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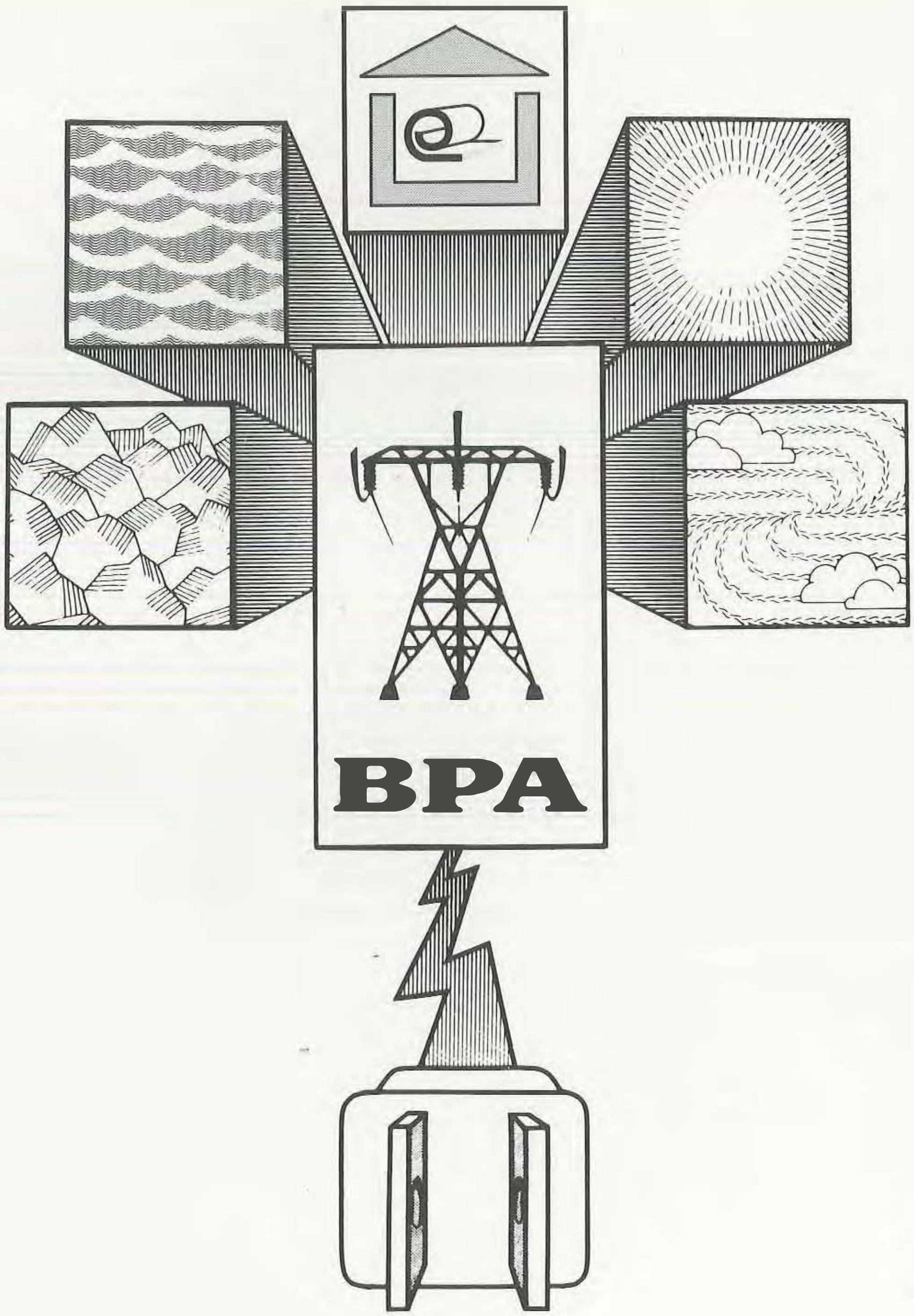
Final Environmental Impact Statement
Resource Programs

DOE/EIS

Summary

February 1993



U.S. Department
of Energy

Bonneville
POWER ADMINISTRATION

Resource Programs
Final Environmental Impact Statement

Summary

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Background

The Bonneville Power Administration (BPA) is the largest power marketing agency within the U.S. Department of Energy. BPA's primary service area is the Pacific Northwest, including Oregon, Washington, Idaho, and western Montana. The Bonneville Project Act of 1937 (Project Act) established BPA as the marketing and transmission agent for power produced by the Bonneville Dam. Today BPA markets power from 31 Federal dams and two nuclear plants in the Pacific Northwest and has built one of the largest and most reliable transmission systems in the United States. Almost half of all the power used in the Northwest comes from BPA, and BPA provides about three-fourths of the region's transmission capacity.

BPA markets wholesale electric power to several customer groups inside and outside the region. Within the region, BPA customers include four groups: Preference Customers, Direct-Service Industries (DSIs), Investor-Owned Utilities (IOUs), and Federal agencies. BPA also sells or exchanges power with utilities in California and Canada. BPA uses revenues from the sale of power and transmission services to recover the costs of operating the system, to repay the Federal investment in the system, and to back the financing of new power generation and transmission facilities, conservation measures, and fish and wildlife enhancements.

The Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act) was enacted in response to the need for coordinated planning and development of the Pacific Northwest's power supplies. Under the Northwest Power Act, BPA is authorized to acquire conservation and the output of additional generating resources to meet the future needs of its customers. The Northwest Power Act also created the Northwest Power Planning Council (the Council) which includes representatives from the four Pacific Northwest States. The Council developed a 20-year Northwest Power Plan to ensure that the region has adequate and reliable energy at the lowest cost. BPA relies on the Council's guidance in the Power Plan to provide the long-range context within which BPA's own resource planning takes place. This Resource Programs Environmental Impact Statement (RPEIS) is part of the planning being done to assure that BPA will be able to meet its loads in a cost-effective and environmentally sound manner.

BPA's Resource Program

Every two years, BPA prepares a Resource Program, which describes the actions BPA will take to meet the power requirements of its customers. In developing a Resource Program, BPA prepares load forecasts in cooperation with the Council. A range of five forecasts (low, medium-low, medium, medium-high, and high) is prepared to reflect uncertainties about future load growth. Next, a range of load/resource balances is prepared by comparing the energy capability of the existing Federal system resources to the range of projected Federal system energy loads over the next 20 years. In a parallel process, BPA and the Council develop new resource supply forecasts.

Under the 1990 long-term medium forecast, the Federal system was in load/resource balance, with sufficient resources to meet BPA's needs for the rest of the decade. Under the 1991 long-term medium forecast, the Federal system was 400 to 500 aMW in deficit in the near term and would require 800 aMW by the year 2000. Total public utility load growth averaged 3.1 percent annually from 1983 through 1990. However, the actual level of future loads is not known. If demand grows faster or if resources do not perform as expected, BPA could face a deficit. Under high load growth, BPA could have almost 5,000 average megawatts (aMW) of additional load to meet by the end of its 20-year planning period.

In addition to these projected energy loads, changes in the operations of the hydroelectric system to increase fish survival may reduce the capacity of the Federal system. The need to replace capacity to meet peak loads may become an increasingly important goal of BPA's future Resource Programs. To continue to meet its obligations, BPA needs to plan for the acquisition of additional resources now.

Purpose of and Need for Action

Need

BPA needs to acquire sufficient new resources to meet electricity deficits caused by growing customer loads.

Purpose

The purposes of this action are to:

- Ensure that BPA can meet its contractual obligations to supply cost-effective electric power as requested by its customers--taking into account potential environmental consequences when making any decisions to acquire resources to meet those loads;

- Assure consistency with BPA's statutory responsibilities, including the Northwest Power Act, while taking into consideration the Council's Power Plan and its Fish and Wildlife Program; and
- Restore and enhance environmental quality and avoid or minimize possible adverse environmental effects.

Scope of the EIS

The RPEIS is a programmatic document that addresses broad issues associated with resource acquisitions. The EIS evaluates the environmental trade-offs among generic resource types and the cumulative effects of adding various combinations of these resources to the existing system. Although supplements may be necessary, the RPEIS is intended to be broad enough to support Records of Decision for several Resource Programs. Following the identification of actions in each Resource Program, proposals will be made to acquire specific conservation or generating resources. Separate site-specific environmental documents will be prepared, as necessary, to evaluate the impacts of those acquisitions. These site-specific documents will be tiered to the RPEIS.

Many of the potential environmental effects of acquiring and operating new resources are site-specific. BPA recognizes its responsibilities to evaluate these potential impacts and to take action to protect, enhance, and restore the environment. Therefore, these environmental impacts are acknowledged in the RPEIS and will also be considered in the site-specific documents that will be tiered to this EIS.

Resource Types

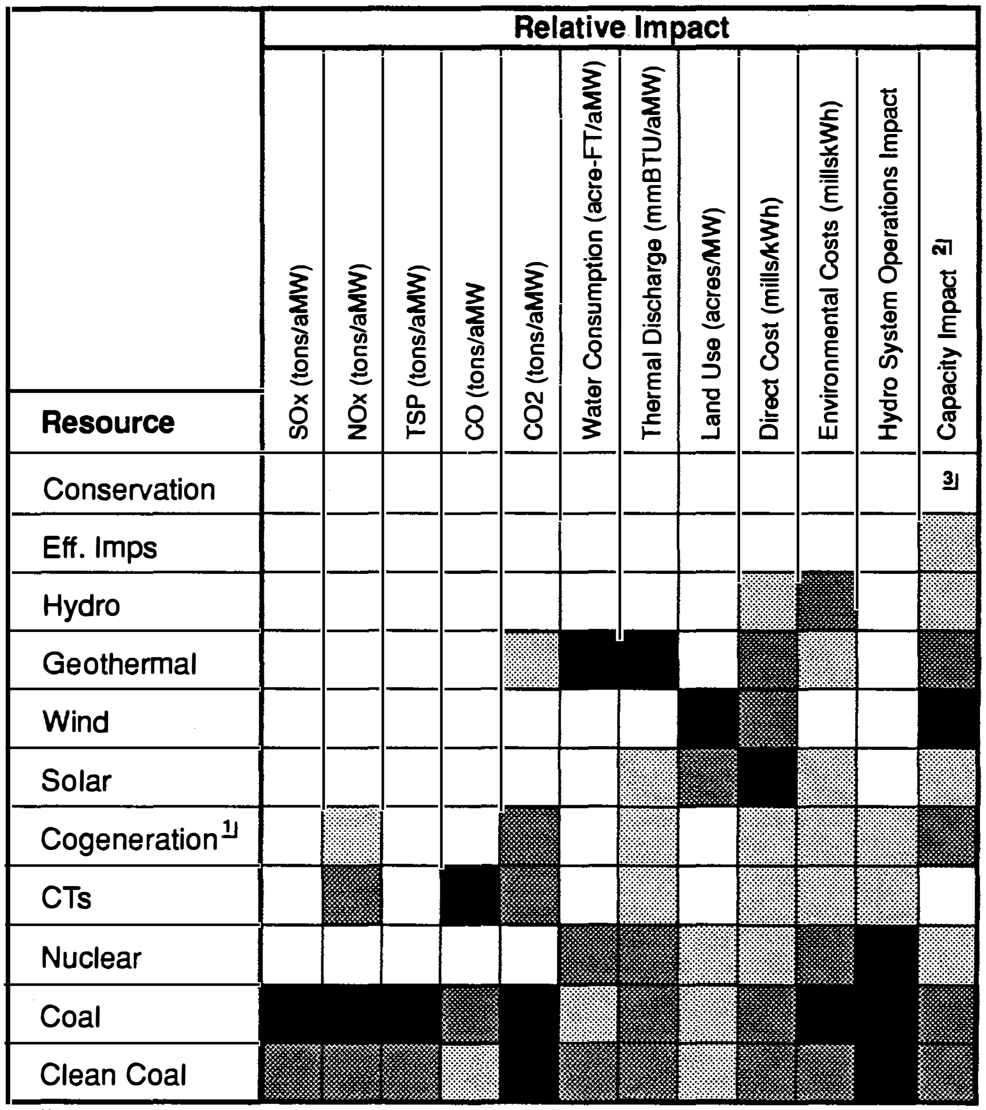
Before analyzing the actions BPA could take to meet the underlying need, the RPEIS evaluates the environmental effects of generic resource types and potential mitigation measures for each. Current supply curve analysis indicates that the following resource types could be available to meet future load growth through 2010:

- conservation (including the commercial, residential, and industrial sectors)
- renewable resources (including hydropower, geothermal, wind, and solar power)
- efficiency improvements
- cogeneration
- combustion turbines
- nuclear power
- coal (including conventional coal and clean coal technologies).

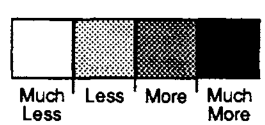
A relative comparison of principal environmental impacts of each resource type is shown in Figure S-1.

Other means of meeting load, such as fuel switching from electricity to natural gas for some applications, energy imports, and efficiency improvements, are also evaluated. Emerging technologies that could become commercially available within the planning period, and several types of load management, have been included as well.

Figure S-1
Selected Environmental Impacts of Conservation and Generation Resource Operations



Note: Fuel Switching not shown because comparable data are not available, but generally has low impact in all areas.



1/ Natural gas fired cogeneration assumed

2/ "More" means a more negative impact to capacity

3/ Capacity value of conservation varies considerably among conservation measures, from positive to negative

Conservation

The Northwest Power Act prioritizes new resources to be acquired for the region. The first priority is conservation, which reduces the need to build new generation. Conservation in commercial and residential buildings consists of increasing energy use efficiency by upgrading or retrofitting existing buildings and by designing new buildings to be as energy efficient as warranted. The largest potential for energy savings is in lighting and heating measures. Proper handling and disposal of fluorescent light ballasts and lamps from commercial buildings can prevent the hazards associated with polychlorinated biphenyls and mercury. Although changes to the heating, ventilation and cooling systems may affect air quality inside commercial buildings, energy-efficient designs can be installed such that indoor air quality in not affected adversely.

Residential conservation includes a wide variety of measures to reduce electricity use in single family homes, multi-family dwellings, and manufactured homes. Conservation programs promote retrofitting existing homes to make them more energy efficient and employing construction techniques in new homes to tighten the structure, thus reducing air infiltration and heat loss. Of primary concern has been the effects of the reduction in indoor air quality, especially from radon and formaldehyde, on human health. These impacts were evaluated in previous documents: The Expanded Residential Weatherization EIS (DOE/EIS-0095F, 1984) and the Final Environmental Impact Statement on New Energy-Efficient Homes Programs (DOE/EIS-0127F, 1988). Avoiding certain building materials and products is effective mitigation for formaldehyde. Many radon mitigation techniques are available. However, more recent studies have shown that there is no direct correlation between house tightening and radon levels.

Industrial and agricultural sector conservation measures include high efficiency motors, motor speed controls, energy efficient motor rewinds, heat recovery equipment, insulation, lighting, energy management systems, power factor improvements, and irrigation efficiency improvements.

Since these measures do not alter the mechanical processes in such a way as to substantially affect waste streams, and because industrial applications are highly regulated, minor, if any, environmental impacts are likely.

Renewable Resources

Second priority is given to renewable resources. Four renewable resources are under consideration: hydroelectric power, geothermal, wind, and solar power.

<u>Hydroelectric facilities</u> vary greatly in size and can be run-of-river dams, storage reservoirs, or small projects such as the addition of turbines to existing pipe or ditch systems. Environmental impacts include the alteration of surface water and stream habitat. Water temperature, water quality, and stream flow may be affected. Dams may block migration of fish, such as salmon, and alter wildlife habitat. However, the Protected Areas amendments adopted by the Council help protect critical fish and wildlife habitat.

<u>Geothermal</u> energy taps heat available within the earth's core. The most likely locations in the Northwest for geothermal development are in southeastern Oregon and southern Idaho and in the high Cascades of southern Oregon. The three principal types of geothermal conversion technologies used in power generation are dry steam, flash, and binary cycle plants. The major environmental impacts associated with geothermal energy are contaminants from geothermal steam

(particularly hydrogen sulfide), waste heat, degradation of water quality, and solid waste. However, mitigation measures are available to minimize these impacts.

Almost 40 locations in the Northwest have been identified as having potential for commercial development of wind sites. The environmental impacts are associated with siting the wind turbines, which are usually grouped together in wind parks. These wind parks require the development of large tracts of land, and some of the best sites in the region are in scenic areas along the Pacific coast and in the Columbia River Gorge. Wind parks may pose a hazard to birds from striking the turbine blades. Noise and electromagnetic interference are also potential impacts. Many of these siting impacts can be mitigated.

The best potential solar site in the Northwest is in southeastern Oregon. Solar energy can be captured by solar thermal plants, which convert heat energy into electricity through a turbine-generator, and by photovoltaic cells, in which the sun's radiation is converted directly into power. Solar energy is characterized by daily and seasonal variations. Because solar radiation is diffuse, large tracts of land are required for developing commercial-sized solar thermal sites, and land use is also a major impact of photovoltaic systems. In addition, the industrial processing of the photovoltaic materials uses hazardous chemicals, but they are generally highly regulated.

Cogeneration

The Northwest Power Act gives third priority to high efficiency resources such as cogeneration, in which electric power is generated from an existing heat-producing industrial operation. A variety of fuel types, including natural gas, coal, and biomass, can be used in cogeneration; however, for modeling purposes in this EIS, cogeneration was assumed to be gas-fired. The environmental effects depend largely on the type of fuel used; plant emissions would be similar to any combustion facility using these fuels. Because cogeneration plants satisfy thermal energy as well as electricity needs with a single energy source, there is less overall pollution than if separate energy sources were used.

Thermal Resources

Combustion turbines, or CTs, are based on the same technology as jet engines. A combined cycle combustion turbine couples a CT with a steam plant to generate power very efficiently. CT designs are simple, reliable, and relatively easy to site. CTs that use natural gas are relatively clean burning. Although oxides of nitrogen (NO_X) tend to be a problem because of the high combustion temperatures, the NO_X emissions can be controlled. Carbon dioxide, which is a greenhouse gas, and waste heat are also produced. Noise can be a problem, especially in an urban setting, but silencing packages are available.

Another possible thermal resource choice is the completion of Washington Nuclear Plants 1 and 3. In these pressurized water reactors, nuclear fission is used to produce steam, which turns a turbine-generator to produce electricity. Both plants are sited on large tracts of land. Environmental impacts from operating a nuclear plant include thermal discharge, water consumption, release of airborne radioactive materials, and release of waterborne chemical pollutants. Radioactive waste disposal continues to be an issue. Long-term storage proposals have met considerable public opposition and some technological questions remain unsolved.

Conventional coal plants are a traditional thermal resource with a well-established technology. Coal is burned to boil water and produce steam. The steam then turns a turbine, which generates electricity. A large amount of domestic coal is available to the Pacific Northwest. The impact of greatest environmental concern from coal generation is air pollution. Emissions include oxides of sulfur and nitrogen (SO_X and NO_X), which contribute to acid rain, and carbon dioxide, which has been implicated in global warming. Although there are ways to scrub exhaust gases to reduce SO_X and NO_X, there currently is no effective way to mitigate CO_2 pollution. Coal combustion also releases particulates, and coal plants require large quantities of cooling water. Several clean coal technologies, including fluidized bed combustion and coal gasification, have higher thermal efficiencies and produce fewer emissions compared to conventional coal.

Alternatives

Key Assumptions

The high load growth forecast was used in the analysis to identify maximum environmental effects. A combination of load growth plus the loss of existing or planned resources could mean that BPA will have to acquire as many resources as under the high forecast. However, high load growth is considered unlikely, and as a result, the more expensive resources needed under high growth conditions are not expected to be acquired in the 20-year study period.

The estimated costs for each resource type in this analysis were based on the 1990 Resource Program. Some resource costs have since changed. The effects of shifts among relative costs of the different resources comprise a major element of the economic analysis that will be part of each future Resource Program.

Environmental externalities are the economic costs and benefits that are not directly borne by the party causing the environmental effect. BPA is required by the Northwest Power Act to include quantifiable environmental externalities in determining a resource's total system cost for BPA's planning and acquisition activities. The Northwest Power Act also directed the Council to develop, as a guide to BPA, a methodology for quantifying environmental costs. In developing estimates of environmental costs and benefits, BPA has followed the methodology proposed by the Council.

A technical work group was formed in November 1990 to review the methodology and information used by BPA for the estimates of environmental costs and benefits developed for the RPEIS. The work group, which included representatives from public and investor-owned utilities, state and Federal agencies, independent power producers, interest groups, and private citizens, met throughout the development of this EIS.

BPA's environmental cost estimates focus on the effects of operating generic resources on atmospheric visibility, human health risks, forests, crops, materials, and on land and water. Three airborne pollutants are analyzed--sulfur oxides, oxides of nitrogen, and particulate matter. The effects of carbon dioxide emissions were initially included. It was determined that the uncertain scientific evidence concerning the effects of CO_2 preclude placing a value on the effects of CO_2 emissions. BPA recognizes, however, that some states and utilities have placed a cost on CO_2 emissions based on existing studies, and BPA has included CO_2 in the non-cost analysis of air quality impacts of each alternative.

The potential environmental costs associated with radioactive emissions from a catastrophic nuclear event are not estimated or included in this analysis. The environmental costs for nuclear plants cited in the document consist only of estimates associated with land and water use impacts for all large thermal plants.

It was also assumed that BPA and the IOUs planned separately. None of the IOU load growth was placed on BPA; all of the load growth of the generating public utilities (GPUBs) was. In addition, it was assumed that BPA's contracts with utilities and the DSIs were renewed in 2001 without major changes.

In the past, BPA has focused on planning to meet energy deficits because, historically, the Northwest hydropower-based system has been relatively capacity-abundant. However, in the future, as the region acquires more conservation, renewable, and thermal resources, and as the operations of the hydroelectric system change to increase fish survival, the capacity attributes of new resource acquisitions may become increasingly important.

In this EIS, it is assumed that when the Canadian Entitlement sale to U.S. utilities expires, its energy and capacity will be returned to Canada. Other options (such as repurchasing all of the Entitlement, or its capacity or energy elements) are also possible.

Development of the Alternatives

Thirteen alternatives were developed to represent the range of actions BPA could take to meet its load obligations. The resource acquisitions proposed in future Resource Programs are expected to fall within this range. With the exception of No Action, each alternative is made up of a combination of resources that allows BPA to meet the almost 5,000 average megawatt load growth projected under the high forecast, or an equivalent need for resources caused by a combination of load growth and possible loss of resources. The Integrated System for Analysis of Acquisitions (ISAAC) was used to simulate resource acquisitions and operations. A resource stack (a least-cost ordering of resources available to meet load growth) was used as input to the model. Variations of the resource stack were developed for each alternative. For comparison purposes, in the Final EIS, a set of resource additions to serve expected (medium) loads was identified.

Description of the Alternatives

Under the No Action Alternative, the underlying need for energy to meet the growing loads of BPA customers would not be met. There would be an increased emphasis on conservation and on more efficient use of existing generating resources. Efficiency improvements and interregional exchanges would be pursued, as well as fuel switching to natural gas or wood. Although the environmental effects associated with the large-scale development of thermal resources would be avoided, there would be degradation of air quality from wood burning, and water quality and land use impacts from changes in population dispersion and numerous small generating facilities. Socioeconomic impacts could be major.

In the Status Quo Alternative, resource acquisitions continue on the least-cost planning course set in the 1990 Resource Program. Resources are acquired based on minimizing system costs, without including quantifiable external environmental costs. The primary difference between this alternative and the Base Case Alternative is that coal is acquired and operated instead of some geothermal and cogeneration.

The Base Case Alternative reflects BPA's decision to include quantifiable environmental costs in resource planning, and is the benchmark against which all of the other alternatives are compared. Under this alternative, resources would be acquired based on minimizing total system cost, including quantified external costs. Since the Base Case Alternative was developed specifically to minimize total system costs, it is the least-cost alternative, with the exception of the Fuel Switching and High Conservation Alternatives. Both fuel switching and the conservation resources included in the High Conservation Alternative were assumed to be relatively inexpensive and to have fairly low environmental costs. However, neither of these types of resources were included in the Base Case because neither has yet been confirmed as to cost or availability. The Base Case Alternative is, in essence then, the least-cost alternative.

The remaining alternatives were developed by placing the available supply of the emphasized resource at the top of the stack of resources developed for the Base Case Alternative, after nondiscretionary conservation.

Because of its relatively low cost, all of the available conservation is already at the top of the resource stack in the Base Case Alternative. Therefore, the Emphasize Conservation Alternative and the Base Case Alternative are the same.

In the Emphasize High Conservation Alternative, additional conservation resource potential was assumed for residential refrigeration, residential freezers, other residential appliances, new commercial buildings, and industrial facilities (excluding aluminum smelters operated by direct-service industrial customers of BPA). This additional achievable potential is based, in large part, on the 1990 analysis of the regional energy conservation resource potential by the Natural Resources Defense Council and the Northwest Conservation Act Coalition.

In the Emphasize Renewables Alternative, the renewable energy resources (hydropower, geothermal, wind, and solar) available to BPA were moved to the top of the Base Case resource stack and acquired first.

For the Emphasize Cogeneration Alternative, cogeneration resources were moved to the top of the Base Case resource stack. For the purpose of modeling environmental impacts, cogeneration was assumed to use natural gas because gas is the fuel used for most new cogeneration. However, a variety of fuel types--including biomass and municipal solid waste--can be used in cogeneration.

In the Emphasize Combustion Turbines Alternative, all of the available combustion turbine resources were moved to the top of the Base Case stack. Because CTs are already near the top of BPA's resource stack and because the alternatives are modeled against future high load growth, all of the available CTs were acquired in the Base Case by 2000. Therefore, moving the CTs to the top of the stack did not change the average megawatts of resources acquired or operated in 2000 or 2010; thus this alternative is identical to the Base Case.

The partially completed Washington Nuclear Projects (WNP)-1 and -3 were placed at the top of the resource stack in the Emphasize Nuclear Alternative. The major difference between this alternative and the Base Case Alternative is that both nuclear plants are acquired and operated by 2000 and almost no cogeneration or CT resources are operated.

In the Emphasize Coal Alternative, the conventional coal resources available to BPA were moved to the top of the resource stack. The major difference from the Base Case is that coal replaces nuclear plants in 2000 and in 2010, coal replaces some renewables, cogeneration, and CTs.

In the Emphasize Clean Coal Alternative, the amount of high technology coal, including fluidized bed combustion and coal gasification, available to BPA was moved to the top of the resource stack. In 2000, clean coal replaces a nuclear plant, and in 2010, clean coal replaces some renewables, cogeneration, and CTs.

Fuel switching from electricity to natural gas for some applications is a means of reducing load and an option now being pursued by some Pacific Northwest utilities. In the hypothetical program modeled for the Emphasize Fuel Switching Alternative, BPA would pay the costs involved in bringing gas lines near residential areas and subsidize conversion from electric to gas.

In the Emphasize Imports Alternative, an estimated supply of imports was moved to the top of the resource stack. These imports were modeled as gas-fired CTs--two-thirds new and one-third existing. It was assumed that half of the imports were from Canada and half were from the Pacific Southwest. In addition, the imports from Canada were assumed to be available all year and the imports from the Pacific Southwest were shaped into the September through April period.

Because of the long lead time to plan for and build resources, large amounts of resources are not acquired in any of the alternatives before the mid-1990s. It is assumed that extra-regional purchases of firm power can be made on a short-term basis to meet the near-term loads. The year 2000 was chosen to represent the mid-term and 2010 to represent the long-term. BPA resource acquisitions and operations in 2000 and 2010 for all the alternatives (excepting No Action) are presented in Tables S-1 through S-4.

Table S-1

New Resource Acquisitions - 2000

	Alternatives											
Resource Types (in aMW):	Status Quo	Base Case	Conservation	High Conservation	Renewables	Cogeneration	CT's	Nuclear	Coal	Clean Coal	Fuel Switching	Imports
Conservation	477	477	477	815	477	458	477	404	441	452	477	197
Effic Imp	134	134	134	134	134	134	134	114	134	134	134	133
Renewables	60	105	105	60	716	49	105	46	49	60	105	0
Cogen	140	260	260	260	140	1380	260	10	170	140	260	0
CT's	1046	1046	1046	1046	696	349	1046	349	698	698	1046	0
Nuclear	813	813	813	0	0	0	813	1619	0	0	0	0
Coal	0	0	0	0	0	0	0	0	1127	0	0	0
Clean Coal	0	0	0	0	0	0	0	0	0	806	0	0
Fuel Switching	0	0	0	0	0	0	0	0	0	0	241	0
Imports	0	0	0	0	0	0	0	0	0	0	0	2000
Total	2670	2835	2835	2315	2163	2370	2835	2542	2619	2290	2263	2330
Load/Resource Balance	397	562	562	44	-107	99	562	272	345	16	-10	60

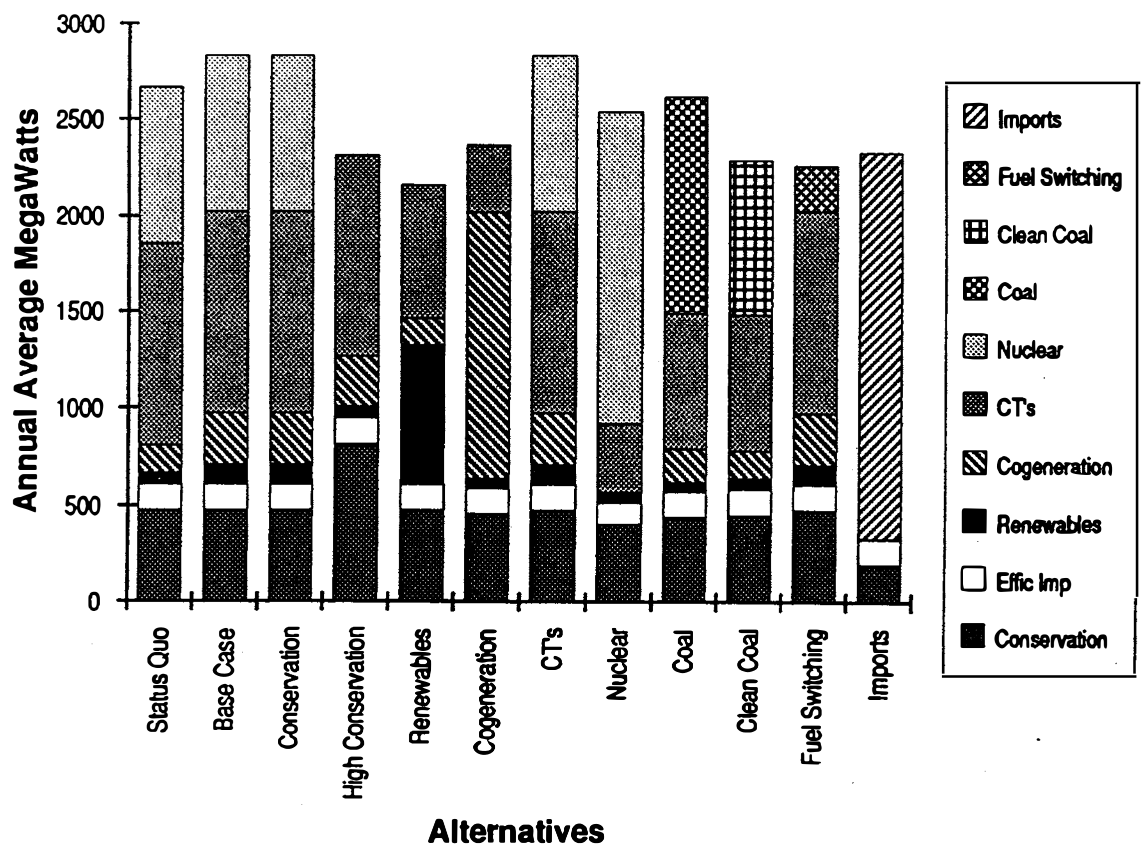


Table S-2
New Resource Acquisitions - 2010

	Alternatives											
Resource Types (in aMW):	Status Quo	Base Case	Conservation	High Conservation	Renewables	Cogeneration	CT's	Nuclear	Coal	Clean Coal	Fuel Switching	Imports
Conservation	1033	1033	1033	1881	1033	1029	1033	1011	1029	1033	1033	858
Effic Imp	134	134	134	134	134	134	134	134	134	134	134	134
Renewables	367	480	480	349	967	405	480	412	314	213	367	60
Cogen	390	840	840	400	490	1380	840	930	340	280	430	120
CT's	1046	1046	1046	1046	1046	1046	1046	1046	1046	1046	1046	1046
Nuclear	1619	1619	1619	1619	1619	1819	1619	1619	1619	1619	1619	0
Coal	563	0	0	0	0	0	0	0	1127	0	0	0
Clean Coal	0	0	0	0	0	0	0	0	0	1286	0	0
Fuel Switching	0	0	0	0	0	0	0	0	0	0	556	0
Imports	0	0	0	0	0	0	0	0	0	0	0	3000
Total	5152	5152	5152	5429	5289	5613	5152	5152	5609	5611	5185	5218
Load/Resource Balance	55	55	55	333	193	517	55	56	512	514	89	124

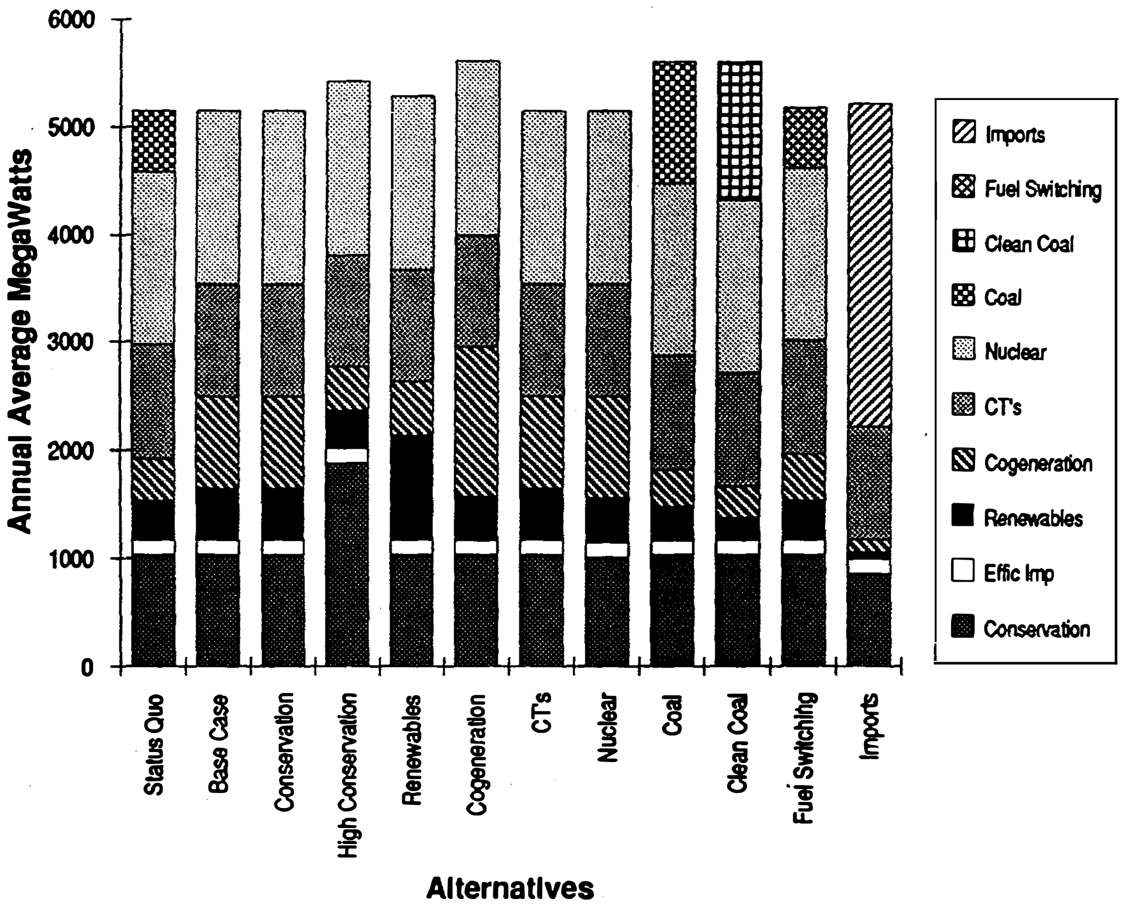


Table S-3

New Resource Operations - 2000

Resource Types (in aMW):	Alternatives											
	Status Quo	Base Case	Conservation	High Conservation	Renewables	Cogeneration	CT's	Nuclear	Coal	Clean Coal	Fuel Switching	Imports
Conservation	477	477	477	815	477	458	477	404	441	452	477	197
Effic Imp	134	134	134	134	134	134	134	114	134	134	134	134
Renewables	60	105	105	60	716	49	105	46	49	60	105	0
Cogen	140	260	260	260	140	1380	260	10	170	140	260	0
CT's	185	140	140	277	185	70	141	35	109	176	283	0
Nuclear	813	813	813	0	0	0	813	1619	0	0	0	0
Coal	0	0	0	0	0	0	0	0	958	0	0	0
Clean Coal	0	0	0	0	0	0	0	0	0	697	0	0
Fuel Switching	0	0	0	0	0	0	0	0	0	0	241	0
Imports	0	0	0	0	0	0	0	0	0	0	0	681

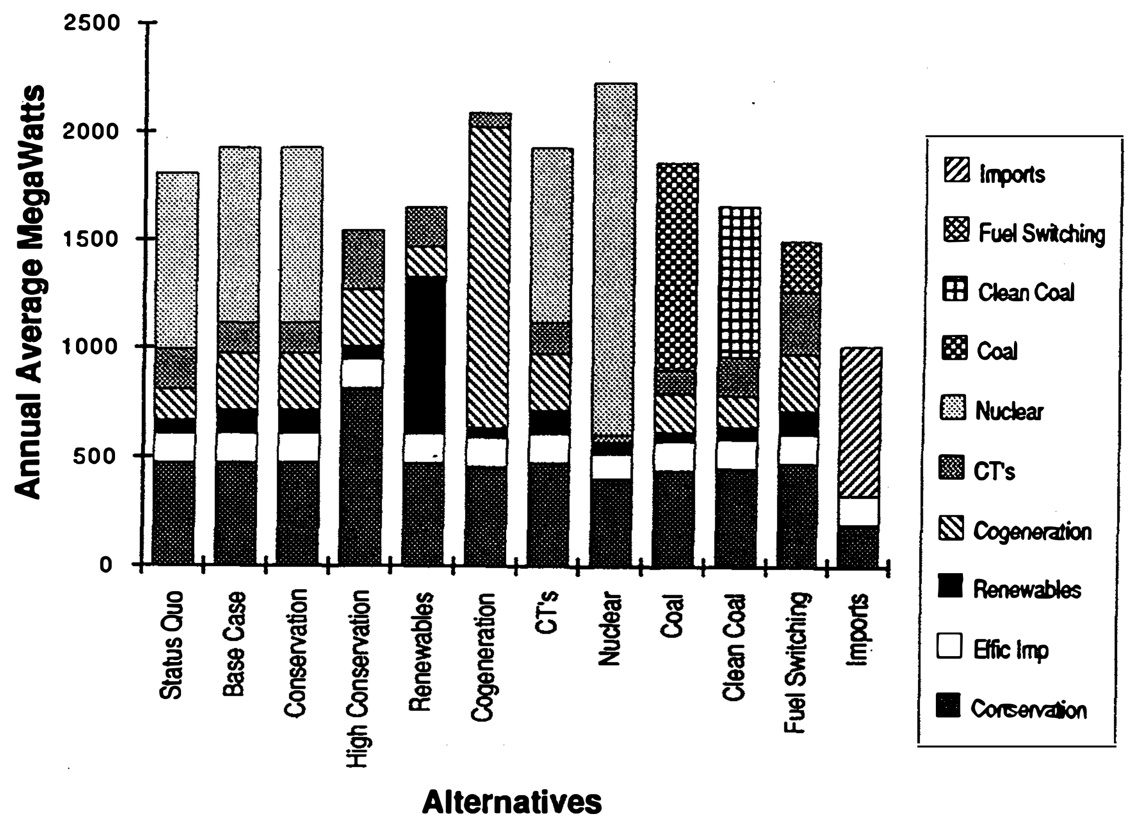
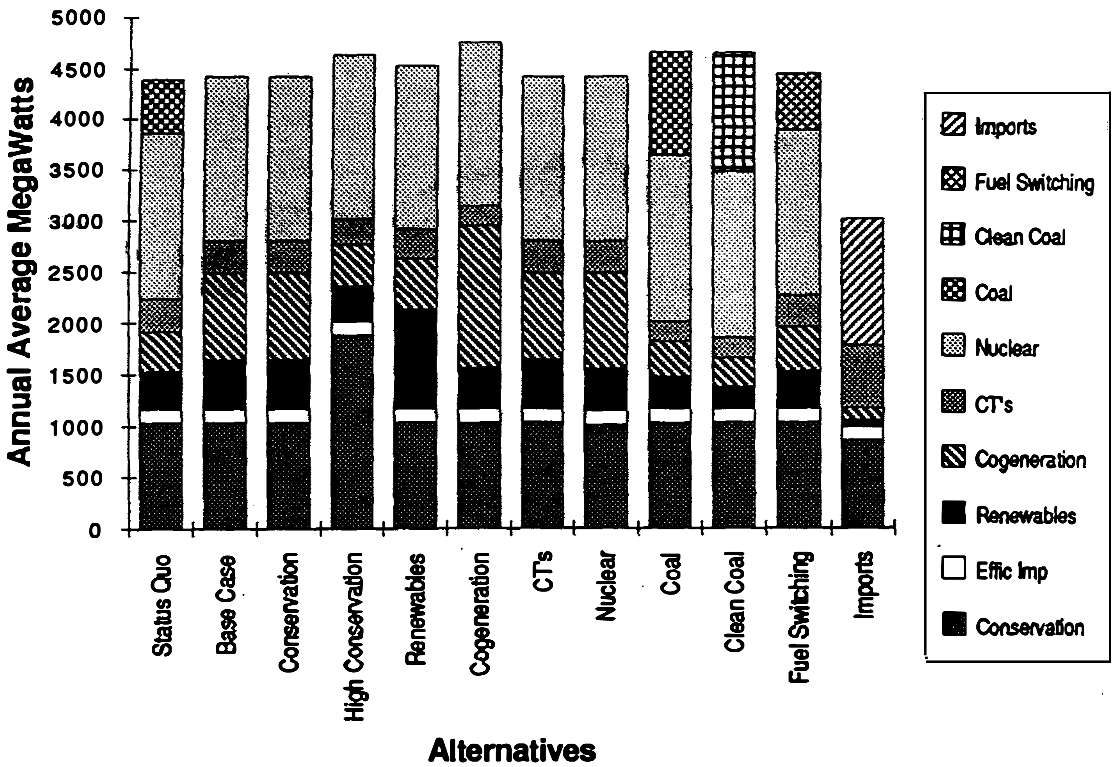


Table S-4

New Resource Operations - 2010

Resource Types (in aMW):	Status Quo	Base Case	Conservation	High Conservation	Renewables	Cogeneration	CT's	Nuclear	Coal	Clean Coal	Fuel Switching	Imports
	Alternatives											
Conservation	1033	1033	1033	1881	1033	1029	1033	1011	1029	1033	1033	858
Effic Imp	134	134	134	134	134	134	134	134	134	134	134	134
Renewables	367	480	480	349	967	405	480	412	314	213	367	60
Cogen	390	840	840	400	490	1380	840	930	340	280	430	120
CT's	315	316	316	253	290	198	316	315	200	198	305	613
Nuclear	1619	1619	1619	1619	1619	1619	1619	1619	1619	1619	1619	0
Coal	534	0	0	0	0	0	0	0	1032	0	0	0
Clean Coal	0	0	0	0	0	0	0	0	0	1176	0	0
Fuel Switching	0	0	0	0	0	0	0	0	0	0	556	0
Imports	0	0	0	0	0	0	0	0	0	0	0	1235



Environmental Effects of the Alternatives

Except for the No Action Alternative, all of the alternatives are compared to the Base Case Alternative. Since most of the potential impacts from conservation measures could be mitigated, the comparison of alternatives focused on impacts to air quality, water quality and use, and land use from the operation of the new generating resources acquired.

The potential for each alternative to affect the operation of the hydro system was also examined. Scenarios were developed to determine which characteristics--magnitude, monthly shape, displaceability, and load resource balance--of adding new resources have the greatest potential to affect hydro system operations. The System Analysis Model (SAM) was then used to simulate operation of the system for each scenario. The hydro system operation studies showed that the resource characteristics that most affect hydro system operation are resource shaping throughout the year and the load/resource balance. In general, the greater the amount of shaping and the greater the amount of surplus, the greater the potential for effects on hydro system operations. The hydro system analysis scenarios were then compared to the alternatives. Alternatives were also compared in terms of the amount of capacity they provide overall, as determined by comparing the ratio of the total capacity of all the resources in each alternative with the total energy provided.

The potential environmental impacts of the alternatives compared to the Base Case are summarized on the following pages in Figure S-2 for 2000 and in Figure S-3 for 2010. The system costs of the various alternatives are also compared.

Other Considerations

The alternatives analyzed in the RPEIS were modeled to assess the cumulative impacts of adding different combinations of resources to the existing system. Therefore, the cumulative impacts of actions taken to meet the underlying need have been addressed.

In addition, all of the alternatives involve trade-offs between short-term uses of man's environment and the maintenance and enhancement of long-term productivity. As new resources are acquired in the region to meet BPA's need, short-term and long-term impacts will occur to the affected environment. All alternatives in the study are expected to have short-term impacts from the building or installation of new resources, noise from construction and operation of large generating units, soil erosion, displacement of wildlife, disruption of habitat, and altered land use. Socio-economic impacts are expected in the short-term from the increase in work force required during construction of large generating units. In the long-term, impacts could occur to air quality, land use from mining, and water consumption and thermal discharge from thermal generating plants.

In every alternative, resources which use fossil fuels or other nonrenewable resources are operated. Even the alternatives that emphasize conservation and renewable resources include thermal resources, and nonrenewable resources are required for the construction of the generating facilities, for the renewable resources, and for the materials used in the various energy conservation measures.

Therefore, every alternative involves the irreversible or irretrievable commitment of resources.

In addition, controversy involving the environmental trade-offs among the various resource types is expected.

Figure S-2
Selected Environmental Impacts of Operations of Resource Alternatives Compared to the Base Case Alternative - 2000

		ALTERNATIVE										
POTENTIAL EFFECT	BASE CASE	Status Quo	Conservation	High Conservation	Renewables	Cogeneration	CTs	Nuclear	Coal	Clean Coal	Fuel Switching	Imports
SO_2	9 tons	Same	Same	Same	Same	Same	Same	Same	Much More	More	Same	More
NO_X	1,800 tons	Same	Same	More	Same	More	Same	Less	Much More	More	More	More
TSP	9 tons	Same	Same	Same	Same	Same	Same	Same	Much More	More	Same	Same
CO	300 tons	Same	Same	More	Same	Less	Same	Less	Much More	More	More	Much More
CO_2	1.24 million tons	Same	Same	Same	Same	More	Same	Less	Much More	Much More	Same	More
Water Consumption	17,000 acre-ft	Less	Same	Much Less	Less	Much Less	Same	Much More	Less	Less	Much Less	Much Less
Thermal Discharge	52 million MMBtu	Less	Same	Much Less	Less	Less	Same	Much More	Less	Less	Much Less	Much Less
Land Use	1,900 acres	Same	Same	Much Less	Much More	Much Less	Same	More	Less	Less	Much Less	Much Less
Direct Cost [1]	Base case	Less	Same	Much Less	Same	Much More	Same	Same	More	More	Less	Less
Environmental Cost [1]	Base case	More	Same	Much Less	Less	Same	Same	Same	Much More	More	More	More
Hydro System Operations	800 aMW large thermal with maintenance; no shaped import	Same	Same	Less	Less	Less	Same	More	Same	Same	Less	More
Capacity Contribution	Base case	Same	Same	Less	Less	Much Less	Same	More	Less	Much Less	Less	Much Less

1] Relative expected present value over entire study period

Much Less | Less | Same | More | Much More

Figure S-3
Selected Environmental Impacts of Operations of Resource Alternatives Compared to the Base Case Alternative - 2010

POTENTIAL EFFECT	BASE CASE	Status Quo	Conservation	High Conservation	Renewables	Cogeneration	CTs	Nuclear	Coal	Clean Coal	Fuel Switching	Imports
		ALTERNATIVE										
SO_2	26 tons	Much More	Same	Same	Same	Same	Same	Same	Much More	More	Same	Same
NO_X	5,100 tons	More	Same	Much Less	Much Less	More	Same	Same	Much More	More	Much Less	Much More
TSP	26 tons	More	Same	Same	Same	Same	Same	Same	Much More	Much More	Same	Same
CO	700 tons	More	Same	Same	Same	Less	Same	Same	More	More	Same	Much More
CO_2	3.7 million tons	More	Same	Less	Less	More	Same	More	Much More	Much More	Less	More
Water Consumption	48,000 acre-ft	Less	Same	Much Less	Same	Less	Same	Less	Much More	Much More	Less	Much Less
Thermal Discharge	151 million MMBtu	Less	Same	Much Less	Less	Same	Same	Less	More	Same	Much Less	Much Less
Land Use	3,900 acres	More	Same	Same	Much More	More	Same	Same	More	More	Same	Much Less
Direct Cost [1]	Base case	Less	Same	Much Less	Much More	Much More	Same	Same	More	More	Less	Less
Environmental Cost [1]	Base case	More	Same	Much Less	Less	Same	Same	Same	Much More	More	More	More
Hydro System Operations	1600 aMW large thermal with maintenance; no shaped import	More	Same	Same	Same	Same	Same	Same	More	More	Same	More
Capacity Contribution	Base case	More	Same	Less	Same	Less	Same	Same	More	Less	Less	Much Less

[1] Relative expected present value over entire study period

Much Less | Less | Same | More | Much More

Preferred Alternative

BPA's preferred alternative is the Emphasize Conservation Alternative. System and environmental costs are low. Environmental impacts from conservation are minimal. This alternative is cost-effective and environmentally responsible; only the High Conservation Alternative has lower costs and fewer environmental impacts. However, there is some concern about the cost-effectiveness, reliability, and commercial availability of the high conservation resources. If the supply of the additional conservation potential was confirmed and it became cost-effective, the High Conservation Alternative would be preferred.

Relationship to the Columbia River System Operation Review

The Corps of Engineers, Bureau of Reclamation, and Bonneville Power Administration are jointly preparing a System Operation Review (SOR) EIS on the operation of the Columbia River hydropower system. The SOR EIS will include extensive analyses of the effects of alternative hydro system operations on the multiple uses of the hydro system. These multiple uses include navigation, flood control, recreation, hydropower generation, fish (both resident and anadromous), wildlife, cultural resources, and irrigation.

The RPEIS assumes current operating practices and constraints on the hydro system for all alternatives. In the SOR EIS, however, those constraints will be removed and alternative operations which accommodate the river uses in different ways will be analyzed. Upon completion, the SOR EIS will provide additional information on the environmental effects of changes in hydro system operations. If an alternative in the SOR EIS causes a reduction in hydropower operation or capability, the RPEIS will provide information on the potential replacement resource(s) and their environmental impacts.

Changes in the Final Environmental Impact Statement

The Draft Resource Programs EIS was released for public review during the summer of 1992. Comments received by letter or in the public hearing held June 16, 1992, were used to revise and update data and analyses of the EIS (public comments and BPA's responses are contained in Volume III of the Final EIS). In addition, a number of revisions were made in the Chapter 3 material describing each resource type, and in Chapter 4 and the Summary, to assure consistency with the modeling and analysis in Chapter 5. Additional information about the capacity aspects of each resource type and alternative has been added, and the material on conservation and its impacts has been reorganized.

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