UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

PUGET SOUND POWER & LIGHT CO., et al.	)	
	)	Nos. STN 50-522, 50-523
(Skagit/Hanford Nuclear Project, Units 1 and 2)	)	(47 Fed. Reg. 5554 (1982))

AMENDED PETITION OF THE NATURAL RESOURCES DEFENSE COUNCIL, INC. FOR LEAVE TO INTERVENE

INTRODUCTION

1. Pursuant to 10 C.F.R. § 2.714(a)(3), the Natural Resources Defense Council, Inc. (NRDC) submits this amended petition for leave to intervene in the above-captioned proceeding. This document supplements the petition for leave to intervene filed by NRDC on March 5, 1982.

2. On behalf of itself and its approximately 1500 individual members residing in the states of Washington, Oregon, Idaho, and Montana (including those members identified specifically in item 11 below), NRDC hereby petitions the Nuclear Regulatory Commission (NRC) for leave to intervene in proceedings for the issuance of construction permits in the above-captioned matter, pursuant to Section 2.714 of the NRC's Rules of Practice and Procedure, 10 C.F.R. § 2.714, and the Commission's Notice of February 5, 1982 (47 Fed. Reg. 5554).

3. NRDC is a nonprofit environmental organization incorporated under the laws of New York. For reasons more fully set out below, NRDC is entitled to intervene to assert the interests of itself and its members in the NRC's decision whether construction permits for the Skagit/Hanford Nuclear Project should be issued, denied, or appropriately conditioned to protect environmental values.

NATURE OF PETITIONER'S RIGHT TO BE MADE A PARTY

4. Section 189(a) of the Atomic Energy Act, 42 U.S.C. § 2239(a), requires that the Commission admit as a party "any person whose interest may be affected by the proceeding." NRDC is entitled to intervene in order to protect its own interests as an organization and the interests of its Northwest members. These interests, and their relationship to this proceeding, are enumerated in items 6-11 below.

5. In the alternative, for the reasons enumerated in items 15-18 below, NRDC should be permitted to intervene as a matter of the Commission's discretion. Cf. Portland General Electric Co. (Pebble Springs Nuclear Plant, Units 1 & 2), 4 NRC 610 (1976); Nuclear Engineering Co. (Sheffield Illinois Low-Level Radioactive Waste Disposal Site), 7 NRC 737 (1978).

PETITIONER'S INTEREST IN THE PROCEEDING

6. NRDC has a nationwide membership composed of scientists, lawyers, educators, and other citizens dedicated to the defense and preservation of the human environment and the

natural resources of the United States. Approximately 1500 of NRDC's members reside in Oregon, Washington, Idaho, and Montana.

7. NRDC has maintained a Northwest Energy Project since 1974. One of the Project's primary goals is preventing unnecessary construction of coal and nuclear power plants by promoting the development of cost-effective, environmentally preferable alternatives. NRDC has developed extensive expertise in, among other things, projecting regional electricity needs and the potential for implementation of conservation measures and other environmentally preferable alternatives to nuclear power plants.

8. NRDC seeks leave to intervene on its own behalf and on behalf of its members who reside in the Pacific Northwest. NRDC's members live, work, travel, consume electricity, and enjoy recreational activities in areas that will be directly and indirectly affected by the construction of Skagit/Hanford Units 1 and 2. To name only a few such effects, members will be harmed by

-- increased fish mortality and decreased recreational safety on the Columbia River due to expanded use of hydro generators for peaking power and related fluctuations in river flows following construction of the Skagit/Hanford Units, affecting adversely all NRDC members who use the Columbia River for fishing,

boating, and other recreational purposes;*

-- risks of catastrophic accidents during plant operation and disposal of radioactive wastes generated by the facilities, affecting adversely all NRDC members who live or travel within the geographical zone that might be damaged by accidental release of fission products;

-- thermal and chemical pollution of the Columbia River by the Skagit/Hanford Units;

-- increased regional electricity costs, which could have been avoided or reduced by adoption of environmentally preferable alternatives, and a diversion of billions of dollars of capital to the Skagit/Hanford project that could otherwise be invested, by utilities serving NRDC members, in less environmentally destructive conservation measures and generating resources.

POSSIBLE EFFECT OF ORDER ON PETITIONER'S INTEREST

9. A decision by the NRC to grant construction permits for Skagit/Hanford Units 1 and 2 would materially increase the likelihood that the plants ultimately will be built and

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*These impacts, the result of "a transition from using hydroelectric energy as the [Northwest's] baseload to a thermal base with hydro providing the peaking," are described at greater length in Bonneville Power Administration, The Role of the Bonneville Power Administration in the Pacific Northwest Power Supply System (1980), at IV-9, IV-20 (fish destruction) and IV-26 (recreational impacts resulting from "greater and more rapid fluctuations in flows and reservoir levels").

operated, resulting in the adverse effects on interests of NRDC and its members that are enumerated in item 8 above.

10. Such a decision by the NRC also would materially increase the likelihood that the costs of Skagit/Hanford Units 1 and 2 would be assumed by the Bonneville Power Administration pursuant to section 6(c) of the Pacific Northwest Electric Power Planning and Conservation Act, Pub. L. No. 96-501. Thus, all NRDC members whose utilities purchase electricity from the Bonneville Power Administration now and in the future share an interest in preventing diversion of BPA funds to Skagit/Hanford that might otherwise have been used to help their utilities develop environmentally preferable ways to meet consumers' electrical energy needs.

11. For the reasons enumerated in items 8-10 above, the following individual NRDC members residing in Washington and Oregon have specifically authorized NRDC to intervene on their behalf and request a hearing on the issuance of construction permits for the Skagit/Hanford Nuclear Project:

Thomas Brucker
9111 Southeast 44th Street
Mercer Island WA 98040

Don Waggoner
2715 S.W. Glen Eagles Road
Lake Oswego OR 97034

Peter Willing
3843 26th Avenue W.
Seattle WA 98199

Georgia Yuan
S.E. 435 Gladstone Street
Pullman WA 99163

Larry L. Caldwell
1449 Thayer Drive
Richland WA 99352

Affidavits were filed with the Commission on March 24, 1982, enumerating the environmental and economic interests of four of the above-listed members (Brucker, Waggoner, Willing, and Yuan), and authorizing NRDC to represent those interests. A fifth affidavit, executed by Mr. Caldwell, is attached to this Petition. Authorization for NRDC intervention also has been obtained from the Legal Committee of the Board of Trustees of NRDC and the Senior Staff of NRDC.

SUBJECT-MATTER AS TO WHICH PETITIONER WISHES TO INTERVENE

12. The National Environmental Policy Act (NEPA) and the regulations of the Nuclear Regulatory Commission require that, prior to issuance of construction permits for the Skagit/ Hanford Units, the Commission must "conside[r] and balanc[e] the environmental and other effects of the facility and the alternatives available for reducing or avoiding adverse environmental and other effects, as well as the environmental, economic, technical and other benefits of the facility." See 10 C.F.R. § 51.23(c); 42 U.S.C. § 4332(2)(C). The Commission must, in particular, address "conservation potential of various alternatives and mitigation measures." 40 C.F.R. § 1502.16(e), 10 C.F.R. § 51.23(d).

13. NRDC will present evidence regarding the lack of need for the electrical energy generation anticipated from Skagit/Hanford Units 1 and 2. This presentation will include evidence on the availability of alternative, environmentally and economically preferable, measures for meeting the needs those plants are designed to serve. NRDC will sponsor expert testimony on all these issues by, among others, Dr. David Goldstein, whose qualifications are summarized in item 18 below.

14. To the extent that Applicants in this proceeding contend that the Skagit/Hanford Nuclear Project is the most cost-effective and environmentally acceptable way to meet electrical energy needs in the Northwest region, NRDC will cross-examine Applicants' witnesses and present evidence to rebut applicant's contentions.

PETITIONER'S QUALIFICATIONS FOR INTERVENTION AS A MATTER OF THE COMMISSION'S DISCRETION

15. The NRC may allow wider participation in its proceedings than is required by statute, and intervention may be granted as a matter of discretion "where petitioners show significant ability to contribute on substantial issues of law or fact which will not otherwise be properly raised or presented, set forth these matters with suitable specificity to allow evaluation, and demonstrate their importance and immediacy, justifying the time necessary to consider them." Portland General Electric Co. (Pebble Springs Nuclear Plant, Units 1 and 2), 4 NRC 610, 614, 617 (1976).

16. NRDC's expertise in analyzing and developing projections of regional electricity needs and conservation potentials renders the organization both willing and able to make a valuable contribution to the full airing of issues which the Licensing Board must consider and resolve in this proceeding. This expertise is reflected in Exhibit 1 to this Petition, a partial list of recent testimony, filings, and publications by the staff of NRDC's Northwest Energy Project.

17. The importance of the NEPA issues identified in items 12, 13, and 14 above is attested both by the authorities therein cited and by recent developments in Northwest electrical energy planning. Plummetting electrical energy demand forecasts, which receive inadequate or no treatment in Applicants' Application for Site Certification/Environmental Report, recently helped force termination of two partially-completed nuclear power plants in Washington State, one of which is located only a few miles from the proposed Skagit/Hanford Nuclear Project. NRDC's participation in this proceeding will draw extensively on forecasts that Applicants' submissions have largely ignored, including (1) comprehensive studies of Northwest electricity needs prepared by NRDC staff in 1980 and 1982, and (2) a 20-year forecast of regional electricity demand commissioned by the Washington legislature in 1981. NRDC will also assist the Commission in interpreting the Bonneville Power Administration's first region-wide

electricity forecast, released in draft form on March 30, 1982.* Excerpts from the NRDC and Washington State studies are annexed as Exhibits 2, 3, and 4 to this Petition. Singly and in combination, they reveal serious flaws and omissions in the forecasting and environmental analyses submitted by Applicants in support of the Skagit/Hanford Nuclear Project.

18. NRDC's contributions on these and related issues will include expert testimony by Dr. David B. Goldstein, the senior scientist on the staff of the organization's Western Office. Dr. Goldstein's extensive qualifications include:

-- Ph.D., Physics, 1978 (University of California, Berkeley,);

-- Member, Bonneville Power Administration's Expert Panel on Forecasting, 1982;

-- Member, California Energy Commission's Nonresidential Building Standards Professional Advisory Group, 1981-1982;

- Member, California Building Standards Commission's Energy Advisory Panel, 1981;

-- Consultant to NRDC in preparation of 1980 study of Northwest energy needs commissioned by U.S. Department of Energy (excerpt attached),

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*Bonneville Power Administration, Division of Power Requirements, Bonneville Power Administration Forecasts of Electricity Consumption in the Pacific Northwest (1982).

-- Coauthor of NRDC's 1982 "Model Conservation and Electric Power Plan for the Pacific Northwest" (excerpt attached);

-- Invited to testify on Northwest forecasting issues before the Washington State Senate's Energy and Utilities Committee, the Oregon House of Representatives' Committee on Environment and Energy, and the Northwest Power Planning Council.

A copy of Dr. Goldstein's resume is annexed as Exhibit 5 to this Petition.

CONCLUSION

19. NRDC is entitled to intervene in this proceeding as a matter of right and, in the alternative, as a matter of the NRC's discretion. For both of these reasons, NRDC requests the NRC to grant this amended petition for leave to intervene.

Dated this 5th day of April, 1982.

Respectfully submitted,

Ralph Cavanagh

RALPH CAVANAGH
Attorney for Natural Resources
Defense Council, Inc.
25 Kearny Street
San Francisco CA 94108
415/421-6561

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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STATE OF CALIFORNIA)
)
City and County of San Francisco)

AFFIDAVIT OF COUNSEL FOR PETITIONER, RALPH CAVANAGH

I, Ralph Cavanagh, being first duly sworn, depose and say:

1. I am an attorney for petitioner, the Natural Resources Defense Council, Inc. (NRDC);

2. I am authorized to submit the foregoing Amended Petition of the Natural Resources Defense Council, Inc. for Leave to Intervene;

3. I have read the attached Petition and I know its contents. To the best of my knowledge, information, and belief, all statements therein are true and correct.

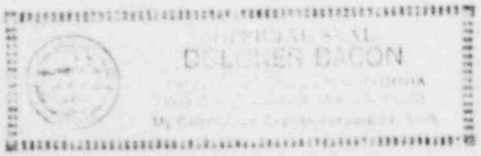
Ralph Cavanagh

RALPH CAVANAGH, Attorney
Natural Resources Defense
Council, Inc.
25 Kearny Street
San Francisco CA 94108

Subscribed and sworn to
before me this 5 day of
April, 1982.

Dolores Bacon

NOTARY PUBLIC, STATE OF CALIFORNIA,
COUNTY OF SAN FRANCISCO



UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

PUGET SOUND POWER & LIGHT CO., et al.	)	Nos. STN 50-552, 50-523
(Skagit/Hanford Nuclear Project, Units 1 and 2)	)	(47 Fed. Reg. 5554 (1982))

AFFIDAVIT OF LARRY L. CALDWELL

1. My name is Larry L. Caldwell. I live at 1449 Thayer Drive, Richland, Wa. 99352, which is less than 20 air miles from the proposed Skagit/Hanford Nuclear Project.

2. I have lived at this address for 5 years, and in the Richland area for 30 years.

3. I am a member of the Natural Resources Defense Council, Inc. (NRDC). I share NRDC's goal of ensuring that environmentally and economically preferable alternatives are addressed fully in decisions whether to build new nuclear power plants in the Pacific Northwest.

4. My residence is within the geographical zone that might be affected by an accidental release of fission products from the proposed Skagit/Hanford Nuclear Project. I also engage frequently in leisure pursuits, recreational activities, and travel within that zone. As a result, I

have health, safety, and recreational interests that would be affected adversely by construction of the Skagit/Hanford Project.

5. I authorize NRDC to represent my interests in construction licensing hearings before the Nuclear Regulatory Commission concerning the Skagit/Hanford Nuclear Project and in related proceedings.

Signature

Sworn and subscribed to before me this 29th day of March, 1982.

Notary Public

My commission expires

August 1, 1983

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PUGET SOUND POWER & LIGHT CO., et al.	)	Nos. STN 50-522, 50-523
	)	
(Skagit/Hanford Nuclear Project, Units 1 and 2)	)	(47 Fed. Reg. 5554 (1982))
	)	

LIST OF EXHIBITS TO AMENDED PETITION
OF THE NATURAL RESOURCES DEFENSE COUNCIL, INC.
FOR LEAVE TO INTERVENE

1. Publications and Testimony Prepared for the Northwest Energy Project of the Natural Resources Defense Council (1979-1982)

2. Excerpt from: Natural Resources Defense Council, Choosing an Electrical Energy Future for the Pacific Northwest: An Alternative Scenario (U.S. Department of Energy, 1980)

3. Excerpt from: Natural Resources Defense Council, A Model Electric Power and Conservation Plan for the Pacific Northwest (1982)

4. Excerpt from: Draft Final Report: Independent Review of WNP-4 and 5 (Washington Energy Research Center/Washington State University)

5. Resume of David B. Goldstein, Senior Project Scientist, Natural Resources Defense Council

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	)	(47 Fed. Reg. 5554 (1982))
(Skagit/Hanford Nuclear Project, Units 1 and 2)	)	
	)	

PROOF OF SERVICE

I hereby certify that I have this day served upon the persons listed below the Amended Petition of the Natural Resources Defense Council, Inc. for Leave to Intervene in the above-captioned proceeding, and all supporting Exhibits to that Amended Petition, by depositing copies thereof in the United States mail on April 6, 1982 with proper postage affixed for first class mail:

Richard L. Black, Esq.
U.S. Nuclear Regulatory Commission
Office of the Executive Legal Director
Washington DC 20555

F. Theodore Thomsen
Perkins, Coie, Stone, Olsen & Williams
1900 Washington Building
Seattle WA 98101

Dated at San Francisco this 6th day of April, 1982.

Ralph Cavanagh

RALPH CAVANAGH
Natural Resources Defense
Council, Inc.
25 Kearny Street
San Francisco CA 94108

Publications and Testimony Prepared for the Northwest Energy Project

R. Beers & R. Cavanagh, Statement of the Natural Resources Defense Council, Inc. on S. 885 and H.R. 3508, "The Pacific Northwest Electric Power Planning and Conservation Act" (Sept. 27, 1979) (filed with House Committee on Interior and Insular Affairs)

R. Beers, R. Cavanagh, & T. Lash, Comments of the Natural Resources Defense Council, Inc. on the Bonneville Power Administration's Notice of Intent to Prepare a Draft Environmental Impact Statement on the Allocation of Firm Electric Energy and System Reserve Energy (Dec. 14, 1980)

Papers prepared by R. Cavanagh for circulation prior to NRDC's Conference on the Electrical Energy Future of the Pacific Northwest (March 1, 1980):

1. "NRDC's Alternative Scenario for the Electrical Energy Future of the Pacific Northwest"
2. "Review of Ongoing Programs Sponsored by Governments and Utilities"
3. "BPA's Proposed Allocation Plan: An Opportunity to Promote Conservation and Renewable Resources"
4. "The Pacific Northwest Electric Power Planning and Conservation Act"
5. "Development of Pacific Northwest Electric Energy Policies: Upcoming Opportunities for Citizen Involvement"

R. Cavanagh, Comments of the Natural Resources Defense Council, Inc. on the Bonneville Power Administration's Revised Draft Environmental Impact Statement "The Role of the Bonneville Power Administration in the Pacific Northwest Power Supply System" (June 12, 1980)

R. Cavanagh, "Perspectives on Energy Policy Direction for the 80's" (speech before the Western Conference of Public Service Commissions) (June 17, 1980)

R. Cavanagh, "The Pacific Northwest is Praying for Rain -- A Cautionary Tale for Utility Executives," 2 Amicus Journal 31 (July 1980)

D. Goldstein, Projecting Regional Potentials for Cost-Effective Energy Conservation and Renewable Resource Applications: A Feasibility Study (July 1980)

R. Cavanagh, L. Mott, R. Beers, & T. Lash, Choosing an Electrical Energy Future for the Pacific Northwest -- An Alternative Scenario (U.S. Department of Energy, August 1980)

D. Goldstein, "A Cost-Effective Electrical Energy Conservation Program for the Puget Sound Power and Light Company," Testimony Before the Utilities and Transportation Commission of the State of Washington (September 12, 1980)

R. Cavanagh & D. Goldstein, Comments of the Natural Resources Defense Council, Inc., on the Department of Energy's Proposed Energy Efficiency Standards for Consumer Products (September 12, 1980)

R. Cavanagh & D. Goldstein, Comments of the Natural Resources Defense Council, Inc. on the Bonneville Power Administration's Evaluation of the NRDC "Alternative Scenario" for the Electrical Energy Future of the Pacific Northwest (September 29, 1980)

R. Cavanagh & D. Goldstein, Testimony of the Natural Resources Defense Council, Inc. before the Washington State Senate Energy and Utilities Committee, "Differing Views of the Northwest's Electrical Energy Future" (October 3, 1980)

R. Cavanagh, "The Pacific Northwest Electric Power Planning and Conservation [and Thermal Power Plant Relief] Act", 4 Univ. Puget Sound Law Review 27 (1980).

R. Cavanagh & B. Gardiner, Comments of the Natural Resources Defense Council, Inc., on the Bonneville Power Administration's Notice of Intent to Revise Wholesale Power Rates Which Will Become Effective July 1, 1981 (November 26, 1980)

R. Cavanagh, Comments of the Natural Resources Defense Council, Inc. on the Draft Report of the U.S. Department of Energy's Pacific Northwest Energy Task Force (December 18, 1980)

R. Cavanagh & D. Goldstein, Comments of the Natural Resources Defense Council, Inc. on the Bonneville Power Administration's Proposed Conservation Programs Under the Pacific Northwest Electric Power Planning and Conservation Act (January 19, 1981)

R. Cavanagh & M. Reis, Opportunities for Public Involvement in the Implementation of the Northwest Regional Power Act (February 17, 1981) (circulated to participants at NRDC's February 1981 Conference on the Implementation of the Northwest Power Act)

R. Cavanagh & D. Goldstein, Statement of the Natural Resources Defense Council, Inc. on Electrical Energy Demand Forecasting in the Pacific Northwest (February 20, 1981)(testimony submitted to the Committee on Environment & Energy of the Oregon House of Representatives)

R. Cavanagh & D. Goldstein, Preliminary Comments of the Natural Resources Defense Council, Inc. on a Cost-Effective Regional Energy Conservation Program for the Pacific Northwest (March 24, 1981).

R. Cavanagh, "BPA's Power Sales Contracts: Briefing Paper for Public Participants" (April 1981).

R. Cavanagh, "Stumbling Toward Utopia: The Implementation of the Pacific Northwest Electric Power Planning and Conservation Act" (May 1, 1981) (Speech before Pacific Northwest Regional Economic Conference.)

R. Cavanagh, Comments of the Natural Resources Defense Council, Inc. on the Negotiation of Power Sales Contracts Under the Pacific Northwest Electric Power Planning and Conservation Act (May 18, 1981).

R. Cavanagh & D. Goldstein, Testimony of the Natural Resources Defense Council, Inc. Before the Northwest Power Planning Council, "Energy Forecasting: Crystal Ball or Planning Tool?" (May 21, 1981).

R. Cavanagh & D. Goldstein, Comments of the Natural Resources Defense Council, Inc. on the Development of a Methodology for Quantifying Environmental Costs and Benefits (May 29, 1981).

R. Cavanagh, B. Black, & D. Goldstein, Statement of the Natural Resources Defense Council, Inc. in Response to Bonneville Power Administration's Notice of Intent to Develop Policy Guidelines and a Methodology to Compute Billing Credits (June 29, 1981).

R. Cavanagh & M. Shuman, Comments of the Natural Resources Defense Council, Inc. on Power Sales Contracts that Bonneville Power Administration Proposes to Offer Under the Pacific Northwest Electric Power Planning and Conservation Act (July 13, 1981).

R. Cavanagh, Testimony of Natural Resources Defense Council, Inc. Before the Northwest Power Planning Council, "Bonneville Power Administration's Proposed Long-Term Power Sales Contracts" (July 14, 1981).

R. Cavanagh & D. Goldstein, Projecting Northwest Electricity Needs After Conservation (September 14, 1981).

R. Cavanagh, Washington Public Power Supply System Units 4 and 5: The Inevitability of Termination (September 24, 1981).

R. Cavanagh, "The Regional Power Act: Problems and Remedies," September/October 1981 Solar Washington 20.

R. Cavanagh, D. Goldstein, & M. Shuman, Quantifying Environmental Costs and Benefits: A Methodology for Electric Power Planners (November 10, 1981).

R. Cavanagh & E. Temkin, Comments of the Natural Resources Defense Council, Inc. on the Draft Environmental Impact Statement for the Creston Generating Station (November 23, 1981).

R. Cavanagh, M. Gardner, D. Goldstein, & M. Shuman, A Model Conservation and Electric Power Plan for the Pacific Northwest (January 22, 1982).

ENERGY

DOE/CS/10045-T1

CHOOSING AN ELECTRICAL ENERGY FUTURE FOR THE PACIFIC NORTHWEST: AN ALTERNATIVE SCENARIO

By
Ralph C. Cavanagh
Lawrie Mott
J. Roger Beers
Terry L. Lash

August 1980

Work Performed Under Contract No. FG03-79CS10045

Natural Resources Defense Council, Inc.
San Francisco, California

U. S. DEPARTMENT OF ENERGY

DOE/EH/0104

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September 1, 1980

NRDC's "ALTERNATIVE SCENARIO" FOR THE PACIFIC NORTHWEST's ELECTRICAL ENERGY FUTURE: A SUMMARY

Under contract to the U.S. Department of Energy, the Natural Resources Defense Council (NRDC) has prepared an analysis of the Pacific Northwest's electrical energy needs over the 1980-1995 period. DOE asked NRDC to update, and significantly expand, a 1976 assessment of the untapped conservation potential in the region. The resulting report, entitled "Choosing an Electrical Energy Future for the Pacific Northwest: An Alternative Scenario," identifies readily achievable increases in the efficiency with which electricity is used in the residential, commercial, industrial, and agricultural sectors. The Scenario also assumes modest contributions, by 1995, from several new energy supply sources, including waste heat from industrial sources (cogeneration) and wind. The Scenario's recommendations are limited to measures that would cost the region less than additions of an equivalent amount of nuclear- and coal-fired generating capacity.

The Scenario concludes that, if its recommendations are adopted, no new coal or nuclear plants are needed through 1995 at least, except for three already under construction. The report does not describe a "no growth" future -- in projecting electricity needs, NRDC used bullish population and employment growth estimates that were prepared by the Bonneville Power Administration(BPA) and used

in conventional forecasts by the region's utilities. Indeed, the Scenario offers a way to increase economic growth. Implementation of the report's recommendations would meet the region's energy needs less expensively than investment in new power plants, freeing up additional funds for consumer expenditures and business investment.

The Scenario's principal assumptions, for the residential, commercial, industrial and agricultural sectors, circa 1995, are summarized below. As is evident, NRDC assumed neither significant lifestyle changes nor technological breakthroughs. All the recommended measures are well within the region's capabilities, and most are already being promoted in a variety of recently commenced programs.

I. Assumptions of the Scenario

A. Manufacturing Sector (44% of Pacific Northwest electricity consumption in 1975)

By 1995, industries throughout the region will install cogeneration facilities at sites identified in a recent BPA study; according to that study, cogenerated electricity at those sites would be competitive now with electricity from new coal or nuclear plants (cogeneration involves the generation of electricity with the waste heat produced by industrial processes). The aluminum industry, which consumes more than one-fifth of the Northwest's electricity, will cut 1975 energy requirements per pound of output 20% by 1985 and 40% by 1995 (four major plants in the region have already met the 1985 target). Other industries will reduce 1975 requirements per unit of output 10-17% by 1985 and 18-29% by 1995, in line with projections by a recent Lawrence Berkeley Laboratory study.

B. Commercial Sector (17% of Pacific Northwest electricity consumption in 1975)

As mercury vapor street lights wear out, they will be replaced

with more efficient high pressure sodium units. Existing buildings (circa 1976) still in use in 1995 will adopt highly cost-effective energy efficiency improvements identified in a 1976 study performed for the Bonneville Power Administration by the architectural/engineering firm of Skidmore, Owings and Merrill. These include lowering lighting levels outside work areas, reducing water heating temperatures, and reducing energy waste in ventilation systems. New buildings will comply with construction standards already in force throughout most of the Northwest. Modest contributions (cumulatively totalling a 5% reduction in energy needs after conservation in 1995) will be realized from waste heat recovery, solar water heating, and direct use of geothermal heat.

C. Residential Sector (35% of Pacific Northwest electricity consumption in 1975)

Over the next fifteen years, insulation will be installed in the ceilings, walls, and floors of 90% of existing (circa 1976) single family dwellings, and in 85% of multiple family units. Comparable percentages of existing homes will install storm windows and weather-stripping, and will set thermostats in winter at an average of 68° during the day and 62° at night. Financing mechanisms for spreading the costs of the installation measures are described in detail. New homes will be constructed to meet efficiency standards that are actually somewhat less stringent than those established in draft nationwide Building Energy Performance Standards (BEPS) recently released by the U.S. Department of Energy. By 1995, 20% of single-family homes will incorporate passive solar design features (e.g., south-facing windows, installation of stone, brick or water heat-storage masses); heat pumps will provide space heating in 25% of single-family homes and 7% of multiple family units; 20% of single family homes will have heat pump water heaters, and 8%

will have solar water heaters. Appliance and lighting efficiencies will increase from 1980-1995 at a rate conforming to predictions in a University of Texas study sponsored by the federal government.

D. Agricultural Sector (4% of Pacific Northwest electricity consumption in 1975)

Efficiency improvements in irrigation pumps, plus modest contributions from small wind machines and photovoltaic cells, will displace ten percent of the conventionally generated electric energy that would otherwise be needed for irrigation in 1995.

E. Conservatisms of the Scenario

The Scenario does not impose major demands on renewable energy technologies. Total wind-generated electricity by 1995 is assumed to total only about 75% of the potential identified in Oregon alone by the Governor's Wind Task Force. No wood-fired power plants or other biomass converters (e.g., wood stoves) are assumed. Photovoltaics are restricted to limited agricultural applications. Hydropower availability under the Scenario reflects only the "worst-case" drought year estimates used by the Bonneville Power Administration for planning purposes.

In addition, in order to ensure no overestimation of achievable savings, the Scenario anticipates continued heavy reliance on electric energy to meet space heating needs of residential and commercial buildings. For example, the Scenario assumes that 95 percent of the homes built between 1975 and 1995 will be electrically heated. Also, BPA population and employment projections are used, even though NRDC believes that they are inflated (the BPA estimates significantly exceed those of the U.S. Census Bureau).

Finally, demand from a new energy-intensive aluminum plant (Alumax) is incorporated in the NRDC projections, although that facility may never in fact be built.

II. Conclusions of the Scenario

Phased adoption of the Scenario's recommendations would result in electrical energy surpluses for the region in 1985 and 1995, even assuming completion of only three of the seven coal and nuclear plants now under construction. Plants that could be deferred indefinitely include the following:

Under construction: WPPSS Units 4 & 5 (nuclear/Washington); Colstrip Units 3 & 4 (coal/Montana).

Planned: Skagit units 1 & 2 (nuclear/Washington); Pebble Springs units 1 & 2 (nuclear/Oregon); plus the equivalent of at least eight nuclear units comparable in size to the four planned plants, which would be needed to eliminate a 1995 energy deficit currently projected in the conventional forecasts of the region's utilities.

III. Implementation of the Scenario's Recommendations

The Scenario incorporates a detailed agenda for all major institutions that play a role in shaping the Northwest's energy future: state and local governments, investor and consumer-owned utilities, and the Bonneville Power Administration. Recommended measures include revised rate structures, rehabilitation programs for residential and commercial buildings, more stringent building codes, efficiency-related restrictions on access to cheap BPA energy, new incentives for utilities and their customers to reduce energy waste, and financing mechanisms designed to minimize

the burden of the new programs on individual homeowners and businesses. The recently enacted Pacific Northwest Electric Power Planning and Conservation Act will help ease that transition through institutional mechanisms that are designed to promote the necessary regulatory and fiscal measures. The Scenario cannot be realized without significant political and financial effort; but the same is true of any solution to the region's current electrical energy dilemma. It bears recalling that the construction bill for five nuclear units now being built by the Washington Public Power Supply System is projected at $23.9 billion; new units are likely to cost still more, and cannot be available in time to deflect the shortages the region's utilities foresee in the 1980's. The alternative to heeding the Scenario's recommendations, if the utilities are right about the implications of "business as usual" demand growth, is a decade of learning to live with electricity rationing in the Pacific Northwest.

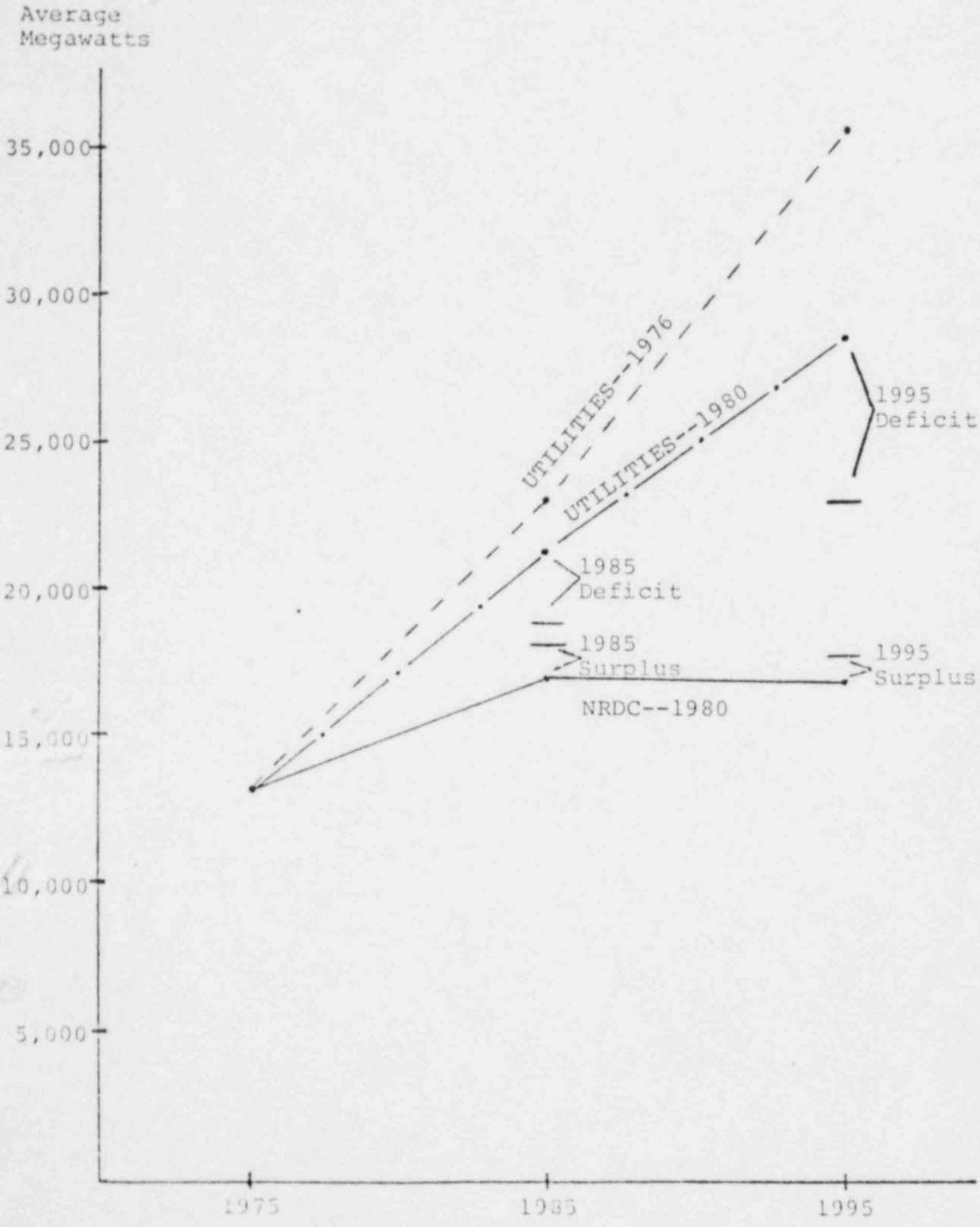
Obtaining Copies of the Scenario

Copies of the Scenario (320 pp., paperbound) are available at $18 each from:

U.S. Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

(Ask for Choosing an Electrical Energy Future for the Pacific Northwest: An Alternative Scenario, report no. DOE-CS-10045-T1.)

Electric Energy Supply and Demand in the Northwest:
Alternative Futures



- - - 1976 Forecast:Pacific Northwest Utilities Conference Committee

• ——— • 1980 Forecast:Pacific Northwest Utilities Conference Committee

——— 1980 Alternative Scenario: Natural Resources Defense Council

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D R A F T

A MODEL ELECTRIC POWER AND CONSERVATION PLAN FOR THE PACIFIC NORTHWEST

-- Summary --

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Distributed to the Board of Directors of the Northwest Conservation Act Coalition:

March 22, 1982

This Model Plan is a blueprint for securing a cheaper, cleaner, and less unsettled electrical energy future in the Pacific Northwest. Its provisions are governed by seven principles in the by-laws of the Northwest Conservation Act Coalition:

> Specifically, the Coalition will advocate that the implementation of the Pacific Northwest Electric Power Planning and Conservation Act:
>
> -- maximize the use of environmentally acceptable and cost-effective energy conservation and renewable resources;
>
> -- avoid unnecessary thermal power development;
>
> -- optimize regional economic development through the promotion of labor-intensive energy resources and local financing;
>
> -- assure that the financial assistance and local development provisions of the Act be made available on an accelerated basis to those most in need of such provisions -- the low income and elderly;
>
> -- promote equitable and resource-conservative rate structures;
>
> -- protect the natural environment, including the fish and wildlife resources, of the region;
>
> -- maximize the use and development of community-based resources and structures in implementation of the Act.

The sections that follow explain how the Model Plan advances each of these goals. The body of the plan consists of chapters and appendices that explain in detail the technical and policy justifications for the Plan's recommendations. The

bulk of that work was submitted to the Coalition on January 22, 1982, and is now being revised in response to comments. This summary describes the final product that is emerging from that process. It also suggests ways that citizens, Coalition members, and other groups can make the Model Plan work for them. Among other things, the Plan offers a way to control increasingly unmanageable residential utility bills; expand job opportunities, and stimulate a depressed regional economy; decentralize control of energy resources and increase local self-sufficiency; and convince local utilities to reject involvement in high-risk, high-cost efforts to build new coal and nuclear power plants.

A theme that dominates the Model Plan is the importance of public participation in regional energy planning, with particular reference to the implementation of the Pacific Northwest Electric Power Planning and Conservation Act ("the Regional Act"). True to that spirit, the Model Plan itself already has undergone extensive review and comment, and will continue to evolve as that process continues.

I. Maximizing the Use of Environmentally Acceptable and Cost-Effective Conservation and Renewable Resources

In passing the Regional Act, Congress made clear its view that no new coal or nuclear power plants should be built in the Pacific Northwest until all options had been exhausted for developing cost-effective conservation and renewable resources. The economic and environmental justifications for this decision are obvious. Nonetheless, the region's utilities are still attempting to secure constructon permits for eight new coal and nuclear ("thermal") plants in Oregon and Washington alone, while seeking to retain the option of completing two recently "terminated" plants, WPPSS Nuclear Units 4 and 5.

The Model Plan assembles an extensive -- although by no means exhaustive -- inventory of conservation and renewable energy measures that would cost less than, and eliminate the need for, new thermal plants. This analysis begins with an estimate of the economic and environmental costs of additional coal and nuclear generation. Discussion then turns to the nature and potential of less expensive conservation and renewable energy alternatives.

A. The Cost-Effectiveness Threshold: Economic and Environmental Costs of New Thermal Plants

The Model Plan develops separate estimates for the economic costs of new coal and nuclear plants, taking into account -- as the Regional Act requires -- construction and maintenance,

transmission, waste disposal, end-of-cycle costs, and fuel costs. The Plan then addresses environmental costs, and argues -- based on a detailed analysis of the different impacts of various measures -- that the quantifiable environmental damage (including destruction of human life and property) associated with coal and nuclear facilities is significantly greater than that accompanying wind machines, solar heating systems, and most conservation measures. Projected dollar costs of coal and nuclear facilities are based on Creston Unit 1, the next coal-fired plant scheduled for construction in the region, and WPPSS Units 4 and 5, the nuclear units now under construction that are furthest from completion. The results of the calculation are presented below.

	Creston Unit 1	WPPSS Units 4 & 5
Construction, maintenance waste disposal, end-of-cycle costs, fuel costs	7¢/kWh*	8.2¢/kWh
Line losses and transmission costs	1.4¢/kWh	1.6¢/kWh
Quantifiable environmental costs	2¢/kWh (minimum)	2¢/kWh (minimum)
Total	10.4¢/kWh	11.8¢/kWh

*Results of preliminary calculation; additional data will be needed to confirm this estimate.

These costs are given in 1982 dollars. Actual costs to consumers in future years would be higher, reflecting the impact of inflation.

These results mean, concretely, that the region is better off investing in measures that cost less than 10.4 cents/kWh than purchasing Creston or a comparable coal plant, and that this "cost-effectiveness threshold" increases to 11.8 cents/kWh if the alternative is WPPSS Units 4 and 5 or a comparable nuclear plant.* The Model Plan identifies many such alternatives, which are described below; what bears emphasis here is that the list should not be considered exclusive. Additions can and will be made continually by Coalition members and others.

B. Conservation and Renewable Energy Measures

The Model Plan's discussion of measures is intended to serve two purposes. First, it shows how to determine whether a particular conservation or renewable energy option is cost-effective. The same methods can be applied to any measure that is not discussed specifically in the Plan. Second, the Plan projects the likely impact of widespread adoption of

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*Under the Regional Act, conservation measures would have priority over these plants even if their costs per kilowatt-hour saved were up to 10% higher than the figures cited in the text.

certain readily available and well-understood measures, for which costs and savings could be documented and quantified.

Thus, the Plan assembles packages of cost-effective conservation and renewable energy measures for "retrofitting" existing homes, commercial buildings, industrial processes, and irrigation systems. It also identifies ways of ensuring that such measures are included in new buildings, processes, and systems. The next four subsections give details on the Plan's recommendations for each major category of electricity use.

These recommendations focus on buildings and equipment, because efficiency improvements in "hardware" are capable of producing reliable energy savings or production at no sacrifice in comfort or convenience. While "belt-tightening" of various kinds can also reduce energy needs, reliance on such actions in the Model Plan would imply undesirable levels of coercion or interference with consumer choices. Educational programs publicizing ways in which modest lifestyle changes can save energy are desirable, but the Model Plan does not rely on such changes. To that extent, the Model Plan's assumptions regarding future energy needs are conservatively high.

1. Residential Sector

Conservation measures are identified for all of the dozen or so major end uses that account for residential electricity consumption. Conservation "packages," for existing homes, include:

-- high levels of ceiling, floor, wall, and water heater insulation (generally up to R-49, R-38, R-11, and R-19 respectively), where structurally feasible;

-- leak-sealing to reduce air infiltration, accompanied by caulking and weatherstripping around doors and windows;

-- low-flow showerheads and plumbing;

-- substitution of high-efficiency heat pumps for resistance space heaters;

-- substitution of solar units or high-efficiency heat pumps for resistance water heaters;

-- reducing heat loss from windows through additional panes, thermal shutters, and surface treatments;

-- air-to-air heat exchangers, where needed to ensure high indoor air quality;

-- passive solar retrofits, including greenhouse or sunspace additions, Trombe wall conversions in existing masonry walls, and thermosiphon panels;

-- high efficiency electric appliances; and

-- high efficiency lights.

It should be noted here that nearly all these measures, raised in some instances to still higher levels, were included in a conservation proposal recently submitted to the Bonneville Power Administration by the Pacific Power and Light Company ("The Hood River Pilot Conservation Project," February 24, 1982).

The Model Plan recognizes that not all measures are appropriate or practicable candidates for installation in all existing homes. Thus, in projecting the impact of retrofits on regional energy needs, provision is made for the inability of

many houses to accommodate certain measures, due to structural or other constraints. Moreover, although conservation measures are discussed on a region-wide average basis, implementation strategies are tailored to the needs of individual houses and climate zones. Each house would be visited by an energy auditor, who would produce a list of conservation and renewable energy measures appropriate for that house. This list would generally include some or all of the measures described above, although in climates east of the Cascades still more extensive retrofits often will be cost-effective. In many cases, special family characteristics will lead auditors to broaden the scope of their recommendations. For example, a large family with above-average hot water needs might benefit by installing both a solar water heater and a heat pump back-up system, along with a super-low-flow showerhead.

We assume that retrofits will be phased in gradually, and that some households will decline to participate in all or part of the retrofit programs. Also, recognizing the uncertainties inherent in predictions of this kind, we identify a range of likely outcomes bounded by "high conservation" and "low conservation" scenarios. The table below illustrates this procedure, listing assumptions used to project residential needs for space heating in future years.

Percentage of Total "Achievable Savings"* From Space Heating Retrofits Realized Between 1980 and 2000

	Low Conservation Case	High Conservation Case
1985	9%	25%
1990	39%	70%
1995	54%	90%
2000	60%	95%

*The target for "achievable savings" is less than 100% of the technical potential for retrofits; it assumes that some households would refuse to participate in any program, and incorporates an allowance for weatherization already completed.

These and comparable assumptions provide specific targets for use by Coalition members and others in monitoring the progress of retrofit programs at the local level. On average, households participating in the Model Plan program should realize reductions in electricity needs of almost 50%; in some instances, savings will exceed 75%. The calculation of energy savings assumes higher thermostat settings in the aftermath of retrofits, as a conservatism. The average cost of residential sector savings is less than 3.5 cents per kilowatt-hour, in 1982 dollars.

For new houses, the Model Plan recommends enactment of building codes calculated to minimize the life-cycle cost of housing to occupants (purchase price plus utility bills). The proposed codes incorporate substantial flexibility in choice of

design, and allow trade-offs between different measures as long as an overall target for energy consumption per square foot is reached. This "energy budget" is based on a prototype house incorporating passive solar heating, a high-efficiency heat pump, and cost-minimizing insulation levels. Energy budgets will need to be adjusted to reflect differences in regional climate zones. The Model Plan uses the zone west of the Cascades to illustrate the methodology and results. Solar and conservation measures, working together, typically will reduce space heating needs per square foot of housing by 90% compared with current practice. The proposed building codes will encourage, in addition to measures discussed for existing homes, the widespread incorporation of passive solar design principles in new housing, and the accelerated development of solar-assisted heat pumps and ground water-based heat pumps. These codes would be preceded and supplemented by financial incentives based on the energy performance of new housing construction, which would override the increase in purchase prices and help more people qualify for home ownership.

The Model Plan also describes regulatory and incentive approaches for increasing the efficiency of appliances. The table below lists savings over current average consumption for the major appliance categories that will result if these recommendations are adopted.

Appliance Category	Savings Realized by New Appliances, Compared to Current Average Consumption, After 1985	
	Low Conservation Case	High Conservation Case
Refrigerators	46%	70% (after 1987)
Freezers	31%	73% (after 1987)
Cooking Equipment	10%	57% (after 1990)
Televisions	55%	55%
Central Air Conditioners	35%	51%
Room Air Conditioners	28%	56%
Clothes Dryers	10%	10%

2. Commercial Sector

In the commercial sector, where variation in building types and uses is much greater than that found in the residential sector, the Model Plan relies on a combined program of audits and incentives to reduce electricity needs of existing buildings. Generic measures recommended for retrofits include:

Lighting

-- use daylighting to replace artificial lighting

-- reduce excessive general or background lighting intensities

-- focus high illumination levels exclusively on work surfaces

-- use more efficient bulbs and fixtures

Cooling

-- lighting conservation will greatly reduce cooling loads

-- reduce solar heat gains by shading windows

-- use outside air for cooling whenever possible

Space Heating

-- increase insulation and seal leaks

-- install high-efficiency heat pumps

-- cut back ventilation to code standards

-- recover heat from ventilation air

Water Heating

-- increase heating efficiency by installing solar water heaters or heat pumps

-- reduce hot water needs by installing more efficient dishwashing appliances or low-flow plumbing units

Based on these and related measures, we assume that 15% savings can be achieved, on average, through measures that will pay for themselves in electricity bills in two years or less. That figure increases to 40%, again on average, if incentives are in place to induce building owners to take advantage of the full potential of cost-effective efficiency improvements. The table below gives the Model Plan's targets for implementation of the 15% and 40% retrofits, respectively.

Percentage of Buildings Retrofitted for 15% or 40% savings (based on surviving mid-1982 stock)

	Low Conservation Case		High Conservation Case	
	15% savings	40% savings	15% savings	40% savings
1985	6%	10%	7%	13%
1990	8%	40%	9%	51%
1995	14%	50%	10%	66%
2000	17%	52%	18%	67%

Savings realized through this program would cost ratepayers less than 40% as much as an equivalent amount of output from a new coal or nuclear power plant.

For new all-electric buildings, the Model Plan proposes building codes based on energy consumption targets averaging 6 kWh per square foot, a reduction of more than 50% from levels typical of current new construction. As in the residential sector, flexibility will be the cornerstone of the new codes. Lower lighting energy needs, which would result from systems emphasizing daylighting and automatic switch-offs, could be used to displace heavy insulation; higher lighting energy could be compensated by extra-efficient cooling systems and active solar units. Factor-of-three or greater variation in lighting and insulation levels would be within reach of designers willing to employ these or other innovative approaches. Passive solar design principles will play an increasingly important role, particularly in reducing energy needs for cooling through adroit use of thermal mass.

3. Industrial Sector

In the postwar era, declining real prices for electricity have been a mainstay of industrial growth in the Pacific Northwest. However, recent developments have eliminated the prospect of expansion fueled by cheap energy. The region is now experiencing reduced industrial electricity consumption through production cutbacks and business failures. Forecasters and utilities need to recognize what plant managers understand all too well: business as usual, in the form of a return to robust growth in electricity consumption, is not an option. The region's industries will cut back on electricity consumption -- either through curtailment or through efficiency improvements. The Model Plan seeks to promote the latter course, as the only viable route to expanded production and employment in the industrial sector.

The Model Plan's "high demand scenario" for industry assumes that growth in industrial production will soon resume at the high rates featured in conventional utility forecasts. The "low demand scenario" is based on somewhat lower -- and more plausible -- growth rates. Both scenarios assume that Northwest industries will take advantage of some -- but by no means all -- opportunities for increasing the efficiency of four major processes: mechanical drive, production of process heat, electrolysis, and lighting. Together, these broad end use categories account for almost all of the industrial sector's electricity consumption.

In addition to process efficiency improvements, we assume that Northwest industries will expand substantially their use of waste heat for the production of electricity, through cogeneration. The Model Plan derives its estimate of cogeneration potential from a recent regional survey commissioned by the Bonneville Power Administration (BPA).

The results of the analysis are highly encouraging. The industrial sector can maintain the highest twenty-year growth rates envisioned in the most optimistic current utility forecasts and still reduce total electricity needs by 20%, compared with 1980 levels. The measures needed to sustain these efficiency increases all pass the cost-effectiveness test outlined in the Model Plan.

4. Irrigation Sector

The Model Plan's irrigation sector analysis is based on a comprehensive study prepared recently for the Bonneville Power Administration.* That study identifies extensive cost-effective opportunities for improving the efficiency of water application and pumping, and describes likely changes in crop patterns and irrigation systems. It also provides a basis for projecting future increases in acreage under irrigation, which affect electricity consumption in two ways. Such increases

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*Norman Whittlesey et al., Demand for Electricity by Pacific Northwest Irrigated Agriculture (January 1982).

lead to withdrawals of additional river water, which otherwise could be used to generate electricity, and boost electricity consumption for irrigation itself.

The Model Plan presents "high" and "low" demand scenarios for irrigation, based on differing assumptions about implementation rates for conservation and growth in irrigated acreage.* Thanks to extensive efficiency improvements, electricity needs under even the high demand scenario constitute a 20% reduction from levels recorded in 1980; the low demand scenario produces a 35% reduction.

The expansions in irrigated acreage constitute our best estimate of "business as usual," if current subsidies and other policies encouraging new irrigation are retained. However, because these expansions would cost the hydropower system dearly (up to 197 average megawatts in the year 2000), the region may well want to adopt policies that would stem growth in irrigated acreage. We will return to this option in the next section.

C. The Regional Council's Model Conservation Standards

The Model Plan's recommendations for utility-financed incentives and regulatory reform should find a powerful ally in the Northwest Power Planning Council. The Regional Act charges

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*The two scenarios assume that, by 2000, lands under irrigation will expand by 729,000 acres and 600,500 acres, respectively.

the Council with developing "model conservation standards" by April of 1983; these standards must "include, but not be limited to, standards applicable to (a) new and existing structures, (b) utility, customer, and governmental conservation programs, and (c) other consumer actions for achieving conservation." Moreover, the standards "shall be designed to produce all power savings that are cost-effective for the region and economically feasible for consumers, taking into account financial assistance made available to consumers [by the Bonneville Power Administration]." Every regulation, code, and financial incentive program mentioned in the earlier part of this section is a strong candidate for Council adoption, pursuant to these statutory requirements. Jurisdictions that fail to adopt the Council's recommendations will face substantial rate penalties. In addition, the Council will be developing estimates regarding the amount of energy that BPA should plan to acquire from renewable energy resources.

Thus, the Model Plan provides Coalition members and others with a comprehensive set of proposals to put before the Council during a series of region-wide hearings that will precede enactment of model conservation standards. If the Council is receptive, its actions will help ensure that the benefits of the Model Plan are fully realized.

II. Avoiding Unnecessary Thermal Power Development

One of the Coalition's objectives in preparing the Model Plan was to determine whether new nuclear or coal-fired power plants would be required to meet the Northwest's energy needs over the next two decades, if vigorous efforts were made to increase the efficiency of electricity use and utilize cost-effective renewable energy resources. We conclude that no new thermal plants are needed; indeed, under the Model Plan, it would be possible to defer at least five plants that are now under construction.

This section summarizes our forecast of regional electricity needs through the year 2000 if the Model Plan is implemented. We have not attempted to fix a single demand "point" for future years; the forecast is expressed as a range, bounded by "high demand" and "low demand" estimates. The "high" scenario assumes somewhat smaller efficiency increases, less rapid "penetration" of conservation measures, and higher industrial growth than the "low" scenario. Regional requirements under the Model Plan are compared in Table 1 with those predicted in two other recent studies: the official forecast of the Pacific Northwest Utilities Conference Committee (PNUCC) and the Washington State University (WSU) forecast, which was commissioned by the state legislature in 1981. The "high demand" scenario in the Model Plan projects electricity needs for 1990 that are 12% and 32% below the

lowest WSU estimate and the PNUCC estimate, respectively. Comparable figures for the "low demand" scenario are 26% and 43%.

Table 2 compares energy requirements under the Model Plan's "high demand" forecast with energy resources available to the Northwest now and in the future. Generous margins of safety result, despite the following assumptions:

- o every year of the forecast is part of a "critical water" period in which droughts drastically reduce hydropower availability;
- o only three of the eight large-scale plants now under construction in the region are completed (Valmy Unit 2, Colstrip Unit 3, and WPPSS Unit 2);
- o the two nuclear plants in operation during most of the forecast period, Trojan and WPPSS Unit 2, produce only 56% of their rated capacity (PNUCC assumes 71% and 75% capacity factors, respectively)
- o Colstrip Unit 3 operates at only 64% of its rated capacity (PNUCC assumes a 75% capacity factor); and
- o PNUCC's assumptions regarding the future energy contribution of the hydropower system are reduced by 900 average megawatts to allow increased fish protection (with a net loss of 600 average megawatts, as explained in section VI below).

In other words, under the Model Plan, the following thermal plants could be deferred indefinitely without creating a danger of electricity shortages:

1. Colstrip Unit 4 (Coal, Montana)
2. Creston Unit 1 (Coal, Washington)
3. Creston Unit 2 (Coal, Washington)
4. Creston Unit 3 (Coal, Washington)
5. Creston Unit 4 (Coal, Washington)
6. WPPSS Unit 1 (Nuclear, Washington)
7. WPPSS Unit 3 (Nuclear, Washington)
8. WPPSS Unit 4 (Nuclear, Washington)
9. WPPSS Unit 5 (Nuclear, Washington)
10. Pebble Springs Unit 1 (Nuclear, Oregon)
11. Pebble Springs Unit 2 (Nuclear, Washington)
12. Skagit/Hanford Unit 1 (Nuclear, Washington)
13. Skagit/Hanford Unit 2 (Nuclear, Washington)

The Model Plan also identifies a number of options, preferable to thermal plants on both cost and reliability grounds, which provide an additional margin of safety in case demand growth outstrips expectations or the region must prematurely retire some of its coal, nuclear, or hydro plants. These include:

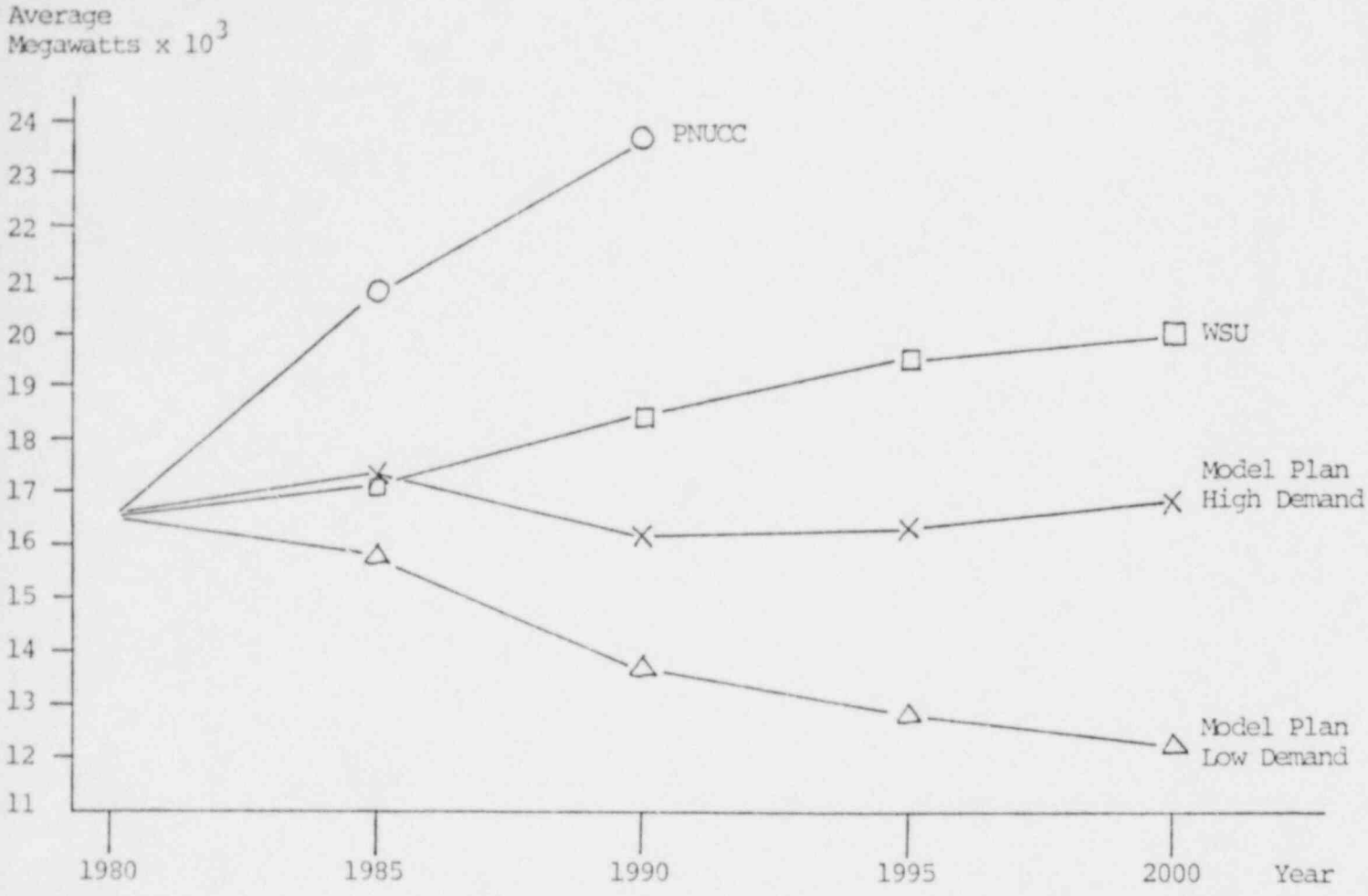
o Wind-generated electricity: The Model Plan provides a survey of cost-effective, environmentally acceptable wind energy potential, which reaches 170 average megawatts

by 1990 and 984 average megawatts by the year 2000. Wind units lend themselves well to a flexible power planning strategy, since they can be added to the system in small increments (unit sizes range from 50 kilowatts or less to 6 megawatts) and require only one to two years for site preparation and installation.

- o Electricity surcharges or "curtailment purchases" in times of threatened supply insufficiency: The Northwest Power Planning Council has expressed considerable interest in readjusting economic incentives to minimize disruptions in response to unexpected supply insufficiencies. Rather than paying to stockpile expensive power to meet such emergencies, ratepayers would benefit from less costly alternatives that include temporary surcharges and "buy-backs" of energy from large industries, in the event that appeals for voluntary short-term cutbacks are insufficient.
- o Environmentally acceptable small-scale hydropower projects: Unfortunately, the current surge of interest in "small hydro" projects has produced many proposals that could seriously harm the region's fish and wildlife resources. However, such damage can be minimized where facilities are installed at existing dams and irrigation systems. If properly managed and sited, these resources offer an additional alternative to thermal power for meeting future electrical energy needs in the Northwest.

- Geothermal district heating: Both Klamath Falls, Oregon and Boise, Idaho now make direct use of hot water geothermal resources. Applications include pavement de-icing and heating of residential and industrial buildings, commercial buildings, and pools. Many other communities may be able to take advantage of the Northwest's ample endowment of low temperature geothermal resources, for district heating and other purposes.
- Financial incentives to prevent net growth in irrigated acreage: If irrigated acreage can be stabilized at current levels, instead of growing as the Model Plan assumes, up to 200 average megawatts could be restored to the Northwest's hydropower system by the year 2000. Our preliminary calculations indicate that irrigation subsidies so distort the market that the region could actually save money by buying land targeted for irrigation, instead of replacing the energy lost through additional water withdrawals. Less expensive strategies almost certainly can be found for correcting the skewed incentives that create this anomalous situation.

Table 1: Comparison of PNUCC, WSU, and Model Plan Forecasts



	PNUCC[a]	WSU[b]	Model Plan: High Demand Scenario	Model Plan: Low Demand Scenario
1985	20,765	17,120	17,292	15,885
1990	23,834	18,410	16,168	13,683
1995	not available	19,510	16,290	12,801
2000	not available	20,490	16,818	12,370

a. From Pacific Northwest Utilities Conference Committee, Northwest Regional Forecast of Power Loads and Resources: July 1981-June 1992.

b. From Washington Energy Research Center/Washington State University, Draft Final Report, Independent Review of WNP-4 and 5 (Table A-16) (Projected loads, assuming termination of WPPSS Units 4 and 5, "moderate demand growth," and "moderate conservation and renewables").

Table 2: Comparisons of Projected Loads and Resources Under the Model Plan

(In Average Megawatts)

(All resource estimates are taken from Pacific Northwest Utilities Conference Committee, Northwest Regional Forecast of Power Loads and Resources (1981).)

1980		1985		1990		1995		2000	
Loads	Resources	Loads	Resources	Loads	Resources	Loads	Resources	Loads	Resources
16621	17595[a]	15885 to 17292	17878[b]	13683 to 16168	17335[c]	12801 to 16290	17285[c]	12370 to 16818	17238[c]
Reserve in future years under the High Demand Scenario:		586		1167		995		420	

a. Reflects resources available in a "critical water" (drought) year.

b. Reflects resources available in a critical water year; assumes retirement of Hanford N-Reactor and operation of Valmy Unit 2, Colstrip Unit 3, and WPPSS Unit 2. Hydropower contributi ns have been reduced for fish protection and irrigation, as explained in the text.

c. Same assumptions as note b except that contributions from combustion turbines are reduced 50% (adopting PNUCC's assumption).

DRAFT

DRAFT FINAL REPORT
INDEPENDENT REVIEW
OF WNP-4 AND 5

Washington Energy Research Center
Washington State University
University of Washington

January, 1982

EXECUTIVE SUMMARY

The 1981 session of the Washington State Legislature directed the joint Energy Research Center of the University of Washington and Washington State University to perform "an independent study . . . of the feasibility of completion and operation of Washington Public Power Supply System (WPPSS) Nuclear Projects Nos. 4 and 5". The "Independent Review of WNP-4 and WNP-5" was subsequently organized to "examine project financing, estimate the amount necessary to finance, assess the need for financing the projects as compared to cost-effective alternatives, and determine the electric rate impacts of the projects to be financed."

The Independent Review was organized into six study modules:

Module IA: Load Forecasting and Load-Resource Balancing
Module IB: Electricity and Conservation Supply and Costs
Module II: WNP-4 and 5 Financing
Module III: WNP-4 and 5 Costs and Schedules
Module IV: Markets for Imports and Exports of Electricity
Module V: Impacts of Rate Changes, Deficits and Surpluses

Analyses for each study module were conducted by independent consultants who prepared final reports of their work. The Independent Review staff prepared this draft which summarizes the findings of the study.

Construction Costs and Schedules

An examination of the Supply System FY 82 Budget found that if the construction of WNP-4 and 5 had not been halted, the two plants could have been completed within the Supply System FY 82 budget of costs and schedule if 1) the most diligent effort had continuously been made to keep all engineering and procurement activity ahead of the needs of the on-site construction forces, 2) design changes had been limited to those necessary to correct mistakes and assure the safe functioning of the plants 3) all unnecessary procedural and methods restraints on construction work had been removed and 4) no major strikes had occured.

The estimated costs to complete WNP-4 and 5 as planned, to complete after two-year or ten-year deferrals or to terminate in either July, 1981, or July, 1983 are shown in Table ES-1. The direct costs of completing after a delay will be significantly greater than the costs to complete as planned. In the case of a two-year deferral, the costs of "mothballing" and the escalation of costs which occurs during the deferral period contribute about equally to the 22 per cent increase in direct cost. For the ten-year deferral, most of a projected 90 per cent increase in costs is due simply to inflation that is expected to occur during the ten years.

Direct costs of $2,064 million would have been incurred if the plants had been terminated July 1, 1981. Termination in July, 1983, was estimated to cost about $200 million more, mostly due to inflation during the two-year deferral. Direct termination costs, including the sunk costs of work already completed, are almost one-third as large as the costs to comlete the plant. If the costs at completion are adjusted for inflation, their real value is only about twice the value of the costs that must be paid if the plants are terminated.

Financing Costs and Cost of Power

The estimated costs of financing construction of WNP-4 and 5, up to the date of completion or termination, are shown in the second column of Table ES-1. These include all interest expense at projected rates for Supply System borrowings for WNP-4 and 5. It is assumed that the interest rate for financing any further construction will move from about 3 per cent above the general market rates in 1982 gradually downward until it reaches the market rate by 1991. This convergence presumes that present uncertainties surrounding WNP-4 and 5 securities will have been rectified as they, in fact, must be before any new bonds can be sold.

The construction financing costs for the different alternatives generally make up slightly less than one-half of the total cost at completion or termination.

Table ES.1 Total Costs of WNP-4 and 5

Completion Alternative	Total Direct Cost Including Initial Fueling Plus First Core Reload	Total Financing Cost Assuming All Interest During Construction is Capitalized	Total Cost at Completion or Termination
	(millions of as spent dollars)		
Completed as Planned			
WNP-4 Completed 6/87	3137	2978	6115
WNP-5 Completed 12/87	3395	3025	6420
Two-Year Deferral			
WNP-4 Completed 12/89	3807	3020	6827
WNP-5 Completed 2/90	4198	3636	7834
Ten-Year Deferral			
WNP-4 Completed 12/97	5884	4889	10773
WNP-5 Completed 2/98	6520	6257	12777
Termination			
WNP-4 Terminated 7/1/81	1002	613	1615
WNP-5 Terminated 7/1/81	1062	723	1785
Termination After Two-Year Deferral			
WNP-4 Terminated 7/1/83	1094	929	2023
WNP-5 Terminated 7/1/83	1167	1071	2238

Note: The financing costs shown assume that all interest during construction is capitalized. The dollar values shown in the above table are expressed as the dollar values in the year spent. They are not corrected for the effect of general price inflation. Thus the difference in direct costs between completing WNP-4 in June of 1987 and December of 1989 is shown in the table as $670 million. Most of this difference in costs is due to general price inflation which depreciates the value of the dollar rather than cause the plants to cost more in real terms.

The total cost at completion, including financing costs, ranges from $12.5 billion for completion in 1987 upward to a projected $23.5 billion for completion in 1997-98, after a ten-year deferral. However, when costs for completion at the later dates are adjusted for general inflation expected to occur by that time, they are all roughly equal in value. Total costs at termination are approximately one-half the costs of completion, when both are expressed in inflation-corrected values.

The cost of power from WNP-4 and 5, if completed in early 1990, was estimated to be 109 mills/kWh (51 mills/kWh in 1980 dollars) and 121 mills/kWh (56 mills/kWh in 1980 dollars), respectively, if the plants are completed after a two-year deferral. The value in 1990 of the cost of power from WNP-4 and 5 levelized in constant 1980 dollars was estimated to be 41 mills/kWh for WNP-4 and 44 mills/kWh for WNP-5. These costs are substantially less than the combined costs of terminating WNP-4 or 5 and building a coal plant to produce the power.

Financing Construction of WNP-4 and 5

An examination of the financing of WNP-4 and 5 revealed several conditions must be met before investors would consider the plants' securities to be of medium quality, or risk, and therefore be willing to resume financing the construction of the two plants:

1) Load forecasting studies in the region must show the need for the outputs from WNP-4 and 5;
2) The participants in WNP-4 and 5 must begin paying interest during construction on borrowed funds:
3) Some method of spreading the risk beyond the 88 participants must be developed and implemented; and
4) The Supply System management must demonstrate its ability to control construction costs and schedules and successfully complete similar projects.

The Region's Need for Power

Load forecasts prepared for the Independent Review indicate that the most likely rate of load growth in regional electricity over the period 1980 to 2000 is about 1.5 percent/year. Projections based on high growth in population, economic activity and other demand factors range up to 2 percent/year. Low growth rates, on the other hand, drop to about 1.2 percent/year. These forecasts are lower than many others that have been prepared for the region principally because the Independent Review's forecasts take account of the relationship between loads and retail rates. The demand dampening effect is projected to be particularly strong during the period 1980-86 because rates will rise much more rapidly that other prices during that time.

In spite of these low rates of growth, additions to the region's electricity production capacity, beyond that which is currently under construction, will be required to balance the region's loads and resources in the 1990's. As demonstrated in the table below, under moderate economic and demographic growth conditions, this energy will be needed in the mid 1990's; and, under low economic and demographic conditions it will be needed in the late 1990's.

TABLE ES-2. Year When Additional Resources Are Needed Under Alternative Supply/Demand Scenarios.

	Year Needed
High Demand	
Conventional Supply	1990
Moderate Conservation and Renewables	1992
All Options	1996
Moderate Demand	
Conventional Supply	1992
Moderate Conservation and Renewables	1995
All Options	2000+
Low Demand	
Conventional Supply	1996
Moderate Conservation and Renewables	2000+
All Options	2000+

Three possible sources of this additional electricity were identified:

1) Completion of WNP-4 and 5.

2) Completion of new coal-fired units (in addition to Colstrip 3 and 4)

3) Use of a combination of unconventional resources such as increased reliance on savings from a variety of additional conservation programs; the addition of renewable sources of electricity (mostly small hydropower units and some small amounts of wind generation); and the use of secondary hydro to serve firm loads with combustion turbines or imports used to back up the hydro in low water years.

In terms of comparable overall costs to the region, increased conservation savings are slightly less expensive than power produced by completion of WNP-4 and 5. The option of terminating WNP-4 and 5, and adding other conventional resources in the 1990's to replace their output, is significantly more expensive than completing WNP-4 and 5.

Exports

If WNP-4 and 5 were completed and the output of the plants is not needed to serve the Pacific Northwest loads, some of the two plants' output could be exported under the following conditions:

1) Up to 2 billion kWhs per year (one-fourth of the annual output of either WNP-4 or WNP-5) could be sold on the spot market at 15-20 mills per kWh (1980 dollars) in those years when the spot market is not overwhelmed by Pacific Northwest hydro surplus.

2) If short term contract sales of from four to five years were arranged after WNP-4 and 5 are placed in service, part of the output could probably be exported for up to 70 mills per kWh (1980 dollars).

3) If long-term sales contracts of from ten to twenty years were arranged after the two plants were placed in service, between 4.4 and 6.1 billion kWhs per year could probably be exported at 50 to 60 mills per kWh (1980 dollars). Six billion kWh is approximately 80 percent of the annual output of either WNP-4 or WNP-5.

4) If the third 500 kV AC Line to California were completed then the amount of long term exports (described in 3 above) could probably be increased by 8.8 to 10.5 billion kWh per year at a price of 50 to 60 mills per kWh.

Imports

It is possible that the Pacific Northwest could find itself in a power deficit situation if, for example, WNP-4 and 5 are terminated and no other resources are added to meet load growth or loads grow more rapidly than expected. However, the Independent Review's investigation of western markets for power indicates that up to 7 billion kWh could be purchased, if needed, at prices ranging from 35 up to 50 mills/kWh. Since the Northwest's very cheap secondary hydropower could be available to cover a deficit in about three years out of four, the cost with imports averaged in only one year out of four would not be prohibitive. An alternative to spot market purchase would be a seasonal diversity exchange in which the Pacific Northwest exports power each year but is entitled to draw all of its return power in one year out of five.

Deficit Impacts

If the Pacific Northwest were to experience a region-wide six-month shortfall of up to 3000 Mw, there would be only a small impact on the economy of the State of Washington. Approximately one-third of the deficit could be handled by appeals for voluntary curtailment from all residential, commercial and industrial consumers. If a decision were to be made to allocate the remaining deficit in such a way as to minimize economic losses to Washington and the region, it would be borne by cutting back power deliveries to the aluminum industry, which uses more electricity per job and per dollar of value-added than any other regional consumer.

Future Rates for Individual Utilities

The participants in WNP-4 and WNP-5 will experience increased costs in the future because of continuing expenses and debt service on the two plants. Some also will have to pay more for other supplies such as purchases from BPA. To pay these

added costs they will have to raise their rates. The rate increases will be small for those utilities with small ownership in WNP-4 and 5 which have their own resources, e.g., Chelan County PUD. On the other hand, the increases will be as much as 500% by the end of the century (100% in inflation corrected terms) for utilities with relatively large ownership in WNP-4 and 5 which buy power from BPA.

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EDUCATION

A.B., Physics, 1973, University of California, Berkeley
Ph.D., Physics, 1978, University of California, Berkeley

PROFESSIONAL EXPERIENCE

Currently: Senior Project Scientist, Natural Resources Defense Council, Inc. Responsibilities include:

Technical and policy analysis of energy conservation strategies for California and the Pacific Northwest. Concentrations involve:

(1) Research to determine the engineering and economic feasibility of efficiency improvements in appliances and buildings
(2) Design of appropriate economic incentives for implementation of cost-effective conservation measures
(3) Administrative and legislative proceedings on energy forecasting and planning; state and federal efficiency regulations; design of utility conservation programs
(4) Public education on the role of energy conservation in environmental and economic policy

11/78-8/80 Staff Scientist (Physics) at Lawrence Berkeley Laboratory. Major projects were:

1) Technical manager for a project which provided analysis for the derivation of residential building energy performance standards for the U.S. Department of Energy. This project involved the development of methodology and assumptions to compute most equitably energy budgets which represent minima in life-cycle cost for houses in different climates of the U.S. and the communication of assumptions and results to DOE and its contractors. Supervised a programmer in the use of the DOE-2 and TWOZONE computerized buiding energy analysis models. Project was under the direction of Mark Levine.

2) Research on the theoretical aspects of building energy modelling, with emphasis on analytic approaches to passive solar building modelling. Developed hand-calculator routines for design-day temperature prediction in passive solar buildings, and simplified methods of describing building parameters. Project was under the direction of Sam Berman.

3) Construction of a scenario for reducing U.S. energy consumption in residential buidings over the period 1980-2000, based on conservation measures which minimize life cycle cost. The report addresses both the technical conservation measures and the policy changes needed to approach the projections in the scenario. The project was part of a study on national energy policy, directed by Denis Hayes at SERI for John Sawhill at the Department of Energy. The Buildings sector report was directed by Art Rosenfeld at LBL.

10/78 Consultant for the Natural Resources Defense Council, Inc., San Francisco office. Worked on a scenario for high energy conservation in California; modelled results of a conservation program for residential and commercial building energy use for 1985 and 1995.

4/75-9/78 Research Assistant at Lawrence Berkeley Laboratory. Work spanned a wide variety of topics concerning efficient use of energy in buildings.

Major work included: coordination of a data collection effort describing the end uses of electricity in California, and co-authorship of the residential energy use section of the report; studies on the applicability of various conservation measures for residential buildings including a tabulation of the cost and energy savings of several dozen measures; work on implementation schemes for conservation measures, including energy extension and inspection services, incentives, and standards; studies of long-range conservation strategies; deriving analytic models of passive solar building performance, and comparisons of the results with test cell data and computer simulation methodologies.

Work was performed under the direction of Professor A. H. Rosenfeld and Professor S. M. Berman.

5/76-3/77 Chairman of the Building Envelope Subcommittee of the California Energy Commission's Residential Standards Advisory Committee. The Committee worked on changes in energy conserving construction standards for residential buildings in California.

Presented testimony on behalf of the Energy Commission staff and also represented the majority of the committee; recomendations on double-glazing, passive solar, and efficient heating systems were followed in adopted standard.

4/75-7/75 Consultant for the Environmental Defense Fund, Berkeley, California office. Worked on conservation strategies for electric energy in California; testified for EDF before the California Energy Resources Conservation and Development Commission.

6/74-9/74 Research Assistant at the Foundation for Ocean Research, 11696 Sorrento Valley Road, San Diego, California. Worked with Professor John Isaacs of Scripps Institute of Oceanography on the plausibility of a hypothesis connecting anthropogenic atmospheric vorticity with the triggering of tornadoes in the U.S.

6/73-9/73 Research Assistant at the Institute of Urban and Regional Development, University of California, Berkeley, California. Worked with a group of twelve under the direction of Professor D.B. Lee to develop an analysis of the costs of the different forms of surface transportation in the San Francisco Bay Area; wrote the working paper "AC Transit: A Cost Model for Different Types of Service," which attempted to separate costs into peak and base service.

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