a hydropower system based on the system's lowest recorded sequence of streamflows and the maximum amount of reservoir storage currently available to the system.

firm surplus
Firm energy in excess of the firm load.

generation
The act or process of producing electricity from other forms of energy. Also, the amount of energy so produced.

geothermal
Useful energy derived from hot rock, hot water, or steam in the earth's surface.

head
The vertical height of water in a reservoir above the turbine.

heat engines
Devices that convert thermal energy to mechanical energy. Examples include steam turbines, gas turbines, internal combustion engines, and Stirling engines.

heating degree days
The average degrees per year it takes to bring the daily temperature to an interior temperature of 65 degrees. Heating degree days are determined by the National Weather Service.

hydroelectric power (hydropower)
The generation of electricity using falling water to turn turbo-electric generators.

infiltration control
Conservation measures, such as caulking and weatherstripping, which are taken to reduce the amount of cold air entering or warm air escaping from a building through cracks around doors and windows and poorly sealed vent dampers.

Intercompany Pool (ICP)
An organization formed to coordinate the power operations of the investor- owned utilities of the Pacific Northwest. The ICP includes Portland General Electric, Pacific Power and Light, Puget Sound Power and Light, Washington Water Power, Montana

Power Company, Idaho Power Company, Utah Power and Light, and Sierra Pacific Power Company.

interruptible power
Power that, by contract, can be interrupted in the event of a power deficiency.

intertie
A transmission line or system of lines permitting a flow of energy between major power systems.

investor-owned utility
A utility which is organized under state law as a corporation to provide electric power service and earn a profit for its stockholders.

kilowatt (kW)
The electrical unit of power which equals 1,000 watts.

kilowatt-hour (kWh)
A basic unit of electrical energy which equals one kilowatt of power applied for one hour.

levelized life cycle cost
The present value of a resource's cost (including capital, financing and operating costs) converted into a stream of equal annual payments. For example, if no down payment is paid on a house, and the entire amount needed to buy it is borrowed from a bank, that amount is the present value of buying a house. The mortgage payment including interest on a house is the levelized cost of that house. (Unit levelized life cycle costs, in cents per kilowatt-hour, are obtained by dividing this payment by annual kilowatt-hours saved or produced.) Unlike installed cost, levelized costs permit comparisons of resources with different lifetimes and generating capabilities.

load
The amount of electric power required at a given point on a system.

load forecast
An estimate of the level of energy that must be generated to meet a need. This differs from a demand forecast in that transmission and distribution losses are considered.

load path
One future scenario for electric load growth, as opposed to a range that accomodates multiple forecasts of future load growth.

lost opportunity resources
Resources which, because of physical or institutional characteristics, may lose their cost effectiveness unless actions are taken to develop these resources or to hold them for future use.

major resource
According to the Northwest Power Act, a resource with a planned capability greater than 50 average megawatts, and if acquired by Bonneville, acquired for more than five years.

manufactured home
A structure, such as a mobile home, that is transportable in one or more sections, and that is built on a permanent chassis and designed to be used as a dwelling, with or without a permanent foundation, when connected to the required utilities. These homes must comply with the Manufactured Home Construction and Safety Standards issued by the U.S. Department of Housing and Urban Development in response to the 1974 Act.

This does not include other categories of homes whose components are manufactured, such as modular, sectional, panelized, and precut homes. These homes must comply with state and local building codes.

marginal cost
The cost of producing the last unit of energy (the long-run incremental cost of production). In the plan, "regional marginal cost" means the long-run cost of additional consumption to the region due to additional resources being required. It does not include consideration of such additional costs to any specific utility due to its purchases from Bonneville at average cost.

measure
Either an individual conservation measure or action or a combination of actions.

megawatt (MW)
The electrical unit of power which equals one million watts or one thousand kilowatts.

mill
A tenth of a cent. The cost of electricity is often given in mills per kilowatt-hour.

model conservation standards
Energy efficient building standards (developed by the Council) for new electrically heated buildings.

municipal solid waste (MSW)
The waste that is collected in a municipality. This refuse can be burned in an MSW electric generator to produce electricity.

net billed plants
Refers to the 30 percent share of the Trojan Nuclear Plant and all of WNP-1 and 2, and 70 percent of WNP-3.

net billing
A financial arrangement that allowed Bonneville to underwrite the costs of electric generating projects. Utilities that owned shares in thermal projects, and paid a share of their costs, assigned to Bonneville all or part of the generating capability of these resources. Bonneville, in turn, credited and continues to credit the wholesale power bills of these utilities to cover the costs of their shares in the thermal resources. Bonneville then sells the output of the thermal plants, averaging the higher costs of the thermal power with lower cost hydropower. Washington Public Power Supply System Nuclear Projects 1, 2, and 3, and part of the Trojan Nuclear Project, are net billed.

nominal dollars
Dollars that include the effects of inflation. These are the dollars that, at the time they are spent, have no adjustments made for the amount of inflation that has affected their value over time.

nonfirm energy
Energy produced by the hydropower system that is available with water conditions better than critical and after reservoir refill is assured. It is available in varying amounts depending upon season and weather conditions.

option
The purchase of a right to acquire a resource within a particular time on specified terms.

Pacific Northwest (the region)
According to the Northwest Power Act, the area consisting of Oregon, Washington, Idaho, Montana west of the Continental Divide, and such portions of Nevada, Utah,

and Wyoming as are within the Columbia River Basin. It also includes any contiguous areas not more than 75 miles from the above areas that are part of the service area of a rural electric cooperative customer served by Bonneville on the effective date of the Act and whose distribution system serves both within and without the region.

Pacific Northwest Coordination Agreement
An agreement between federal and non-federal owners of hydropower generation on the Columbia River system. It governs the seasonal release of stored water to obtain the maximum usable energy subject to other uses.

Pacific Northwest Utilities Conference Committee (PNUCC)
Formed by Pacific Northwest utilities officials in order to coordinate policy on Pacific Northwest power supply issues and activities. It lacks contractual authority, but it does play a major role in regional power planning through its Policy, Steering, Fish and Wildlife, and Lawyers committees, and the Technical Coordination Group. PNUCC publishes the Northwest Regional Forecast containing information on regional loads and resources.

peak capacity
The maximum capacity of a system to meet loads.

peak demand
The highest demand for power during a stated period of time.

penetration rate
The annual share of a potential market for conservation that is realized, as in "7 percent of the region's homes have been weatherized this year."

photovoltaic
Direct conversion of sunlight to electric energy through the concentration of solar radiation through thin layers of semi-conductor materials (silicon).

preference
Priority access to federal power by public bodies and cooperatives.

present value
The worth of future returns or costs in terms of their value now. To obtain a present value, an interest rate is used to discount these future returns and costs.

Public Utility Regulatory Policies Act of 1978 (PURPA)
Federal legislation that requires utilities to purchase electricity from qualified independent power producers at a price that reflects what the utilities would have to pay for the construction of new generating resources (see 'avoided cost'). The act was designed to encourage the development of small-scale cogeneration and renewable resources.

quantifiable environmental costs and benefits
Costs and benefits capable of being expressed in numeric terms (for example, in dollars, deaths, reductions in crop yields).

quartile
The direct service industries load is divided into four quartiles. The top quartile is the portion of that load most susceptible to interruption.

real dollars
Dollars that do not include the effects of inflation. They represent constant purchasing power. A real dollar has the same value in 1985 that it has in 1995.

region (See Pacific Northwest)

reliability
The ability of the power system to provide customers uninterrupted electric service at their point of service. Includes generation, transmission, and distribution reliability. The plan deals only with generation reliability.

renewable resource
Under the Northwest Power Act, a resource which uses solar, wind, water (hydro), geothermal, biomass, or similar sources of energy, and which either is used for electric power generation or for reducing the electric power requirements of a customer.

reserve capacity
Generating capacity available to meet unanticipated demands for power, or to generate power in the event of outages in normal generating capacity. This includes delays in operations of new scheduled generation. Forced outage reserves apply to those reserves intended to replace power lost by accident or breakdown of equipment. Load growth reserves are those reserves intended for use as a cushion to meet unanticipated load growth.

resource
Under the Northwest Power Act, electric power, including the actual or planning electric capability of generating facilities, or actual or planned load reduction resulting from direct application of a renewable resource by a consumer, or from a conservation measure.

retrofit
To weatherize an existing structure. Also, the process of modifying an electric generating plant subsequent to its construction for the purpose of improving its performance.

sectors
The economy is divided into four sectors for energy planning. These are the residential, commercial (e.g., retail stores, office and institutional buildings), industrial, and irrigation sectors.

simple payback
The time period required before the savings from a particular investment offsets its cost. For example, an investment costing $100 and resulting in a savings of $25 the first year would be said to have a simple payback of four years. Simple paybacks do not account for future cost escalation, nor other investment opportunities.

siting
The process of locating a site for a power plant, including meeting any applicable regulatory requirements and obtaining the necessary licenses and permits.

space conditioning
Controlling the conditions inside a building in order to maintain human comfort and other desired environmental conditions through heating, cooling, humidification, dehumidification, and/or air quality modifications.

sunk cost
A cost already incurred and therefore not considered in making a current investment decision.

supply curve
A traditional economic tool used to depict the amount of a product available across a range of prices.

surcharge
Under the Northwest Power Act, an additional sum added to the usual wholesale power rate charged to a utility customer of Bonneville to recover costs incurred by Bonneville due to the failure of that customer (or of a state or local government served by that customer) to achieve conservation savings comparable to those achievable under the Council's model conservation standards.

System Analysis Model (SAM)
One of the computer models used by the Council to determine resource cost-effectiveness. The model performs a detailed simulation of the Northwest generating system to estimate the cost associated with a specific set of loads and resources. It incorporates uncertainty associated with hydropower, thermal availability, resource arrival, and load fluctuation due to economic cycles.

ystem cost
According to the Northwest Power Act, all direct costs of a measure or resource over its effective life. It includes, if applicable, distribution and transmission costs, waste disposal costs, end-of-cycle costs, fuel costs including projected increases), and quantifiable environmental measures. The Council is also required to take into account projected resource operations based on appropriate historical experience with similar measures or resources.

hermal resource
facility that generates electricity by burning oal, oil, or other fuel, or by nuclear fission.

pping fee
he fee assessed for disposal of waste. This e is used when estimating the cost of proucing electricity from municipal solid waste.

ansmission
he act or process of transporting electric nergy. In the Pacific Northwest, Bonneville perates a majority of the high-voltage, longistance transmission lines.

Washington Public Power Supply System (WPPSS)
Municipal corporation and joint operation agency in Washington comprised of representatives of public utility districts and municipal utilities. Based on power purchase contracts of its members or other utilities, WPPSS has the power to acquire, construct, and operate plants and facilities for the generation or transmission of electric power.

water budget
A means of increasing survival of downstream migrating juvenile fish by increasing flow during the spring migration period. The water budget was proposed by the Council and is overseen by it in conjunction with the U.S. Army Corps of Engineers, the fishery agencies and Indian tribes, the Bonneville Power Administration, and the Bureau of Reclamation.

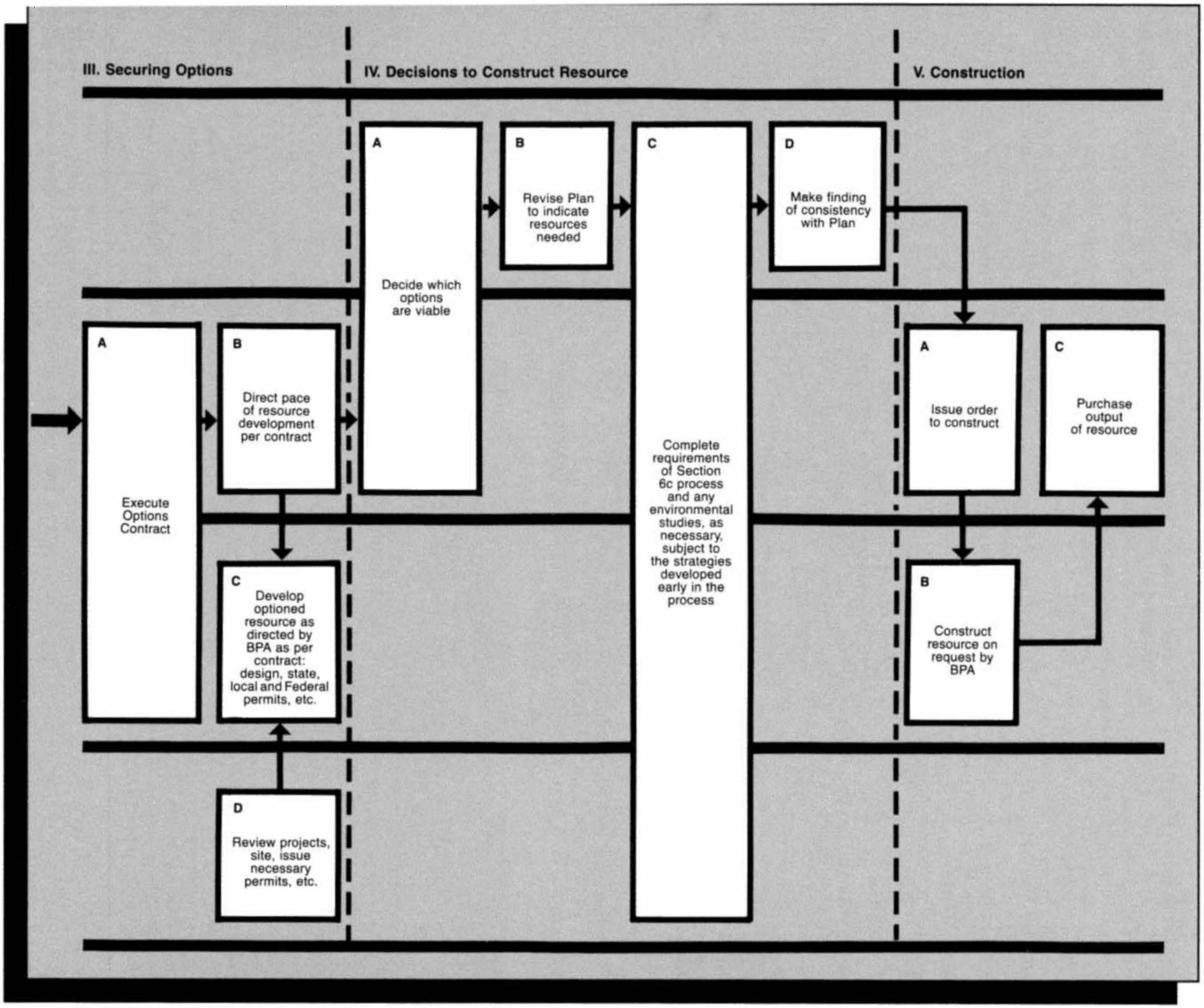


Figure I-A-1:
One Approach to Optioning Resources (Cont.)

B. Identify Need for Options

The options concept will significantly alter the region's selection process for new generating resources. In this plan and in future regional plans, the Council will identify categories of resources and the order in which they should be optioned to meet load growth projections and resource lead time requirements. The Action Plan (Chapter 9) will specify the need to acquire options for these resources. It will identify Bonneville actions for specific types and quantities of resources that should be optioned as insurance against load growth uncertainty.

C. Identify Resources and Assist Resource Developers

Bonneville will identify specific projects that are consistent with the plan and provide technical assistance to developers to assess their resources. Through this effort, Bonneville can help to secure a broad base of option candidates while insuring against the loss of resource opportunities that are consistent with the Council's plan. Specific resources will be identified for acquisition through a process that begins with a request for qualifications (RFQ) and proceeds through a request for proposals (RFP) from qualified developers.

D. Issue Request for Qualifications

Bonneville will issue a Request for Qualifications (RFQ) providing notice of the request for option candidates and requesting interested sponsors to submit statements of qualification. The RFQ should provide information on the options being sought by Bonneville, including the type and size of resource, development time frames and other key conditions and steps in the option and resource acquisition processes. The RFQ will be issued for a specified period of time ('window of opportunity') during which time any potential developers of resources can respond with a statement of their qualifications. The Council expects that an open request such as this will assist in identifying all of the potentially cost-effective resources in the region. This process could produce new information about the cost and availability of resources that could cause the Council to consider amendments to the 1986 Power Plan.

This step and the next two steps may be simplified to a pre-bidders' conference. At this conference, Bonneville would brief potential resource developers on the characteristics of projects that are being solicited in the request for proposal. The purpose of the conference would be to indicate the types of projects that are consistent with the plan and to discourage developers of those projects that have little chance of being optioned from investing time and money in a detailed formal proposal.

E. Prepare Statement of Qualification

Interested resource sponsors prepare statements of qualification for their projects. These statements should be brief, containing information regarding the qualifications of the project and sponsor relative to the proposed acquisition of options.

F. Select Qualifying Developers and Projects

Bonneville reviews the statements of qualification and, in consultation with the Council and state and local governments, select those that appear to qualify as prospective options.

G. Issue Request for Proposals

In response to the Council's Action Plan and based on the results of the RFQ, Bonneville issues a Request for Proposals (RFP), soliciting selected resource developers for entering into an option contract. The RFP will be open for a specified period of time or until a specified number of resources are selected, and will set forth in detail the technical, economic, environmental and institutional characteristics of the resources sought for optioning and will describe the options evaluation process, the process of purchasing options and the resource acquisition process. Prior to issuing an RFP, Bonneville will consult with the Council, the various state agencies, and the public on the specific types of options being requested. This step will ensure consistency with the priorities of the plan.

H. Prepare Detailed Proposal

Prospective resource developers interested in entering into an option agreement with Bonneville would prepare a detailed proposal to sell an option on their resource. This proposal should contain information on the technical, economic, environmental and institutional characteristics of their project sufficient to permit Bonneville to evaluate its suitability as an option.

I. Select Prospective Options

Upon receipt of option proposals from resource developers and utilities, Bonneville will evaluate those proposals using the evaluation procedure and methods described in the RFP. This evaluation will include consultation with the states to address their specific concerns, and with the Council to ensure that the options Bonneville is selecting are consistent with the Council's plan. After Bonneville has reached concurrence with the states and the Council concerning the selection of specific resources, Bonneville will enter into formal negotiations with resource developers to purchase an option on the resource.

III. Securing Options

The purpose of this step is to sign option contracts and to satisfy all requirements of the preconstruction phase of development. This will typically require that preliminary engineering design and environmental assessment be completed and that the state and federal permits and licenses required for construction be obtained. Sites will be purchased or options acquired for purchase. Much or all of this development will be funded by Bonneville subject to the provisions of the Act and the option contract.

A. Execute Option Contract

Based on the expected cost effectiveness of the project and the negotiations between Bonneville and the resource developer, a contract will be offered to purchase an option

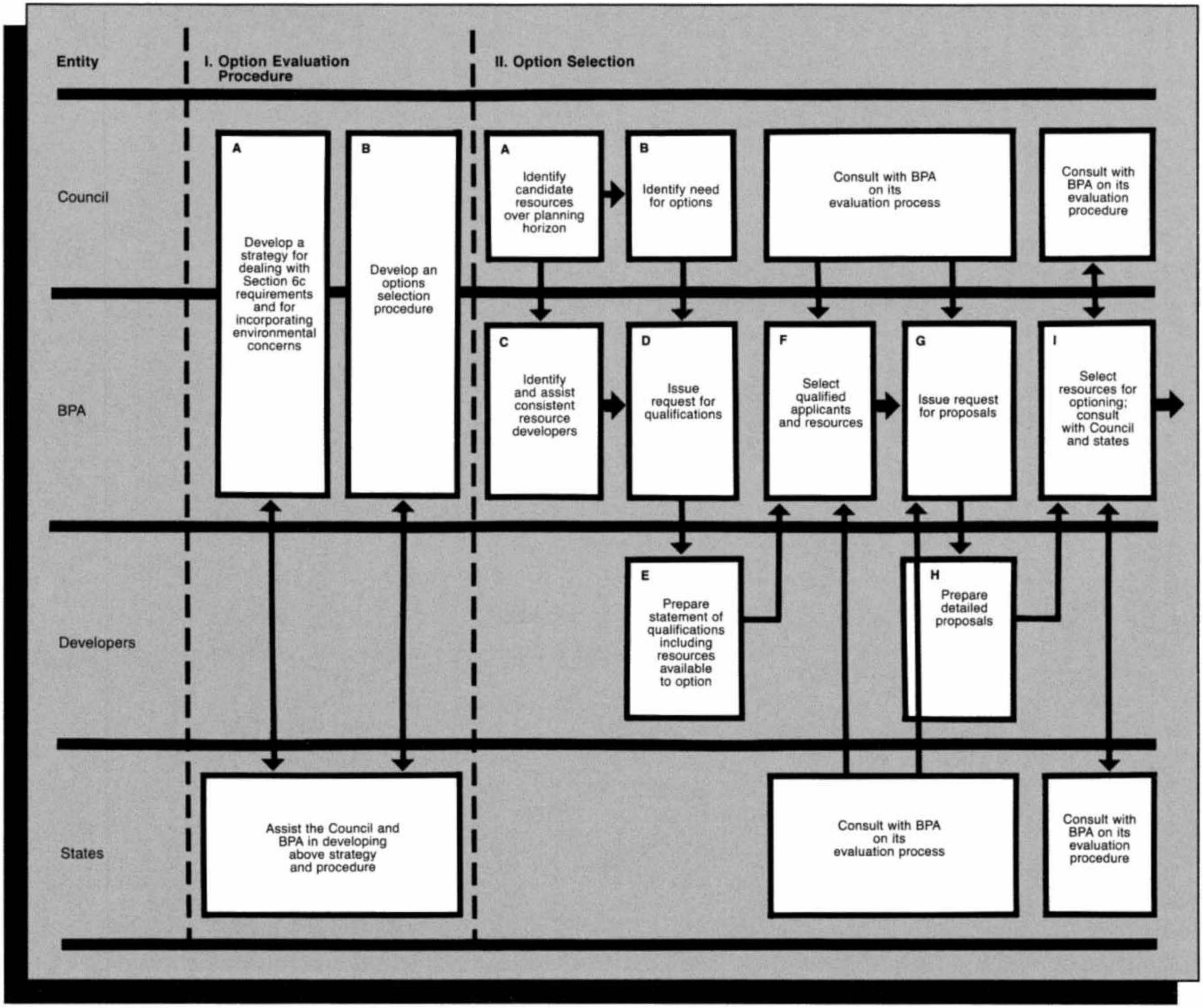


Figure I-A-1:
One Approach to Optioning Resources

Appendix I-A
Model Process for Acquiring Resources

In 1984, the Council's Options Steering Committee and several of its task forces suggested it was important for the Council to develop an overall approach for the purchase of options on and the eventual construction of resources. In response, the Council developed this model process for acquiring resources. Although the language is specific to the Bonneville Power Administration, the process can accommodate resource acquisition by other regional utilities or private developers. Options on resources would provide insurance against failure to meet regional load growth. If these resources are consistent with the plan, the Council believes they should receive favorable regulatory treatment.

The model process requires a number of actions by several different entities as illustrated by Figure I-A-1. The most important actions are described in the discussion that follows. The development of a specific resource may require deviations from the model process presented here.

This process begins with the Council's planning for options and continues through Bonneville's selection of options, the state and federal siting and licensing decisions, and finally to the construction of the resource. Opportunities for significant public involvement have been included throughout this model process. The various entities involved in the development of options and resources and their respective activities are discussed below.

I. Develop Option Evaluation Procedure

Prior to acquiring an option on a resource, Bonneville needs to develop procedures for evaluating and selecting among candidate options. A procedure is required to assess competing alternatives at various stages of the option process and to identify those alternatives that are in the best interest of the states and the region in meeting the region's future power needs.

A. Develop Procedure for Council Review and for Addressing Environmental Consideration

Bonneville, in consultation with the Council and others, needs to develop a procedure for complying with 1) the requirements of section 6(c) of the Northwest Power Act, which requires the Council to review all Bonneville resource acquisitions greater than 50 average megawatts, and 2) the National Environmental Policy Act (NEPA). These procedures should identify when major Bonneville decisions will be made and allow for appropriate input from all interested regional parties. The procedure for Council review will consider whether the option is one of a group of options identified in the Council's plan. The outcome of the review would be a decision on need for the option and on whether the project is expected to be environmentally acceptable and cost effective.

B. Develop Options Evaluation Procedure

An effective options evaluation procedure should contain an agreement among Bonneville, the Council, the host state and appropriate local governments to implement a joint hearings process to complete all NEPA and Northwest Power Act reviews and to secure all state and local licenses for proposed options. A decision to construct the resource would not be made at this time, and further environmental review might be necessary when that decision is made. The procedures for evaluating and selecting projects should appear in the requests for qualifications and requests for proposals.

II. Option Selection

The Council envisions that the selection process will occur within a 'window of opportunity' over which time prospective resource developers will respond to a Bonneville request for qualifications and subsequently a request for resources. When options have been secured on a sufficient number of resources, then the window would close, to open again when the options inventory has fallen below an established threshold level.

The Council believes the concept of a window of opportunity is an important part of the selection process, one that will assist in identifying all cost-effective resources.

The goal of a procedure to select options should be to minimize overall costs to the region's electrical system and to avoid burdening resource developers unnecessarily in the process. For certain resource types, such as cogeneration and hydropower, there are a large number of potentially acceptable projects within the region. For these resources, it may be desirable to use a preliminary screening process prior to issuing a formal Request for Proposals (RFP) for candidate options.

A preliminary screening may have several benefits. Some projects may be obviously unsuitable for development for technical, economical or environmental reasons. They can be eliminated at this stage, reducing the time and effort required on the part of the sponsor for proposal preparation and on the part of Bonneville for proposal review. Furthermore, projects passing the initial screening are likely to be viewed by their sponsor as having more potential. As a result, qualifying sponsors are likely to put greater effort into development of their proposals, providing better evidence for the selection of prospective options. For larger resources with only a few candidates, preliminary screening may not be feasible or desirable, and a prebidders' conference could suffice as an alternative.

A. Identify Candidate Resources

In the 1986 plan, the Council has identified categories of conservation and generation resources and the order in which they should be acquired to meet the forecast range of future load uncertainty. These resources provide the basis for the selection of options that would be consistent with the Council's plan. It is expected that future revisions to the plan will continue to identify the amounts and categories and schedules of conservation and generation resources required to meet future loads.

on the project. This contract will identify the legal rights of Bonneville and the developer. These rights will include, at a minimum, Bonneville's ability to direct the construction start date and the pace of development.

The Council recognizes that the specific terms and conditions of option contracts will govern both the cost and viability of the options concept. For this reason, the Council and Bonneville should work with resource developers and utilities to develop sample option contracts.

Sales options are also envisioned in the plan. At this point, Bonneville could reach an agreement that includes sale of a resource out of region, with callback provisions. Such an agreement might even involve early construction of a resource.

B. Bonneville Direction of Resource Development

Bonneville will direct the start and pace of project development. This will allow Bonneville to match the timing and expenditures for securing and exercising the option to the evolving need for resources in the region.

C. Develop Options at the Direction of Bonneville

Resource developers will secure an option for Bonneville and the region as directed by Bonneville in the option contract and pursuant to state, federal and local licenses and permits. At this point, developers will complete the key steps of siting, licensing and designing the project. The region could then decide to complete construction or to hold the option until regional needs dictate its construction.

Not all projects will be optioned successfully. The economic attractiveness of some projects may wane as engineering design advances. Other projects may fail to qualify for necessary permits and licenses. Nor is it expected that all projects for which permits and licenses are obtained will necessarily be constructed. For example, following the development of the option, Bonneville may wish to relinquish projects which subsequent analysis indicates are not reliable, less cost effective than other potential options or environmentally unacceptable. Of course, if the procedures to select options are effective, the failure rate of options would be low, but it is important to recognize that not all options will ultimately be built.

D. State Review of Projects and Issuance of Necessary Licenses and Permits

In response to material submitted by Bonneville and the developer, each state should review the project and decide whether to issue the licenses and permits necessary to complete the project when it is needed. This review will encompass all siting and licensing issues with the exception of the critical determination of the need for power. Final need will be established as part of the 'decision to construct' process.

A joint hearings process could be designed, preferably taking the form of a generic Memorandum of Agreement (MOA) between each state, Bonneville and the Council. Subagreements for each proposed option could reflect any unique considerations and incorporate participation of the appropriate local governments and federal agencies. The MOA could have the following features:

a. All federal, state and local decision makers should be explicitly recognized as independent bodies whose authorities will not be abridged but who have agreed to conduct a single administrative proceeding. In the proceedings each decision maker can choose the level of its participation so long as decisions are made promptly.

b. A single administrative process could be established to meet the needs of all decision makers. A single Notice of Hearings could be used by all decision makers that explains to the public how the process will work. Opportunities for legislative and contested case formats could be included to meet all administrative requirements. The scope of issues would be identified by the decision makers at the outset. The information and evidence requirements of each decision maker could be identified at the outset so that the applicant may minimize duplicative studies and reports. The process should have a definite schedule. A single hearings examiner, possibly from the state, would administer the hearings. Each decision maker would be free to ask questions or to request additional information.

c. There should be a process for reopening hearings on specific issues at the decision-to-construct stage. These issues should primarily concern questions of need for power and any new significant information.

It is expected that Bonneville will consult with the states and the Council in the process of developing these review procedures. It is also expected that the states and the Council will have a significant role in the application of the evaluation procedures.

IV. Decisions to Construct Resource

The purpose of this step is to decide to acquire and construct resources to meet regional load. The decision to enter construction is a separate decision from the decision to begin siting and licensing. By making a second decision to enter construction based on current loads and resources, the probability and cost of overbuilding resources will be reduced. At this stage, prior to commencing construction, Bonneville, in consultation with the Council, would again examine the inventory of options to see that no lower cost resources were being delayed while construction was proceeding on a higher cost resource. It would also be prudent, before construction begins, to assess whether other lower cost resources exist outside of the inventory of options.

A. Monitor Viability of Secured Options

As previously stated, it is possible that some options will never be constructed. This may result from technical or economic problems or regulatory obsolescence that could occur as a result of holding options beyond a reasonable lifetime. Bonneville and the Council could extend options that are about to expire legally or technologically by repeating previous steps to decide if the project remains an attractive resource. In certain cases it may be desirable to update the design of the resource to be consistent with current regulatory and environmental standards. In any event, both the Council and Bonneville must determine which options remain viable and reliable for regional planning.

B. Identify Need for Resources

During the normal planning cycle, the Council will periodically revise the plan to update both the options inventory and to recommend that construction begin on optioned projects. The normal Council process of public review and comment, including hearings throughout the region, will provide the basis for a regional consensus both on the viability of options that have been previously acquired and on the prudence of beginning construction on cost-effective and environmentally sound projects required to serve regional loads.

C. Complete Northwest Power Act Requirements

Section 6(c) of the Northwest Power Act requires Bonneville to perform a review process prior to acquiring any resource larger than 50 average megawatts. This review process should be expedited since much of the review will already have been completed in previous steps of this optioning process.

It is the Council's expectation that its strategy of purchasing options will minimize the probability of loads and resources being out of balance, by reducing the time between the decision to construct a resource and the need for the resource. However, additional state review of the resource acquisition, particularly in the determination of need for power, may be necessary as a part of the 6(c) review process. Significant uncertainties remaining at this step with respect to state and federal regulatory requirements, lessen the value of the resource as an option.

D. Council Finding of Consistency with Plan

The Act provides that 'the Council may determine by majority vote of all members of the Council, and notify the Administrator that the proposal is either consistent or inconsistent with the Plan.' (section 6(c)(2)) Because an optioned resource will have gone through an extensive public review process involving local and state governments, the Council and Bonneville, it is expected that, unless the Council review process uncovers new information, the resource will be found consistent with the plan.

Following a finding of consistency by the Council, Bonneville will direct the developer of the resource to commence construction.

V. Construct Resource

At this step in the process, the resource developer, with Bonneville financial backing, will construct the resource. During the construction phase, Bonneville, the Council and the other entities in the region will closely monitor the progress of construction. Rapid cost escalations and/or major design problems could cause a reevaluation of resources on which construction has begun. Even though uncertainty can be reduced through successful implementation of the options concept, some uncertainty remains that projects may not be completed as planned. The Council factors into its planning the probabilities that resources could be lost during the process of optioning and constructing and other replacement resources may be needed.

Conclusion

The wide variety of possible alternative options processes and interactions among the many agencies and individuals involved in the development of a resource makes it difficult to formulate a firm process. For this reason, the Council views the activities described above as a starting point in the establishment of a process to acquire options and resources. The Action Plan calls on Bonneville to develop the process so it can be implemented when needed.

Appendix I-B
Model Conservation Standards for New Residential Buildings, New Commercial Buildings, Conversions, and Utility Residential and Commercial Conservation Programs; and Surcharge Methodology

The Model Conservation Standards

The Council has adopted five model conservation standards (MCS). The MCS include the MCS for new electrically heated residential buildings, the MCS for utility residential conservation programs, the MCS for new commercial buildings, the MCS for utility commercial conservation programs, and the MCS for conversions.

The MCS for New Residential Buildings

The Council's model conservation standard for new single and multifamily electrically heated residential buildings[1] is as follows: new buildings are to be built to energy efficiency levels equal to those which would be achieved by using the illustrative component performance paths displayed in Table I-B-1 for each of the Northwest climate zones.[2]

The electric power savings represented by the measures in Table I-B-1 are estimated to result in savings equivalent to those which would be produced by the performance standards as set forth and as amended in the Council's 1983 Power Plan. Trade-offs among components may be made so long as the overall efficiency and indoor air quality of the building are at least equivalent to a building containing the measures listed in Table I-B-1. Other illustrative approaches to building to this standard are described in those portions of the Council's *Model Conservation Standards Equivalent Code,* dated February 1985, as it will be conformed to this rule and as it may be amended from time to time, which apply to low-rise residential buildings.

The MCS for Utility Residential Conservation Programs

The MCS for utility residential conservation programs is that utilities must implement, in accordance with the requirements detailed below, the Bonneville/utility residential MCS program, an equivalent alternative program, or rely on improved building codes to the MCS level. The BPA/utility residential MCS

Table I-B-1
Illustrative Paths for Residences Built to the MCS Level

COMPONENT	CLIMATE ZONE Zone 1	Zone 2	Zone 3
• Ceilings			
— Attic	R-38(U-0.032)[a]	R-38(U-0.032)	R-38(U-0.032)
— Vaults	R-38(U-0.028)	R-38(U-0.028)	R-38(U-0.028)
• Walls			
— Above grade	R-19(U-0.057)	R-25(U-0.045)	R-31(U-0.035)[b]
— Below grade	R-19[c]	R-19	R-25
• Floors			
— Crawlspaces & Unheated Basements	R-19(U-0.040)	R-30(U-0.030)	R-30(U-0.030)
— Slab-on-grade Perimeters	R-10	R-12	R-15
• Glazing[d]	R-2.5 (U-0.40)	R-2.5 (U-0.40)	R-2.5 (U-0.40)
• Maximum Glazed Area (% floor area)	15	15	15
• Exterior Doors	R-7(U-0.16)	R-7(U-0.16)	R-7(U-0.16)
• Infiltration Control	0.1 ach[e]	0.1 ach	0.1 ach
• Mechanical Ventilation w/ Heat Recovery	0.5 ach	0.5 ach	0.5 ach

[a] R-values listed in this table are for the insulation only. U-values listed in this table are for the full assembly of the respective component.

[b] Multifamily exterior walls above grade in Zone 3 should be insulated to a nominal R-25 (U-0.045).

[c] Only the R-value is listed for below grade insulation. The corresponding U-value is not known with precision.

[d] U-values for glazing shall be the tested values for thermal transmittance due to conduction resulting from either the American Architectural Manufacturers Association (AAMA) 1503.1-1980 test procedure or the American Society for Testing and Materials (ASTM) C236 or C976 test procedures. Testing shall be conducted under established winter horizontal heat flow test conditions using a 15 mph wind speed and product sample sizes specified under AAMA 1503.1-1980. Testing shall be conducted by a certified testing laboratory. EXCEPTION: Site-built fixed glazing shall be exempt from the thermal testing requirements; provided the insulating glass is tested and certified under a Society of Insulated Glass Manufacturers of America (SIGMA) approved certification program as class "A" in accordance with ASTM E-744-81; and this insulating glass is installed either in an aluminum frame having a minimum 0.25 inch low conductance thermal break or in wood framing in accordance with SIGMA glazing specifications; and provided further, that site-built double glazed units with fixed panes shall have a dead air space between panes of not less than ½ inch and site-built triple glazed units with fixed panes shall have a dead air space between panes of not less than ¼ inch.

[e] Air changes per hour.

program consists of an aggressive marketing[3] and financial assistance program made available by Bonneville and the local utility to homebuilders during 1987 and 1988, and thereafter as set forth below.

Financial Assistance in 1987 and 1988

The amount of financial assistance for the Bonneville/utility residential MCS program during the 1987 and 1988 calendar years should be as stated in Table I-B-2. The local share of financial assistance shown in Table I-B-2 is the minimum required of a utility in order for it to receive the Bonneville share. Utilities may elect to offer more if needed to achieve compliance with the minimum performance or equivalence standard.

Financial Assistance in 1989 and Thereafter

Beginning on January 1, 1989, the level of total financial assistance for the Bonneville/utility residential MCS program should be established by Bonneville within the range of values calculated by the Council. The minimum value for the range will be the difference in net present value of life cycle cost to the consumer between a house built to the minimum life cycle cost level and a house built to the full residential MCS level. The maximum value for the range will be the median builders' costs in the previous year or years for conservation measures more efficient than the level of the 1983 building practice. The Council's current calculation of the minimum and maximum values is shown in Table I-B-3. The financial assistance beyond January 1, 1989, should be provided by Bonneville and local utilities[4] based on shares established in Table I-B-4. The Council may, from time to time, revise these tables based on new information, including, but not limited to, that made available by early adopter jurisdictions and by utilities participating in the Bonneville/utility residential MCS program.

The Minimum Performance Standard for Residential Programs

All utilities must meet the annual minimum performance standard for each performance

Table I-B-2
Financial Assistance for an Average Single Family House (approx. 1,850 sq ft) for Full Requirements Customers of Bonneville (Calendar Years 1987 and 1988)*

STATE	CLIMATE ZONE 1		CLIMATE ZONE 2		CLIMATE ZONE 3	
	Local	Bonneville	Local	Bonneville	Local	Bonneville
Washington	$130	$2,500	$280	$2,500	N/A	N/A
Oregon	$440	$2,500	$830	$2,500	N/A	N/A
Idaho	$1,070	$2,500	$1,070	$2,500	$440	$2,500
Montana	N/A	N/A	N/A	N/A	$440	$2,500

*Financial assistance to generating public utilities, investor-owned utilities not currently placing a load on Bonneville, and other utilities in the region should be set as provided in the Action Plan, Chapter 9.

Table I-B-3
Minimum and Maximum Financial Assistance Levels

CLIMATE ZONE	MINIMUM	MAXIMUM
1	$1,400	$5,000
2	$1,300	$6,000
3	$1,000	$5,100

Table I-B-4
Percentage of Financial Assistance to be Made by Local Utilities (for Full Requirements Customers of Bonneville)*

STATE	CLIMATE ZONE 1	CLIMATE ZONE 2	CLIMATE ZONE 3
Idaho	30	30	15
Montana	N/A	N/A	15
Oregon	15	25	N/A
Washington	5	10	N/A

*Financial assistance to generating public utilities, investor-owned utilities not currently placing a load on Bonneville, and other utilities in the region should be set as provided in the Action Plan, Chapter 9.

year or be subject to a surcharge, except, in the limited circumstances described below, utilities whose total load is less than 25 average annual megawatts.

The Council has set the annual minimum performance standard for residential programs for calendar year 1987 (the first performance year) to equal 30 percent of the electricity that could be saved if all new electrically heated residential buildings in a utility service territory were built to the residential MCS levels. The Council will set the minimum performance standard for calendar year 1988 (the second performance year) by January 1, 1987.

By July 1988, Bonneville should establish the minimum performance standard for 1989 (the third performance year). By each July thereafter, Bonneville should set the minimum performance standard for the following performance year based on the relative performance of utilities during the past performance year. The minimum performance standard should be set by Bonneville in the following way:

- All utilities, including those participating in the Bonneville/utility residential MCS program, those which have had codes adopted in their service territory, and those which have adopted other alternatives (where reliable data is available) will be ranked each year based on their performance in achieving in the previous performance year the electricity savings potential of the MCS. Savings should be measured from existing practice in 1983.[5] Performance will be measured by the percentage of electricity savings achieved out of all the electricity that could have been saved if all new electrically heated residential buildings in a utility service territory had been built to the residential MCS level. Thus, for example, if ten identical single family residences were built in a utility service territory, five of which were built to the residential MCS level and five to 1983 practice, that utility's performance level would be 50 percent. If five were built to the residential MCS level and the remaining five were built to a revised code or building practice that achieved 50 percent of the MCS savings, the utility's performance would be 75 percent.
- Utilities with the highest performance and that represent 80 percent of the new electrically heated residences will be grouped. The performance level of the poorest performing utility in that group is the minimum performance standard for the next performance year. If there is little difference in performance among utilities, the Council may reconsider this minimum performance standard. The Administrator should use caution when evaluating utilities with very few new electrically heated dwellings in their service area and should consider evaluating these utilities over more than one calendar year.

The Equivalence Standard for Residential Programs

The equivalence standard applies only to utilities selecting an alternative program to the Bonneville/utility residential MCS program. The equivalence standard is the average savings achieved by any means by utilities participating in the Bonneville/utility residential MCS program during the previous performance year. Savings are measured as a percentage of all the electricity savings achieved out of all the electricity that could have been saved if all new electrically heated residences were built to MCS levels. Beginning in 1988, Bonneville should announce the equivalence standard for the next performance year by July 1 of each year. Utilities with alternative programs not performing at the level of the equivalence standard when it is announced must, by January 1 of the next performance year: 1) secure Bonneville's approval of another alternative plan for meeting the equivalence standard; or 2) adopt the Bonneville/utility residential MCS program. If a utility fails to take one of these two corrective actions, and fails to meet the equivalence standard during that next performance year, the utility will be subject to a surcharge.

Submission of Utility Plans for Compliance with the MCS for Residential Programs

Utilities must, by September 1, 1986, submit to Bonneville an initial plan declaring how they intend to meet the MCS for utility residential conservation programs. The ultimate goal for such programs is to obtain, as soon as possible, at least 85 percent of the savings which would have been obtained if all electrically heated residential buildings had been constructed to the residential MCS level.[6] In subsequent years, a utility may change its declaration, subject to the same Bonneville approvals required for the 1986 initial plan submissions.

There are several ways utilities can comply with the MCS for utility residential conservation programs. These are:

1. Submit by September 1 of any year beginning in 1986, and have approved by Bonneville prior to January 1 of the next year, a declaration that the MCS for residential buildings have been or will be met no later than January 1 of that next year, and for each subsequent year, through codes at MCS levels adopted and enforced by a state and/or local government, and thereafter in each performance year, achieve and maintain the level of savings required by the annual minimum performance standard;
2. Agree by September 1 of any year beginning in 1986, to adopt and implement the Bonneville/utility residential MCS program by January 1 of the next year, and thereafter in each performance year achieve and maintain the level of savings required by the annual minimum performance standard;
3. For utilities with less than 25 average annual megawatts of load, agree by September 1 of any year beginning in 1986, to adopt and implement the Bonneville/utility residential MCS program by January 1, of the next year, and offer to pay financial assistance throughout each performance year equal to or greater than the maximum value of financial assistance shown in Table I-B-3; or
4. Submit by September 1, of any year beginning in 1986, an alternative program that will be implemented and enforced and is initially approved by Bonneville, prior to the next performance year, as being capable of providing savings equivalent to the Bonneville/utility residential MCS program and which does not duplicate the acquisition of

other resources that are already in the Council's plan. In addition, in order to continue to be considered equivalent, an alternative program must comply with the equivalence standard. Further, utilities with an alternative program must achieve and maintain in each performance year, the level of savings annually required by the annual minimum performance standard. Alternative programs may include, but are not limited to, state or local government or utility marketing programs, financial assistance, codes that achieve part of the MCS level of savings, or other measures to encourage energy efficient construction of new residential buildings or other lost opportunity conservation resources. Each alternative plan should specify at least the following:

- Thermal efficiency specifications per building.
- Measures to maintain adequate indoor air quality, by providing no less than .5 air changes per hour.
- Target market share.
- Level of utility payments or other activities to promote residential MCS level construction.
- Marketing plan.
- Contingency plans for achieving targets with alternative marketing strategies.
- Compliance certification strategy (e.g., utility inspection).
- Data gathering to meet Bonneville information needs.

Surcharge Recommendation

The evaluation of utility performance and the annual establishment of the minimum performance standard and equivalence standard should become part of Bonneville's surcharge policy. Bonneville should monitor performance and equivalence during each year beginning with the first performance year (1987).

The Council recommends that a 10 percent surcharge be imposed as of January 1, 1987, on utilities which have not complied with the September 1, 1986, deadline to submit: 1) an initial plan for implementation of the Bonneville/utility residential MCS program; 2) a plan for implementation of an alternative program which is approved by Bonneville as being equivalent as set forth above; or 3) a declaration, approved by Bonneville, that the MCS for residential buildings will be met by building codes. This surcharge continues in effect until a utility has filed an initial plan and has obtained the necessary Bonneville approvals.

The Council recommends that on each January 1, beginning in 1989, a 10 percent surcharge be imposed for one year on all utilities which did not comply with the annual minimum performance standard for the performance year beginning two years earlier. For example, utilities failing to meet the 1987 minimum performance standard should be surcharged commencing January 1, 1989, for one year. Utilities failing to meet the 1988 minimum performance standard should be surcharged commencing January 1, 1990, for one year. However, utilities with a total load of less than 25 average megawatts that participate in the Bonneville/utility residential MCS program and offer, throughout each year to which a minimum performance standard is applicable, financial assistance equal to or greater than the maximum value of financial assistance shown in Table I-B-3 should not be surcharged regardless of their performance.

The Council recommends that on each July 1, beginning in 1990, a 10 percent surcharge be imposed for one year on utilities with alternative residential programs that have not taken the corrective actions for alternative programs as set forth above, and which have not met the equivalence standard for the previous performance year beginning in 1989. For example, on July 1, 1988, Bonneville will announce the equivalence standard for 1989 based on performance in 1987. A utility with an existing alternative program not performing to that level when it is announced, which does not by January 1, 1989, either adopt and implement the Bonneville/utility residential MCS program or secure Bonneville's approval of an alternative plan and which fails to meet the equivalence standard during 1989, should be surcharged on July 1, 1990.

The Council's surcharge methodology is set forth below. The total surcharge on a utility for failing to meet the MCS for residential and commercial utility programs should not exceed 10 percent of its rate at any time.

In no event should a utility be surcharged if it achieves and maintains, in any of the ways enumerated above, a level of electrical energy savings equivalent to 85 percent of those which would be achieved if all new electrically heated residences in its service territories were constructed to the level of the residential MCS.[7]

A utility operating the Bonneville/utility residential MCS program or a program approved by Bonneville as equivalent should not be surcharged if Bonneville does not offer it financial assistance to be provided to home builders for each residence meeting the standards at least equal to the minimum value of financial assistance shown in Table I-B-3.

Exemptions

The Council finds there is no need for exemptions at this time. If Bonneville finds that hardship exists, Bonneville should, if necessary, fully finance the MCS in those jurisdictions.

The Model Conservation Standards for New Commercial Buildings

The Council's model conservation standard for new commercial buildings is as follows: New commercial buildings are to be constructed to achieve savings equivalent to those achievable through constructing buildings to the Council of American Building Officials (CABO) 1983 Model Energy Code, which is based on the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), ASHRAE 90-80, with the following modifications. The ventilation requirements are those set forth in ASHRAE Standard 62-81, and the interior lighting standard for all office buildings and for those retail

Table I-B-5
Interior Lighting Power Budget[a]

GROUP	OCCUPANCY DESCRIPTION	LIGHTING POWER BUDGET[b] (W/sq ft)
A	Assembly w/stage	1.1
	Stage lighting	Exempt
	Assembly w/o stage: other than B and E	1.1
B	Gasoline service station	2.0
	Storage garages	0.3
	Office buildings, wholesale stores, police and fire stations	1.5
	Retail stores	
	— less than 1,000 square feet	4.5
	— 1,000 to 6,000 square feet	3.5
	— 6,000-20,000 square feet	2.5
	— Over 20,000 square feet	1.5
	Drinking and dining establishments	1.85
	Food preparation task lighting	Exempt
	Aircraft hangers	0.7
	Process plants	1.0
	Factories and workshops	2.0
	Storage structures	0.7
E	Schools and daycare centers	2.0
	Audio-visual presentation lighting	Exempt
H	Storage structures	0.7
	Handling areas	2.0
	Paint shops	2.5
	Paint spray booths	5.0
	Auto repair booths	2.0
	Aircraft repair hangers	2.0
I	Institutions	2.0
	Administrative support areas	2.0
	Nursing areas	0.9
	Diagnostic, treatment, food service task lighting	Exempt
R	Dwelling units	Exempt
	Other areas	1.1
	Food preparation task lighting	Exempt

[a] Watts/square foot of room may be increased by 2 percent per foot of height above 20 feet.
[b] Emergency exit lighting is exempt from interior lighting budget.

areas containing over 20,000 square feet is 1.5 watts per square foot. The lighting efficiency requirements for all commercial buildings are as shown in Table I-B-5.

The Council recognizes that in some situations the lighting budgets shown in Table I-B-5 may not provide acceptable lighting. Consequently, the Council's lighting standard for new commercial buildings may be met by documenting through the use of ASHRAE/IES (Illuminating Engineering Society) 90R-1986 and/or IES LEM-1-1986 that the lighting power budgets set forth in Table I-B-5 are insufficient to achieve the recommended illuminance values for lighting design specified in the IES 1981 *Lighting Handbook, Applications Volume*. Such documentation must demonstrate that the recommended illuminance values cannot be achieved within the lighting budget when the most efficient equipment and lighting controls suitable for the specific task are used.

Illustrative ways for a commercial building to meet this standard are described in those portions of the *Council's Model Conservation Standards Equivalent Code* dated February 1985, as it will be conformed to this rule and may be subsequently amended from time to time, which apply to all buildings except low-rise residential buildings.

The Council's MCS for new commercial buildings were developed using the ASHRAE 90-80 standard originally issued in 1980. ASHRAE intends to adopt and issue an updated version of Standard 90 (ASHRAE 90.1) by mid-1986. The ASHRAE standard serves as the basis for the Council of American Building Officials 'Model Energy Code.' Therefore, the Council intends to review the updated standard for potential adoption as its MCS. This review process will commence as soon as the ASHRAE standard has been adopted in its final form.

The MCS for Utility Commercial Conservation Programs

The model conservation standard for utility commercial conservation programs is that utilities must: 1) implement a joint marketing program with Bonneville, which may contain financial assistance payments to developers (the Bonneville/utility commercial MCS program); or 2) implement an equivalent alternative program; or 3) rely on improved building codes to the MCS levels and achieve compliance with the annual minimum performance standard calculated as set forth below.

The Minimum Performance Standard for Commercial Programs

All utilities must meet the annual minimum performance standard. All utilities including those participating in the Bonneville/utility MCS program for commercial buildings, those which have had codes adopted in their service territory to the MCS level, and those which have adopted other alternatives (where reliable data is available) will be ranked each year based on their performance in achieving in the previous year the electricity savings potential of the commercial MCS. Savings should be measured from existing practice in 1983.[8] Performance will be measured by electricity savings achieved as a percentage of the electricity savings that could have been saved if all new commercial buildings in a utility service territory had been constructed to MCS levels. Thus, for example, if ten identical commercial buildings were built in a utility service territory, five of which were constructed to MCS levels (through codes or any other means), that utility's performance level would be calculated at 50 percent.

Utilities with the highest performance and which represent 80 percent of the new commercial floorspace will be grouped. The performance level of the poorest performing utility in that group is the annual minimum performance standard. If there is little difference in performance among utilities, the Council may reconsider this minimum performance standard. The Administrator should use caution when evaluating utilities with very few new commercial buildings and should consider evaluating these utilities over more than one calendar year.

The Equivalence Standard for Commercial Programs

The equivalence standard applies only to utilities selecting an alternative program to the Bonneville/utility commercial MCS program. The equivalence standard is the average savings achieved by any means by utilities participating in the Bonneville/utility commercial MCS program during the previous performance year. Savings are measured as a percentage of all the electricity savings achieved out of all the electricity that could have been saved if all new commercial buildings were built to MCS levels. Beginning in 1988, Bonneville should announce the equivalence standard for the next performance year by July 1 of each year. Utilities with alternative programs not performing at the level of the equivalence standard when it is announced must, by January 1 of the next performance year: 1) secure Bonneville's approval of another alternative plan for meeting the equivalence standard; or 2) adopt the Bonneville/utility MCS program. If a utility fails to take one of these two corrective actions, and fails to meet the equivalence standard during that next performance year, the utility will be subject to a surcharge.

Submission of Utility Plans for Compliance with the MCS for Commercial Programs

Utilities must, by September 1, 1986, submit to Bonneville an initial plan declaring how they intend to meet the MCS for utility commercial conservation programs. The ultimate goal for such programs is to obtain, as soon as possible, at least 85 percent of the savings which would have been obtained if all commercial buildings had been constructed to the commercial MCS level.[9] In subsequent years, a utility may change its declaration, subject to the same Bonneville approvals required for the 1986 initial plan submission.

There are several ways utilities can comply with the MCS for utility commercial conservation programs. These are:

1. Submit by September 1 of any year beginning in 1986, and have approved by Bonneville prior to January 1 of the next year, a declaration that the MCS for commercial buildings have been or will be met no later than January 1 of that next year, and for each subsequent year, through codes at the MCS levels adopted and enforced by a state and/or local government, and thereafter in each performance year achieve and maintain the level of savings required by the annual minimum performance standard;

2. Agree by September 1 of any year beginning in 1986, to adopt and implement the Bonneville/utility commercial MCS program by January 1 of the next year, which may contain financial assistance payments, and thereafter achieve and maintain the level of savings required by the annual minimum performance standard; or

3. Submit by September 1 of any year beginning in 1986, an alternative program that will be implemented and enforced by January 1 of the next year, and is initially approved by Bonneville prior to the next performance year as being capable of providing savings equivalent to the Bonneville/utility commercial MCS program, and which does not duplicate acquisition of other resources that are already in the Council's plan. In addition, in order to continue to be considered equivalent, an alternative program must comply with the equivalence standard. Further, utilities with an alternative program must achieve and maintain in each performance year the level of savings annually required by the annual minimum performance standard. Alternative programs may include, but are not limited to, state or local government or utility marketing programs, financial assistance, codes that achieve part of the MCS level of savings, or other measures to encourage energy efficient construction of new commercial buildings or other lost opportunity conservation resources. Each alternative plan should specify at least the following:

- Electric efficiency specifications per building.
- Target market share.
- Level of utility payments or other activities to promote commercial MCS level construction.
- Marketing plan.
- Contingency plans for achieving targets with alternative marketing strategies.
- Compliance certification strategy (e.g., utility inspection).
- Data gathering to meet Bonneville information needs.

Surcharge Recommendation

The evaluation of utility performance and establishment of a minimum performance standard and equivalence standard should become part of Bonneville's surcharge policy. Bonneville should monitor performance and equivalence during each performance year beginning with the first performance year (1987).

The Council recommends that a 10 percent surcharge be imposed as of January 1, 1987, on utilities which have not complied with the September 1, 1986, deadline to submit an initial plan for implementation of the Bonneville/utility commercial MCS program, a plan for implementation of an alternative program which is approved by Bonneville as equivalent, as set forth above, or a declaration, approved by Bonneville, that the MCS for commercial buildings will be met by building codes at the MCS levels. This surcharge continues in effect until a utility has filed an initial plan and has obtained the necessary Bonneville approvals.

The Council recommends that on each January 1, beginning in 1989, a 10 percent surcharge be imposed for one year on utilities which have not complied with the annual minimum performance standard for the performance year beginning two years earlier.

The Council recommends that on each July 1, beginning in 1990, a 10 percent surcharge be imposed for one year on utilities with alternative commercial programs that have not taken the corrective actions for alternative programs as set forth above, and which have not met the equivalence standard for that performance year beginning in 1989. For example, on July 1, 1988, Bonneville will announce the equivalence standard for 1989 based on performance in 1987. A utility with an existing alternative program not performing to that level when it is announced, which does not by January 1, 1989, either adopt and implement the Bonneville/utility commercial MCS program or secure Bonneville's approval of another alternative plan and which fails to meet the equivalence standard during 1989, should be surcharged on July 1, 1990.

The Council's surcharge methodology is set forth below. The total surcharge on a utility for failing to meet the MCS for residential and commercial utility programs should not exceed 10 percent of its rate at any time.

In no event should a utility be surcharged if it achieves and maintains, in any of the three ways enumerated above, a level of electrical energy savings equivalent to 85 percent of those which would be achieved if all new commercial buildings in their service territories were constructed to the level of the commercial MCS.[10]

Exemptions

The Council finds there is no need for exemptions at this time. If Bonneville finds that hardship exists, Bonneville should, if necessary, fully finance the achievement of the MCS in those jurisdictions.

The Model Conservation Standard for Buildings Converting to Electric Space Conditioning

The Council's Model Conservation Standard for residential and commercial buildings converting to electric space conditioning is that state or local governments or utilities should take actions through codes, alternative programs or a combination thereof to achieve electric power savings from buildings which convert to electrical space conditioning. These savings should be comparable to those savings that would be achieved if each building converting to electric space conditioning were upgraded to include all regionally cost-effective electricity conservation measures. Although the conversion standard is highly recommended, the Council is not recommending that a surcharge be imposed for failure to act accordingly.

Surcharge Methodology

Section 4(f)(2) of the Northwest Power Act provides for Council recommendation of a 10 percent to 50 percent surcharge on Bonneville customers for those portions of their loads within the region that are within states or political subdivisions which have not, or on customers which have not, implemented conservation measures that achieve savings of electricity comparable to those which would be obtained under the model conservation standards. The purpose of the surcharge is twofold: 1) to recover costs imposed on the region's electric system by failure to adopt the model conservation standards or achieve equivalent electricity savings, and 2) to provide a strong incentive to utilities and state and local jurisdictions to adopt and enforce the standards or comparable alternatives.

The Administrator is responsible for implementing the surcharge in accordance with the Council methodology for the surcharge calculation. The Council recommends that the Bonneville Administrator impose surcharges as specified above. The method is set out below.

A. Identification of Customers Subject to Surcharge

In accordance with the schedule set forth above, the Administrator should identify those customers, states, or political subdivisions which have:

1. Failed to comply with the model conservation standards for utility residential and commercial conservation programs, including meeting all filing deadlines, and

2. Failed to achieve equivalent savings of electricity through an acceptable alternative program, as determined by the Administrator.

B. Calculation of Surcharge

The annual surcharge for noncomplying customers or customers in noncomplying jurisdictions is then calculated by the Bonneville Administrator as follows:

1. If the customer is purchasing firm power from Bonneville under a power sales contract and is not exchanging under a residential purchase and sales agreement, the surcharge is 10 percent of the cost to the customer of all firm power purchased from Bonneville under the power sales contract for that portion of the customer's load in jurisdictions not implementing the MCS or comparable programs.

2. If the customer is not purchasing firm power from Bonneville under a power sales contract but is exchanging (or is deemed to be exchanging) under a residential purchase and sales agreement, the surcharge is 10 percent of the cost to the customer of the power purchased from Bonneville in the exchange (or deemed to be purchased) for that portion of the customer's load in jurisdictions not implementing the MCS or comparable programs.

3. If the customer is purchasing firm power from Bonneville under a power sales contract and also is exchanging (or is deemed to be exchanging) under a residential purchase and sales agreement, the surcharge is: a) 10 percent of the cost to the customer of firm power purchased under the power sales contract, plus b) 10 percent of the cost to the customer of power purchased from Bonneville in the exchange (or deemed to be purchased) multiplied by the fraction of the utility's exchange load originally served by the utility's own resources.

   This calculation of the surcharge is designed to eliminate the possibility of surcharging a utility twice on the same load. In the calculation, the portion of a utility's exchange resource purchased from Bonneville and already surcharged under the power sales contract is subtracted from the exchange resources before establishing a surcharge on the exchange load.

C. Evaluation of Alternatives and Electricity Savings

To assist Bonneville in estimating comparable electricity savings from alternative plans, a utility or jurisdiction should present its best estimate of new residential and commercial building construction in noncomplying areas within its service territory or boundaries. Bonneville will determine, in consultation with the Council, whether the alternative conservation plan of a utility or jurisdiction will achieve savings of electricity comparable to those that would have been achieved under the utility programs identified in the MCS. When determining electricity savings that would have occurred had the utility program standards been implemented, jurisdiction-specific weather data and construction estimates, where available, should be used along with the Council's residential and commercial heat loss models.

The Council recognizes that in many cases data will not be available. In these cases Bonneville should rely on average electricity savings estimated by building type and climate zone and included in the Council's Plan. For single-family residential buildings, Bonneville should assume the following regarding houses built to the model conservation standards: 1) houses in climate zone 1 would save, on average, 6,725 kWh per year; 2) houses in climate zone 2 would save, on average, 8,853 kWh per year; and 3) houses in climate zone 3 would save, on average, 6,535 kWh per year. For multifamily dwellings, Bonneville should assume the following: 1) dwelling units in climate zone 1 would save, on average, 3,120 kWh per year, 2) dwelling units in climate zone 2 would save, on average, 4,489 kWh per year, and 3) dwelling units in climate zone 3 would save, on average, 5,235 kWh per year. For commercial buildings, and where good estimates are not available for the number of new residential buildings, the estimated electricity savings should be determined by multiplying total regional average megawatt savings by sector expected from the standards, as shown in the plan, by the utility's noncomplying share of total regional load in the applicable sectors.

If the Bonneville Administrator determines that a proposed alternative plan is not acceptable, he should notify the entity that its alternative plan has been judged to be not acceptable and that Bonneville will add a surcharge to the affected utility's bill as of the dates set forth above. The surcharge is calculated as described in section B above. If subsequent modifications to the entity's alternative plan are determined by the Administrator to be acceptable, then the surcharge should be removed.

A general method of determining the estimated electrical energy savings of an alternative conservation plan should be developed in consultation with the Council and included in Bonneville's policy to implement the surcharge.

1./ Single family residences are defined to include duplexes. Multifamily residences include triplexes and larger structures up to and including 4-story low-rise residential structures. The standard applies to site-built residences and not to residences which are regulated under the National Manufactured Housing Construction and Safety Standards Act of 1974. 42 USC 5401 et seq (1983).

2./ The Council has established climate zones for the region based on the number of heating degree days as follows: Zone 1 — 4-6,000 heating degree days; Zone 2 — 6-8,000 heating degree days; and Zone 3 — over 8,000 heating degree days.

3./ "Super Good Cents" is the current name given to the Bonneville marketing program to encourage residential construction at the MCS level of efficiency. The Council believes the design and features of the Super Good Cents program will, if implemented regionwide, provide a successful mechanism for advancing building practices to the full residential MCS level of savings throughout the region.

4./ If local utilities determine that higher levels of financial assistance are required to achieve compliance, they should adjust their assistance level as appropriate.

5./ The Council will work with Bonneville in defining 1983 practice for use as a benchmark and will supply this information to utilities.

6./ 85 percent is the level of compliance that the Council believes is achievable by utility programs.

7./ A utility relying on codes may, in its declaration, use that portion of savings from any commercial building codes which exceed the commercial MCS level as an offset against the full residential MCS level.

8./ The Council will work with Bonneville in defining 1983 practice for use as a benchmark and will supply this information to utilities.

9./ 85 percent is the level of compliance that the Council believes is achievable by utility programs.

10./ A utility relying on codes may, in its declaration, use that portion of savings from any residential building codes which exceed the residential MCS level as an offset against the full commercial MCS level.