1991 NORTHWEST CONSERVATION and ELECTRIC POWER PLAN VOLUME I

91-04

To the People of the Pacific Northwest:

These are pivotal times in the Pacific Northwest, urgent times. The region needs new supplies of electricity now, and this plan describes the most financially and environmentally sound means of acquiring them. It is a plan that calls on everyone in the Northwest to use electricity as efficiently as possible. It sets an agenda for a regional commitment to study and develop new energy producing technologies.

Throughout the 1980s, the Northwest had more electric power than it required. But we experienced such an economic rebound that we've exhausted that surplus.

That's why this plan is a call to action. In it, we outline a strategy designed to respond to a wide range of uncertainty. Between now and the year 2000, we are asking this region to lead the nation by securing at least 1,500 megawatts of conservation in our homes, farms, businesses and industries, as well as efficiency improvements to our power system. This will be an exciting challenge.

We are calling for exploration and demonstration of renewable resource technologies. And we seek answers to questions that have hobbled this region's ability to be decisive about our future use of thermal power plants.

While we were designing this plan, we were also mindful of the need to protect the Columbia River Basin's salmon, particularly those runs that have become the focus of possible declarations under the Endangered Species Act. Much of what we do in our society affects the salmon's survival, but there is no question that the dams we rely on for power are a major source of the problem. Changes in how the dams are operated—changes that could reduce the amount of electricity we can draw from the dams at certain times of the year—are one possible response to any salmon listing. We have already begun the process of amending our Columbia River Basin Fish and Wildlife Program to improve conditions for salmon.

If we are to continue to meet this region's electrical needs at the lowest possible cost—to ratepayers, the environment and the Northwest's economy—we will need the cooperation of every Northwesterner. Now is the time to act. The power is yours; make the most of it.

James Goller, chairman
Idaho

R. Ted Bottiger, vice chairman
Washington

Robert Saxvik
Idaho

Tom Trulove
Washington

John C. Brenden
Montana

Angus Duncan
Oregon

Stan Grace
Montana

Ted Hallock
Oregon

A Time for Action

"To assure the Pacific Northwest of an adequate, efficient, economical and reliable power supply..."
Pacific Northwest Electric Power Planning and Conservation Act
Public Law 96–501

The goal of this power plan is to ensure that the Pacific Northwest will have an adequate, efficient, economical and reliable electricity supply well into the next century.

The plan incorporates a broad and detailed review of electrical resources that balance sometimes-competing attributes. Actions derived from this careful review chart the least expensive (both in economic and environmental terms), yet most flexible course the region can take down an uncertain path.

There is some history behind this plan. Ten years ago, the Pacific Northwest embarked on a grand experiment. It was a test, initiated by the Northwest Power Act of 1980, to determine whether four states, sharing common needs and assets, could coordinate their efforts to ensure their people energy services at the lowest possible cost.

This 1991 Northwest Power Plan is the most recent product of that regionwide collaboration. In it we face a new challenge, the challenge the Act was designed to manage. For the first time since the Act was passed, the Northwest needs new resources. Until now, there was more than enough electricity in the region. But the Northwest's economic recovery and remarkable population increases in recent years have absorbed the excess power.

Our challenge now is to prudently select from among all available sources of electricity a diverse mix that offers the region the most value for its money. Our preferences will help frame the region's future prospects.

In this and the next decade, the Pacific Northwest almost certainly will be called upon to add thousands of megawatts[1] of resources to its power system. One thousand megawatts is enough to power the city of Seattle. If the region continues to grow rapidly, we could need more than 13 times that amount in 20 years.

Even a few hundred megawatts do not come cheaply, nor are they without complex consequences. In preparing for the region's energy future, it is the job of the Northwest Power Planning Council, working with the Bonneville Power Administration, utilities and electricity consumers, to weigh all resource alternatives and choose carefully among them.

The Act provided guidance on this choice—wise guidance. It called for a regional power plan that turns to conservation as its most cost-effective and environmentally responsible resource. This plan does just that.

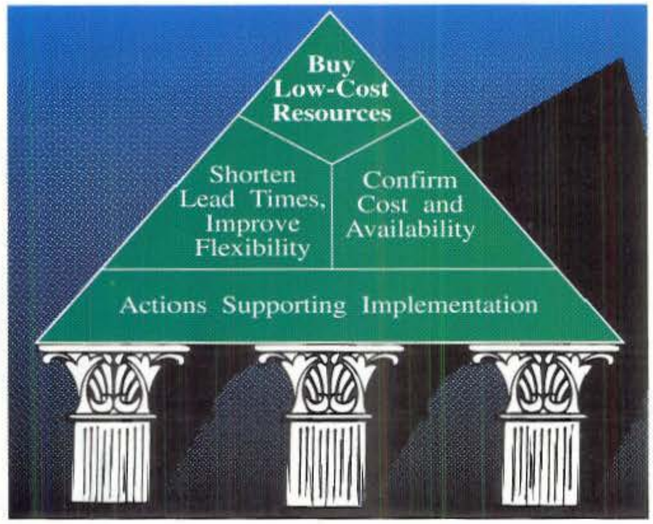
Four Objectives

The strategy behind this plan is evident in its four objectives. (See Figure 1.)

First, the plan calls on the Northwest to purchase more than 1,500[2] megawatts of energy savings by the year 2000. This means concerted efforts to conserve electricity in new and existing residences, commercial buildings, industrial processes and irrigated farming practices. It means upgrading power plants and transmission systems to make them more efficient. About 800 megawatts of low-cost hydropower and cogenerated electricity are cost-effective and should also be developed now.

Action Plan

Figure 1
Four Objectives



Second, the plan calls for efforts to shorten the time needed to bring new resources into the power system. If it takes years to develop a resource from idea to reality, then the odds increase that conditions will have changed by the time the power is delivered. The demand for electricity could have been exacerbated, or it could have declined. Short lead times and resources that can be secured in small increments are important keys to responding flexibly to uncertain future power needs.

The third focus of this plan includes actions to confirm still more resources by pinning down their costs, reliability and availability. The Council is calling for an examination of resources that could be incorporated into future plans. Some of these resources are newer technologies, others are currently expensive or poorly understood. Most are not ready for development in the Northwest at this time.

Many of these resources may turn out to be bargains, but the region needs more information before major investments can be made. Research is needed, and in some cases, demonstration projects must be initiated to resolve questions.

Finally, to make all of this possible, this power plan's fourth objective outlines regulatory changes and other actions that encourage implementation and improve power system planning. For example, one important regulatory change that needs to be considered is a mechanism to link power company profits to energy the utility saves.

1. The megawatts referred to in this plan are average megawatts. An average megawatt is 8,760 megawatt-hours of energy. When megawatt is used to refer to capacity, it is noted. Capacity is the maximum output of an electrical generator.

2. Numbers are rounded off in Volume I, which accounts for the slight discrepancy compared to the more precise figures in Volume II.

Thus, the four basic objectives of this plan are: Acquire more than 2,300 megawatts of conservation and other low–cost resources by the year 2000; shorten lead times to enable quick and flexible responses to energy needs; confirm the costs, reliability and availability of additional resources; and encourage regulatory and other changes to help implement this plan.

These objectives are not meant to be sequential. Immediate action on all of them is needed. This volume provides the Council's rationale and the Action Plan. Volume II, Chapter 1 contains detailed activities that must be started now. The rest of Volume II covers the technical, environmental and economic basis for these conclusions.

The Players

Responsibility for implementing this plan is shared by a number of regional entities, and cooperation among them will be critical to the plan's success. (See Figure 2.) Utility regulators will have to play a major role in facilitating resource acquisition processes and ensuring there are no barriers—especially for conservation—that can impede implementation.

Government support at all levels will be necessary to achieve cost–effective conservation standards and to adopt other policies that encourage the resource development called for in this plan.

The Bonneville Power Administration and the region's utilities will bear the fundamental responsibility for buying or building most new resources. Utilities and local governments serving rapidly growing areas will have to be especially aggressive in implementing this plan.

Environmental groups, consumer groups and the public at large need to lend their support to make this plan a reality.

For the Council, drafting this plan is only the beginning. We are committed to its implementation. We will actively participate with all interested parties in efforts to make the vision embodied in this plan become reality.

The Players

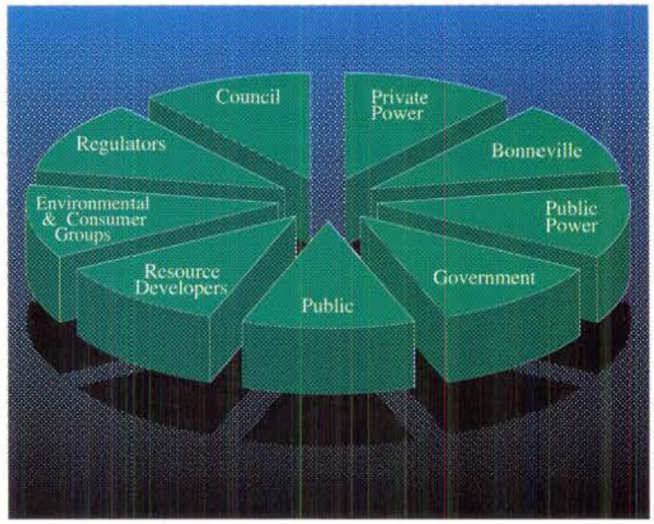


Figure 2
Cooperation is Needed to Make this Plan a Reality

Why Now?

This is not the first Northwest Power Plan; it is the third. But the region changed so dramatically in the last half of the 1980s that, in some ways, the whole focus of power planning has had to change with it. The first two plans reflected a period when the region had surplus electricity. It was an expensive surplus, fueled by thermal power plants that cost considerably more than the hydropower that supplies most of the region's electricity. Nonetheless, the surplus bought us time.

Regional power planners, power system managers, state and local governments and electricity consumers used that time to lay the foundation to implement this plan. The concept that energy conservation is a resource like any generating power plant was introduced by the Northwest Power Act. This region's utility managers had to find ways to bring a conservation "power plant" into their electrical grids.

They developed and offered programs to enable their consumers to save electricity in homes and businesses, on farms and in industries. Without attempting to make all the efficiency improvements that are possible, the region managed to obtain more than 550 megawatts of savings, at a price roughly half that of power from a new generating plant.

Hundreds of thousands of homes were weatherized. Millions of dollars in annual heating, cooling and operating costs were cut. New building codes that met the Council's energy–efficiency standards were adopted in parts of the Northwest, including statewide codes in Oregon and Washington. These new codes plus national appliance efficiency standards mean that the region will have saved up to another 1,300 megawatts by 2010. All in all, we started creating the infrastructure to "acquire" large amounts of energy by saving it.

The Surplus Is Gone

Now the region is in what utility planners call "load/resource balance." This means that there is just about enough power supplied by the existing system to meet regional electricity needs at their present level. Some power is still sold to California, and it can be recalled if necessary, but in practical terms, the region's supply of electricity is equal to the demand for it.

Despite the progress of the last 10 years, the region enters the 1990s without the capability to successfully run conservation programs in all sectors of the economy and without an inventory of resources that can be developed quickly. Even with moderate growth, the region will need an additional 2,000 megawatts by the turn of the century.

A System Under Stress

The situation could get worse. Other pressures also are influencing the amount of power we can expect to produce in the future. (See Figure 3.)

To make sense of the stresses compelling this region to acquire more electricity, it is important to understand that, unlike any other part of the nation, the four Northwest states of Idaho, Montana, Oregon and Washington rely on a single source for about two-thirds of their electricity—hydropower.

Of all the options the region faces, inaction would expose the people and the economy to the greatest risk.

The number of hydroelectric dams that can transform the Columbia's waters into power is limited. That limit, in large part, has been reached. The electrical output of the Columbia's system is also limited by the amount of water flowing past the turbines. The analysis carried out for this plan assumed power output would be at what is termed "critical water." This is the amount of power produced during record low-water years, accounting for the water released to aid fish. It is the amount of power the existing system can guarantee and sell as firm power.[3]

Both the United States and Canada constructed dams on the mainstem of the Columbia River and its tributaries, and the two countries negotiated agreements to allocate the cost of those dams and the power they produce. Some of those agreements expire in this decade. Under the terms of one agreement, about 500 megawatts of energy was sold to U.S. utilities for 30 years. When that agreement expires in 1998, we assume the power will begin to return to Canada.

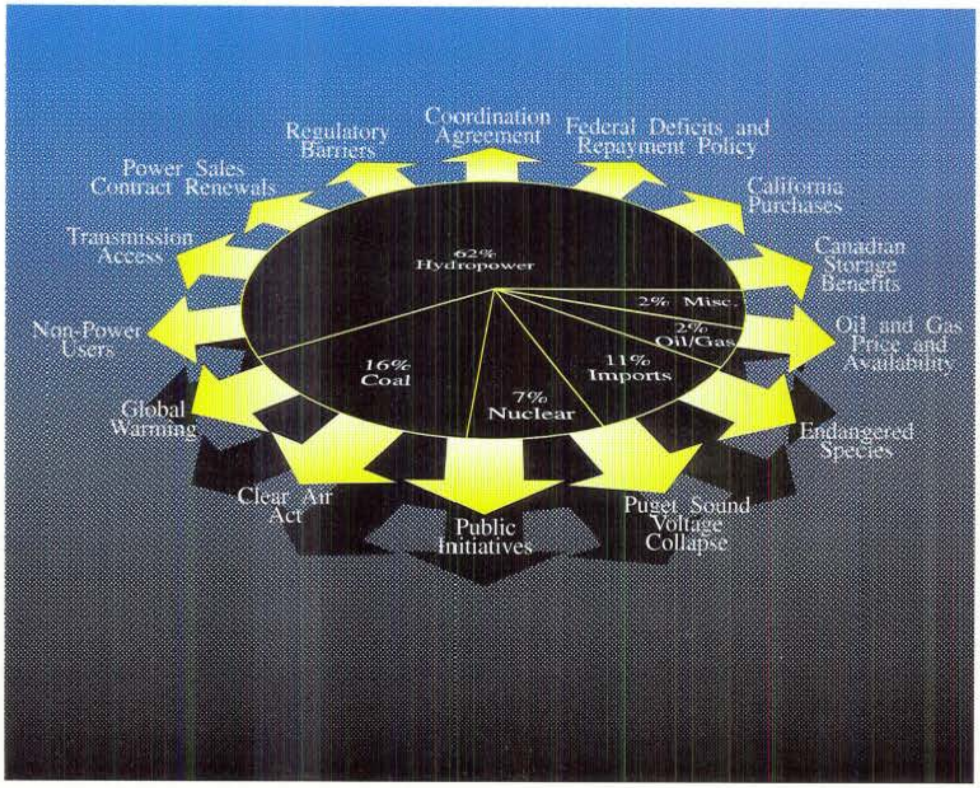
Another agreement governs the way much of the hydropower system is coordinated, so it can be operated as if by one entity. In fact, many agencies run the individual projects. That agreement expires in 2003, raising the question of how the river will be managed in the future.

New demands on Columbia River water are not so easy to predict. In the spring of 1990, several groups filed petitions to have five species of Columbia and Snake river salmon listed as threatened or endangered under the Endangered Species Act.

3. Hydroelectric resources are divided into "firm" and "nonfirm" categories. Firm power can be guaranteed and sold at a premium because it is the amount of electricity the dams can provide under even the worst recorded water conditions. Nonfirm power is what is available in any year that has additional water. If nonfirm power could be backed up by other resources, such as combustion turbines, it could be counted on to serve firm loads.

A System Under Stress

Figure 3
The Pacific Northwest Power System Must Cope with Many Challenges



Salmon use the rivers as spawning and rearing habitat, but the fish mature in the ocean. Each year, during their migration to the sea, millions of them die in the hydroelectric dams and reservoirs. If some salmon species are declared endangered, all other water uses, including irrigation, power production, recreation and transportation, could be affected.

Even before the petitions, however, there were concerns about the adequacy of flows for salmon migration. The Council's Columbia River Basin Fish and Wildlife Program calls for a broad array of measures to protect and enhance production of these fish, including minimum flow levels and a "water budget." The water budget refers to Columbia and Snake river water released to speed the young fish in their migration to the sea. But only one-third of the Snake River water budget comes from storage. The remainder comes from uncontrolled runoff, which has been consistently low for the last five years.

The Council, working with fisheries agencies, Indian tribes and other interested parties, is revising the fish and wildlife program. The Council is examining the water budget, flows, habitat and salmon production methods and expects to add additional measures to protect salmon.

The fish and wildlife program is an integral part of this power plan. This plan counts the water budget, flow requirements and all other measures in the fish and wildlife program as hard constraints on power generation. A change in the fish and wildlife program will affect this planning.

However, the Council's Action Plan is designed to flexibly meet a range of future conditions, including the sudden need for replacement resources. If further action is required, the Council is prepared to amend this plan.

Potential new claims on the Columbia's water are not the only unknowns in the region's future energy picture.

Other resources also are vulnerable. Concerns about the environmental consequences of emissions from power plants may lead to new regulations that could raise costs and lessen the availability of these power sources. Public opinion also may influence reliance on some resources, such as nuclear power plants, and the siting and construction of transmission lines.

Another recent Northwest concern is the possibility of blackouts in the Puget Sound area because transmission lines are becoming inadequate to carry the amount of power needed during peak-use periods. While this plan focuses on maintaining the region's supply of energy in the least-expensive and most environmentally sound manner, the Council also recognizes that reliability of electric service depends on an adequate and well-maintained transmission and distribution system.

Industries that buy large amounts of electricity directly from Bonneville—mostly alumi-

The Salmon We Prize and the Dams We Need

When Congress was deliberating over the Northwest Power Act, the Act this plan responds to, urgent concerns were raised about the Northwest's disappearing runs of salmon and steelhead. Before there were dams corralling the Columbia River and its tributaries, 11 million to 16 million adult salmon swam these waters. The Columbia was the path the salmon took from their upriver spawning beds to the sea and back again.

The dams blocked that path, but they also generate nearly two-thirds of the region's electricity, manage flows to prevent flooding, provide both water and power to irrigate farms, and create vast lakes for recreation.

By 1980, when the Act was passed, only about 2.5 million salmon and steelhead navigated these waters, and their numbers were declining. It wasn't just the dams that caused the near ruin of the runs. Fishing, irrigated farming, logging, road-building, mining, cattle grazing, and urban and rural development in general all took their toll. But the dams are among the biggest killers.

The fish and wildlife program and the power plan are really two components of a single planning effort.

Congress pushed the salmon crisis to the front of the Power Act. It called for an immediate and comprehensive response from the ratepayers of this region. The cost of power from the Columbia, Congress ruled, should include the expense of rebuilding fish runs put at risk by the power system.

The Council's Columbia River Basin Fish and Wildlife Program has guided that regionwide response for nearly a decade. It calls for significant changes in how the hydropower system is operated—changes specifically intended to increase the odds of salmon and steelhead surviving their journey past the dams. The power plan incorporates all fish and wildlife measures that affect the power system.

So the Council operates with two interlocking mandates. Although published separately, the fish and wildlife program and the power plan are really two components of a single planning effort. The program requires that water be spilled over dams or flushed through the reservoirs to benefit fish. Each year, this amounts to hundreds of megawatts of lost firm power. It also adds the complexity of balancing the changes we make to save salmon against the effects those changes might have on other aspects of the system, such as their impact on non-migrating fish above dams.

In the fish and wildlife program, we also worked with the states and Indian tribes to determine where new dams would pose a threat to critical fish or wildlife populations. Based on the state and tribal recommendations, we designated 44,000 miles of streams to be protected from new hydropower development.

The power plan incorporates these decisions. It is based on what we expect the hydropower system to produce, assuming full implementation of the fish and wildlife program. This means that the program is a "hard constraint" on the power plan.

Furthermore, as we analyze each possible resource—whether conservation, hydropower, combustion turbines, coal gasification plants or any other—we review its environmental consequences. We want to be certain that we do not counteract on one side what we enact on the other.

num plants—have a major influence on the power system, too. When they are operating at capacity, these direct service industries account for about 17 percent of total regional electricity sales. They currently are stable seasonal and hourly power users. In addition, because part of their load is interruptible, they provide reserves for the electricity system to draw on when necessary.

But the world price of aluminum has historically been volatile, and that price affects the profitability of Northwest plants. Furthermore, the industries' and utilities' contracts for Bonneville power expire in 2001. For both

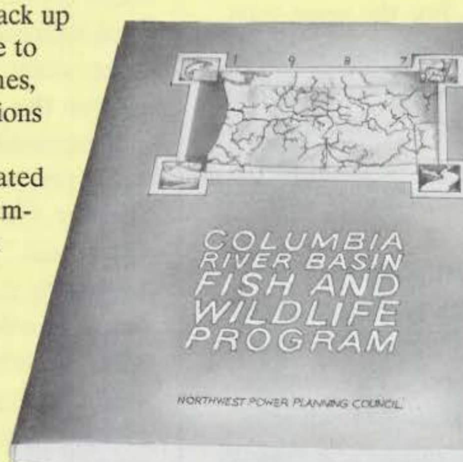
Today, the Northwest is having to contend with trade–offs on the river that are more severe than ever before. Many salmon populations have improved because of actions taken in the fish and wildlife program and elsewhere, but other stocks are still declining precipitously. It is likely that several runs will be declared threatened or endangered under the Endangered Species Act.

The region will need to respond with great speed and possibly great sacrifice. We are committed to that response. We are prepared to amend the Columbia River Basin Fish and Wildlife Program to incorporate changes necessary for the survival of these fish. While we are convinced that this power plan is flexible enough to accommodate huge swings in our resource supplies, we also are prepared to amend the plan to provide further protection for salmon.

We already have taken many steps in this process. At the request of the Northwest congressional delegation and the four state governors, we helped convene the "Salmon Summit." We conducted extensive analysis of the biological and economic effects of various proposals for increasing flows for fish and are continuing that analysis. We are working with the agencies and tribes to develop an early implementation strategy to aid salmon migration and add detail to the Summit's conclusions.

But because the dams are not the only cause of this crisis, the region's ratepayers should not be the only ones who pay for the cure. Everyone who benefits from the river at the expense of the salmon should participate in the salmon recovery.

For our part, the Council has been exploring ways to back up the hydropower system in years when flows are inadequate to meet either power or fish needs. Use of combustion turbines, purchases of power from outside the region and other options could serve to leave water in the river for fish.



We also are studying ways new resources can be integrated seasonally, so water can be stored for release when the salmon are migrating. In addition, we have begun working with the region's utilities and others to identify resources that can be brought into the system quickly, in case a declaration of endangerment necessitates emergency action.

Last year, we opened our fish and wildlife program and solicited recommendations for measures to increase salmon production. We are still extending that invitation. We also intend to solicit suggestions that can increase salmon survival at and between the dams. We plan to introduce some of these measures into the program this year.

Perhaps most important, we will continue to monitor the effects of changes in river operations on fish and wildlife, and will be looking at innovative ways to operate the region's entire power system so that it serves the needs of the salmon better. Ours is a resilient system. We believe it can be made to conform more precisely to the salmon's unique life cycle. We are committed to striking the careful balance between a cost–effective power supply and the survival of our prized salmon.

economic and contractual reasons, the future of the direct service industries is uncertain.

Even the federal government, by threatening to require the Bonneville Power Administration to accelerate its repayment of billions of dollars in federal loans, is challenging the stability of this region's supply of affordable electricity.

All of these forces bring tremendous uncertainty to the process of planning for the Northwest's energy future, but one thing is clear: The time to act is now. Of all the options the region faces, inaction would expose the people and the economy to the greatest risk.

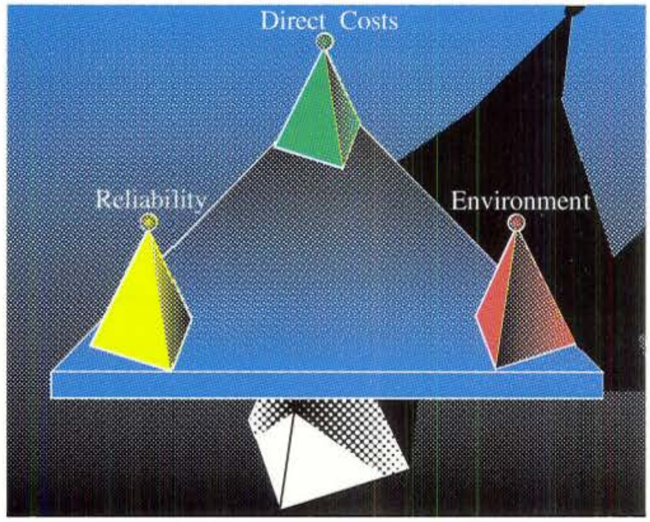
Selecting Resources

The past 10 years have not been without conflict in the region's energy community. There were long and heated debates over how to forecast power needs. There was argument over how much energy could be saved and at what costs. For the most part, however, those arguments have now been overshadowed by the need to secure the electricity required to meet even moderate growth in the Northwest's economy.

Without new resources, the economic stability of this region will be jeopardized. The region's utilities, its regulatory agencies, its state and local governments, and energy consumers in general must act now to prevent future power shortages. This plan is designed to ensure that judicious actions are taken to guarantee the region electricity at the least expense to the consumers and their environment.

Delicate Balance

Figure 4
Balancing the Power System



Finding the Balance

The term "least cost" is often misunderstood. It has a broader meaning than just the capital, labor and overhead costs to build a power plant, or the cost to fuel and maintain a plant over its lifetime.

In least-cost planning, these costs are calculated along with all other resource development and decommissioning costs. But these direct costs must be balanced against the difficult-to-quantify environmental consequences of using one resource rather than another. (See: "Protecting the Environment.") These less tangible attributes must be factored into resource selections along with the value of risk management. For example, certain resources come in smaller increments, have fewer environmental effects or take less time to bring online. They may cost more to build or operate than some other resources, but their other characteristics make them particularly well suited to lessening risks to the environment or the economy.

This is the intricate balancing act the Council must perform, weighing the direct costs, environmental impacts and reliability of each resource. How such balance is achieved is fundamentally a judgment call, and that is an important part of understanding this power plan. (See Figure 4.)

This plan represents far more than numbers fed into and spewed out of a computer. It is the product of analysis, judgment and exhaustive public input. Scientific and technical advisers in each resource field participated in lengthy meetings, suggesting the most up-to-date technologies and cost figures to help shape these recommendations.

Protecting the Environment

In examining the three most important considerations this plan must balance—resource costs, reliability of the power supply and protection of the environment—responsible attention to the environment posed the greatest challenge. Many who commented on our draft plan wanted assurance that the Council had fully considered the environmental ramifications of each resource. A number of commentors suggested we quantify environmental costs by assigning specific dollar values to the environmental risks associated with each resource in this plan.

But merely quantifying known impacts does not ensure environmental protection. Resources with unacceptable consequences could still be built, if their base costs were low enough to offset the quantified environmental costs. Instead, we carefully studied the environmental repercussions of each resource (see Volume II, Chapter 9) and made deliberate policy decisions to guide resource development.

For example, we picked conservation as our lead resource and gave it an economic edge. Unlike generating resources, for which the cut-off purchase price is 7.5 cents per kilowatt-hour, we are recommending that all conservation measures costing up to 11 cents per kilowatt-hour be acquired. Part of this credit is due to the environmental advantages of conservation.

We also agreed to limit the amount of hydropower we included because of our concern that important fish and wildlife habitat not be destroyed by new dams. We have protected 44,000 miles of stream and prepared a list of criteria developers must use to determine which hydropower sites and projects outside those areas can be advanced without causing great harm.

Responsible attention to the environment poses the greatest challenge.

We even took our concerns into people's homes by requiring much higher indoor air quality assurances for houses built to our model conservation standards than are called for by any other existing building codes. Securing the best air quality for these homes adds to their costs, but they still offer the region some of the most affordable energy savings available.

For every resource in this plan, we have examined and incorporated the expense of meeting the most stringent state and federal environmental protection, waste disposal, air pollution and decommissioning requirements. In most cases, we have opted to go beyond those requirements.

Furthermore, because we expect that environmental laws and regulations will be made more rigorous over time, we intentionally constrained our reliance on generating resources. Uncertainty about their future costs makes them less reliable place holders in our resource stack.

We developed a methodology the Bonneville Power Administration is using to further account for environmental considerations, and we are asking that Bonneville determine the environmental impacts caused by the hydropower system and incorporate those costs into operational, and fish and wildlife decisions.

In this plan, we are calling for the creation of siting, design and operating criteria, similar to those we adopted for hydropower development, for each new resource. The goal is to direct new resource construction toward sites that will have the lowest possible environmental disruptions.

Ultimately, the environmental cost and acceptability of a resource will be determined by the specific site and design of a given project. In preparing this plan, we didn't have the benefit of knowing exactly where each resource would be located. We expect that state facility siting agencies in the Northwest will carefully evaluate all site-specific impacts of new generating projects.

We take seriously our responsibility to protect both this region's electrical supply and its environment. We believe we have met that responsibility in the most prudent and conscientious manner possible.

A Level Playing Field

The only way to determine if a resource is cost-effective is to compare it to another resource. Is it cheaper or more expensive? This comparison is not as easy as it sounds. For one thing, not all resource costs come in equal increments. Some resources, such as a hydropower dam or conservation, require large capital outlays up front, but have low operating costs after that. Other resources, such as gas-fired combustion turbines, are relatively inexpensive to build, but they are expensive to run because of their ongoing fuel costs.

To account for these differences, the Council determines the total cost of each resource (including capital, financing, fuel, operation, maintenance and decommissioning). These costs are spread over the lifetime of the resource and divided into equal annual payments much like a home mortgage. When those costs are divided by the number of kilowatt-hours the resource produces, the result is called the *levelized life-cycle cost*. This allows resources with different cost and benefit patterns to be compared on a level playing field.

Some resources require large capital outlays up front, but have low operating costs after that. Other resources are relatively inexpensive to build, but they are expensive to run because of their ongoing fuel costs.

A dollar by any other name

There are two ways to report costs: in nominal or real dollars. Nominal dollars represent the face value of money at any given moment in time.

Real dollars represent the purchasing power of future dollars stated in terms of today's dollars. Over time, the purchasing power of money ordinarily declines, due to inflation. Consequently, an item that costs, in nominal dollars, $100 today may have a price tag, in nominal dollars, of $200, 10 years from now. Removing the effects of inflation reveals how many of today's dollars ($100) it would take to purchase the item at some moment in the future. In this example, the cost of the item has risen in nominal dollars, from $100 to $200, but remains constant, at $100, in real terms.

The costs in this plan are reported in nominal levelized life-cycle costs. This approach allows us to compare new resource costs with the current price of electricity. For resources that have primarily capital costs, such as conservation and hydropower, the rule of thumb is that levelized costs in nominal dollars will be approximately twice as much as they would be in real dollars.

For more information, see Volume II, Chapter 13.

Consumer groups and individuals contributed important perspectives. The Council collected an enormous amount of data. It subjected this data, along with assumptions and hypotheses, to public scrutiny in a series of 33 issue papers, released between April 1989 and March 1990.

These papers asked the public for more than confirmation of, or additions to, the data. These papers asked for opinions on and interpretations of the data, for guidance in direction, for areas that might have been overlooked and, in short, for vision. The Council listened to public testimony and read a three-foot-high stack of comments on these issues. The Council evaluated this testimony, along with the technical and economic data, as it made preliminary decisions regarding the best actions to include in its draft power plan.

Public response to the draft released in November 1990 was equally impressive. More than 1,300 individuals and groups submitted their opinions in writing. This was three times the comment the Council received on its 1986 Power Plan. Hundreds more attended one or more of the 16 public hearings held throughout the region. Others simply phoned in their concerns.

Many of their questions and suggestions are reflected in this final plan. Largely in response to comments, this plan zeros in on four key issues:

- Load uncertainty.
- The role of coal and nuclear.
- Success of conservation efforts.
- Natural gas prices and availability.

A separate resource portfolio is described for each. The Action Plan addresses all four portfolios.

This plan contains the most diverse set of resources the Council has ever explored. This diversity is deliberate. It is one of the strengths of this plan.

This plan contains the most diverse set of resources the Council has ever explored. This diversity is deliberate. It is one of the strengths of this plan. The Council looked at every resource that could potentially produce or save electricity. These included small resources, such as new efficient light bulbs, and more esoteric technologies, such as power produced by the action of waves in the ocean.

The Council made an especially careful study of renewable resources, such as wind, geothermal and solar power. These resources often are proposed as alternatives to more conventional power plants. (See Volume II, Chapters 8 and 9, for further discussion.)

Figure 5 describes the resources, expected costs and predicted availability used in the resource studies that follow.

With these resource alternatives in mind, the Council turned to the kinds of futures the region can reasonably expect and what can be done to best shape those futures.

Resource Supply

This is not a list of resources to buy. Nor is it a list of priorities. The resources are ranked by cost, but for all the reasons listed earlier and described in detail in coming pages, it should be clear that it will not be cost alone that determines which resources are built when.

In the future, resources not currently on this list may mature, be tested and prove cost-competitive with some of those on the list. The cost and availability of others could improve. That is, in fact, one of the goals of this plan—to encourage emerging technologies. Through this encouragement, future plans may have even more diversity in their mix of available resources.

The top of Figure 5 illustrates what is called a resource supply curve. A supply curve shows the amount of power that can be purchased at less than any given price. To create a supply curve, the Council estimates the total levelized cost of every resource and its generation or load-reduction capability. (See: "A Level Playing Field.")

Some have asked how the Council's estimates of potential energy-efficiency improvements shown in Figure 5 compare to estimates made in other parts of the country. We evaluate hundreds of individual actions that can save energy. These individual actions are called measures and are combined into programs that are shown in Figure 5. The average cost and savings of each program in Figure 5 is made up of high-cost and low-cost measures. We carefully compared our technical analysis to others' estimates and discovered that we are all calling for virtually the same conservation measures in homes, businesses, farms and factories.

Clearly, there is a lot of cost-effective conservation out there, and we need it all. We won't turn any of it away.

But the Council also estimates savings differently. In developing our forecasts of future electricity use, we take a realistic look at what conservation actions consumers are likely to take without further regional action. For example, when consumers buy a new refrigerator, they won't find one in the store that's as inefficient as their old model. Technologies have changed, and standards regulating the energy use of the appliance have been tightened. Our forecasts of future energy needs incorporate this conservation by reducing the amount of energy we expect the region to need.

We then ask the question: How much *more* conservation can we achieve? If we don't begin with our forecasted level of efficiency, we would double-count the future conservation savings—and underestimate the need for other resources.

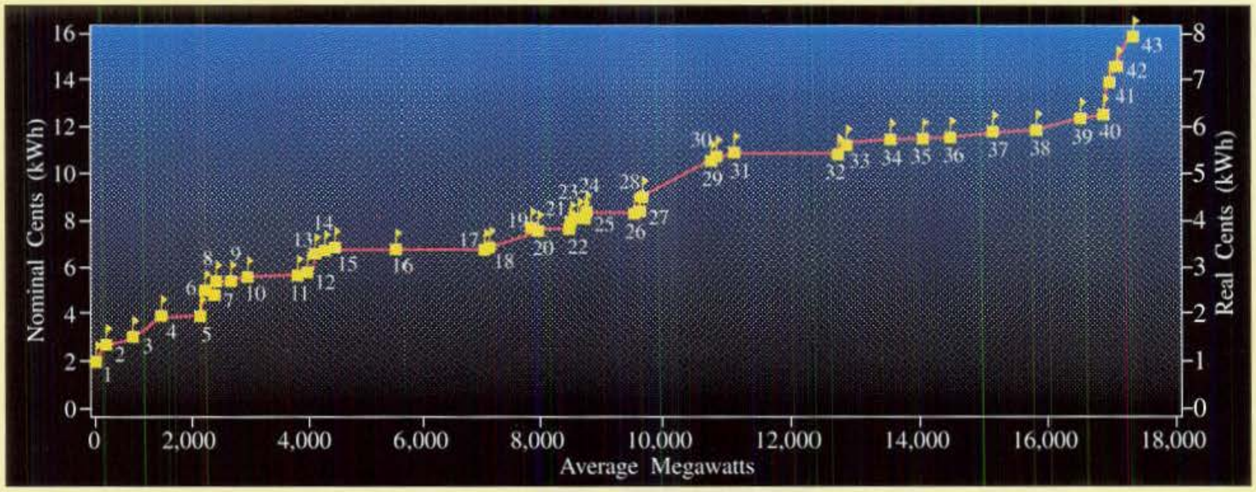
Others have counted conservation assuming no recent improvements in technology or standards. If we adopted this view, it would raise our forecast of future energy demand significantly. It also would overestimate the amount of new conservation that actually is available.

A second key difference between ours and others' estimates has to do with how fast the savings will occur. Our estimates are based on normal replacement cycles of buildings and appliances, and pragmatic estimates of how fast conservation programs can be geared up.

In the final analysis, the amount of conservation savings is less important than the adoption of the same energy-efficiency technologies. Clearly, there is a lot of cost-effective conservation out there, and we need it all. We won't turn any of it away.

Resource Supply

Figure 5
How Much at What Cost?



	Available Resource	High Forecast Megawatts	Levelized Nominal Cost	Levelized Real Cost	Resource Category
1.	Conservation Voltage Regulation	100	1.4	0.7	Conservation
2.	Hydro Efficiency Improvements	110	2.2	1.1	Renewable
3.	Industrial 1	491	2.6	1.3	Conservation
4.	Water Heat	472	3.5	1.8	Conservation
5.	New Commercial Model Conservation Standards	647	3.7	1.9	Conservation
6.	Irrigation	43	4.6	2.3	Conservation
7.	Commercial Renovations and Remodel	144	4.6	2.3	Conservation
8.	Small Hydro 1	90	5.0	2.5	Renewable
9.	Transmission and Distribution Efficiency Improvements	200	5.1	2.6	Conservation
10.	Industrial 2	308	5.3	2.7	Conservation
11.	Existing Commercial	859	5.4	2.7	Conservation
12.	New Single-Family Residential Model Conservation Standards	213	5.6	2.8	Conservation
13.	Multifamily Residential Weatherization	57	6.3	3.2	Conservation
14.	Single-Family Residential Weatherization	124	6.4	3.2	Conservation
15.	New Manufactured Housing	131	6.5	3.3	Conservation
16.	Hydrofirming (Combined-Cycle 1)	1,070	6.6	3.3	High Efficiency
17.	Hydrofirming (Combined-Cycle 2)	1,430	6.6	3.3	High Efficiency
18.	New Multifamily Residential Model Conservation Standards	20	6.7	3.4	Conservation
19.	WNP-3	868	7.3	3.7	Thermal
20.	Thermal Plant Efficiency Improvements	56	7.4	3.7	High Efficiency
21.	Cogeneration 1 (Biomass Fueled)	480	7.5	3.8	Renewable
22.	Cogeneration 2	57	7.6	3.9	High Efficiency
23.	New Residential Lighting	63	7.9	4.0	Conservation
24.	Hot Water Heat Pumps	136	8.0	4.1	Conservation
25.	Municipal Solid Waste	30	8.1	4.1	Renewable
26.	WNP-1	818	8.1	4.1	Thermal
27.	Small Hydro 2	100	8.2	4.2	Renewable
28.	Existing Residential Lighting	26	8.8	4.5	Conservation
29.	Cogeneration 3	1,130	10.3	5.3	High Efficiency
30.	Wind 1	29	10.5	5.3	Renewable
31.	Geothermal	350	10.7	5.4	Renewable
32.	Eastern Montana Coal Gasification	1,704	10.7	5.5	Thermal
33.	Small Hydro 3	130	11.1	5.6	Renewable
34.	Eastern Washington Coal Gasification	745	11.3	5.7	Thermal
35.	Cogeneration 4	540	11.3	5.7	High Efficiency
36.	Expensive Conservation	412	11.4	5.8	Conservation
37.	Eastern Oregon Coal Gasification	745	11.5	5.8	Thermal
38.	Western Washington/Oregon Coal Gasification	750	11.7	5.9	Thermal
39.	Nevada Coal Gasification	716	12.2	6.2	Thermal
40.	Wind 2	376	12.3	6.3	Renewable
41.	Small Hydro 4	90	13.7	6.9	Renewable
42.	Biomass	90	14.5	7.4	Renewable
43.	Wind 3	253	15.7	8.0	Renewable
44.	Solar Thermal	480	16.0	8.0	Renewable
45.	Ocean Wave Power	N/A	16.0	8.0	Renewable
46.	Solar Photovoltaics	On-Site Applications	30.0	15.0	Renewable

Forecasting the Future

The lesson history teaches is "expect the unexpected." Contending with this challenge is the power planners' task. They must address a time 20 years from now and anticipate economic outcomes that have innumerable variables influencing them. They must imagine how much electricity a rapidly growing region might draw in two decades. Then they hypothesize how to supply the power to meet that magnified need.

Because tomorrow will always bring surprises, the Council wastes no time trying to pinpoint future electricity needs. Instead, we assume that the future can play itself out along an infinite number of paths. Some are more likely than others. The "20-year demand forecast scenarios" described in this section, establish the range of load uncertainty.

In addition to uncertain future energy needs, the Council must plan for resources whose costs and availability are difficult to predict. To do this, we study dozens of alternative resource packages, looking primarily at plausible conditions under which our energy future could be altered. In a departure from earlier plans, this plan presents four of the resource portfolios we examined instead of one. These four respond to the major questions confronting the Northwest.

- How much and how fast will the region's use of electricity grow?
- Will coal and nuclear power plants be available and acceptable?
- How much conservation can actually be achieved?
- How stable are natural gas prices and supplies?

The actions in this plan were designed to cope with movement in the economy and uncertain future resources. This is essential because the investments called for are considerable.

If the region bets wrong and builds too many power plants, as was the case in the 1970s, electricity consumers will be paying a premium for power they can neither use nor sell to recover their investment. If too few resources are acquired or they are built too slowly, the region could be forced to buy expensive power from other regions or face curtailments and blackouts.

This is why the Council is particularly attracted to resources that can be acquired relatively quickly and in small increments. They are the best hedge against uncertainty.

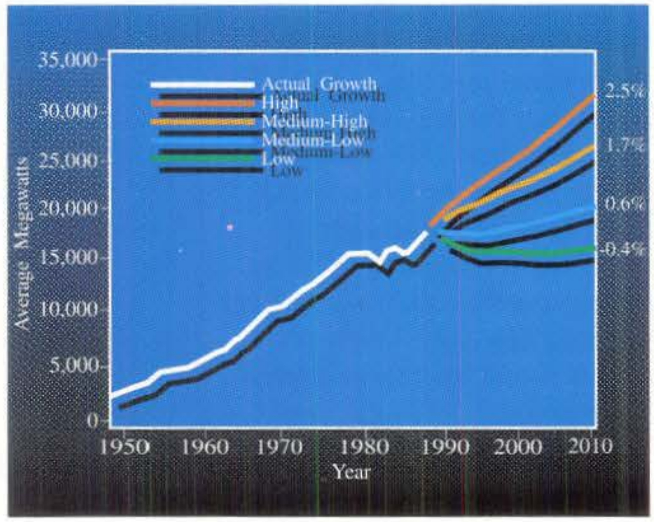
Forecast Scenarios

The Council works with the Bonneville Power Administration to estimate the region's economic growth and the energy it will use in the next two decades. Together, we look at historical trends, study reams of data and use economic computer models to make projections about the future. Because economic growth, and the costs of electricity and alternative fuels are the major determinants of energy use, they serve as the basis for the demand forecast.

The 20-year demand forecast portrays a broad range of growth banded by a low forecast, where the region's need for electricity declines at an average annual rate of -0.4 percent, and by a high annual growth rate of 2.5 percent. The Council looked at hundreds of possible scenarios within this range. Some would have the region grow quickly, then level off. Some portray the opposite pattern. Others indicate several peaks and valleys in growth.

Loads: Past and Future

Figure 6
A Wide Range of Energy Futures



While the Council plans for resources to meet any growth within the overall range, it places more emphasis on loads between the two mid-range levels. These are a medium-high growth rate of 1.7 percent and a medium-low rate of 0.6 percent. (See Figure 6.)

The four load-growth scenarios cover what could happen in the next 20 years, but the most crucial actions are those we take between now and the year 2000.

What follows are illustrations of the kinds of events that could happen. It is unlikely that the future will evolve precisely as described in any one of these scenarios, but each is plausible.

1. High Scenario: Economy Booms

The next two decades could be characterized by strong world and national economies. The region has recovered from its recession of the early 1980s and currently is outpacing the rest of the nation's economy. That economic vibrancy could continue.

Consider that the marketing outreach the region has been engaged in pays big dividends, and the Northwest becomes a major Pacific Rim economic power. Worldwide demand for our lumber supports healthy levels of production in our wood products industry. The food-poor Soviet Union becomes a big purchaser of Northwest wheat.

Our aluminum plants continue operating at full capacity, as strong prices for aluminum and efficiency improvements in the region's industry make our plants competitive in the world market.

Economic development is booming, and Boeing continues to get big airline and government contracts to replace aging aircraft. The suburban areas of Seattle and Portland emerge as national centers for research and production in the fields of biotechnology, computers and advanced materials.

International businesses and industries take a new look at the Northwest. The environment is attracting the best-educated and most valuable employees, an asset businesses cannot pass up.

None of this is implausible; the regional economy has grown faster than the high forecast since 1986. Sustained high economic growth during the 1990s would mean that the region's energy needs expand annually by about 600 megawatts, nearly the amount Portland now uses. Utility response would have to be immediate, with rapid and aggressive deployment of conservation programs.

Because of the time it takes to bring resources into production, we would be short about 2,900 megawatts by 1997, and the shortfall would continue until just before the year 2004. This assumes the Columbia River's dams are producing only their most reliable amount of power, called "critical water." In years with better water levels, the deficit would not be as severe. But a poor water year would have serious consequences for power system reliability.

The region would have to purchase power from outside the Northwest and likely pay a premium for it. A one-year deficit of 2,900 megawatts could cost the region billions of dollars.

If power isn't available from outside the region because no one else has a surplus, curtailments would be likely. The first to suffer would be the aluminum industry because part of its power is interruptible. But other consumers also might be cut off.

A one-year deficit of 2,900 megawatts could cost the region billions of dollars.

2. Medium-High Scenario: Growth Moderates

Under this scenario, much of the growth described above takes place, but not at such a frenetic pace. Lumber and plywood production falls from current levels, although by the end of the decade, the industry is again on an upswing.

The economy is still very healthy. Several Northwest cities continue to turn up in the list of most liveable places, drawing people from less attractive regions. The Northwest's physical beauty continues to make the region a mecca for tourists. New convention facilities—with their promise of side trips to mountains, sea and rivers—bring in big-ticket conferences.

Overall, employment is increasing 30 percent faster than the national average, and high-technology and commercial industries also are growing fast. Non-manufacturing employment expands by more than 50 percent.

At this economic pace, electric loads are increasing at a rate of 1.7 percent or about 360 megawatts per year until the end of this decade.

This is sufficient growth to mean a power deficit until 2000, with a maximum deficit of more than 1,100 megawatts in 1997.

3. Medium-Low Scenario: Economy Slows

In the medium-low growth scenario, the nation and the region experience a recession in the early 1990s. The region recovers slowly, and employment growth falls slightly behind the national rate. Migration into the region drops off. Population growth is dominated by the resident birth rate, which still exceeds the death rate.

Economies in the nation's "sunbelt" pick up, and industrial investment is drawn away from a lethargic Northwest. Aluminum plants run at two-thirds of their capacity as world prices for the product weaken. Employment in the lumber and wood products industries drops off by 30 percent.

Even with this slowed economy, the region needs new resources by the end of the decade. Conservation will take care of the bulk of this need.

4. Low Scenario: Recession Deepens

The recession, which has spread across the country, settles deeply in the Northwest, and the region never fully recovers. The Cold War ends, and defense budgets are cut. Boeing's contracts for new planes evaporate. There are massive layoffs in the aerospace industry, with employment dropping by nearly 50 percent. The lumber and wood products industry sees a 35-percent drop.

The aluminum industry is at a quarter of its operating capacity, and there is serious talk of closing Northwest plants.

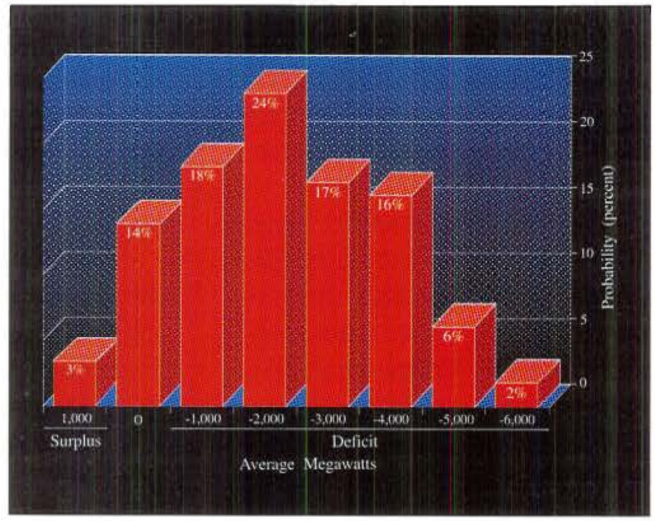
Even with a solid service industry, the ripple effects of a sinking economy are strong, and regional unemployment increases. With jobs scarce, the Northwest begins to lose population. People look to the South and East for better opportunities.

Power planners don't get to pick one of these scenarios to plan for; any of them (or, most likely, some other) could happen. If the region fails to add resources by the turn of the century, there is enough electricity in only 17 percent of the estimated futures. In 83 percent of the possible futures, the region will be deficit. In 65 percent of the cases, the region's deficit is 2,000 megawatts or greater. (See Figure 7.)

Furthermore, as noted earlier, the economic scenarios are only one part of the equation. Resources carry their own uncertainties, including public acceptability, resource performance (savings and output), future costs and availability of fuel. There also is the fundamental question of whether anyone will sponsor resource development.

Resource Needs

Figure 7
Without Action, Large Deficits Are Likely in the Year 2000



Resource Portfolios

The uncertainties that have the most impact are likely to be the ones we know the least about. These may be impacts that are not even hinted at in the contemporary planning world. In addition, actions we take now will reshape the future.

By developing and testing a series of alternative resource portfolios, the Council was able to identify the most significant load and resource-related risks the region might face, and compile the best set of actions to ensure an adequate and reliable power supply. Immediate actions that are common to several portfolios have the highest priority in the Action Plan.

In these studies, the Council shifted resources around, testing the power system's sensitivity to changes in any one of them. This was an opportunity to explore more fully the effects on the region of calling on different resources with different lead times, different costs and different environmental impacts.

The resource portfolios also incorporate judgments of the amount of each resource that is likely to be available. In specific cases, the Council has set its own limits on this amount, generally for environmental reasons.

The four portfolios that follow were developed assuming that Bonneville and the investor-owned utilities purchase new resources independently. Each undertakes only those actions that meet the needs of its own customers. However, because similar actions will be necessary for both Bonneville and all utilities during the next several years, we have combined this independent action to form a regional composite picture.

In fact, there are very large benefits to be gained if the region does cooperate to buy the lowest cost resources first. Ratepayers could save $3.6 billion if the utilities that serve them coordinate their resource development.

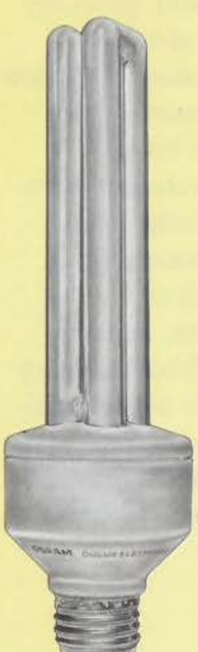
Because these benefits are so large, the Council recommends that, wherever possible, utilities design ways to share resources and resource development. For example, slow-growing utilities and those with surplus power would be able to cost-effectively operate conservation programs if they could sell their energy savings to a utility that needs resources. Other low-cost resources also might be developed if there were access to transmission lines so the power could be moved to utilities that need it.

The four portfolios that follow all assume that our ability to forecast electrical loads is limited. This load uncertainty is the primary focus of the first portfolio. The last three portfolios add to this load uncertainty specific resource concerns.

Conservation: It's Our Middle Name

Most of the time we trim our name, but the fact is, we're the Pacific Northwest Electric Power and *Conservation* Planning Council. That's the name Congress selected, and for good reason. Energy conservation is the best electrical resource money can buy. We were established to help the Northwest meet its future energy needs at the lowest possible cost to the economy and the environment, and conservation is uniquely suited to that purpose.

We define conservation as the wise and efficient use of energy. It means stretching our kilowatts, making them do more. It does not mean doing with less. It doesn't mean lower thermostats. In fact, in a review of data recorded during the "February freeze" of 1989, we learned that our most efficient homes (ones built to the Council's model conservation standards) saved, on average, 2 kilowatts of capacity per home daily, even though these houses were larger than average, and their indoor temperatures were kept higher than conventional homes that used more energy. At the same time, our efficient homes cut the region's demand for power by nearly 200 megawatts, saving an estimated $7 million in seven weeks.



This region is convinced! Every Northwest utility is promoting efficiency through marketing programs and incentives. They have already saved more than 350 megawatts, at a cost less than half that of power from a new generating plant. Aluminum companies also have cut their consumption. And state energy office programs brought us another 200 megawatts.

New energy-efficient building codes and appliance standards already adopted by federal, state and local governments can save the region more than 1,300 average megawatts by the year 2010.

In addition, if the region captures all the energy savings described in this plan over the next 20 years, it could add another 4,600 megawatts of conservation.

Portfolio 1: Load Uncertainty

The question addressed by this portfolio is how could the Northwest most economically respond to uncertainty about future electricity use. To answer that question, the Council looked at a diverse array of resources, assuming that the predicted costs and availability listed in Figure 5 are accurate. The strategy is to confront the unknown with diversity and flexibility.

The Council models hundreds of possible load scenarios. In some cases, the energy contribution of a particular resource is needed in only a few of these load scenarios. In these portfolios, the "expected" or average energy contribution is the energy output or savings of the resource multiplied by the frequency of its occurrence in all the scenarios we modeled. For example, if a 100-megawatt resource is needed in 40 percent of the load scenarios, it contributes 40 megawatts of expected energy.

In the first portfolio, illustrated in Figure 8, conservation is the dominant expected resource in 2000. Conservation contributes almost 1,400 megawatts or a little more than half of the new resource additions. Strategies to back up the hydropower system—known as "hydrofirming resources"—are the second largest resource group. They are expected to make up 23 percent of the resource mix. Renewable resources, such as new hydropower, geothermal, biomass-fired cogeneration and wind are expected to make up 16 percent of the total.

Portfolio 1: Load Uncertainty

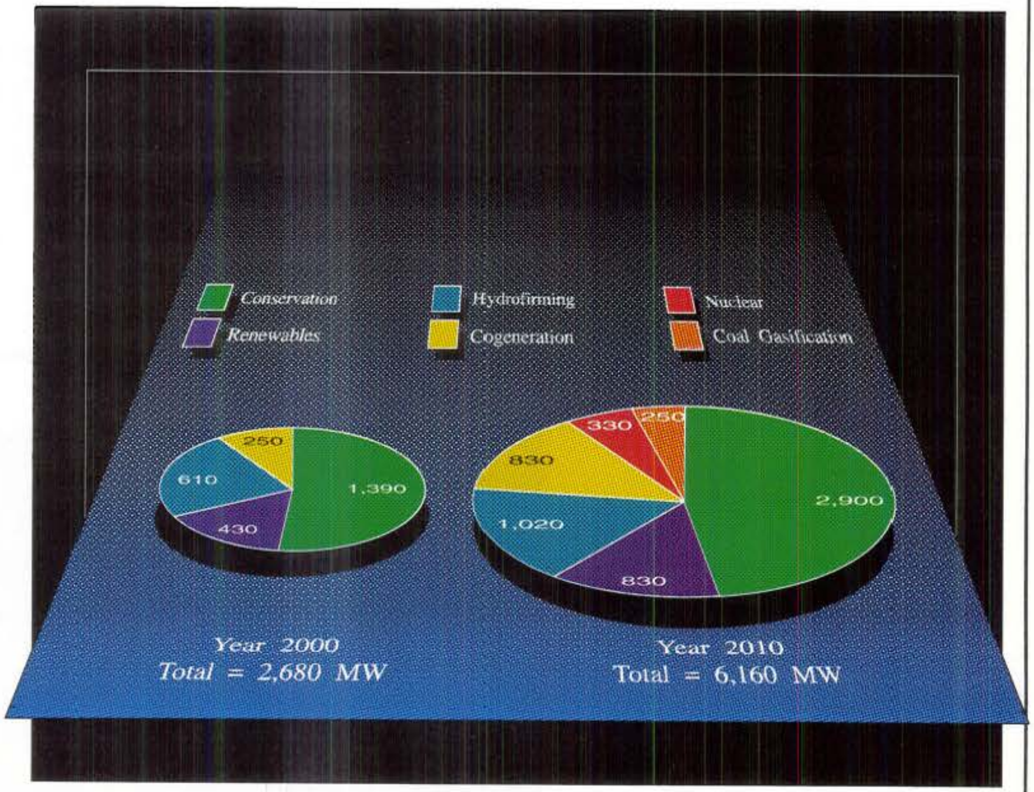


Figure 8
Diverse Least–Cost Resources to Manage Load Uncertainty

Finally, gas–fired cogeneration completes the expected resource additions by the year 2000, providing 9 percent of the overall resource mix.

By 2010, this resource portfolio has the same basic mix, but much more of each resource is likely to be needed. Conservation is still expected to dominate resource additions by providing 2,900 megawatts. Renewables and hydrofirming resources are expected to supply 30 percent of the total. Cogeneration is expected to add about the same amount as renewables or about 14 percent. Relatively small contributions are expected from coal gasification plants and nuclear power plants, which together make up less than 10 percent of the expected mix in 2010.

When estimating portfolio costs, the Council includes operating and maintenance costs of all existing resources, plus the costs of all resources added to the existing power system over the next 20 years. Resources needed to replace existing resources at the end of their useful lives also are included. All costs are accumulated for the next 60 years and converted to present values.[4] This portfolio has an expected present value cost of $47 billion and is the least expensive of the four portfolios. This cost will be used for comparison purposes with the three portfolios that follow.

Figure 9 illustrates the resource additions over the next 20 years in each of the four basic load growth scenarios. From this analysis, the Council made several observations.

First, in both the high and medium–high scenarios, there will be large energy deficits until about 2000. Even assuming the region acts as fast as possible, it is difficult to add significant amounts of new resources by the mid–1990s. In fact, if load continues to grow at a rate faster than 1 percent per year, new resources will not be able to keep up with load growth during the 1990s.

4. "Present value" is a current amount of money that is financially equal to a stream of payments in the future. An everyday example is a home mortgage, where the amount that is borrowed is the present value of the future stream of monthly payments.

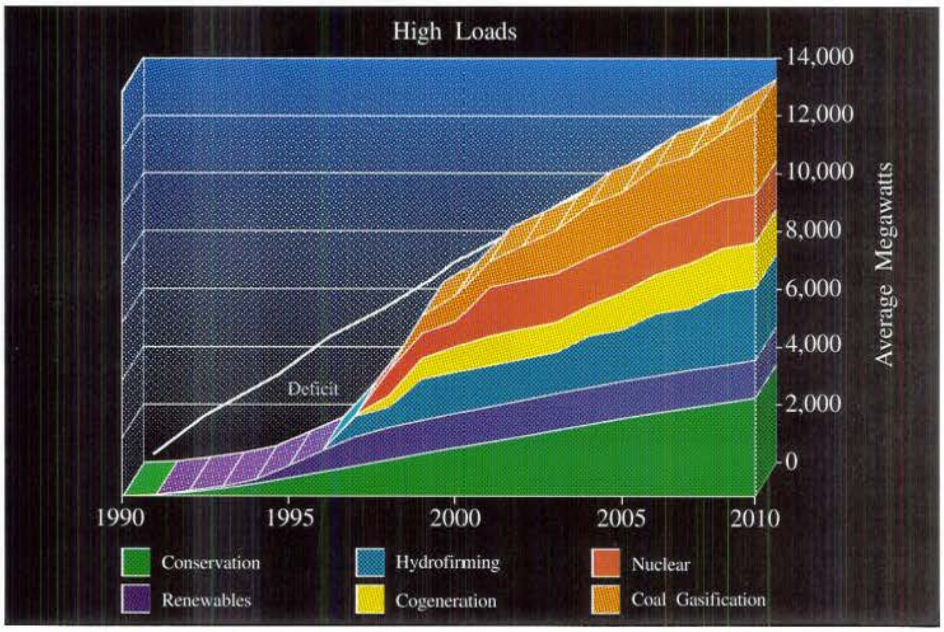
A second observation is the importance of beginning to acquire all cost–effective efficiency improvements as soon as possible. Conservation programs take time to design, staff and operate. If significant savings are going to be secured by 2000, the region needs to begin programs now, in every sector of the economy.

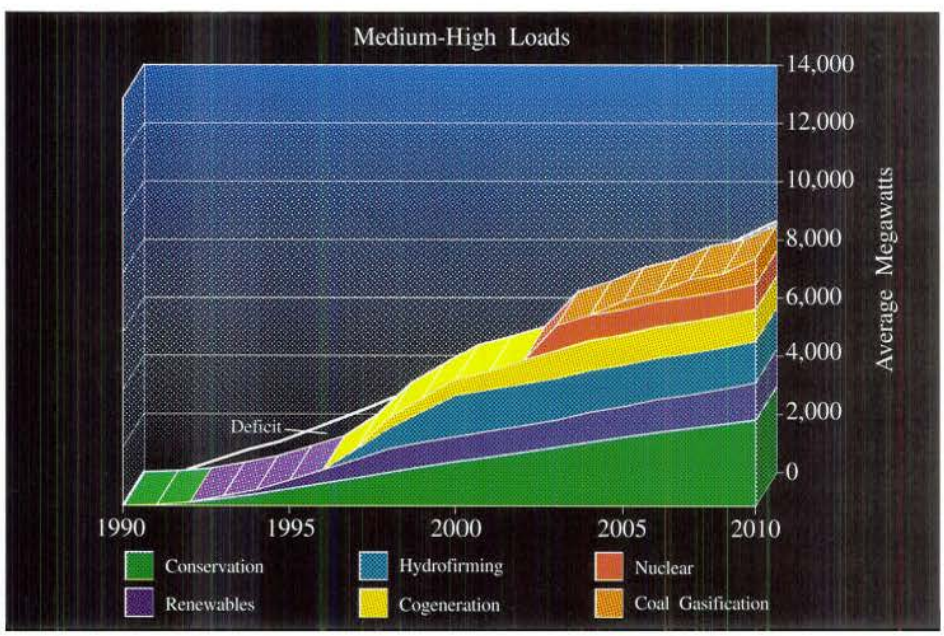
Lower cost renewables and cogeneration resources are probably going to be needed by 2000, too, and we should begin acquiring these. Hydrofirming resources, higher cost renewables and cogeneration resources should be sited, licensed and designed so the region can move quickly to acquire these resources if load growth accelerates.

Finally, efforts to determine the cost and availability of geothermal, wind, solar and the region's two partially completed nuclear power plants could clarify the Northwest's resource alternatives for the next power plan.

Portfolio 1: Load Uncertainty

Figure 9
Diverse Least–Cost Resources to Meet Each Load Scenario

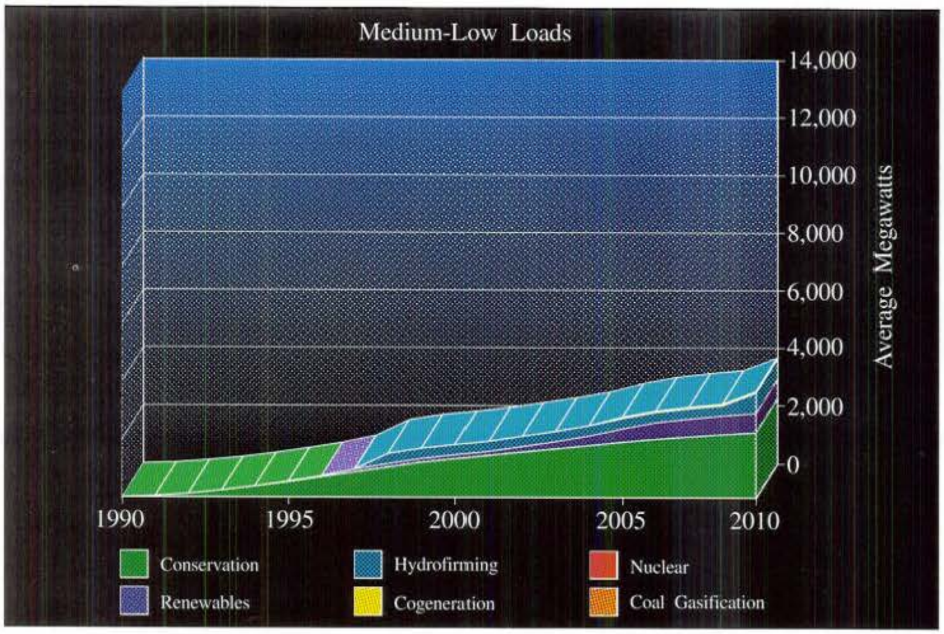


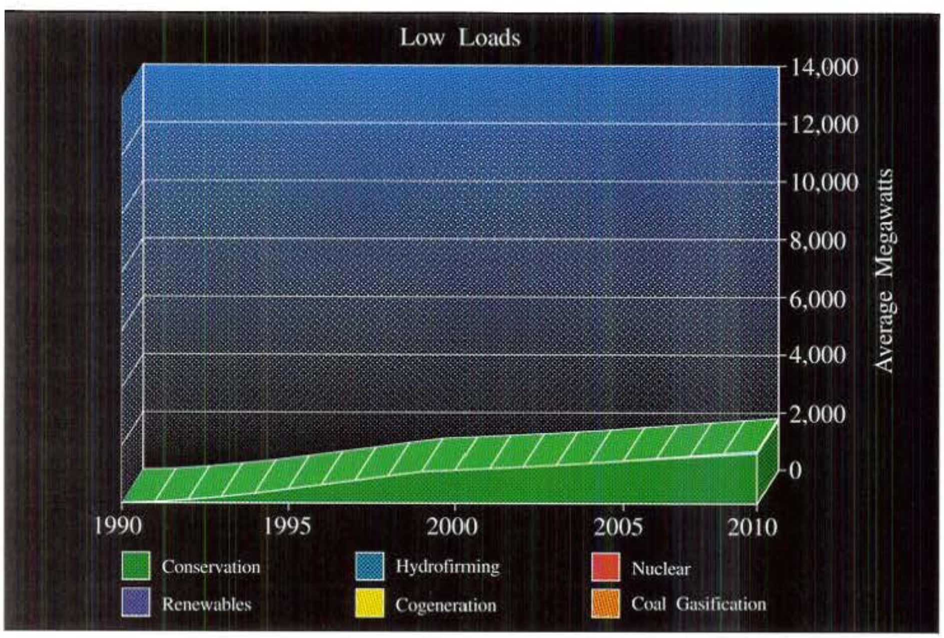


Portfolio 2: Nuclear and Coal Plants are Unavailable or Unacceptable

There has been much discussion of the unique uncertainties regarding both nuclear and coal-fired generating resources. This portfolio asks the question: Can the Northwest's electric energy requirements be met without turning to coal or nuclear plants?

To evaluate how the region could most cost-effectively respond in an energy future without nuclear or coal-fired power plants, the Council developed a resource portfolio that excluded them. This portfolio's expected resource mix is shown in Figure 10. It relies on conservation, renewables, cogeneration and strategies to back up the region's existing hydropower system.





For the first portion of the planning period—up to the year 2000—this second portfolio closely resembles the first. Efficiency improvements continue to dominate the expected resource additions by the year 2000. The rest of the resource mix in 2000 is made up of renewables, hydrofirming strategies and cogeneration.

By 2010, conservation still supplies about half of the total mix. Renewables, hydrofirming strategies and cogeneration provide approximately equal shares of the resources that replace nuclear and coal gasification plants.

On average, this portfolio increases the region's expected cost by $670 million over the cost of the first portfolio. (See Figure 11.) If loads grow as fast as the high-load scenario, the region will need to identify an additional 3,200 megawatts of resources.

Using today's estimates of resource availability, the power system's reliability would be reduced. In higher load scenarios the expected cost impacts could be more than $9 billion.

In contrast, for many of the lower load cases, new nuclear and coal-fired plants are not needed. Their absence from the portfolio would have no impact on the region's power system.

Portfolio 2: Nuclear and Coal Uncertainty

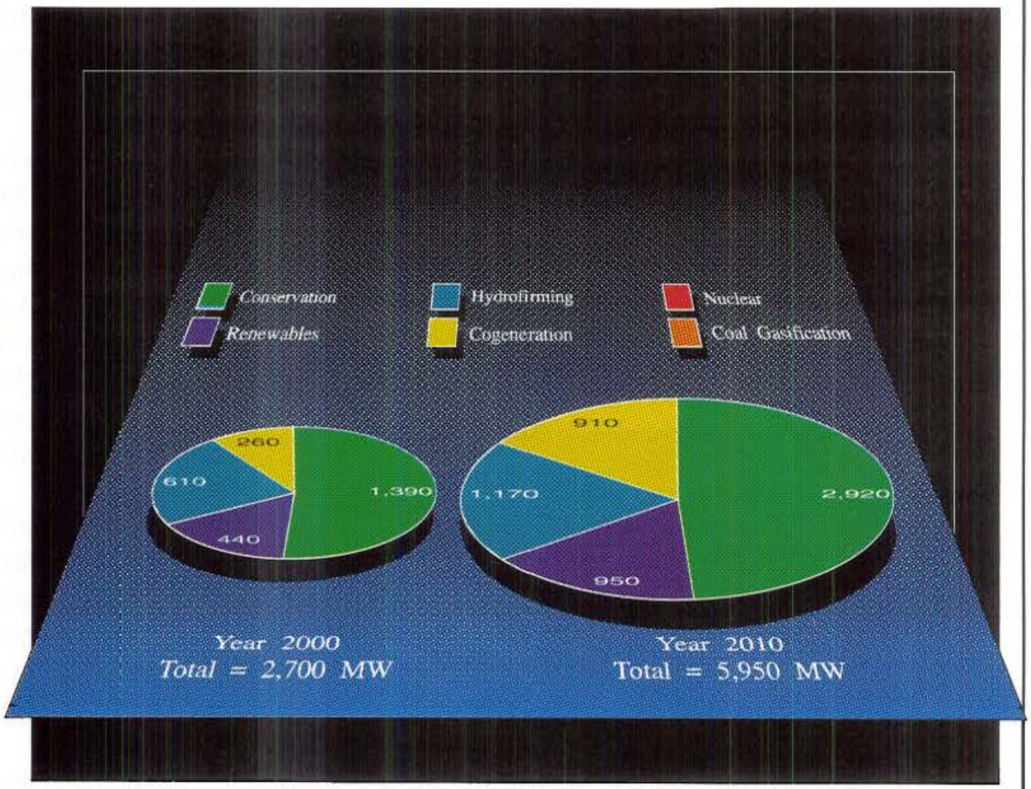


Figure 10
Expected Resource Mix if Large Thermal Resources are Either Unavailable or Unacceptable

It is clear that to prepare for an energy future that contains neither nuclear nor coal plants, the region must quickly secure all cost-effective energy savings and expand the amount of this resource through conservation research and development.

Research and development work is also needed on renewable technologies such as geothermal, wind and solar. If these technologies are found to be environmentally and economically feasible, they could provide large amounts of additional energy.

Finally, if coal and nuclear power plants are not available, the region is likely to need to turn to large amounts of gas-fired electrical generation. Gas-fired generation in this portfolio is almost equally split between cogeneration and gas-fired combustion turbines used to back up the hydropower system.

Portfolio 3: Less Conservation Achievable

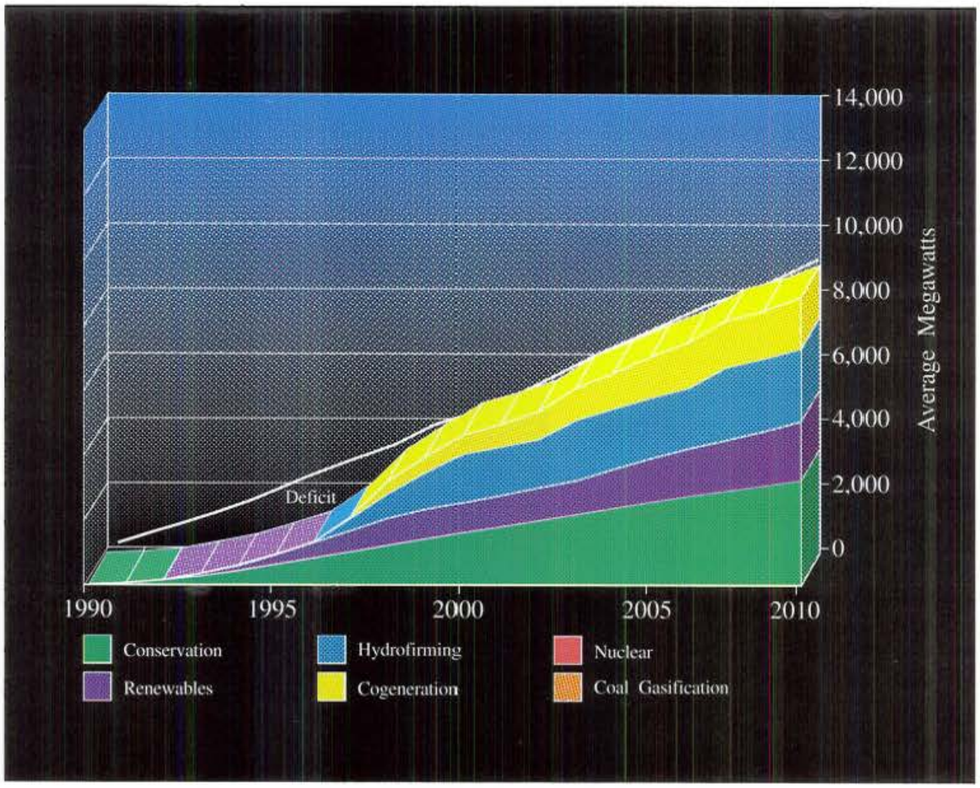
This plan is based on the premise that energy conservation is our most affordable and reliable new source of electricity. There was clear indication throughout our lengthy planning and public review process that that belief is widely held in the Northwest.

But what happens to our energy future if the regional consensus that conservation is the resource of choice is not manifested in behavior? What happens if we fail to meet our goal of acquiring 1,500 megawatts by 2000 and more after that? Conservation may be our highest priority resource, but it is still an uncertain one.

An enormous level of commitment will be necessary to carry out conservation programs capable of garnering these energy savings. We expect it to cost about $7 billion by the turn of the century. It will be a formidable management challenge. All of the Northwest's 9 million citizens will need to participate physically, economically and emotionally.

Portfolio 2: Nuclear and Coal Uncertainty

Figure 11
Resource Schedule to Meet Medium–High Loads



Utilities will need to provide financial and technical support to help develop an improved infrastructure for conservation delivery. In addition, the utilities and the managers of energy service companies will need to influence hundreds of thousands of individual investment decisions. State and local governments will need to facilitate the transition to greater efficiency. We believe this job is achievable; however, the results of an effort of this magnitude are difficult to predict.

Some suggest that our target of achieving 85 percent of the technical conservation potential is overly optimistic. Especially in the existing commercial sector, Bonneville and some utilities have argued that 60 percent is a much more reasonable expectation.

This third portfolio examines the risk posed if the region does not meet the Council's conservation targets. In this portfolio, we assume that only 60 percent of the total technical conservation potential in all sectors is achievable by the year 2010.

If only 60 percent of the total conservation potential is achievable instead of 85 percent, the current target for the region of 1,500 megawatts by the year 2000 is reduced to 1,100 megawatts. By 2010, the reduction from 85-percent penetration to 60-percent penetration cuts the expected energy savings under high load cases from 3,400 megawatts to 2,400 megawatts.

With less conservation, the region must add more generating resources. Figure 12 shows the expected resource mix changes. Renewables and hydrofirming strategies are the leading replacement resources, representing almost 50 percent of the total mix by 2000.

By 2010, conservation's share of the total resource mix is reduced from about 50 percent to 35 percent. Renewables and hydrofirming strategies are up slightly. Increases in the expected

Portfolio 3: Conservation Uncertainty

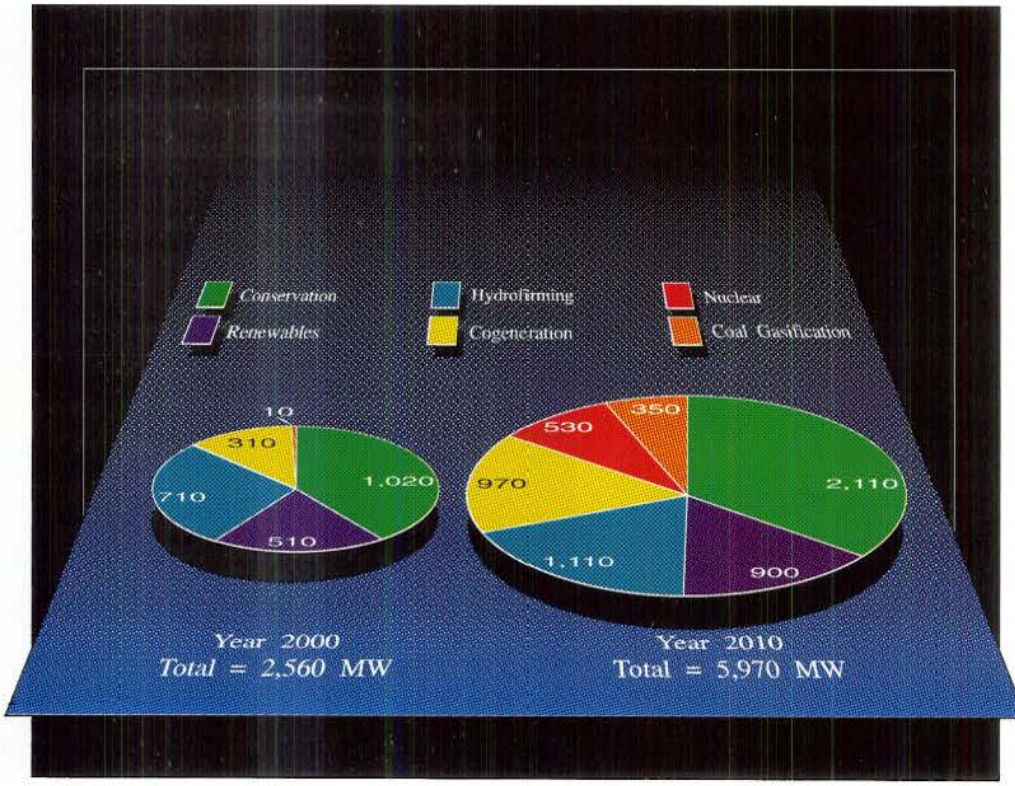


Figure 12
Expected Resource Mix if Conservation Programs are Less Effective

contribution of cogeneration, coal gasification and nuclear make up for most of the reduction in conservation.

Figure 13 shows the resource additions anticipated in this portfolio, assuming medium-high loads. Because the loss of conservation savings happens gradually over the next 20 years, all other resources in the portfolio move forward in time. By 2010, the amount of coal gasification power plant energy has increased to 1,500 megawatts and makes up for most of the reduced conservation savings.

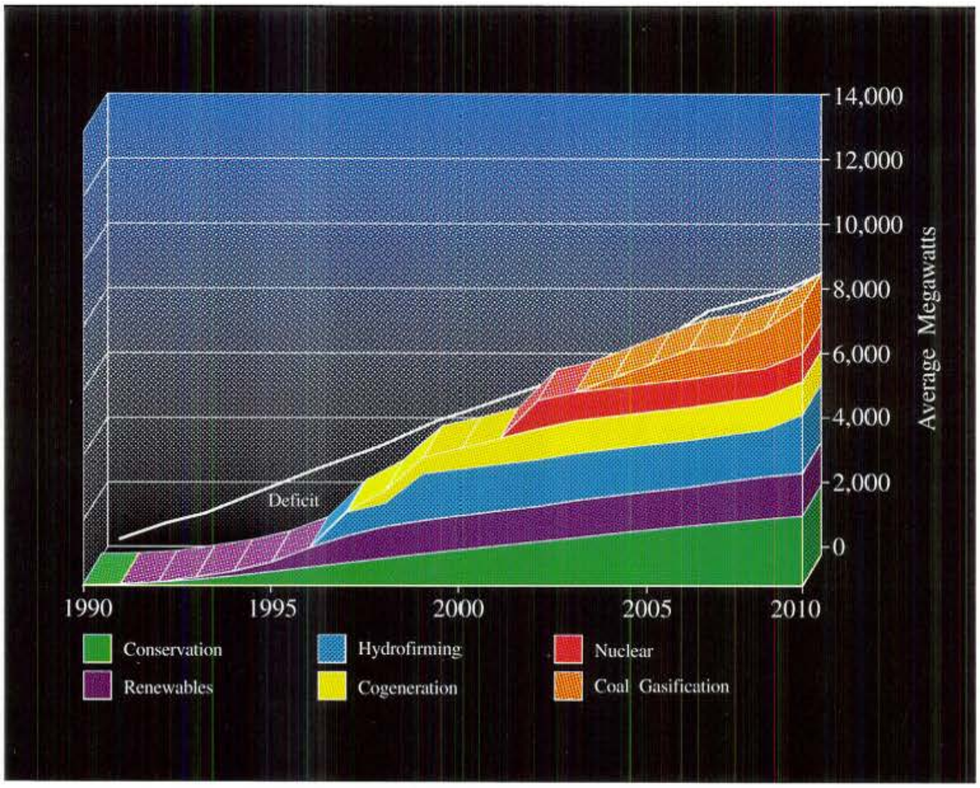
This portfolio illustrates the need to have a diverse resource mix. Using current estimates of cost and availability, cogeneration, coal gasification and nuclear could all be responses to reduced conservation savings, but only at great expense.

This portfolio increases the expected cost of the power system by $2.3 billion. If loads grow quickly, the cost impact could be more than $3.8 billion. Furthermore, the replacement resources are not only much more expensive than conservation, but in many cases, more difficult to obtain and subject to their own uncertainties.

Geothermal and wind resources could add large amounts of cost-effective energy in the future, but we lack regionally specific understanding of their costs and availability. Confirming these resources now could provide insurance against uncertainty about conservation's viability.

Portfolio 3: Conservation Uncertainty

Figure 13
Resource Schedule to Meet Medium–High Loads



Portfolio 4: Natural Gas Uncertainty

The first three portfolios bank heavily on natural gas–fired technologies. The Council estimated that more than 1,700 megawatts, primarily gas–fired cogeneration, could be developed in the region for less than 15 cents per kilowatt–hour. In addition, the Council estimated that about 2,500 megawatts of hydrofirming strategies could be developed cost–effectively, utilizing gas–fired combustion turbines.

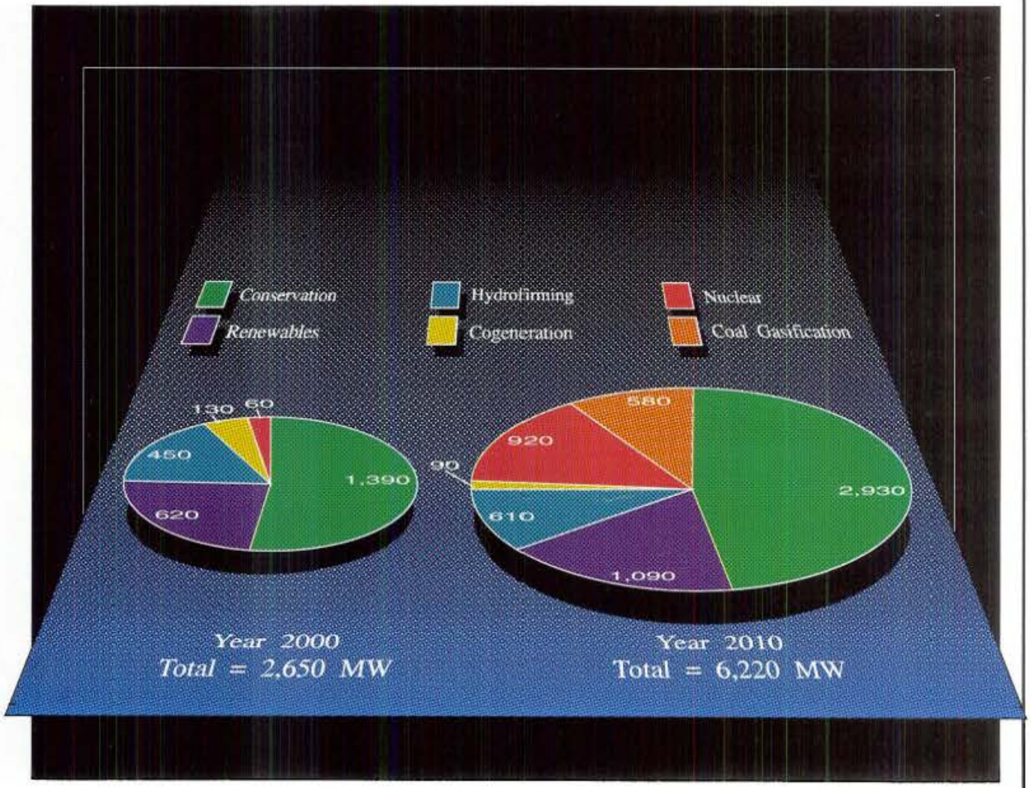
During the 1980s, there were abundant supplies of natural gas at low prices, but only a decade earlier, price and availability of natural gas were problems. The massive shift to natural gas that is occurring not only in the electric power industry, but also in other industrial sectors and among residential consumers, could once again constrict availability of this fuel. For this reason, a heavy dependence on gas–fired electric power generation may bring particular risks to the region.

This portfolio evaluates this source of uncertainty and explores the resources the region could turn to if the cost of natural gas rises to the Council's highest forecast price.

Figure 14 illustrates the resource mix that can minimize the risk of rapid gas price increases. This portfolio turns to renewable resources instead of cogeneration and gas–fired hydrofirming strategies. Conservation continues to play a significant and crucial role in the region's portfolio, providing more than 50 percent of expected resource additions by 2000. Coal gasification and nuclear power make slightly higher contributions to help reduce the region's reliance on gas–fired technologies.

Portfolio 4: Natural Gas Uncertainty

Figure 14
Expected Resource Mix if Natural Gas Prices Increase Rapidly



By 2010, much of the cogeneration and hydrofirming strategies are replaced by renewables, coal gasification and nuclear. Conservation maintains its role as the biggest contributor to the region's expected resource additions.

However, if the region's loads follow the medium-high scenario, there are insufficient conservation and renewable resources to replace the cogeneration and hydrofirming strategies that are no longer cost-effective with higher gas prices. (See Figure 15.) The move to combined-cycle coal gasification plants must be accelerated so that the first plants are operating in 1997.

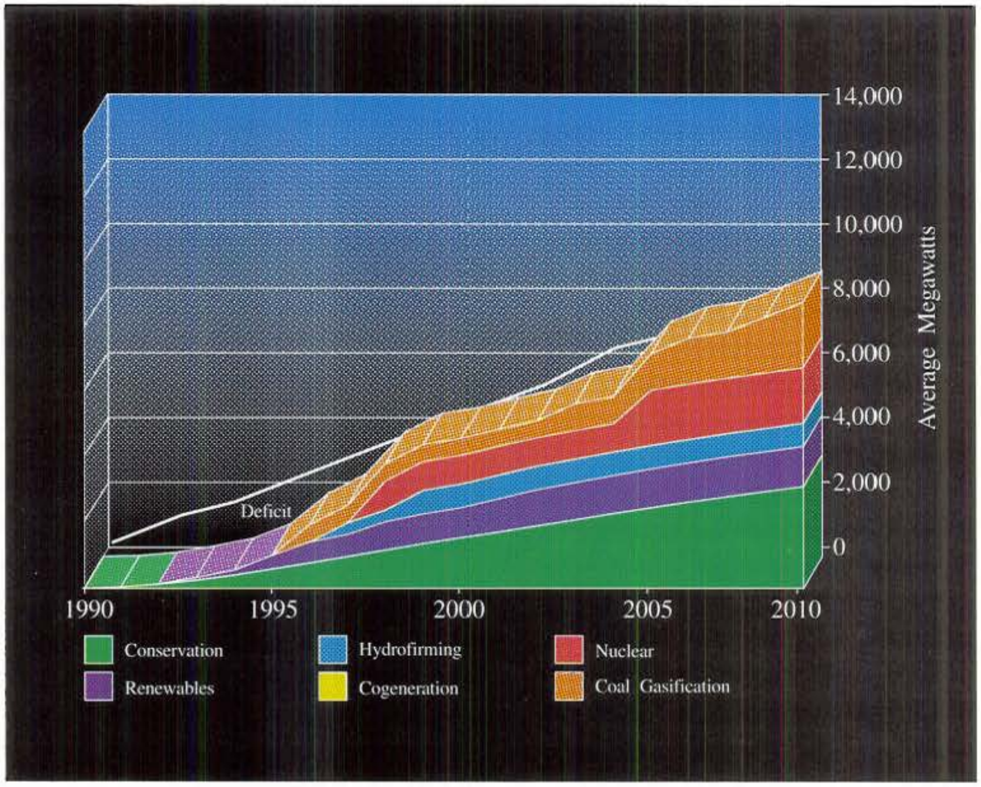
Coal gasification can be used both as a replacement resource in new power plants and also as an addition to existing combustion turbines to reduce natural gas usage. One nuclear plant could be needed by 1999, if loads are growing at the medium-high rate of 1.7 percent.

This portfolio increases expected costs by $950 million when compared to the first portfolio, but the cost impacts in higher load growth scenarios could be more than $3.2 billion. Cost impacts are particularly difficult to estimate in this portfolio because increased gas prices also affect the market for Northwest power in California and will probably result in changes in California's resource mix. The cost and effect of this impact have not been included here.

Given the vulnerability inherent in an overdependence on natural gas as a fuel, this portfolio shows the need to secure the capability to switch to coal gasification from hydrofirming strategies that are gas-fired. Furthermore, the viability of WNP-1 and WNP-3 needs to be determined, so decisions to construct them or terminate them can be made in future power plans.

Portfolio 4: Natural Gas Uncertainty

Figure 15
Resource Schedule to Meet Medium–High Loads



Conclusions from Forecast Scenarios and Resource Portfolios

These planning exercises all reinforced the same themes. First, in all cases, the resource that gives the region time to adapt to uncertainties is conservation.

For this reason, conservation plays a central role in the Council's Action Plan. Conservation programs need to be implemented quickly and brought up to a stable level of activity, so that the region can develop an infrastructure for delivering energy savings. Labor, technology, materials and expertise must be acquired to secure the region's conservation resources. A major conservation acquisition program will require a steady, long-term commitment of both staff and budgets.

With this in mind, the Council looked at the benefits of various conservation targets for the 1990s. The question was, what level of conservation acquisition would balance the greatest benefits and least risk to the region's power system? Should the Northwest acquire enough conservation to meet the highest forecast rate of electrical load growth, the lowest or somewhere in the middle?

Five alternative conservation acquisition targets were tested for the year 2000. These target levels correspond to the amount of conservation acquired in each of the load scenarios, ranging from low to high. Figure 16 shows the cost of acquiring different amounts of conservation, as well as the amount of risk the region experiences with each target level.

The Council chose the medium-high conservation target level because it increased costs only slightly more than a medium target, while at the same time substantially reducing future risk.

Acquiring enough energy savings to meet medium-high load growth helps reduce risk for two reasons.

First, all available conservation is needed in most future load scenarios, and it takes time to achieve the full cost-effective potential. By starting an aggressive effort now, the region is more likely to be able to acquire all of this low-cost resource.

Second, in those scenarios where few new resources are needed, the conservation acquired is relatively low cost. This creates an inexpensive surplus that can be sold outside the region to recoup some of our investment.

Many of the resource portfolios illustrated the need for an inventory of resources that can be brought into operation without long delays. Among the best resources for responding to quick economic or other turnarounds are gas-fired technologies.

In all cases, the resource that gives the region time to adapt to uncertainties is conservation.

Obviously, the acquisition of significant amounts of gas-fired technologies poses a larger and larger risk, due to future uncertainty surrounding gas availability and price. Nevertheless, the Council recommends that the region acquire the lowest cost cogeneration and begin the process of identifying sites and obtaining the necessary licenses and approvals for higher cost gas-fired resources. These could either operate in a cogeneration mode or as stand-alone plants to back up the region's existing hydropower system.

In a number of the portfolios, significant amounts of new or existing resources may become unavailable. In these events, the primary resources the region can turn to are newer, emerging technologies with which we have less experience. For this reason, the Council has selected resource confirmation activities to improve our understanding of and our ability to predict the cost and availability of geothermal, wind, solar and other resources.

Also, new conservation technologies are being introduced each year. It is important to promote this development, so the region can rapidly assimilate new conservation measures as they become commercially available and cost-effective.

Our findings in this planning process led directly to the actions described in the Action Plan. These actions are designed to secure the resources that are needed by the region at the lowest possible cost. Additional actions are identified to help us shorten lead times and better manage the risks and uncertainties the region faces.

Conservation Target Risk Analysis

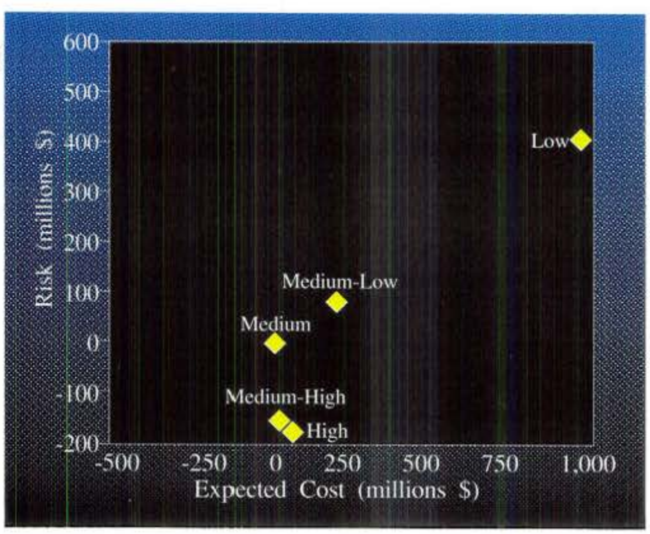


Figure 16
Trade-offs of Building to a Medium-High Load Growth Level

Action Plan

Action now is imperative, and, as already explained, the Council designed a framework of four broad objectives to structure that action. To meet these objectives, we've identified more than 80 activities. These activities are listed on pages 49 and 50, and described in detail in Volume II, Chapter 1.

The first objective is perhaps the most ambitious: start now to buy all the low-cost resources available. All resources take time to develop, and it is likely that at least the low-cost ones will be needed within the coming decade.

The second objective is to shorten the time it takes to acquire and fully develop a resource to the point that it is producing electricity. This shortened lead time improves the region's ability to respond quickly to growth or to changing patterns of energy use.

The third objective is to promote diversity in future plans by confirming the cost and availability of additional resources. This Action Plan is not meant to limit the pursuit of new technologies or alternative resources. On the contrary, it is an invitation to expand that research. We need to get reliable information about these resources so that, if needed, they will be there.

The fourth objective focuses on regulatory, legislative and environmental actions that provide incentives for, and remove barriers to, the successful implementation of this plan. The Council will work with regulatory and legislative bodies to improve public policies and laws that can facilitate the actions called for in this plan.

Actions for Bonneville, the region's utilities, regulatory bodies, and state and local governments are included. The Council recognizes that each of these entities faces different problems and opportunities. They have different constituencies. But their constituencies overlap, forming a network we hope will stretch to every Northwest ratepayer.

In this plan, the Council assumes that Bonneville will meet the needs of its current customers—public power and the direct service industries. At the same time, we assume that investor-owned utilities develop resources independently to meet the needs of their customers.

While aggressive action is needed by all utilities, those that are investor-owned will likely need new power supplies before most of the public utilities. But if all utilities cooperatively buy the lowest-cost resources first, we have estimated that the region could save $3.6 billion over the cost of independent resource development. (See Volume II, Chapter 10, for more detail.)

Objective 1: Acquire All Low-Cost Resources

The region's electricity system is currently in load/resource balance. That is, the supply of electricity is equal to the demand for it. But 84 percent of the hundreds of forecast scenarios we tested indicated additional growth in electricity demand by the year 2000. Therefore, the need for additional resources is highly probable during the coming decade, and with strong growth, that need is urgent. Under these conditions, immediate acquisition, particularly of low-cost resources, makes sense.

Low-cost resources called for in this plan include efficiency improvements in the generation, transmission, distribution and end use of electricity. Energy conservation in all sectors—residential, commercial, industrial and agricultural—falls into this category.

The 1,500-megawatt conservation figure is not a cap.

There also are low-cost generating resources, such as hydroelectricity and cogeneration, that are cost-effective and needed by the year 2000 under most future scenarios. The average cost of these resources is less than the regional avoided cost[5] of about 7.5 cents per kilowatt-hour.

While the current regional avoided cost is useful as a guide for acquiring generating resources, it is *not* the appropriate cost-effectiveness limit for individual conservation measures. Instead, conservation programs should include all commercially available energy-saving measures that are expected to cost up to 11 cents per kilowatt-hour.

This is because conservation as a resource has several advantages that are not captured in the 7.5 cents per kilowatt-hour figure. Electricity that is generated requires transmission and distribution lines, and energy is lost on its way to customers. Conservation has neither the added expense of transmission lines nor the line loss en route. Energy savings also have fewer environmental impacts than any of the generating resources included in this plan. Furthermore, many conservation programs closely track growth and decline in the economy.

Failure to purchase these environmentally sound and economical resources now could force acquisition of more costly and more environmentally damaging resources later. If only cheaper measures are installed, and the higher cost measures are postponed, it will cost more and be much more difficult to return to the site to install additional measures.

Efficiency Improvements

The Council calls for immediate activities to begin acquisition of all regionally cost-effective efficiency improvements. We have chosen a target of 1,500 average megawatts of efficiency gains to be acquired by the year 2000. This is enough energy to meet the needs of one and a half Seattles. In the medium-high scenario, this amount of conservation would provide more than half the region's new electricity needs. (See Figure 17.)

No opportunity for energy conservation should be missed. The successful completion of this action will mean installing cost-effective measures in nearly every residence, commercial enterprise and industrial facility in the

5. Avoided cost is an investment guideline to use when choosing resources. It is the cost of alternatives that are avoided if you purchase the resource you are reviewing.

Northwest. It means operating programs in the commercial and industrial sectors at levels many times greater than anything attempted to date in this region. Acquiring the efficiency improvements identified under this objective will require capital expenditures by utilities and customers of about $7 billion by the year 2000. (See Figure 18.)

While we are targeting 1,500 megawatts, the actual amount of efficiency improvements could be higher, depending on how well acquisition mechanisms work, how quickly the infrastructure is developed to support this level of acquisition and the rate of development of new conservation measures.

The 1,500-megawatt figure is not to be interpreted as a cap. It is instead, a planning target for the Council to use in establishing actions related to other resources. Because of the current stresses on the system, the Council has committed itself to take actions to speed up resource acquisitions. For example, we intend to work with state legislatures and regulatory agencies to promote the purchase of conservation.

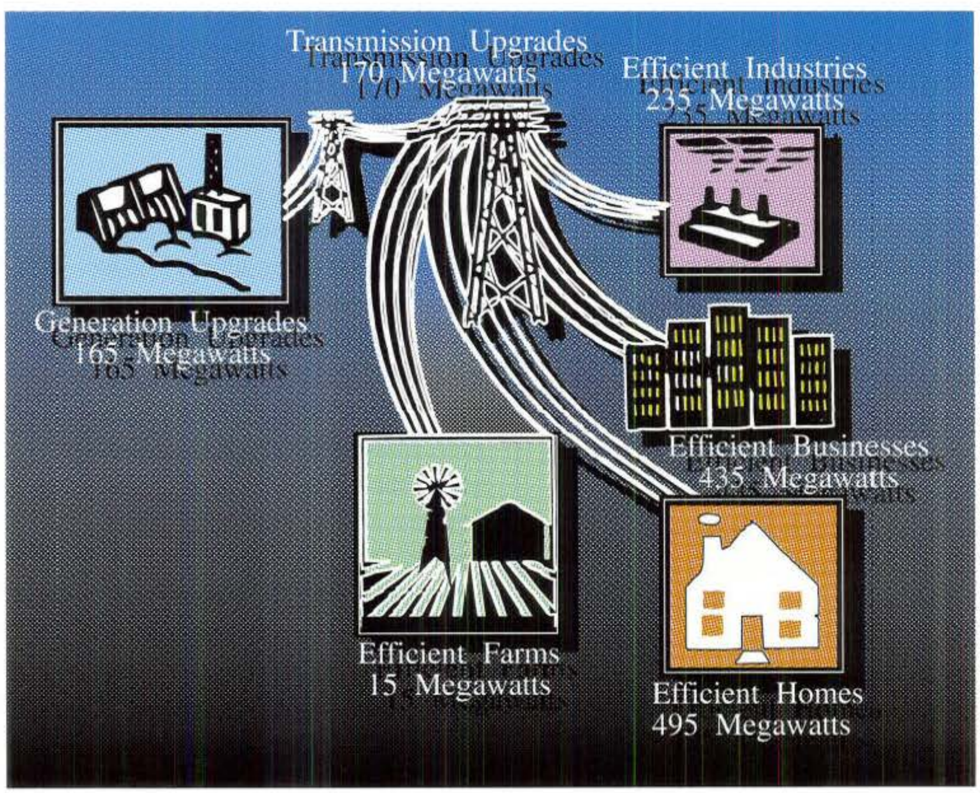
In addition, we will encourage refinements in conservation programs, so energy savings can be secured more easily, and we also will support investigations to bring in still more cost-effective conservation.

Utilities running conservation programs should periodically review their budgets to ensure that they are adequate to capture all regionally cost-effective conservation resources as they become available.

This first objective, like all significant resource decisions, does not come without risk. If electrical loads suddenly drop off, the resource commitments started in this action item could lead to a moderate energy surplus. However, conservation needs a substantial long-term commitment to allow for programs and other acquisition mechanisms to be designed, implemented, evaluated and modified. For this reason, the Council's highest priority is a stable, yet aggressive, conservation effort during the 1990s.

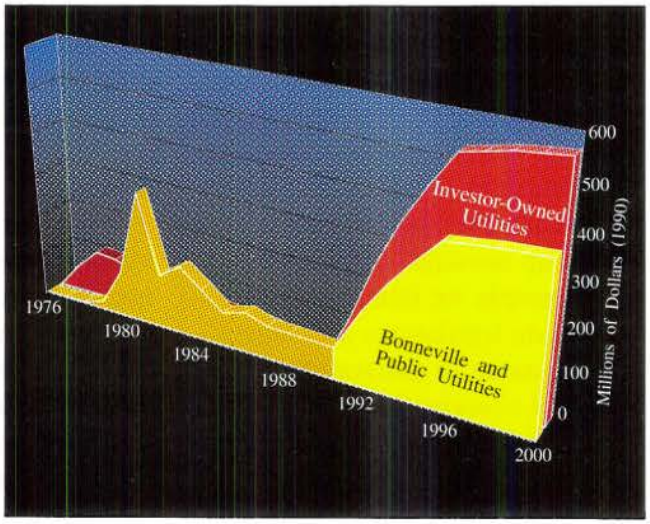
The Power System

Figure 17
Acquire at Least 1,500 Megawatts of Conservation and Efficiency Improvements by the Year 2000



Efficiency Spending

Figure 18
Expenditures by Consumers and Utilities Will Total About $7 Billion Between 1991 and 2000



There also is little risk of "overbuilding" conservation because significant energy savings are needed in all of the most likely growth scenarios. With slower growth, conservation savings from new buildings and equipment are automatically reduced because fewer homes and businesses are built. Even if some overbuilding occurs, because of its low cost and likely sales to California, the cost to the region is not great. Underbuilding is a much more serious outcome, which could cost the region billions of dollars.

Acquiring these efficiency improvements will require a variety of approaches, including aggressive conservation programs and innovative marketing. Bonneville and the utilities should encourage creative approaches for acquiring cost-effective conservation measures, whether these are developed by utility or non-utility providers. At the same time, utilities need to continue their traditional conservation programs until innovative approaches can be proven to be a more effective means of delivery.

It will take a remarkable financial and institutional commitment from the region to expand education and training opportunities to provide the work force for this large-scale undertaking. To achieve the conservation needed, the Northwest should begin now to train large numbers of personnel to assess energy-saving opportunities, install efficiency measures and evaluate savings over time.

In addition to savings in the end use of electricity, this plan calls for acquiring all cost-effective efficiency improvements in existing generating facilities, as well as in the transmission and distribution of electricity. Many generating plants can be modified to get more energy for a given amount of fuel burned or water passed through the turbines. Transmission and distribution systems also can be modified to reduce energy losses. These actions are expected to provide about 260 megawatts by the end of this decade.

Generating Resources

In most forecast scenarios, efficiency improvements cannot provide all the energy needed by the turn of the century. To meet this challenge, the plan calls for the development of the least expensive and most environmentally sound hydropower and cogeneration facilities.

Hydropower

The Council recommends that Bonneville and the region's utilities begin the process of acquiring hydropower by siting, licensing and designing facilities at the most cost-effective sites in the Northwest. The Council estimates this would yield about 150 megawatts by 2000. These new hydropower projects must comply with the protected area requirements of the Council's Columbia River Basin Fish and Wildlife Program and with the Council's hydropower acquisition criteria. (See Volume II, Chapter 11.)

Cogeneration

The Council recommends that Bonneville and the region's utilities also begin the process of acquiring the most cost-effective and environmentally sound cogeneration resources in the region. Studies conducted by the Council indicate that approximately 650 megawatts of these resources will probably be needed by the year 2000. Because of their significant potential and apparent acceptability to the public, cogeneration resources could be a very important component of future electric power generation.

Cogeneration projects that match their electricity output with industrial heat requirements (known as thermally matched projects) will maximize the efficient use of natural gas or biomass and thus have minimum impacts on the environment. For this reason, the Council prefers such systems.

Resources from Outside the Region

The Council is aware that significant amounts of energy may be available from utility systems surrounding the Pacific Northwest, but it is very difficult to predict the cost and availability of this resource. Nonetheless, we urge Bonneville and this region's utilities to negotiate with utilities outside the region to acquire additional resources that are cost-competitive and compatible with resources in this Action Plan.

In particular, it appears there are significant opportunities for interregional power exchanges. These exchanges have the potential of providing energy to the Northwest during the times of year when this region needs it most, and capacity to the Southwest when it is most valuable to that region. Possible changes in the operation of the Northwest's hydropower system as a result of needs for fish flows or the system operations review, being carried out by Bonneville, the U.S. Army Corps of Engineers and the Bureau of Reclamation, may create more opportunities for advantageous exchanges.

To the extent these seasonal exchanges can be negotiated, additional firm (guaranteed) energy could be available to the Pacific Northwest without the construction of new generating resources. No specific amounts of this resource have been included in the Action Plan, but they will be taken into account as contracts are signed. Access to transmission will be key to facilitating these exchanges.

On-Site Renewables

The Council looked at a number of on-site applications of renewable energy that can effectively displace electric loads. These applications, such as solar photovoltaics, passive solar heating, and solar and geothermal water heating, can be cost-effective in particular locations.

The Council recommends that Bonneville and the utilities acquire the cost-effective on-site applications of renewable energy that are available to the region. In addition, state and local governments should adopt solar access ordinances to preserve this resource for the future.

We have not identified precise amounts of on-site renewable resources in this Action Plan because of their site-specific nature, the difficulty in predicting their availability, and the fact that they are not likely to be available in large amounts. Instead, we will incorporate their impact in future electric load forecasts.

Acquire These Resources Now

Resources		Megawatts
Conservation Resources:		
New Residential	70	
New Commercial	160	
Water Heat	185	
Manufactured Housing	55	
Industrial	235	
Existing Commercial	275	
Existing Residential	185	
Irrigation	15	
System Efficiency Improvements	335	
Total Conservation Megawatts		**1,515**
Generating Resources:		
Low-Cost Hydropower	150	
Low-Cost Cogeneration	650	
Total Generating Megawatts		**800**
Total Acquisition Megawatts		**2,315**

Acquisition Principles

All of the acquisition efforts called for in this Action Plan should comply with the acquisition principles described in Volume II, Chapter 11. These principles are designed to ensure the cost-effectiveness of resources, and the incorporation of important environmental criteria and risk management strategies in the acquisition process.

This plan recognizes the unique aspects of acquiring any resource. Many factors influence the integration of a resource with each utility's system. Not all of these factors are incorporated in the general regional cost-effectiveness limits calculated in this plan and described in Volume II, Chapter 14. Some of the more important factors that are difficult to integrate include environmental concerns, siting issues, system interconnection, proximity to major loads and future uncertainties in costs of fuel, operations, maintenance and repairs.

The Council will work with utilities, developers and regulators to ensure that non-cost factors are appropriately incorporated into resource acquisitions. In addition, we will work with siting agencies and other interested and affected parties to establish general siting, design and operating criteria for each resource. (See Volume II, Chapter 1.)

It will take a remarkable financial and institutional commitment to expand education and training opportunities to provide the work force for this large-scale undertaking.

Objective 2: Reduce Resource Lead Times

Reducing the time it takes from a resource proposal until the resource begins producing electricity is critical to reducing investment risk. Some power plants may take 10 or more years to go from concept to delivered energy. These long lead times force planners to make major investments now, hoping the resource will be needed 10 years from now.

But economic changes, new regulations and emerging technologies are only a few of the factors that can alter the need for a particular resource. The more we can shorten lead times, the greater chance we have of accurately matching demand with supply. Underbuilding resources has an obvious economic impact, in that an inadequate power supply can curtail economic development. But overbuilding resources also has serious economic repercussions.

A diverse inventory of resources with short lead times gives the Northwest a key advantage: flexibility. It enables us to react quickly to changes in demand for power, and thus secure a reliable and low-cost system. The Council has found that siting, licensing and design activities can take half the time needed to develop a resource, but these activities represent a small fraction of the total project cost. (See Figure 19.)

The key to reducing lead times is to introduce multiple decision points in the resource development process, so that energy needs can be periodically reassessed before committing large amounts of money to the next step in development. This concept is what is called the "options process" in Volume II and in previous plans. While this concept has the potential to reduce risk and save ratepayers money, changes in siting and rate-making regulations will be needed to facilitate multiple decision points.

This objective calls for actions to reduce lead times for three resources: cogeneration, hydropower and strategies that could be used to firm up nonfirm hydropower. (See Figure 20.)

In preparation for the possibility of rapid load growth during the 1990s, this plan recommends siting, licensing and design of the most cost-effective of these resources during the next five years. If these resources are completed, they will represent substantial investments. But the preparation needed to confirm these resources in the next five years will be relatively inexpensive. The plan does not call for construction of these resources. Construction decisions may be made in future revisions to this plan.

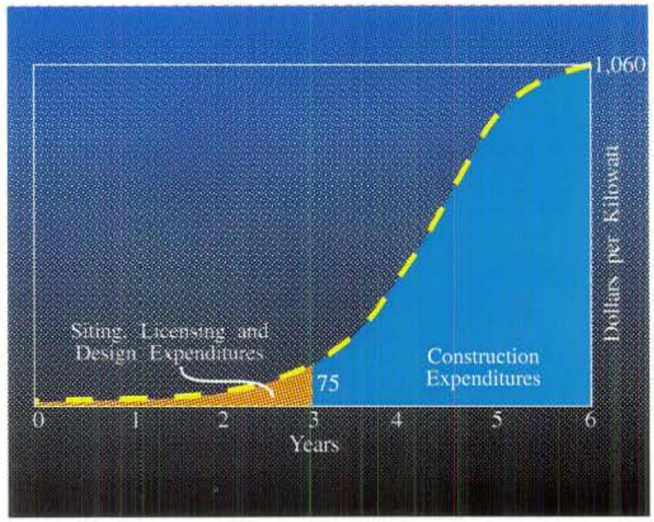
Hydropower

The Council recommends that Bonneville and the utilities begin the process of siting, licensing and designing 100 megawatts of hydropower projects that are somewhat more expensive than those called for in Objective 1. These projects also must comply with protected area requirements and meet the Council's acquisition criteria for siting, design and operating.

The energy from these projects may not be needed by the year 2000; however, if loads do grow rapidly, these projects will be cost-effective and necessary. If load growth does not occur at a rapid pace, these projects can be held for up to four years under current Federal Energy Regulatory Commission regulations.

Resource Cost and Timing

Figure 19
Cost and Timing of Resource Pre-Construction and Construction (Hydropower)



Cogeneration

Estimates suggest that between 700 and 3,700 megawatts of cogeneration opportunities exist in the Northwest.

While cogeneration facilities typically have relatively short lead times, their installation is often delayed until industrial plants are expanded for other reasons. If, for example, when an industry plans to add or replace a steam boiler it could negotiate an agreement that would speed development of cogeneration, the lead time for acquisition could be reduced.

For this reason, in addition to the cogeneration called for under the first objective, we recommend that Bonneville and the utilities secure the necessary approvals and contracts that would enable them to quickly install 750 megawatts of cogeneration equipment in regional industrial facilities, as need and opportunities arise.

Research indicates that cogeneration development is very sensitive to the price utilities are willing to pay for the resource. If loads grow quickly, and more power is needed, utilities probably will pay more for new supplies of electricity, making cogeneration more attractive to developers. If the economy stagnates, and there is little or no load growth, the price for new resources will remain low, and there will be much less cogeneration development.

Gaining a better sense of how much cost-effective cogeneration potential is available in this region and taking steps to reduce the time it takes to construct these facilities will significantly improve the flexibility of the region's power system.

Hydrofirming

Bonneville and the region's utilities should investigate alternative methods for cost-effectively backing up 1,500 megawatts of the region's nonfirm hydropower. Hydrofirming strategies will become even more important if spring flows are increased for fish because such flows could convert firm energy to nonfirm energy.

A diverse inventory of resources with short lead times gives the Northwest a key advantage: flexibility.

The Council expects that the Columbia River Basin Fish and Wildlife Program and any flow levels or other requirements of the Endangered Species Act will be hard constraints on the hydropower system's operation, including operation for hydrofirming. In the event there are additional constraints, hydrofirming strategies could be positively or negatively affected. Before acquiring any hydrofirming resources, Bonneville and the utilities should evaluate their effects on system operating constraints.

With adequate back-up strategies, a portion of the nonfirm hydropower currently produced in this region can be used to meet firm loads. Interregional energy transactions, increased interruptible loads within the region and gas-fired combustion turbine power plants are prime candidates for hydrofirming. Other strategies for making better use of the existing hydropower system also should be identified.

If a strategy that requires power plant development is chosen, the Council recommends that Bonneville and the utilities acquire the necessary sites and licenses, and conduct the design process so these facilities can be constructed quickly when needed.

To hedge against too much reliance on natural gas-fired technologies for hydrofirming, the Council recommends that at least two-thirds of the combustion turbine capacity should be at sites that have the ability to switch to coal gasification or other fuels.

If natural gas prices escalate rapidly, or the fuel becomes unavailable, then the region can convert combustion turbines fueled with natural gas to coal gasification. To facilitate this conversion, sites that are developed for combustion turbines also should have the necessary land, access to coal supply and permits to allow for conversion to coal gasification in the future.

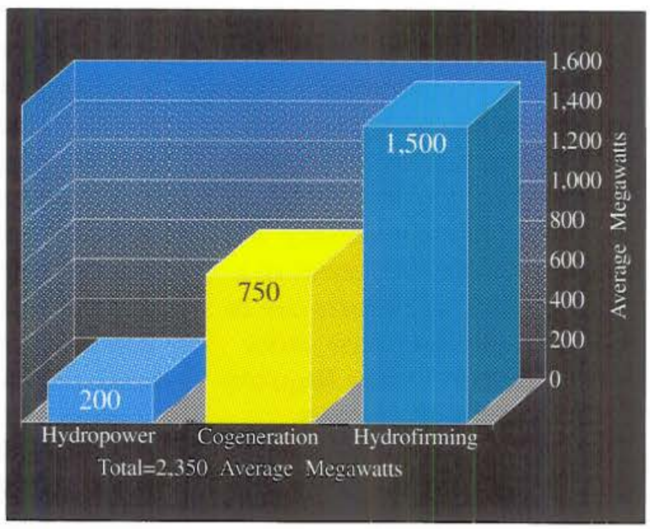
Three thermal power plant sites that are likely to be considered for hydrofirming purposes are the Creston site near Spokane, Washington, the Boardman site in eastern Oregon and the Centralia site near Puget Sound.

Of these three, the Creston site appears to have the best potential for either using clean coal technologies or being converted to a combustion turbine site. The Council recommends that the Creston site licenses for coal-fired facilities be maintained to provide increased fuel diversity and shortened lead time. Additional studies will be needed to determine whether the site is capable of being used for combined-cycle combustion turbine power plants that can be converted to coal gasification.

The Council has included combined-cycle, coal gasification power plants as our preferred coal technology. Coal gasification plants, when compared to conventional coal plants, have reduced gaseous emissions, increased efficiency, the ability to be developed in stages, short lead

Reduce Resource Lead Times

Figure 20
Shorten Lead Times for These Resources



times and fuel flexibility. However, by the time such coal-fired power plants may be needed, some other technology, such as pulverized coal or pressurized fluidized bed combustion, might be preferable to gasification.

Objective 3: Determine Cost and Availability of Resources

In addition to the resources described in the first two objectives, there is a category of resources that, because of uncertainties, are not yet ready for utility-scale development in this region. This category includes new conservation technologies, biomass, geothermal, wind and solar. These resources may eventually be less expensive and more environmentally responsible than some other resources in this plan. The region should confirm them through research and demonstration programs. (See Figure 21.)

Many renewable resources, such as small hydropower, solar and wind, are intermittent because they depend on weather to produce power. To compensate, the Northwest could operate its coordinated power system in conjunction with these renewable resources. Therefore, the region must gather data and determine ways to integrate these resources with the power system. The Council has called for this effort in the activities contained in Volume II, Chapter 1 of this plan.

The Council recommends that Bonneville and the utilities initiate the following actions to determine the cost and availability of resources that could play a significant role in future plans. Research, development and demonstration projects should help expand resource diversity. Since the entire region will benefit from these activities, they should be sponsored jointly by Bonneville and the utilities.

The Northwest needs to test the reliability of wind turbine generators in colder areas.

Conservation

New conservation technologies are constantly emerging. This plan calls for activities to monitor their development and, where appropriate, to undertake research, development and demonstration of the most promising new technologies. If successful, these activities could speed the introduction of additional cost-effective conservation.

The Council will convene a Conservation Resources Research, Development and Demonstration Advisory Committee to identify and recommend an agenda for confirming these resources. The region should also explore joint conservation technologies research with California, which is aggressively pursuing conservation, and with the U.S. Department of Energy.

System efficiency improvements beyond those included in this plan also are thought to be available. Owners and operators of generating plants, and transmission and distribution systems should assess the potential for additional efficiency improvements to the existing power system.

Biomass

Abundant combustible residues, including municipal solid waste, are available for power production in the Northwest, but it is difficult to calculate the amount of power that could be generated by burning them. This plan calls for the Council's Generating Resources Research, Development and Demonstration Advisory Committee to identify and recommend an agenda for confirming these resources.

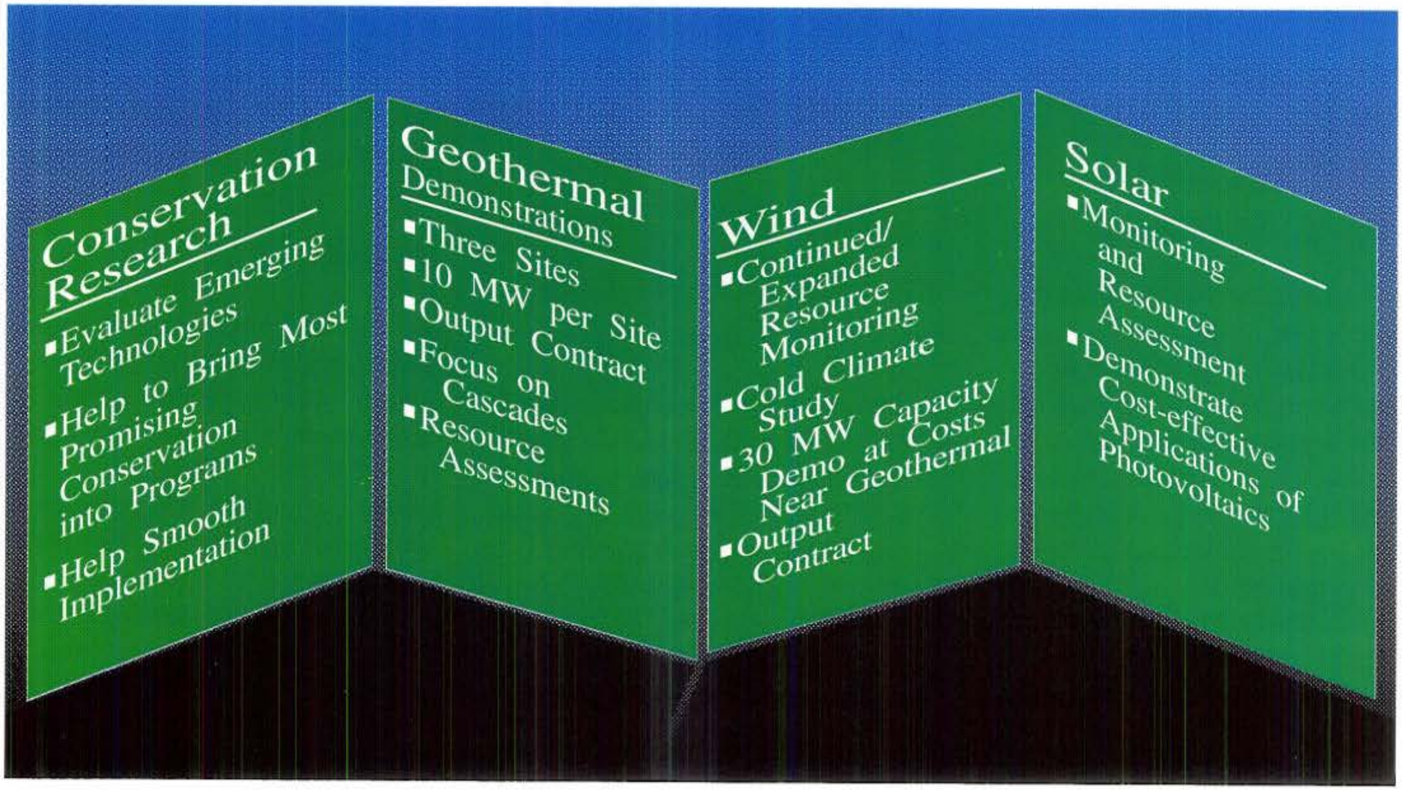
Geothermal

The geothermal resources of the Northwest may offer the potential for producing several thousand megawatts of cost-effective energy. While geothermal energy has been proven in other areas of the country, geothermal energy from the type of fields found in the Cascades has not been proven. Moreover, environmental and other constraints on the development of this resource are poorly understood.

This plan recommends implementation of a geothermal research, development and demonstration agenda including 1) monitoring of geothermal technology and development activities occurring outside the Northwest;

Confirm New Resources

Figure 21
Strategy to Promote Renewables



2) collecting environmental base-line data at promising geothermal resource areas; 3) identifying and preparing plans for resolving constraints to geothermal development at favorable resource areas; and 4) confirming the feasibility of generating electricity from Northwest geothermal resources through development of a series of pilot projects.

The key uncertainty here is whether the geothermal resources of the Cascades can support electric power generation. For this reason, the Council recommends that Bonneville and the utilities acquire at least 10 megawatts of geothermal energy from each of three separate fields ultimately capable of producing at least 100 average megawatts each. These acquisitions should be secured through output contracts, where the developer bears the risk of development in return for guaranteed sales of electricity at a price higher than current avoided costs.

If successful, these demonstration projects would result in shortening the lead time for development of 300 megawatts of geothermal power currently in the plan and potentially confirm a much larger resource.

Wind

The wind resources of the Northwest also may offer the potential for producing several thousand megawatts of cost-effective energy. However, the size and quality of probable wind areas are not fully understood. There also is great uncertainty regarding system integration requirements and other constraints on the development of this resource. The Northwest needs to test the reliability of wind turbine generators in colder areas and gain operating experience with commercial-scale projects.

This plan recommends implementation of a wind research, development and demonstration agenda including 1) monitoring of wind technology and development activities occurring outside the Northwest; 2) collecting additional information regarding quantity and quality of wind resources at the better wind resource areas; 3) identifying and preparing plans for resolving constraints to wind development at promising resource areas; 4) developing a cold-climate wind turbine field test facility; and 5) developing a commercial-scale wind demonstration project.

Bonneville and the utilities should secure a commercial-scale wind demonstration project. A premium price should be offered for projects that provide additional information about areas with significant resource potential and challenging operating conditions. This action should determine whether wind power can be incorporated into the region's power system as a reliable and cost-effective source of power.

Solar

As the costs of solar electric generating technologies continue to decline, solar energy may eventually provide a significant contribution to the Northwest's electricity supply. This plan recommends implementation of a solar research, development and demonstration agenda including: 1) monitoring of solar technology and development activities occurring outside the Northwest; 2) expanding the collection of regional solar insolation data; 3) identifying and acquiring cost-effective applications of solar photovoltaics; and 4) commencing activities that may eventually lead to a regional solar photovoltaic demonstration facility.

The Council is not calling for the start of construction of either of the Washington Public Power Supply System's unfinished nuclear projects.

WNP-1 and WNP-3

The Council is not calling for the start of construction of either of the Washington Public Power Supply System's unfinished nuclear projects (WNP-1 or WNP-3). Nor are we calling for a change in the preservation status of these plants.

The Council believes it is time to determine whether preservation of these plants is a prudent insurance policy. That is, in the event that generating resources of this magnitude are needed, would anyone be able to complete construction and cost-effectively operate these plants? If not, they should be terminated.

WNP-1 is located at Hanford, Washington, and is 65-percent complete. WNP-3 is at Satsop, Washington, and is 76-percent complete. Bonneville and its customers are spending approximately \$11 million[6] per year to preserve these two plants. Together, the plants could supply more than 1,600 megawatts of firm power.

There are issues that would have to be resolved before these plants either could be completed or terminated. For example, in many of the future scenarios analyzed in this plan, the utilities most likely to need the plants are not the public utilities that own them. There are a number of questions about how power from the plants could be transferred to utilities that may need it.

There also is controversy about the agreements that control the financing, budgeting and management of these projects. Other issues include public opposition to nuclear power; compliance with the National Environmental Policy Act; the Washington Initiative 394 settlement requiring cost-effectiveness studies prior to resuming construction, and licensing by the U.S. Nuclear Regulatory Commission.

6. This figure does not include property taxes on the portion of WNP-3 owned by investor-owned utilities because the assessed value on that portion is under dispute.

Other issues would have to be resolved if the plants were terminated. For example, the legal agreements that control these projects offer very little guidance about how a decision to terminate would be made, or what would happen to the assets if the plants were terminated. There are questions regarding the effect of termination on the outstanding bonds issued for these projects. There also are unresolved issues about the extent and cost of restoring the construction sites and whether the sites could be used for other energy resources. (Completion and termination issues are discussed in more detail in Volume II, Chapter 8.)

Bonneville and the Supply System should undertake the work necessary to determine whether these issues are resolvable in order for the Council and the region to make a fully informed judgment in the next power plan whether 1) to continue preserving the plants, 2) to construct either or both of the plants if needed, or 3) to terminate them. The Council intends that before any significant step is taken that would alter the current "preservation" status, whether to commence site construction (or financing for such construction) or to terminate, the Council must find that the proposed action is consistent with the plan.

In any event, Bonneville and the Supply System should report to the Council by 1994 on how outstanding issues, whether related to preservation, construction or termination, can be resolved.

A New Utility World

Until about a dozen years ago, the only way utilities acquired new power supplies was to build generating plants. The process was cumbersome, with siting, licensing, design and construction dilemmas to work through with both the public and regulatory agencies.

Then in 1978, with the signing of the Public Utility Regulatory Policies Act (PURPA), things got more complicated. PURPA required utilities to purchase power from qualified non-utility producers at the price the utility would have had to pay to construct its own new generating plant (the avoided cost). This strategy was designed to encourage competitive small-scale resources, such as industrial cogeneration and small hydroelectric projects.

Although there is disagreement about all of its benefits, PURPA succeeded in opening the door to outside power producers with resources supplying everything from kilowatts to hundreds of megawatts. Today, utilities increasingly turn to outside sources for energy-efficiency improvements (the suppliers are known as "energy service companies" ESCos) as well as large thermal resources (supplied by independent power producers or IPPs). Many utilities have even formed their own subsidiaries devoted to resource development for themselves and other utilities.

These new players have brought with them new ways for utilities to acquire resources. Utilities now are calling for bids from resource providers and choosing the resources that best fit utility needs.

New players have brought with them new ways for utilities to acquire resources.

This has added complexity to the difficult process of planning and acquiring resources. The specific resources called for in this plan may be developed by non-utility providers. Further, utilities may be offered options that break with the sequence of acquisitions identified in the Action Plan.

Nonetheless, the Council will evaluate all resources proposed for acquisition and support those that conform to the goals and objectives of this plan. The most important message in this plan is that the Council is serious about this region's need to acquire cost-effective energy now.

Rapid-Response Resources

As noted in our opening pages, the Northwest's power system is under tremendous stress. One major question is the possible effect of an Endangered Species Act listing on Columbia River salmon. With very short notice, the region could be compelled to forfeit some hydropower to protect salmon.

The Council recommends that Bonneville and the region's utilities respond by beginning immediately to identify 500 to 1,000 megawatts of resource alternatives that could rapidly replace a portion of the existing generating system. Resources located on the western side of the region should be given added credit because, in addition to making up for the loss of a portion of the existing power supply, they also may help alleviate the growing transmission limitations in the Puget Sound area.

First, Bonneville and the utilities should explore ways to use the region's existing combustion turbine resources. Approximately 500 megawatts of gas-fired combustion turbines are owned by Puget Sound Power and Light Company and sited in the Puget Sound area. These turbines could be used to help replace a significant amount of energy. Bonneville and the utilities should begin immediately to resolve the technical, economic, institutional and legal problems surrounding the use of these turbines.

Second, Bonneville and the region's utilities should expand their requests for new resources. Through bidding proposals, utilities are helping to identify a large variety of independently developed resources. Some of these resources could be brought into production quickly. Future requests for bids for new resources should target these short lead time resources.

Third, Bonneville and the utilities need to evaluate those rapid-response opportunities beyond the Pacific Northwest's boundaries. Large amounts of generating capability exist outside the region. It is conceivable that, through seasonal exchanges or energy purchase contracts, the region could rapidly replace a substantial amount of energy. The terms and conditions of necessary contracts need to be understood to make this resource a reality.

New policies should be developed to "decouple" a utility's profits from the energy it sells.

While this activity is in progress, additional information should become available regarding the nature and extent of any potential power loss. If it becomes necessary to alter the existing system to protect endangered salmon, the Council and the region's utilities could move quickly. We could acquire a mix of rapid-response resources that would allow us to replace the lost resource at the lowest possible cost and with the least impact on system reliability. The Council recommends that these efforts begin immediately and have a target completion date of the summer of 1992.

If sufficient rapid-response resources cannot be identified, it may be necessary to seek increased interruptible loads and develop curtailment strategies until resources with longer lead times can be added.

Objective 4: Actions Supporting Implementation

Regulatory Policy

Since the passage of the Northwest Power Act of 1980 and the development of the first regional power plan in 1983, several regulatory conditions have been identified that tend either to frustrate or diminish the incentive for utilities to acquire conservation resources. The Council recommends that the region's public utility commissions, legislatures and other regulatory bodies review and revise current policies regarding regulatory treatment for conservation and generating resources.

New policies should be developed to "decouple" a utility's profits from the energy it sells and link profits to the energy the utility saves. The Council supports regulatory actions that provide positive incentives for aggressive conservation actions.

The Council also recommends that public utility commissions, siting agencies, state legislatures and federal regulatory agencies review their regulatory practices to facilitate the siting and acquisition of generating resources included in this plan. Regulatory policies should encourage utilities to invest in activities that reduce resource lead times and increase flexibility. The Council recommends that utilities receive appropriate rate treatment for such activities.

Regulatory policies also affect utility incentives to participate in research, development and demonstration activities. These activities are essential to identifying resources that may prove to be cheaper and more environmentally sound than those already included in the resource portfolio. The Council asks the regulatory commissions to provide appropriate rate treatment for utility participation in research activities.

Transmission access for non-utility generation may prove to be a contentious issue, as it has been in other states, such as California. Because we expect a large amount of non-utility generation to contribute cost-effectively to the region's future power supply, we urge regulatory agencies, including local public utility boards, to work with Bonneville to minimize any problems that may develop.

Conservation

An integral part of the acquisition of more than 1,500 megawatts of conservation by the end of this decade will be the measurement of actual energy savings. Conservation poses unique challenges in reliable measurement of savings and the predictability of savings over time. Conservation acquisition efforts should contain provisions to ensure that the intended energy savings are being achieved and to provide information to improve future acquisition efforts. Evaluation should be used to modify conservation programs, not to penalize past activities that were based on the best information

Appliance and other equipment manufacturers would be far more likely to cooperate with requests for energy-efficient products if a larger market could be guaranteed.

available at the time. Just as power plants are watched carefully to ensure their best operation, conservation needs to be verified and fine-tuned, if we are to build a reliable conservation "power plant."

A second activity promoting successful conservation acquisition is the open exchange of information on the effectiveness of conservation efforts. The Council will meet periodically with utilities to facilitate an exchange of the utilities' conservation acquisition plans, including their budgets, timelines, staffing levels and expected penetration rates, and to review current estimates of the amount and cost of acquired conservation. In addition, we will convene appropriate forums for the utilities to exchange information on their successes and problems in acquiring conservation.

Finally, the Council also will explore the coordination of some West Coast conservation activities. Appliance and other equipment manufacturers would be far more likely to cooperate with requests for energy-efficient products if a larger market could be guaranteed. In addition, research and development agendas and findings could be shared coastwide.

Least-Cost Planning

Many of the region's utilities are actively engaged in the production of least-cost resource plans. The Council will review and publicly report on all of the Northwest's least-cost plans to ensure that they are consistent with this regional plan and that they support implementation of this plan. These reviews will identify specific actions the utility should take, such as participating in Bonneville's conservation programs or initiating its own programs. The Council and Bonneville will provide assistance to utilities in their planning efforts. The Council also intends to conduct periodic workshops to help the region take stock of planning and conservation efforts.

Environmental Impacts

The Council accounted for known environmental impacts in all its resource decisions. These effects are examined in detail in Volume II, Chapter 9. But we also know that some environmental damages are difficult to gauge. Consequently, we will continue our study of the broad ramifications of resource development.

We also are working with Northwest public utility commissions, Bonneville, utilities and other interested parties to identify and improve methods to evaluate and incorporate estimates of environmental impacts into resource decisions. In addition, we will continue, as we did with hydropower development, to prepare siting, design and operating criteria that will help to minimize the environmental consequences of all resources.

The Council acknowledges the incomplete but growing recognition that the risk of global warming and the potential consequences are serious global concerns, and must also be taken seriously by this region. Such warming is associated by a majority of the scientific community with the atmospheric accumulations of greenhouse gasses—particularly carbon dioxide—from combustion of fossil fuels. The Council's resource portfolio and actions in this plan already reflect this concern in their emphasis on conservation and on combustion technologies that release lesser quantities of greenhouse gases per unit of energy output. This is both sound environmentalism and prudent risk management.

State and local governments have the ability to mobilize businesses and citizens throughout the region.

The Council also acknowledges its responsibility to assess the consequences of actions taken under this power plan that may exacerbate global warming and to propose effective mitigation measures. The Council will work with regional and national authorities and concerned parties to determine what such mitigation measures may be, to recommend that these be prescribed by the appropriate authorities and to amend the plan to reflect its findings.

Bonneville Policy

Just as the region's regulatory commissions can have a significant impact on the incentives provided to utilities for the acquisition of resources, Bonneville has an important role in the successful implementation of the actions called for in this plan.

Bonneville's utility customers see the priority firm rate[7] as their avoided cost when making decisions about conservation and other resource development. This rate is significantly lower than long-term regional avoided cost estimates and, thus, provides little incentive for utility resource development.

By paying utilities up to the difference between avoided cost and the priority firm rate, Bonneville's billing credits program removes the disincentive for utilities that wish to develop conservation or other resources. However, it does not provide any direct incentive for utilities that may not be interested in developing resources.

If billing credits and other acquisition methods, including programs for conservation, are not successful in attaining the plan's conservation goals, we will still need conservation from every end-use sector and utility in the region.

For this reason, if it appears by the time Bonneville begins its 1993 rate case that the plan's conservation goals will not be achieved, the Council recommends that Bonneville and its customers develop a multilevel priority firm rate.

7. The priority firm rate is the rate that applies to Bonneville's public utility loads and exchanging investor-owned utility residential and small farm loads.

Bonneville also needs to reconsider some of the provisions of its average system cost methodology used in the residential exchange program.[8] The region's investor-owned utilities will be responsible for acquiring more than 880 megawatts of efficiency improvements by the year 2000.

Bonneville's average system cost methodology contains provisions that hinder the implementation of conservation actions. For example, audits, advertising and support costs for the Council's model conservation standards are excluded from an investor-owned utility's exchangeable costs, although they may be necessary components of conservation programs developed to be consistent with the plan.

Such disincentives can lead to investment in higher-cost generation. Because these costs would be exchangeable, they would lead to higher Bonneville and regional costs. Bonneville should reopen the average system cost methodology for the limited purpose of eliminating any disincentives to utilities to act consistently with the Council's plan.

Because Bonneville owns such a large portion of the region's transmission system, the Council urges Bonneville to work with the region's utilities and regulatory agencies to facilitate transmission access for non-utility generation. The Council expects this source to contribute cost-effectively to the region's future power supply.

We'll need regionwide collaboration to preserve both the Northwest's economy *and* its environment.

State and Local Government Involvement

The cooperation and services of state and local governments are important if the region is to be successful in acquiring the conservation resources needed by the turn of this century. State and local governments play a unique role through such actions as adopting, updating and enforcing energy codes and solar ordinances, and operating conservation programs. They also can encourage energy conservation through recycling.

Furthermore, state and local governments have the ability to mobilize businesses and citizens throughout the region. Bonneville and the utilities need to form partnerships with state and local governments to speed the pace and ensure the quality of the conservation resource that will be acquired during the next decade.

In addition, state and local governments have a pivotal role in the development of generating resources through their ability to regulate land-use practices, through power plant and transmission line siting, and through zoning procedures. The Council will work with state and local governments to facilitate decisions on the siting and licensing of generating resources. It also is important for state and local governments to be involved with the Council in its development of environmental protection criteria for siting, designing and operating new resources.

Council Actions

We intend to lead the region in promoting and implementing this power plan. We will support a major push to acquire, at a minimum, all the energy savings described in this plan. We will act as regional coordinator for research, demonstration and development of conservation, as well as geothermal, wind, biomass and solar resources. We also will actively promote incentives for risk-management actions and

8. The residential exchange was created in the Northwest Power Act to allow the region's investor-owned utilities' residential and small farm customers to share in the benefits of the low-cost federal hydropower system. Some high-cost public utilities also participate in the exchange. Bonneville reduces the utility's cost of serving these loads by purchasing energy from the utility at the utility's average system cost and selling the utility energy to meet these loads at Bonneville's priority firm rate. Bonneville calculates the price it will pay the utility using the average system cost methodology.

facilitate the decisions needed to achieve the goals of this plan. We will continue to identify and seek removal of barriers to this plan's implementation.

We recognize that federal law requires the Federal Energy Regulatory Commission to consider a resource developer's conservation efforts in initial licensing and relicensing decisions. We will work with interested utilities in the licensing and relicensing processes, to show that these requirements have been satisfied fully through the utilities' conservation efforts in accordance with this power plan.

The Council will participate in the siting initiatives of utilities and resource developers to encourage the development of least–cost, environmentally sound resources and necessary transmission, to improve the ability to shorten resource lead times and site–bank potential resources, and to support need–for–power findings.

This may involve us in land–use planning and zoning issues, particularly as we develop siting, design and operating criteria for resources. This action will be designed to help resolve the conflicts inherent in resource development. The Council will help develop and support proposed initiatives when new legislation or policies are needed.

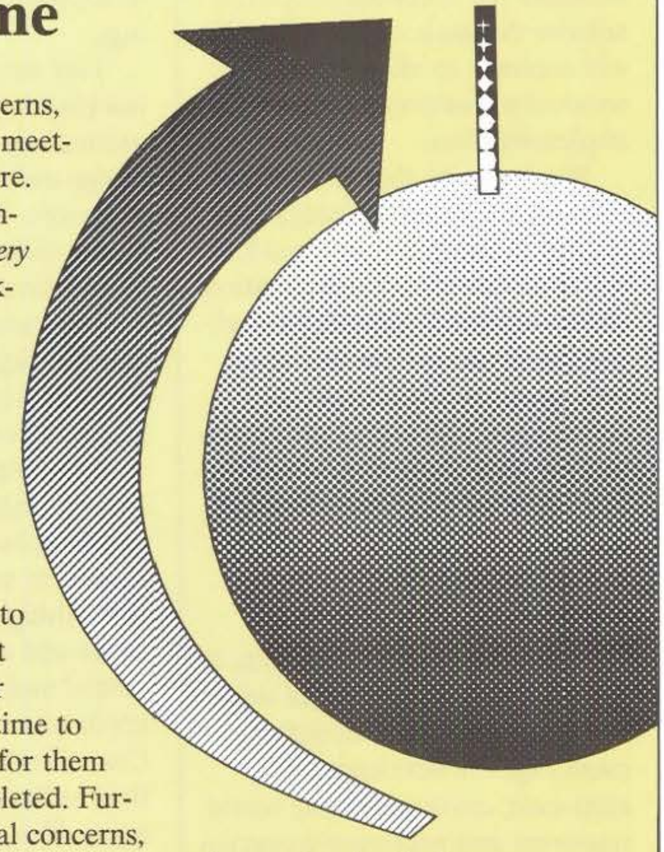
If this Action Plan is to become a reality, legislative and rulemaking initiatives will be needed to secure energy conservation through improved building codes and standards for new residential and commercial buildings, appliances and lighting. The Council will support such initiatives at federal, state and local levels. This includes participation in such activities as U.S. Department of Housing and Urban Development proceedings on manufactured housing, U.S. Department of Energy proceedings on appliance standards, and state and local proceedings on similar energy–related issues.

The Council also will work to see that health and environmental issues related to energy efficiency are resolved by the appropriate agencies.

In recognition of the vital part natural gas plays in this plan, the Council proposes the formation of a gas policy group, including gas distribution companies, pipeline suppliers and other interested entities, to engage in discussions on the continuing role of gas in the Northwest energy picture.

We will further promote this plan by providing a forum for exchanging information on the effectiveness of implementation actions. Implementors are asked to report on progress toward implementing the plan, and we will revise the plan as better information becomes available.

It's Time



The actions in this power plan address many concerns, but the bottom line is—they are the best strategy for meeting the Northwest's energy needs now and in the future. The region is growing. If this economic expansion continues, we'll be prospering, but we'll also face some *very* hard choices about how to fuel that prosperity. Frankly, we don't expect the regional growth patterns of the late 1980s to persist. But it's our job to look at both the best- and worst-case scenarios, because either could come about.

After testing literally hundreds of different resource combinations, against as many forecasts of energy use, we've put together a four-part strategy we believe is the best possible balance of resource cost, environmental protection and system reliability to carry this region into the 21st century. One important goal is to delay the need to build large thermal power plants. These plants are expensive. They take a long time to bring into operation, and it is possible that the need for them could disappear at just about the time they are completed. Furthermore, there are serious environmental and societal concerns, and dozens of unanswered questions, about even the cleanest, most advanced technologies.

So we want answers, and it may take some time to get them. Because we don't think we have time to just think about these problems, our four objectives are designed for simultaneous implementation.

We start the way we usually start, with energy conservation in our homes, businesses, industries and on our farms. Efficiency is simply the best deal around. We can save energy for about half the cost of most other options. At the same time, we want to make sure our existing power plants, and the transmission and distribution system we rely on, operate as efficiently as possible, too. To this block of low-cost resources, we've added some relatively inexpensive hydropower and industrial cogeneration.

While we're busy buying up conservation—and we will be busy if we get the full 1,500 megawatts of savings we're after by the end of this century—we also want to be working on ways to bring other resources online more quickly. The point here is to begin the relatively inexpensive siting, licensing and design processes for certain resources, but stop there and wait for a second decision, closer to the time the electricity is needed. This shortens the resource's lead time, so it can be completed quickly. It also provides a measure of insurance that large amounts of capital will not be wasted on power plant construction that proves to be unnecessary.

Then there are all of the questions about renewable resources, such as wind, solar and geothermal, which may not be ready for development. This plan calls for research and demonstration of these resources.

Finally, this plan looks at the kinds of regulatory, policy and environmental actions that will be necessary to reach our goal, "to ensure the Northwest an adequate, efficient, economical and reliable electricity supply well into the next century." This will take cooperation. We'll need regionwide collaboration to preserve both the Northwest's economy *and* its environment.

Recommended Activities for Implementation of the Power Plan

This 1991 Northwest Power Plan is ambitious. It aims high. But it is also pragmatic. Its goal of an efficient, economically thriving region is achievable, but only if Northwesterners act in unison. The list that follows is an outline of the activities described in detail in Volume II, Chapter 1. To order copies of Volume II, which also contains the technical data that supports this plan, turn to page 51.

Conservation

Targeted New Programs

1. Large commercial and industrial customers.
2. Manufactured housing.
3. Electrical appliances and equipment.
4. Institutional facilities.
5. Federal buildings and facilities.
6. Transmission and distribution system.
7. Existing hydropower projects.
8. Conservation voltage regulation.
9. Existing thermal projects.

Traditional Conservation Programs

10. Additional end uses in residential weatherization.
11. All regionally cost-effective measures in new residences.
12. Electric appliances in non-electrically heated houses.
13. New and existing commercial buildings.
14. Develop energy code adoption program for commercial sector.
15. Lender and appraiser program.
16. Expand education and vocational training in conservation.
17. Support enforcement of energy codes.
18. Institute utility and government conservation competitions.

Federal, State and Local Government Conservation Acquisition

19. Develop policies to reward conservation acquisition.
20. Collaboration between local governments and utilities.
21. Establish state and local building codes, solar ordinances, recycling efforts, etc.
22. Set user fees based on efficiency.
23. Implement rate treatment for conservation expenditures.
24. Encourage conservation actions by permitting, zoning and planning agencies.
25. Establish state health protection criteria for conservation resources.

Evaluation, Verification, Implementation

26. Monitor and evaluate conservation efforts.
27. Pool resources and data.
28. Share information on acquisition plans.
29. Centralize data base on technical aspects of conservation.
30. Centralize data base on conservation programs.
31. Meet annually to share conservation experiences.

Resource Assessment

32. Research, develop and demonstrate new conservation technologies.
33. Assess and acquire cost-effective on-site renewable resources.
34. Monitor conservation voltage regulation.
35. Reassess hydropower efficiency improvements.
36. Assess thermal plant efficiency improvements.

Hydropower

1. Option and acquire low-cost hydropower.
2. Maintain all hydropower data bases.
3. Assess ability to operate power system to serve the needs of salmon better.
4. Determine environmental impacts of hydropower system and incorporate costs into operational, and fish and wildlife decisions.

Biomass

1. Option and acquire cost-effective biomass resources.
2. Participate in Pacific Northwest and Alaska Bioenergy Program.
3. Develop confirmation plan for biomass.

Cogeneration

1. Option and acquire low-cost cogeneration.
2. Refine estimates of cogeneration potential.

Hydropower Firming Natural Gas and Coal

1. Option up to 1,500 megawatts of cost-effective hydrofirming resources.
2. Develop data on central station thermal generation.

Nuclear

1. Determine whether WNP-1 and WNP-3 should be preserved, completed or terminated.

Geothermal

1. Compile and circulate data on geothermal plant operating experience.
2. Document environmental characteristics of Northwest geothermal areas.
3. Facilitate resolution of environmental conflicts.
4. Initiate geothermal demonstration projects.

Solar

1. Assemble improved Northwest solar insolation data.
2. Collect information on solar-electric technology and its applications.
3. Identify promising photovoltaic technologies for the Northwest.
4. Resolve constraints to Northwest applications of photovoltaics.
5. Acquire cost-effective applications of photovoltaics.
6. Begin activities leading to a Northwest photovoltaic demonstration.

Wind

1. Monitor long-term variation in Northwest wind resources.
2. Provide reliable information on wind power technology and resources.
3. Identify promising wind resource areas in the Northwest.
4. Obtain better wind data at promising Northwest sites.
5. Resolve major uncertainties at promising Northwest sites.
6. Demonstrate wind turbines on the Rocky Mountain Front.
7. Demonstrate a state-of-the-art wind project in the Northwest.

Ocean

1. Monitor development of promising ocean power technologies.

Supporting Activities

1. Convene regional meetings on resource planning and acquisition.
2. Determine need and timing of environmental impact statements on resource options.
3. Identify out-of-region resources.
4. Account for natural gas in power planning.
5. Share funding of research, development and demonstration activities.
6. Coordination of research, development and demonstration.
7. Adapt rate treatment for research, development and demonstration activities.
8. Remove barriers to conservation from Bonneville's average system cost methodology.
9. Review transmission constraints, costs, upgrades and environmental hazards.
10. Account for environmental uncertainties.
11. Quantify environmental costs.
12. Convene regional renewable resource forum.
13. Develop multilevel priority firm rate.
14. Allow recovery of costs of optioning.
15. Establish criteria for siting resources.
16. Pursue conservation at federal level.
17. Gain a better understanding of synergisms of resources.
18. Elevate capacity concerns.
19. Identify rapid-replacement resources.