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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

ENERGY AND MINERALS
DIVISION

April 4, 1980

B-198245

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The Honorable James H. Weaver
House of Representatives

Dear Mr. Weaver:

Subject: [Hypothetical Transfer of Construction Funds from Nuclear Powerplants to Electricity Conservation and Renewable Energies] (EMD-80-71)

Your recent letter requested that we conduct a brief analysis to determine how much electric energy might be saved or produced if the construction funds presently budgeted to complete nuclear powerplants WNP-4 and WNP-5 in Washington State were used instead for investments in electricity conservation and renewable energy sources. Your request conjectures that conservation and renewable energy projects can be financed as readily as nuclear powerplants.

To explore this hypothesis, we based our study on data developed in our 1978 report to the Congress on regional power planning and adjusted that data to recognize changed conditions and new information. 1/ In that report we projected that, by adopting a set of comprehensive but moderate conservation policies, the region could realize substantial savings in balancing power supply and demand.

Construction of WNP-4 and WNP-5 is being financed by over 80 electric utilities, including public utility districts, cities, and cooperatives. WNP-4 is a 1,250-megawatt plant being constructed near Richland, Washington. In January 1980, WNP-4 was 13 percent complete. WNP-5 is a 1,240-megawatt plant sited near Satsop, Washington. WNP-5 was 8

1/"Region at the Crossroads--The Pacific Northwest Searches for New Sources of Electric Energy" (EMD-78-76, Aug. 10, 1978). The data revisions and updates involved the use of two consultants who had previously assisted us in preparing the 1978 report.

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percent complete in January 1980. Unlike three other nuclear plants being constructed in Washington State (WNP-1, -2, and -3), WNP-4 and WNP-5 are not guaranteed by the Bonneville Power Administration. However, Bonneville sponsorship of these two plants could be authorized under proposed legislation. According to Bonneville-supplied data, both plants should be in full commercial operation by 1990.

Based on information furnished by the Washington Public Power Supply System (WPPSS), construction agent for WNP-4 and WNP-5, the two plants will cost about $5.6 billion, and should be completed by early 1987. If construction were halted on March 31, 1980, "sunk" construction costs--including the costs of terminating contracts and "mothballing" facilities already built--would total about $1.6 billion. 1/ Conceptually, about $4.0 billion of unexpended construction funds would be available for investments in conservation and renewable energies.

A reexamination of potential energy sources within the region showed that conservation and renewable energies might provide enough average energy by 1990 to equal the anticipated contributions of WNP-4 and WNP-5 (see enclosure I). Conservation and renewables could provide about 1,800 average megawatts by 1990, when WNP-4 and WNP-5 are scheduled to produce about 1,700 average megawatts. 2/ The peak energy provided by conservation and renewable energy sources would likely be about 7 percent less in 1990 than the two nuclear power plants could provide. 3/ Peak energy available from conservation and renewable energies in 1990 would total about 2,300 megawatts compared to peak nuclear generation of about 2,500 megawatts.

1/Construction costs are being financed by the sale of revenue bonds which are obligations on the numerous electric utilities participating in construction of WNP-4 and WNP-5.

2/An average megawatt is the amount of energy 1 megawatt would provide constantly throughout 1 year.

3/Peak energy is the amount of power supplied during a particular point in time during peak demand.

Investments in conservation and renewable energy sources would have a marked advantage in the early years. These sources could begin saving energy in 1981, 5 years before any nuclear power is generated by WNP-4 and WNP-5. However, the two nuclear plants would likely produce more energy than these sources could between 1987 and 1989.

The total investments in conservation and renewable energy sources anticipated would cost about $2.2 billion in 1980 dollars. Inflation and interest costs would raise this total to $3.5 billion by early 1987, when construction of WNP-4 and WNP-5 would be completed. It appears, therefore, that the conservation and renewable alternative would cost the region about $3.5 billion of the $4 billion remaining after termination of WNP-4 and WNP-5. In addition, the energy supplied by conservation and renewable sources before WNP-4 and WNP-5 begin production would have considerable value. Assuming 20 mills per kilowatt-hour, the average energy contribution from these sources could save the region about $0.6 billion in energy and interest costs. This saving would, in effect, reduce the cost of the conservation and renewable alternative to about $2.9 billion--$1.1 billion less than the $4.0 billion remaining after termination of WNP-4 and WNP-5. We project that between $0.5 billion and $1.1 billion of the transferred construction funds would remain unexpended after implementation of various conservation and renewable energy programs.

Future developments in the region's energy posture and in its economic priorities would determine whether the remaining funds would be needed for additional energy investments. If necessary, these funds could be used to (1) reduce or flatten peak loads, (2) develop additional interties and capacity exchanges between the Pacific Northwest and other regions in the U.S. or Canada, (3) finance additional conservation programs and renewable energy projects, and/or (4) construct new baseload or peaking facilities. If unneeded for these purposes, the remaining funds would constitute a net cost savings to regional power consumers.

In reviewing our projections, it is important to recognize that we briefly examined only a few implications of a very significant, albeit hypothetical, shift in regional energy policies. Before such a major policy shift could be implemented many related actions would need to be taken. For example, utilities and agencies of government would need to:

--Demonstrate to the financial community that investments in conservation and renewable energies are as credit worthy as investments in conventional powerplants.

--Establish economic and regulatory incentives to encourage industrial investments in cogeneration and more energy-efficient process equipment.

--Develop a comprehensive regional conservation program, complete with environmental impact statements, energy audits, public involvement and outreach activities, conservation loans or subsidies, and consumer protection activities.

--Establish effective systems to monitor the energy contributions realized from conservation and renewable sources, and thereby assure that such contributions meet regional power needs and peaking requirements.

These and other actions would be needed to overcome existing barriers, and to initiate such a policy shift with confidence of success.

Although our analysis supports a conclusion that conservation and renewable energy programs are economically preferable, it is important to recognize that such programs are somewhat embryonic and are not subject to centralized and direct control. If this policy shift were made, individual decisions and actions by thousands of potential adopters of conservation measures would replace the central administrative control of WPPSS. Uncertainty exists as to how the region could assure that sufficient conservation savings and renewable supplies would be realized in time to replace the planned contributions of WNP-4 and WNP-5. In fact, special monitoring systems would be needed to measure, on a continuing basis, the rate at which conservation measures are being adopted, and the energy savings resulting from such measures.

Our 1978 report to the Congress recognized that, without improved leadership in power planning, regional utilities and industries would be hesitant to make major investments in electricity conservation and renewable energy projects. For that reason, we recommended that the Bonneville Power Administration be assigned a leadership role to conserve

electric power, institute more realistic pricing of electricity, develop renewable technologies, and increase public involvement in power planning and policymaking.

As you requested, we have not submitted this report to other agencies for comment. However, we did have representatives of the Washington Public Power Supply System confirm the reasonableness of our estimated cost to complete WNP-4 and WNP-5. Also, we confirmed the reasonableness of our overall projections for conservation and renewable sources through discussions with a knowledgeable official of the Bonneville Power Administration.

We trust this is responsive to your needs and we would be pleased to meet with you or your representatives to discuss any questions you may have.

Sincerely yours,

J. Dexter Peach
Director

Enclosure

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HYPOTHETICAL

TRANSFER OF CONSTRUCTION FUNDS

BUDGETED TO COMPLETE NUCLEAR POWERPLANTS

WNP-4 AND WNP-5

NUCLEAR CONSTRUCTION SCHEDULES AND PLANNED ENERGY CONTRIBUTIONS

Nuclear powerplants WNP-4 and WNP-5 are under construction in Washington State. They are principally owned by the Washington Public Power Supply System (WPPSS), a construction agent for numerous publicly-owned utilities in the Pacific Northwest. WNP-4 and WNP-5 are designed as twins of WNP-1 and WNP-3, two other WPPSS reactors further advanced in construction. WNP-4, located near Richland, Washington, is planned to have a net generating capability of 1,250 megawatts (MW). According to a WPPSS management report, WNP-4 was about 13 percent complete in January 1980, and was scheduled for completion by July 1985. WNP-5, rated at 1,240 MW, is under construction near Satsop, Washington. As of January 1980, WNP-5 was about 8 percent complete, and was scheduled for completion by July 1986.

According to WPPSS officials, it is reasonable to expect that WNP-4 will begin commercial operation in January 1986, and WNP-5 in January 1987. This assumes that the construction schedules of both plants will slip at least 6 months due to additional unanticipated construction delays and regulatory changes. The plants will undergo equipment and system testing during the first 3 years of operation. In 1990, when, according to data supplied by the Bonneville Power Administration, both plants will reach full commercial operation, the power contributions from WNP-4 and WNP-5 are projected to average about 1,700 MW per year, slightly less than 70 percent of their combined rated capacity.

INVESTMENT CAPITAL AVAILABLE FROM HYPOTHETICAL TERMINATION OF WNP-4 and WNP-5

Based on cost data obtained from WPPSS, we estimate that, conceptually, about $4.0 billion could be transferred into conservation and renewable energies if construction of

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WNP-4 and WNP-5 was terminated by March 31, 1980. This figure was obtained by subtracting anticipated expenditures through March 31, 1980, plus possible termination costs from project budgets adjusted for anticipated slippages. The components of this estimate are summarized in the schedule below, and discussed in subsequent paragraphs.

	Estimated costs of construction and termination		
	WNP-4	WNP-5	Total
	----------(millions)--------		
Construction budget	$2,580	$2,753	$5,333
Plus:			
Allowance for anticipated 6-month slippages	120	120	240
Estimated total cost at completion	$2,700	$2,873	$5,573
Less:			
Expenditures to 3/31/80	649	516	1,165
Estimated termination costs	200	200	400
Subtotals	849	716	1,565
Total remaining construction funds available for transfer	$1,851	$2,157	$4,008

Budgeted costs and adjustments for construction slippages

The WPPSS fiscal year 1980 project budgets were used as source documents for the estimated construction costs for WNP-4 and WNP-5. Adjustments for construction slippages are based on discussions with WPPSS financial managers, who estimated that schedule slippages would cost at least $20 million per month at each plant.

Expenditures to March 31, 1980

Expenditures through March 31, 1980, were compiled by adding reported expenditures through December 31, 1979, to estimates of expenditures for January through March 1980, provided to us by WPPSS financial managers.

Estimated termination costs

WPPSS financial managers and engineers said that many additional costs--beyond those charged through March 31, 1980--would be incurred if WNP-4 and WNP-5 were terminated. For example, they told us that WPPSS has entered into over 170 construction and equipment contracts for WNP-4, some of which contain cancellation penalties, guaranteed profits, or demobilization charges. Although WNP-5 is not as advanced in construction, it is subject to similar contractual provisions. In addition, WNP-5 is physically linked to its twin powerplant and shares various systems which would have to be reengineered or redesigned if WNP-5 were cancelled.

WPPSS officials indicated that other costs would be incurred if the facilities already constructed were "mothballed" for possible future use. They said that mothballing would be the most practical approach because regional power needs would ultimately necessitate completion of the powerplants. According to WPPSS representatives, mothballing existing structures would cost less than one-half as much as restoring the two construction sites to their original conditions. We used WPPSS officials' estimate that termination costs, including mothballing, would equal $200 million for each plant.

Interest costs

As of February 1980, WPPSS had sold $1,360 million in bonds to finance construction of WNP-4 and WNP-5. The utilities sponsoring the two plants are obligated to make interest payments of about $92 million annually from 1980 through 1988, and interest and principal payments of about $108 million annually thereafter through 2018.

ANTICIPATED ENERGY CONTRIBUTIONS FROM CONSERVATION AND RENEWABLE SOURCES

Under moderate government and utility policies, a program of investments in cost-effective conservation and renewable energies could provide enough average energy by 1990 to equal the anticipated contributions of WNP-4 and WNP-5. Such investments in conservation and renewable resources could produce energy for 5 years (1981-85) before the first nuclear power is generated, but WNP-4 and WNP-5 would likely provide more total energy between 1987

and 1989. The peak energy provided by WNP-4 and WNP-5 would likely be about 7 percent more in 1990--and as much as 20 percent more in 1987-89--than conservation and renewable sources could provide. (See fig. 1.)

A comprehensive but moderate approach

To estimate what amounts of electricity might be saved or generated through the investment of capital transferred from WNP-4 and WNP-5, we used the intermediate policy set from our 1978 report to the Congress. 1/

The objective of this policy set is to bring about adoption of all conservation and renewable energy sources that can meet electricity demands with less cost than conventional powerplants. The thrust is toward removing impediments that deter utilities and their customers from investing in conservation and renewable energy systems. This would involve public information programs to extend the understanding of these sources, and a comprehensive revision of regulations, such as building codes, that either inhibit or give insufficient consideration to conservation and renewable energy sources.

The intermediate policy set also includes incentives such as tax credits, loans, grants, or direct utility investment for conservation and renewable energy sources. The "incentives" are necessary mostly because the conventional system of pricing electricity means that customers are faced with the full cost of conservation, if they adopt it, but are only required to pay a fraction of the true cost of new electricity generation if they decide to use power rather than conserve it. This policy set assumes that average cost pricing would be continued, with customers paying less than the true costs of new power supplies. Large industrial customers would also be provided inexpensive power priced at average costs, but only in quantities sufficient for an energy-efficient operation. For power demands exceeding these levels, actual costs of new power would be charged.

1/"Region at the Crossroads--The Pacific Northwest Searches for New Sources of Electric Energy" (EMD-78-76, Aug. 10, 1978).

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Investment requirements for this program are computed on the assumption that utilities or government units would finance investments in the principal conservation and renewable energy sources. In the industrial sector, it is assumed that utilities or government units would finance only that portion of plant modernization or generation which is not offset by savings in labor, maintenance, and power bills.

Projections

Our analysis shows that investments in conservation and renewable energies during the period 1980 through 1989, would produce an average of 1,800 MW by 1990, when WNP-4 and WNP-5 are scheduled for sustained commercial production of about 1,700 MW. Peak energy available from conservation and renewable energy sources in 1990 would only total about 2,300 MW compared to peak nuclear generation of about 2,500 MW. Tables 1 and 2 (see pp. 11 and 12) summarize for 1985 and 1990, respectively, the potential energy contributions projected for the residential, commercial, and industrial sectors, as well as the estimated capital investments required to secure those contributions. Table 3 (pp. 13 and 14) presents material suporting these projections.

Comparison of anticipated energy contributions

In figure 1 (p. 16), our projections are presented in graphic form, and are compared to the nuclear energy contributions planned for WNP-4 and WNP-5. Figure 1 shows that conservation and renewable sources could begin providing energy in 1981, 5 years before any planned contribution from the nuclear plants. After WNP-4 comes on-line in 1986, this advantage is apparently lost, and from 1987 to 1989 nuclear power should provide more energy and peaking capacity. In 1990, the first year we anticipate that both WNP-4 and WNP-5 will be fully operational, average energy saved or produced by conservation and renewables is slightly more than nuclear energy production, but the peaking contributions are still about 7 percent less.

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TABLE 1

Projected Energy Contributions
From Conservation and Renewable Sources
by 1985

Economic sectors	Energy contributions (average Mw)	Energy contributions (peak Mw)	Investments required (million 1980 dollars)
RESIDENTIAL			
Retrofit ceiling insulation	43	172	$ 60
Other retrofit	49	196	514
Efficient appliances	382	382	177
Heat pump	5	20	18
Passive solar	14	--	26
Solar hot water	4	--	39
Subtotals, residential	497	770	834
COMMERCIAL			
Retrofit	62	124	78
Total energy systems	10	20	23
Subtotals, commercial	72	144	101
INDUSTRIAL			
Aluminum plants	200	200	a/ 338
Cogeneration	80	80	160
Municipal waste	70	90	94
Subtotals, industrial	350	370	592
Total contributions and investments	919	1,284	1,527

a/Assumes that utilities or government units will finance one-quarter of plant modernization costs.

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TABLE 2

Projected Energy Contributions From Conservation and Renewable Sources by 1990

Economic sectors	Energy contributions (average Mw)	Energy contributions (peak Mw)	Investments required (million 1980 dollars)
RESIDENTIAL			
Retrofit ceiling insulation	41	165	$ 60
Other retrofit	47	187	514
Efficient appliances	591	591	266
Heat pump	11	44	38
Passive solar	34	--	63
Solar hot water	12	--	98
Subtotals, residential	736	987	1,039
COMMERCIAL			
Retrofit	186	372	232
Total energy systems	20	40	46
Subtotals, commercial	206	412	278
INDUSTRIAL			
Aluminum plants	500	500	a/ 422
Cogeneration	240	240	240
Municipal waste	140	180	188
Subtotals, industrial	880	920	850
Total contributions and investments	1,822	2,319	$2,167

a/Assumes that utilities or government units will finance one-quarter of plant modernization costs.

TABLE 3

Conservation and Renewable Energy Programs

Residential sector

Item description and useful life (in years)				Percent adopt	Total cost (millions in 1980 dollars)
Temperature reduction, time thermostat:					
Retrofit ceiling insulation:					
Uninsulated units (20)	81,000	units	@ $ 435 each	100	$ 35
Partially insulated (30)	480,000	" "	@ 220 " "	25	26
Retrofit other:					
Uninsulated walls (30)	324,000	" "	@ 660 " "	50	107
Uninsulated floors (30)	324,000	" "	@ 530 " "	50	86
Single pane windows and doors (15)	486,000	" "	@ 1,200 " "	50	248
New weatherstrip (5)	810,000	" "	@ 180 " "	50	73
Heating units (new residences) 1980-2000:					
Heat pumps (15)	360,000	new elect. heat	@ 2,100 " "	5	38
Solar hot water (20)	360,000	" " "	@ 2,700 " "	10	97
Passive solar (30)	360,000	" " "	@ 700 " "	25	63
Appliances:					
Water heater wrap existing (15)	2,500,000	elect. water heaters	@ 68 " "	100	170
New energy saving water heaters (15)	270,000	" " "	@ 90 extra	100	24
Energy-saving refrigerators (15)	1,750,000	new and replacement	@ 20 extra	100	35
Other household uses	2,700,000		@ 10	100	27
Sector totals					1,029

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Item description and useful life (in years)	Commercial sector	Percent adopt	Total cost (millions in 1980 dollars)
Retrofit/weatherizing	Potential 25% savings on 2500 Mw average commercial building use $42.00/1 million Btu's/yr. saved	30	$ 235
Total energy systems (20)	275 x 1,000,000 sq. ft. of new commercial construction @ $3.42 per sq. ft. (extra)	5	47
Sector totals			282
	Industrial sector		
Modernized aluminum (20) 1/	1.1 million-ton capacity at $384/ton subsidy	100	422
*Cogeneration 2/	Add cogeneration to industrial steam plants potential, 1054 MW	57	240
*Municipal waste steam generation 3/	Potential 340 MW capacity at $944/kW	59	188
Sector totals			850
Total all sectors			2,161

*See footnotes on page 15.

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Footnotes

1/Aluminum industry savings assume that seven older smelters would be modernized to the efficiency standard of new or recently modernized plants. This would save about 25 percent of the electricity used in those plants. Costs of fully rebuilding a plant are estimated at $1,536/ton of capacity, but most of that will be recovered through reduced labor, maintenance, and power costs. One-fourth of the cost of modernizing 1.1 million tons of capacity is assigned to the conservation program.

2/Cogeneration in industrial plants assumes that 1,054 MW of potential capacity, identified in the Rocket Research Study, would be developed with utilities or the government investing an average of $400/MW and arranging to integrate cogeneration units into the grid. Average plant factor is 40 percent and contribution to peak is estimated at 40 percent of rated capacity.

3/Municipal waste from urban areas is estimated in the Northwest Energy Policy Project's Energy Supply--Unconventional Sources to total 2.2 million tons by 1980. Potential power yield from this amount is 190 MW, growing to 240 MW in 2000. Fairly rapid construction is feasible since the plants are relatively small. We assumed one-third developed by 1985 and two-thirds by 1990 at an average cost of $944/MW at 1980 prices.

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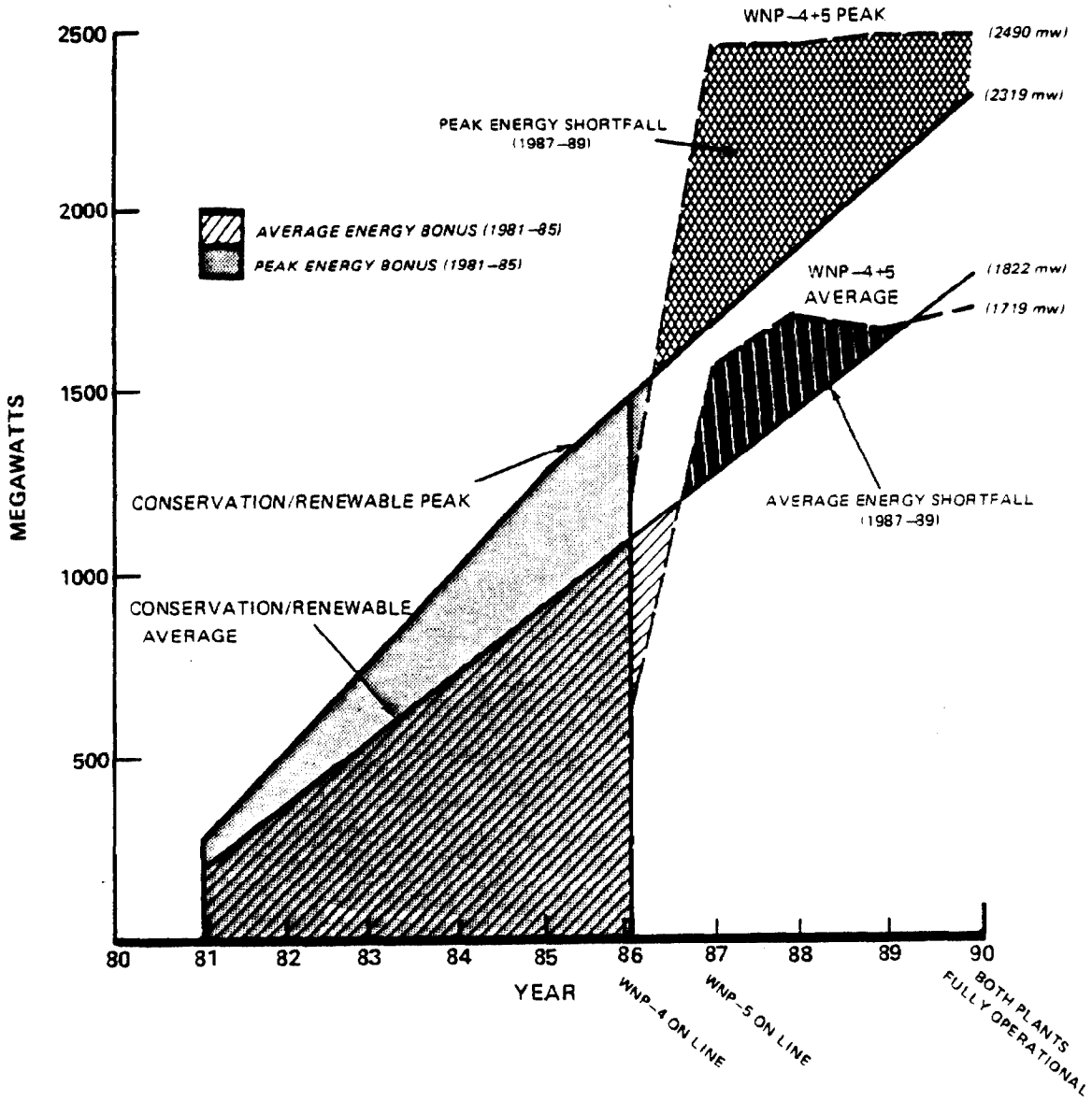
Figure 1
COMPARATIVE ENERGY CONTRIBUTIONS
1981–1990



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Comparison of investment costs

The investments in conservation and renewable energy sources projected would cost about $2.2 billion in 1980 dollars. Inflation (at 8 percent) and interest costs (at 8.75 percent) would raise this investment to $3.5 billion by early 1987, when construction of WNP-4 and WNP-5 is to be completed. It appears, therefore, that conservation and renewable alternatives would cost the region about $3.5 billion of the $4.0 billion in construction funds remaining after termination of WNP-4 and WNP-5. In addition, the energy supplied by conservation and renewable sources before WNP-4 and WNP-5 begin production would have considerable value. At 20 mills/kWh, the average energy contribution could save the region about $0.6 billion in energy and interest costs. This saving would, in effect, reduce the cost of the conservation and renewable alternative to about $2.9 billion--or $1.1 billion less than the $4.0 billion remaining after termination of WNP-4 and WNP-5. These projections indicate that, after implementation of the conservation and renewable alternative, between $0.5 billion and $1.1 billion of the construction funds diverted from WNP-4 and WNP-5 would remain unexpended and available for other purposes.

BARRIERS TO IMPLEMENTATION

We did not attempt to analyze the barriers which could delay or preclude such a significant, albeit hypothetical, shift in regional energy policies--i.e., the termination of two large nuclear construction projects and diversion of $4.0 billion in construction funds to less conventional alternatives.

Before such a major policy shift could be implemented many related actions would need to be taken. For example, utilities and agencies of government would need to:

--Demonstrate to the financial community that investments in conservation and renewable energies are as credit worthy as investments in conventional powerplants.

--Establish economic and regulatory incentives to encourage industrial investments in cogeneration and more energy-efficient process equipment.

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--Develop a comprehensive regional conservation program, complete with environmental impact statements, energy audits, public involvement and outreach activities, conservation loans or subsidies, and consumer protection activities.

--Establish effective systems to monitor the energy contributions realized from conservation and renewable sources, and thereby assure that such contributions meet regional power needs and peaking requirements.

These and other actions would be needed to overcome existing barriers, and to initiate such a policy shift with confidence of success.

Although our analysis supports a conclusion that conservation and renewable energy programs are economically preferable, it is important to recognize that such programs are somewhat embryonic and are not subject to centralized and direct control. If this policy shift were made, individual decisions and actions by thousands of potential adopters of conservation measures would replace the central administrative control of WPPSS. Uncertainty exists as to how the region could assure that sufficient conservation savings and renewable supplies would be realized in time to replace the planned contributions of WNP-4 and WNP-5. In fact, special monitoring systems would be needed to measure, on a continuing basis, the rate at which conservation measures are being adopted, and the energy savings resulting from such measures.