INTEGRATED RESOURCE PLAN

1992-1993

APPENDICES A - H

PUGET POWER

Integrated Resource Plan Appendices Table of Contents

INTEGRATED RESOURCE PLAN 1989 STATUS REPORT AND ACTION ITEM SUMMARY

The results of the company's second Integrated Resource Plan, dated December 1989, focused on pursuing action items related to demand and supply-side resources. The six interrelated action item categories were:

- Conservation and customer programs
- Supply-side alternatives (including competitive bidding and purchased power)
- Transmission and distribution
- Regional involvement
- Leading indicators and monitoring programs
- Planning and evaluations

The major accomplishments are outlined first, followed by detailed descriptions of progress on each Action Item from the 1989 Integrated Resource Plan.

Action Plan Item	Major Accomplishments
CONSERVATION & CUSTOMER PROGRAMS	
Aggressively acquire cost-effective lost-opportunity conservation resources in all sectors and maximize the number of measures taken by customers.	The company continued strong conservation in the residential sector through "Comfort Plus" and the new "Certified Comfort Plus" programs. These programs offered incentives for measures that exceeded the requirements of existing codes. Design assistance was also continued to promote energy efficiency in new commercial construction. Puget Power funded a portion of the incremental costs of resources exceeding the guidelines established by the Northwest Power Planning Council for commercial buildings.
Expand existing programs and add new conservation measures. Increase performance and participation in more difficult-to-reach market segments. Maximize the number of measures taken by customers.	Revisions were filed to Schedule 83 in May 1990 to expand existing programs and to add new conservation measures. Additionally, the low income weatherization program was expanded to include high efficiency shower-heads, insulated doors and setback thermostats. Demonstrations on 200 homes were initiated by the company to expand the low income weatherization program.

Action Plan Item	Major Accomplishments
Maximize cost-effective efficiency improvements in residential and commercial water heating appliances and offer more water heat conservation measures.	The company delivered high efficiency water heaters and high efficiency shower-heads through various programs. In the first few months of the 1991 year, 75,761 showerheads and 36,633 aerators were delivered. The retail water heater program is now available in 45 stores with rental, finance and grant programs resulting in 3,305 hot water tanks installed through June 30, 1991.
Develop new programs to test and build the capability to acquire new conservation resources.	The company implemented a pilot program to test 50 exhaust air heat pump water heaters during 1991. Also under consideration are the Golden Carrot refrigerator programs which awards refrigerator manufacturers for a super efficient refrigerator and the Green Lights Ally Program which encourages major corporations to install energy efficient lighting.
Promote and encourage energy efficient codes and standards.	Puget Power has been involved with the early adopter jurisdictions providing training and individual builder support for code compliance. These jurisdictions account for 70 percent of all residential construction starts in the area served by Puget Power. A publication outlining the 1991 Washington State Energy Code was prepared and distributed to builders.
Conduct market research by further identifying and refining target markets to improve overall performance of conservation programs.	A market study carried out in 1989-1990 enabled the residential conservation programs to utilize targeted marketing and enhanced the cost-effectiveness of the programs. Also, household interviews of residential customers were completed in February 1991. The results contributed to advertisement campaigns and the development of promotional materials.

Action Plan Item	Major Accomplishments
Determine the value of energy and capacity reductions for specific end-use loads.	The marginal production costs have been examined in this area, and time-of-use variations are relatively small.
Improve estimates of conservation potential in commercial and industrial sectors.	New supply curves were developed and the results indicated renewed areas of emphasis for commercial retrofit and lost opportunity activity in new commercial construction.
Evaluate the conservation impacts and cost-effectiveness of conservation programs, pilots and competitive bidding.	A detailed measurement and evaluation plan was developed with the Technical Collaborative Group and various consultants, and filed with the Commission as part of the Incentive Proposal in June 1991. This plan is being implemented over the next three to four years to evaluate the impacts and cost-effectiveness of conservation programs, pilot projects and competitive bidding. (See Appendix E for more on competitive bidding.)
Continue to use load research results for program development, evaluation and marginal cost analysis.	The company is in the process of compiling results of a dual fuel heat pump study of 10 residences. Data is also being collected from end-use devices (i.e., heat monitors, water heating, lights and appliances) for a residential class load and 30 Comfort Plus homes.
SUPPLY ALTERNATIVES	
Implement first round of selected competitive bid proposals submitted in 1989 and pursue additional competitive bids based on program evaluation.	The company requested proposals for new resources for 100 aMW in its first competitive bid. Bids received totaled about 1279 aMW, primarily for gas-fired resources (see Figure A-1). Contracts for both conservation and generation resources were signed for 180 aMW to come on-line by 1993 as shown in Figure A-2. The Municipal Solid Waste Project proposed by Wheelabrator has since been cancelled after county government vetoed the proposal.

Action Plan Item	Major Accomplishments
	Puget Power is currently in its second solicitation for long-term firm electricity supply from either conservation or generation resources. The request is for 100-200 aMW to come on-line beginning 1995 through 1998.

Table A-1

Summary of Resource Bids Received in 1989 Competitive Bid

Bidders	Number of Projects	Resource	Est.aMW
8	8	Conservation	28
3	3	Coal	248
10	13	Gas	771
2	2	Geothermal	59
3	4	Hydro	16
1	1	Municipal Solid Waste	17
2	9	Wood	140
29	40	7	1279

Table A-2

1989 Competitive Bid Results

Conservation	aMW
Abacus	4 aMW
Northwest Energy Services	1 aMW
Puget Energy Services	3 aMW
Sycom Corporation	1 aMW
Washington State Energy Office	1 aMW
Subtotal	10 aMW
Generation	
Encogen Development Corp. *(Cogeneration - Skagit County)*	143 aMW
Trans-Pac Geothermal *(Geothermal - Northern California)*	10 aMW
Wheelabrator Pierce* *(Municipal Solid Waste - Pierce Co.)*	17 aMW
Subtotal	180 aMW
Project Cancellations	17 aMW
Total	163 aMW

*This Project Was Subsequently Cancelled

Action Plan Item	Major Accomplishments
Continue to aggressively pursue long-term purchase power contracts and power exchange agreements.	Puget Power and Pacific Gas & Electric have completed a 300 MW long-term seasonal exchange agreement. Beginning in 1992, Puget Power will receive power during its high load winter months in exchange for power deliveries to PG&E in the summer.
Evaluate mechanics of international power sales and contracts	Puget Power worked with various developers and PowerEx to develop contractual terms appropriate for purchases from Canadian projects.
Pursue conservation transfers with utilities in the Pacific Northwest in conjunction with the Bonneville Power Administration.	The company is in year 1 of an approximately 20-year conservation transfer agreement with Snohomish County PUD and the Bonneville Power Administration (BPA). This agreement will transfer approximately 52,600,000 kWh each year to Puget Power. BPA has not committed to delivery savings beyond 2001. The success of future conservation transfers continues to rely heavily on the cooperation of BPA.
Evaluate and acquire long-term resources through competitive bidding from PURPA Qualifying Facilities and Independent Power Producers.	The company executed three generation contracts through competitive bidding totaling approximately 170 average megawatts but reduced to 153 aMW after the 17 aMW Municipal Solid Waste Project was cancelled due to county government veto.
Pursue a stable natural gas supply.	Puget Power's Fuels and Joint Project Administration group continues to research available options and discuss gas availability with suppliers.
Evaluate alternatives for construction of new combined-cycle combustion turbine generating stations, including using Puget Power's existing combustion turbine generating stations or adding combined cycle to existing simple cycle facilities.	Puget Power has a comprehensive site study for the State of Washington. Generic plant cost data has been prepared for start of operations in the year 1997.

Action Plan Item	Major Accomplishments
Continue to preserve the Creston site for a coal-fired generating station.	Assessments were made of the risks associated with resources with long lead times, including a summary report that was also prepared on global warming. Other factors, such as the company's ongoing costs and Washington Water Power's interest in withdrawing, appear to make continued preservation of the Creston site by Puget Power unattractive at this time. The decision was made to pursue termination of this project if the region is not interested in assuming the site.
Continue plant modernization activities and cost-effective energy improvements.	The Colstrip and Centralia performance highlights and hydro and thermal plant modernization activities are reported under Appendix A, action item 2.8.

TRANSMISSION & DISTRIBUTION

Action Plan Item	Major Accomplishments
Continue to pursue transmission access and strengthen the existing transmission system.	Puget Power and the Bonneville Power Administration continue to conduct a joint technical study on an interconnection with British Columbia Hydro Power.
Explore the feasibility of using targeted conservation programs to reduce Transmission and Distribution system requirements in high load growth areas.	Load shedding at the transmission level was developed to reduce up to 15% of the demand on cross mountain transmission during emergency conditions. Also, peak shaving strategies (i.e., load management and time-of-use rates) may be applied in high load growth areas as distribution management capabilities improve. Demand-side management planning is being considered as part of Transmission and Distribution capacity planning, with demand-side conservation being targeted to specific areas to manage future construction costs.

Action Plan Item	Major Accomplishments
Continue to seek energy efficiency improvements in the Transmission and Distribution systems.	No new transmission line miles were added to the system in 1990 due to permitting delays. A distribution planning group was formed to work with several divisions of the company for a more efficient distribution system. Additionally, a pilot project was initiated to purchase 200 25 kVA overhead distribution amorphous steel core transformers each year. The core energy losses directly affected by this type of core are only 35% of the losses of conventional silicon steel transformers.
Initiate studies with others of potential voltage stability problems in the Puget Sound Basin.	Utilities in the Puget Sound area and the Bonneville Power Administration have developed voltage dependent load models for each distribution substation. Two system tests were performed by Puget Sound area utilities on January 3, 1991 and February 26, 1991 to validate the technical assumptions that were made in voltage stability studies. As a result, area utilities have agreed to install Under Voltage Load Shedding relays to mitigate potential voltage in stability conditions.

REGIONAL INVOLVEMENT

Action Plan Item	Major Accomplishments
Participate in regional studies including the evaluation of regional Direct Services Industries (DSI) top quartile service relative to firm and non-firm requirements.	Puget Power will participate in a public process conducted by the Bonneville Power Administration to evaluate a DSI proposal that assures a particular level of service to top quartile loads. The company will provide comments to ensure that DSI loads are shared appropriately in the burdens of these programs.
Explore Columbia Storage Power Exchange options.	The company continues to work with various interested parties in a cooperative effort to pursue renegotiation of various treaty-related contracts which phase out over the period 1998-2003.

Action Plan Item	Major Accomplishments
Continue efforts to ensure long-term supply from Mid-Columbia generating plants.	Puget Power is working with Grant County for negotiation of new contracts or the extension of existing Wanapum and Priest Rapids power sales contracts. Douglas and Clark Counties have expressed interest in contract extensions in the future.
Continue to participate in regional power and economic planning.	Puget Power continues to actively participate in the Pacific Northwest Utilities Conference Committee (PNUCC), the Northwest Regional Power Planning Council, the Intercompany Pool, the Northwest Power Pool and the Bonneville Power Administration. Participation in regional studies and analyses has provided benefits to Puget Power and its customers, and continues to be an effective and efficient means to exchange ideas and to achieve high quality results. Puget Power and other regional utilities worked together through PNUCC to develop a comprehensive fishery enhancement program. This program was developed in response to recent actions taken and pending future actions being considered by the National Marine Fisheries Service regarding salmon species under the Endangered Species Act.

LEADING INDICATORS & MONITORING PROGRAMS

Assess quarterly the economic growth and determine customer load growth demands. Issue reports and interpret this economic development relative to future energy resource availability needs.	The company's sales forecast continued to perform well, with forecast sales exceeding weather-adjusted sales by only 0.3% during the first three quarters of 1991. In comparison to weather-adjusted sales, the sales forecast was 0.7% higher in the residential sector, 2.0% lower in the commercial sector and 3.1% higher in the industrial sector.

Action Plan Item	Major Accomplishments
Track success with competitive bidding using acquired energy and capacity costs and on-line dates.	Puget Power has signed 10 contracts for resources totalling 443 average megawatts. The ultimate measure of success of competitive bidding is whether bid projects can be developed and can deliver power at the bid price over the contract term. Initial results are inconclusive. Of the five generation resources selected, three are progressing through the early stages of development, but the waste-to-energy project was cancelled and the geothermal project is experiencing delays. All contracts signed through competitive bidding were between 85% and 95% of avoided cost.
Develop indicators for measuring success in negotiating power purchases with others.	A successful utility power purchase agreement requires that: the purchase is consistent with integrated resource planning goals, the price is competitive with alternatives, the supplier is experienced, appropriate wheeling is available, and the power is supplied under the contractual terms for the purchase period. Puget Power has been successful in purchasing power contracts, but indications are that the window of opportunity has, for now, passed for attractive, cost-effective, long-term utility purchases.
Monitor regional natural gas prices. Track natural gas purchases and costs.	New reporting arrangements have been set up between Puget Power's Fuels and Joint Project Administration group and Purchasing department to record all fuel purchases. The company follows natural gas prices and availability on an ongoing basis.
Monitor technological progress and innovations related to end-uses.	The company's Customer Programs department reviews new products designed to promote the efficiency of end-use products on an ongoing basis. Such as water heaters, refrigerators, lighting, showerheads and window products.
Monitor technological progress and innovations related to supply resources.	The company continued to participate in EPRI. Quarterly reports are prepared which cover activities of interest to Puget Power related to solid waste.

Action Plan Item	Major Accomplishments
PLANNING & EVALUATIONS	
Reduce uncertainties related to the long-term purchase of competitively bid resources.	In its evaluation criteria, the company used both price and non-price indicators to assess each project. Experience and ability of the developer to deliver, financial risk to Puget Power, environmental effects, and resource reliability, dispatchability and system compatibility were all factors in the selection process. Charles Rivers and Associates independently reviewed the company's process and made recommendations for improvements. Among the changes in the second competitive bidding process, was the addition of security deposits in the prototype contract. In regards to those projects for which contracts were signed, Puget Power meets regularly with the developers and continues to track progress.
Seek continued involvement of Consumer Panel and Technical Advisory Committee in integrated resource planning studies.	The 1991 Consumer Panels submitted 76 recommendations related to integrated resource planning. Eight major themes emerged addressing conservation, generation resources, alternative generation resources, rates communications, policy planning, load shifting and rebates. The Consumer Panel members will continue to evaluate and develop recommendations for the company's Integrated Resource Plan. This gives Puget Power the customers' perspective regarding integrated resource planning issues. Nine Technical Advisory Committee (TAC) meetings were held between June 1990 and October 1991. The TAC serves as a sounding board on topics related to integrated resource planning and other technical issues. The TAC group is composed of regional and national energy experts representing a number of organizations and government agencies.

Action Plan Item	Major Accomplishments
Continue EPRI support and encourage research in five areas.	This action item describes EPRI research and development in solar, geothermal, global climate changes, energy efficiency and new nuclear power technologies and waste disposal. The company continues to support and encourage research in these areas, as well as electromagnetic fields (EMF).
Continue development and use of new analytical tools and planning approaches.	Puget Power continues to use scenario planning. This preferred method allows assessment of plausible futures through computer modeling, and quantitative and qualitative analysis. Added to the planning process has been collaborative efforts to address issues and concerns from groups representing customer groups, environmental organizations, and government agencies.
Explore opportunities to use rate design to support conservation and power supply objectives.	Puget Power's Rates Department, in conjunction with the Market Research Department, held customer focus groups to explore customer knowledge of rate structures and what alternative rate designs are of interest to customers. A Rates Design Collaborative Group and a Customer Rates Design Task Force have been established. Results from these group efforts will be incorporated into the April 1992 filing on rate design as directed by the Washington Utilities and Transportation Commission (Commission) in the April 1991 PRAM order. (See Appendix G for details on collaborative efforts.)

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.1

Aggressively acquire cost-effective lost-opportunity conservation resources in all sectors. Maximize the number of measures taken by customers.

DESCRIPTION OF ACTIVITIES

The Schedule 83 refile, approved June 1, 1990 has a significant positive impact on maximizing the acquisition of cost-effective lost-opportunity conservation resources in all sectors. Major efforts to acquire lost-opportunity resources are summarized below:

Residential:
In October 1990, the company implemented Certified Comfort Plus in addition to continuing to offer its standard Comfort Plus Program. The Certified Comfort Plus Program offers incentives for measures that exceed the requirements of both the Northwest Energy Code and the 1991 Washington State Energy Code which was implemented on July 1, 1991.

The company continues to promote its Comfort Plus/Super Good Cents Manufactured Home Program. The company worked with the Housing Authority of King County on a development of 148 Comfort Plus manufactured homes in Kent, Washington. It is the largest number of Comfort Plus homes located in a single development in the region. The first homes were sited in early March 1991.

The company dedicated significant resources to assist jurisdictions in the implementation of the Northwest Energy Code Early Adopters Program and continues to work with the 13 Early Adopter jurisdictions in the area it serves. The accelerated implementation of the code maximizes the acquisition of lost-opportunity conservation resources. In Kitsap County, Puget Power's Comfort Plus representatives provide builder assistance to aid in preparation of the Northwest Energy Code compliance requirements and have established an excellent working relationship with the energy code staff at this jurisdiction and others.

Commercial:
Puget Power continues to offer design assistance to promote energy-efficiency in new commercial construction. During the last half of 1990, 36 requests for design assistance services were received and 18 agreements were signed.

The company has also closely followed the development of the revision of the Model Conservation Standards (MCS). The new version of the code addresses many energy conservation measures which Puget Power has been promoting for the past 10 years. For example, the section on simultaneous cooling and heating includes better definitions for economizers using outdoor air in excess of minimum requirements. Also, lighting budgets have been revised, as demonstrated in school lighting budgets reducing from 2.0 to 1.5 watts per square foot.

FINDINGS

Regulatory changes in April 1991 allow for the more timely recovery of changing power costs and new conservation investments. A distinctive attribute of the PRAM is the "decoupling" of base revenues from kilowatt-hour sales. Base revenues, which are revenues that cover base costs, are now determined by the number of customers served rather than the number of kilowatt-hours sold. This "decoupling" lays the foundation for even greater conservation savings through company programs. With removal of some regulatory barriers, the company has moved forward to double its conservation results overall in 1991, which includes a major emphasis on lost-opportunity conservation in all sectors.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

With the addition of financial incentives to the commercial/industrial new construction program in late 1990, the company continues to aggressively pursue this market with a seven-fold increase over 1990 results in the energy savings target for 1991. The residential sector also experienced a major increase in activity with implementation of the Northwest Energy Code, and the company's Certified Comfort Plus Program that encourages installation of measures beyond that required by the 1991 Washington State Energy Code.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.2

Expand existing programs and add new conservation measures (e.g. high efficiency appliances, residential lighting). Increase performance and participation in more difficult-to-reach market segments (low-income and multi-family). Maximize the number of measures taken by customers.

DESCRIPTION OF ACTIVITIES

In May 1990, the company filed revisions to Schedule 83 which expanded existing programs, added new conservation measures, and allowed greater flexibility for providing higher grant levels to maximize the installation of certain cost-effective conservation measures. In addition, special efforts have been taken to increase the participation of low-income customers.

The following changes to Schedule 83 were made to expand existing programs and add new conservation measures:

1. Upgraded water heating efficiency programs to include higher efficiency water heaters and low flow devices.
2. Established a procedure to allow an incentive payment by Puget Power of 25% of the incentives available under the BPA Northwest Energy Code Program.
3. Allowed for the extension of the Comfort Plus Program to provide incentives for measures more efficient than those required by the 1990 Northwest Energy Code.
4. Allowed for incremental cost incentive payments of energy efficient improvements for new commercial facilities and industrial processes.
5. Expanded lighting conservation services to residential applications and to make incremental cost incentives available for new, high efficiency installations.
6. Created Appliance Energy Conservation Service to provide incremental cost incentives for higher efficiency appliances.
7. Allowed greater flexibility in applying the two-year customer-savings ratio for grants, if necessary to facilitate installation of certain measures.

Actions to increase low-income participation, included:

In August 1989, Puget Power combined the Housewarming (low-income senior citizens' program) and Co-op Weatherization Programs (general low-income program). The Housewarming Program provided a 100% grant for weatherization measures and the Co-op Program provided 72% funding. The new combined program expanded eligibility to include all electric heat customers (regardless of age) in the area served by Puget Power that met specific income guidelines. Also, it provides grants equal to 100% of the net avoided cost for all applicable measures. In addition, a more comprehensive infiltration package was added. Previously, Puget Power did not provide funding for infiltration in the Co-op Program.

Puget Power's market research group has done a market segmentation study to assist in target marketing and to understand "hard-to-reach" markets. This information will assist the company in redesigning or better communicating programs that appeal to customers from low participation groups.

In April 1990, low-flow showerheads were added to the Low Income Weatherization Program. The showerheads, provided by Puget Power, will be installed by agencies. During the second half of 1990, the residential weatherization program was expanded to include insulated doors and automatic setback thermostats. Both measures are offered on a contractor-installed and retail basis. The rebate offered per door is $100 with a maximum of two per residence and $80 per home for thermostats.

A Low-Income Demonstration Project, to expand the low-income weatherization program, began in Whatcom County in April 1991, and includes the following components:

- Weatherization of 150 single family and 50 mobile homes
- Energy education
- New measures:
  water heater insulation wraps
  heat traps on water heaters
  heating system improvements
  automatic setback thermostats
  faucet aerators
  insulated entry doors
  compact fluorescent lamps

Special effort is made to reach the low-income population through target marketing. Puget Power staff works closely with the low-income weatherization agencies, providing marketing support such as county-specific brochures and distribution assistance to targeted areas.

FINDINGS

The Low-Income Demonstration Project in Whatcom County completed 24 units through May of 1991 and scheduled 25 units in June. Of the units completed, 19 were manufactured housing. Over 100 additional residences are certified eligible, have been audited and are waiting for installation of measures. Another 100 of the 200 projected participants will receive energy education which will detail energy conservation strategies. An evaluation of the project will be completed in 1992.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

An Energy Efficient Motors pilot program has been under development since April 1991. The initiation was in August 1991. Its design is to promote premium efficiency standards as specified by BPA and subsequently adopted by other regional utilities.

Contractor-initiated Indoor Lighting, under development since January 1991, was implemented in June 1991. It is very similar to the outdoor/unheated Commercial/Industrial Programs.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.3

Maximize cost-effective efficiency improvements in residential and commercial water heating appliances and offer more water heat conservation measures.

DESCRIPTION OF ACTIVITIES

Schedules 83 and 84 were revised to ensure that the highest efficiency water heaters commercially available in the marketplace are installed on the company's programs, and to include low flow showerheads as an additional water heat conservation measure.

The Changes to Schedule 84, recently approved by the Commission, maximize the cost-effectiveness of the rental water heater program. It also provides for upgrading the efficiency of existing tanks, upon removal, by including insulation wraps and heat traps at the time they are reinstalled.

A retail rebate program for high efficiency water heaters began in November 1990. Sears is the first major chain store to offer the rebate for high efficiency water heaters. Approximately 15 retail rebates were issued in 1990.

An energy saving showerhead test program was implemented in August-September 1990. The pilot tested customer acceptance of several different models, and also determined ways to ensure that they are actually installed. This test showed a high customer response rate, resulting in a full-scale program which is currently underway.

FINDINGS

The delivery of low-flow showerheads to Puget Power customers has been extremely successful; over 75,761 showerheads have been delivered. As of May 1, 1991, faucet aerators have been included with the showerheads, and to date the company has delivered more than 36,633 aerators.

Puget Power's retail water heat program is available through 45 stores. Rental, Finance and Grant programs have resulted in 3,305 hot water tanks installed in 1991.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Puget Power is piloting a multi-family water heat savings program where showerheads, faucet aerators, WHIK kits, heat traps and pipe insulation are being installed.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.4

Develop new programs to test and build the capability to acquire new conservation resources.

DESCRIPTION OF ACTIVITIES

Puget Power has been actively involved in developing and piloting new programs which will build the capability to acquire additional conservation resources.

During the last quarter of 1990, Puget Power implemented the addition of Certified Comfort Plus measures to its Comfort Plus Program. These measures exceed the requirements of the Northwest Energy Code and the 1991 Washington State Energy Code. Activity during this reporting period include:

- 376 energy saving showerheads
- 394 high efficiency water heaters
- 700 energy efficient refrigerators
- 584 automatic setback thermostats
- 3 high efficiency heat pumps
- various projects to improve the building shell of heat pump and electric resistance heat

This program is expanding Puget Power's capability to acquire new conservation resources.

Puget Power has been working with a group of interested parties in a collaborative process. Part of the process involved a review of Puget Power's proposed Demand-Side Management Programs and the establishment of annual performance targets. As developed by the collaborative group, Puget Power implemented a pilot program to test 50 exhaust air heat pump water heaters during 1991. This project involves monitoring the performance of the equipment at various sites, determining cost-effectiveness and assessing customer satisfaction in order to determine the feasibility of expanding the program at a future date.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Along with the collaborative group, Puget Power is considering participation in the Golden Carrot refrigerator program. The program involves a consortium of utilities contributing to a pool of funds to be used as an award for a refrigerator manufacturer to develop and mass market a non-CFC (chlorofluorocarbon), super-efficient refrigerator which will serve as a standard for the next generation of high-efficiency refrigerators. This effort would build the capability in the future to continue to acquire conservation resources.

Another effort geared towards capability building, is Puget Power's expected participation in the EPA Green Lights Ally Program. Green Lights is a program sponsored by the Environmental Protection Agency to encourage major corporations to install energy-efficient lighting technologies. Companies joining the program commit to surveying all their facilities and installing new lighting systems that maximize energy savings to the extent possible. As a utility ally, Puget Power will actively publicize the environmental benefits of energy-efficient lighting and recruit major corporations to participate in the program.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.5

Promote and encourage energy efficient codes and standards.

DESCRIPTION OF ACTIVITIES

Residential Model Conservation Standards (MCS):
In the area served by Puget Power, a total of 13 separate cities and counties are in the "Early Adopter" program under the 1991 Northwest Energy Code (NWEC). Included are King, Pierce, Thurston, and Kitsap counties and the cities of Bremerton, Lacey, Olympia, Port Orchard, Poulsbo, Redmond, Snoqualmie, Tumwater, and Olympia. These jurisdictions account for 70 percent of all residential construction starts in the area served by Puget Power.

Commercial MCS:
Puget Power supported the adoption of ASHRAE/IES standard 90.1 as the basis for the commercial MCS and is contributing to the International Conference of Building Officials (ICBO) codification process for this standard. The company continues to follow the development of the revision to the commercial MCS standards. Revisions to the code address many energy conservation measures which Puget Power has been promoting over the past decade.

FINDINGS

Kitsap County has approved 23 electric residential structures since adopting the NWEC. As a result of a decrease in building activity, none of the other jurisdictions have submitted request for builder payments under the "Early Adopter" program.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The commercial MCS will be updated by the State Building Code Council in 1992. Puget Power will continue to develop programs and participate in forums that will raise the level of building construction above codes.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.6

Implement first round of selected competitive bid proposals submitted in 1989 and pursue additional competitive bids based on program evaluation.

DESCRIPTION OF ACTIVITIES

The first round of selected competitive bid proposals, which were first submitted in 1989, have been completed with contracts signed in mid-1991. A second solicitation is currently underway.

FINDINGS

Status of Competitive Bid Contracts:

The company requested proposals for new resources for 100 aMW in its first competitive bid. Bids received totaled about 1279 aMW, primarily for gas (see Figure A-3). The first competitive bid resulted in contracts signed for 10 aMW of conservation due to be delivered by 1993, and generation contracts signed for 170 aMW (see Figure A-4). However, conservation anticipated for delivery in 1991 has not yet been received. Three of the five competitively acquired generation projects are in the early stages of development. The 17 average megawatt Wheelabrator Pierce project, was cancelled after county government vetoed the proposal. The 10 average megawatt Trans-Pacific Geothermal project is experiencing some delays. Although construction has not begun on any of the remaining three generation projects, they are currently on schedule.

Puget Power is currently it is second solicitation for long-term firm electricity supply from either conservation or generation resources. The request is for 100-200 aMW to come on-line beginning 1995 through 1998.

Table A-3

Summary of Resource Bids Received in 1989 Competitive Bid

Bidders	Number of Projects	Resource	Est. aMW
8	8	Conservation	28
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Puget Energy Services	3 aMW
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Subtotal	10 aMW
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Encogen Development Corp. *(Cogeneration - Skagit County)*	143 aMW
Trans-Pac Geothermal *(Geothermal - Northern California)*	10 aMW
Wheelabrator Pierce* *(Municipal Solid Waste - Pierce Co.)*	17 aMW
Subtotal	180 aMW
Project Cancellations	17 aMW
Total	163 aMW

*This Project Was Subsequently Cancelled

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The competitive bidding process appears to be an appropriate option in securing resources although there has been no delivery of resources as yet. It is Puget Power's objective to continue to monitor and evaluate this process.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.7

Continue to enhance Puget Power's analytical capabilities through the following activity:

> Conduct market research by further identifying and refining target markets to improve overall performance of conservation programs.

DESCRIPTION OF ACTIVITIES

A Residential Market Segmentation Study was carried out in 1989-1990. The study segmented the space heating and water heating markets into smaller markets of like customers in terms of energy-related characteristics. In addition, the survey data was matched to program participation data for the residential weatherization program and to geo-demographic cluster codes called Vision. Analysis of the merged set of data showed that there were certain geo-demographic market segments more likely to participate in Puget Power's residential conservation programs than others. A report entitled, "Preliminary Analysis of Vision Codes Applied to the Residential Weatherization Program" is complete. Both studies will enable the program to utilize targeted marketing and thereby enhance the cost-effectiveness of the programs. In addition, markets with low participation rates will require different appeals or program design changes. The two studies may shed light in this regard as well.

A report entitled, "Microvision Profile Analysis" was nearly completed in December 1990. The report profiles Puget Power's residential customers based on geo-demographic data and also examines the geo-demographic profile of Puget Power's water heater and Home Energy Audit program participants. Puget Power also conducted a personal interview survey in November/December 1990 to further define the market segments which were developed in the Residential Market Segmentation Study. As part of this study, attitudes about conservation and environmental protection were probed.

FINDINGS

It is believed that both studies will enhance Puget Power's capabilities to do target marketing.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Household interviews of residential customers were completed in February 1991, as a final phase of the 1990 Market Segmentation Study. Results of this study contributed to the form and content of the present advertising campaign and development of promotional materials. Additional conservation program participants have been profiled, and respondents to promotions are now tracked by MicroVision segments, further enhancing Puget Power's ability to target its programs and services.

A low-income satisfaction survey was conducted that described the level of satisfaction of the participants with Puget Power, contractors and the referral agencies.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.8

Continue to enhance Puget Power's analytical capabilities through the following activity:

Determine the value of energy and capacity reductions for specific end-use loads.

DESCRIPTION OF ACTIVITIES

Marginal costs by sector have been completed for the distribution systems. The completed study became available in the first quarter of 1991. Analysis of marginal transmission and production costs is in progress.

FINDINGS

The utility's marginal production costs have been examined and time-of-use variations are relatively small.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.9

Continue to enhance Puget Power's analytical capabilities through the following activity:

Improve conservation supply curves by using Puget Power and other program evaluations to improve estimates of conservation potential. Emphasis will be placed on the commercial and industrial sectors. Expand measures and programs included in conservation estimates.

DESCRIPTION OF ACTIVITIES

A study has been completed to determine the maximum technical conservation potential in the area served by Puget Power. The estimate is based on maximum penetration of the most efficient equipment available, as well as new technologies. This information is used to set the upper bounds of conservation resources available to help improve company estimates of the "market" conservation potential used in the supply curves (i.e. the amount of conservation which can realistically be expected with aggressive programs).

FINDINGS

Puget Power has developed new supply curves which represent Puget Power's "share" of conservation supply in the Northwest Power Planning Council's 1991 Northwest Conservation and Electric Power Plan. The Technical Collaborative Group reviewed and commented on the development of the supply curves. The results indicate renewed areas of emphasis for commercial retrofit and lost-opportunity activity in new construction, specifically commercial. Puget Power was also involved in commenting on efforts to develop regional conservation programs and conservation potential estimates for the region.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.10

Continue to enhance Puget Power's analytical capabilities through the following activity:

Evaluate the conservation impacts and cost-effectiveness of conservation programs, pilots and competitive bidding.

DESCRIPTION OF ACTIVITIES

A plan has been developed for evaluating the results of Puget Power's Commercial Retrofit Conservation Program. The company has hired staff to conduct evaluations. In addition, several consultants were interviewed to help perform more detailed analysis in commercial evaluation. Puget Power is tracking demand-side evaluation efforts in the region, as well as by others in the country. A measurement and evaluation plan, developed with the Technical Collaborative Group, was filed with the Commission in June 1991 as part of the Incentives proposal. The measurement and evaluation plan is being implemented over the next three to four years.

FINDINGS

Initial tracking system modifications have been implemented with reports being produced for residential retrofit programs. The new tracking system provides data with high integrity and consistency with accounting data.

1.0 CONSERVATION & CUSTOMER PROGRAMS

ACTION ITEM 1.11

Continue to enhance Puget Power's analytical capabilities through the following activity:

Continue to use load research results for program development, program evaluation and marginal cost analysis.

DESCRIPTION OF ACTIVITIES

Load profiles supplied by load research from the BPA ELCAP study were used to determine the avoided cost for water heat loads. The company gathered metered data from 10 locations with residential dual fuel heat pump installations. The data collection ended January 1991. This information will determine the feasibility of future program offerings.

Data is being collected on Comfort Plus Homes. End-use metering devices are being installed at 30 sites to monitor heating, water heating, lights and appliances. Data will be collected through mid-1992. A survey questionnaire was sent to sample sites in early 1991 to obtain demographic and energy use information which was used in analyzing load profiles.

Data is being collected for a residential class load study. The sample of 150 homes was selected by residential structure type and rate schedule. Data will be collected through mid-1992 before the sample is revised.

Load profiles from the BPA ELCAP commercial studies were used to determine conservation lost revenues.

FINDINGS

Results from a dual fuel heat pump study of 10 residences have been compiled. Preliminary information indicates that there was wide variability between sites for space heating and cooling energy consumption. Several sites disconnected their units during the heating season. The major information of interest was the range of cooling kWh which was relatively low (231 to 963 kWh/yr). Collection of energy bills is in process to determine cost-effectiveness for the 10 sites and will be completed by the end of 1991.

Equipment installation for a non-residential class load study was completed on June 30, 1991. Data will be collected through mid-1993. The sample is composed of 50 primary general service customers and 100 secondary general service customers.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.1

Continue to aggressively pursue long-term purchase power contracts and power exchange agreements.

DESCRIPTION OF ACTIVITIES

Puget Power actively examined the power market to identify those regional and extra-regional utilities that could provide long-term firm power. No power purchase agreements with other utilities have been completed since the previous Integrated Resource Plan was completed. [Long-term non-utility purchase activities are described under action item 2.3]

Opportunities for power exchanges were evaluated with the summer-peaking utilities in the Southwest. A 300 MW seasonal exchange contract was executed with Pacific Gas & Electric Company. Under this contract Puget Power receives power during its peak winter season and returns the power to PG&E during the summer.

FINDINGS

Puget Power's past integrated resource plans have recommended utility purchases as an economical source of supply. As the regional surplus of the 1980's diminishes, so does the opportunity for long-term utility purchases. Indications are that the window of opportunity has, for now, passed for attractive, cost-effective, long-term utility purchases.

There may be additional opportunities for seasonal exchanges with utilities in the Southwest. However, transmission availability may limit such contracts.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Although the regional surplus appears to be over, this situation can change quickly. Puget Power will continue to follow the long-term power market and include utility purchases as an supply alternative in future integrated resource plans.

Seasonal exchanges can provide cost-effective capacity for both utilities involved. Puget Power will evaluate both its ability to support further exchanges and the availability of transmission.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.1

Evaluate BPA New Resource Rate stability over time.

DESCRIPTION OF ACTIVITIES

The Bonneville Power Administration has identified New Resource (NR) Rate Predictability as an issue for their 1993 Rate Case.

FINDINGS

BPA has indicated a willingness to hold a special rate process for this issue if there is a regional proposal prior to 1993. BPA is also willing to work with the region to try and resolve as many Rate Case Issues as possible, including NR Rate Predictability, prior to the 1993 Rate Case. BPA, however, has been reluctant to discuss NR Rate Predictability in the absence of a regional proposal.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Although identified as an issue for 1993, NR Rate Predictability might not be achieved as BPA has not addressed this issue to date. Thus, Puget Power has kept its NR purchase to a minimum.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.1

Evaluate mechanics of international power sales and contracts.

DESCRIPTION OF ACTIVITIES

Puget Power has been working with B.C. Hydro, PowerEx, and independent developers of hydroelectric and thermal generation projects in Canada to identify issues regarding long-term power sales.

FINDINGS

PowerEx, the export sales arm of B.C. Hydro, is promoting Canadian power projects to the United States. Through discussions with PowerEx and various independent developers, Puget Power has developed an understanding of the additional legal issues associated with importing power from Canada.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Long-term firm purchases from Canada do not seem to present any insurmountable problems. Generic discussions with Canadian projects and PowerEx have been completed. The next step will occur if Puget Power decides to pursue a specific Canadian project.

PowerEx has been a promoter of export sales. However, its role is determined by the B.C. government and policies regarding exports may change in the future.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.2

Pursue conservation transfers with other utilities in the Pacific Northwest in conjunction with the BPA.

DESCRIPTION OF ACTIVITIES

In December of 1989, Puget Power, Snohomish County Public Utility District and the Bonneville Power Administration (BPA) finalized a 20-year conservation transfer agreement. Snohomish, together with Lewis and Mason County PUDs, are implementing new conservation measures that are expected to save the PUDs approximately 52,600,000 kWh each year. BPA, instead of delivering this power to the PUDs, delivers the power saved through the conservation measures directly to Puget Power. The estimated life of the conservation measures is approximately 20 years. BPA, unwilling to commit to deliver the savings to Puget Power over the life of the measures, will terminate its participation in 2001. Snohomish will continue to deliver the conservation savings to Puget Power for the remaining term of the agreement. BPA's unwillingness to deliver conservation savings to Puget Power over the life of the conservation measures has made it extremely difficult to consummate similar agreements with other utilities. Puget Power continues to express interest in additional conservation transfers, however, without BPA's cooperation, new agreements are highly unlikely.

FINDINGS

Conservation transfers are a viable and cost-effective means to meet future needs. The success of this alternative relies heavily on BPA's cooperation. Snohomish County PUD reports a very successful program after reviewing its performance during the first year of the existing agreement. Snohomish fell slightly short in their water heater program but more than made up for the shortfall through additional weatherization.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Puget Power has concluded that conservation transfers are a highly desirable alternative to meet future needs. Although other utilities have expressed an interest in providing power to Puget Power through this mechanism, BPA's unwillingness to deliver conservation savings to Puget Power over the life of the measures has prevented new agreements. Puget Power is convinced that conservation transfers are in the best interests of the region's utilities and ratepayers and is hopeful that more agreements will be consummated in the future.

In order to promote more activity in the area of conservation transfers, the region's utilities must adopt a more cooperative policy that recognizes the inherent benefits of conservation. In the meantime, Puget Power continues to promote conservation through its own advertising campaigns, competitive bidding and through Puget Power's conservation programs. Puget Power will become even more active in this area in the future.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.3

Evaluate and acquire cost-effective long-term purchase of resources acquired through competitive bidding from PURPA Qualifying Facilities and Independent Power Producers.

DESCRIPTION OF ACTIVITIES

In February 1990, Puget Power selected three generation projects from its pilot competitive bidding process for contract negotiations:

1) a 143 average megawatt gas-fired cogeneration facility to be developed by Encogen Development Corporation at Georgia Pacific in Bellingham, Washington,

2) a 17 average megawatt waste-to-energy facility to be developed by Wheelabrator Pierce Inc. in Pierce County, Washington, and

3) a 10 average megawatt binary geothermal project to be developed by Trans-Pacific Geothermal Corporation in Surprise Valley, California.

After the competitive bid process was complete, a number of the bidders that were not selected requested the opportunity to improve their bids and resubmit them to Puget Power. At this same time, Puget Power was also receiving unsolicited proposals from new developers wanting to sell power. Since there was a need for additional power, Puget Power decided to conduct a competitive evaluation of the new projects and improved proposals to determine whether any additional resources should be acquired.

The process used during this competitive evaluation was very similar to the competitive bidding process. This evaluation process was completed in late 1990 and as a result, Puget Power acquired two additional projects:

1) a 48 average megawatt addition to the March Point Cogeneration Company cogenerator at the Texaco Refinery in Anacortes, Washington and

2) a 215 average megawatt gas-fired cogeneration project to be developed by Tenaska Washington, Inc. at the British Petroleum Refinery in Ferndale, Washington.

Three of the five competitively acquired projects are in the early stages of development. However, the 17 average megawatt Wheelabrator Pierce project was terminated in August 1991 due to eroding political support in Pierce County. The 10 average megawatt Trans-Pacific Geothermal project is experiencing some delays. Although construction has not begun on any of the remaining three projects, they are currently on schedule.

FINDINGS

Competitive bidding can stimulate the power supply market and enhance competition among suppliers. However, acquiring resources through bidding is not without problems as evidenced by the difficulties experienced by the waste-to-energy project.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The competitive bid projects were between 85% and 95% of Puget Power's avoided costs. However, the real measure of the success of competitive bidding is whether these projects can deliver power at the bid price over the contract term. Based upon Puget Power's limited experience, the competitive bidding results can be characterized as mixed. Some of the projects seem to be progressing well and others are experiencing difficulties.

Puget Power is continuing with competitive bidding. Its second Request for Proposals seeking 100 to 200 average megawatts of new resources was issued in September 1991. The result of the first RFP may cause additional emphasis to be placed on non-price factors such as bidder experience and permitting and licensing of projects.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.4

Pursue a stable natural gas supply.

This effort will consider contracting and exploration, including potential resources in Washington State. Studies to conduct are:

- Gas availability related to possible supply and delivery limitations.
- Future gas forecasts – monitor market conditions.
- Market assessment for firm natural gas supplies.

DESCRIPTION OF ACTIVITIES

The Fuels and Joint Project (F& JP) Administration group continues to discuss the availability and price of natural gas supplies with pipeline and natural gas suppliers. These discussions have taken place with greater frequency as the integrated resource planning process has provided a context within which to discuss supply amounts and potential delivery dates.

FINDINGS

At the present time, there is still an abundant supply of natural gas available at low prices. How long this situation will last is uncertain. The availability of future pipeline transportation is still uncertain.

All transportation and supply firms are willing to work with Puget Power to deliver gas to a potential project. However, both suppliers and transporters need lead times in securing adequate gas supplies or transportation rights. Suppliers and transporters need a firm commitment for purchasing and shipping natural gas supplies in order to guarantee that supplies can be delivered when they are needed.

Northwest Pipeline is currently in the middle of an expansion project. In order for Puget Power to insure pipeline access, a commitment is needed to take firm supplies during the next open access period in the Spring of 1993.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The price and availability for a project of any type will largely depend upon the situation that exists in the natural gas market at the time a contract is negotiated. As deregulation continues to change the natural gas industry, Puget Power will continue to monitor the effects on the ability to purchase low-cost natural gas supplies.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.5

Evaluate alternatives for construction of new combined-cycle combustion turbine generating stations, including the possibility of using the company's existing combustion turbine generating stations or adding combined cycle to existing simple cycle facilities.

Design of generating stations will include considerations for alternate fuels, such as coal-gasification and fuel oil. If it appears that other resources will be insufficient to meet future requirements and natural gas-fueled generation continues to appear most cost-effective, then engineering and fuel supply activities will begin.

Conduct following studies:

Availability of turbine equipment.
Site availability in Western Washington.
Perform a preliminary investigation of the feasibility for fueling the company's existing combustion turbines with synthetic gas produced from coal or biomass. Factors to consider will include space requirements, fuel supply and transportation, by-product markets, and regulator requirements.

DESCRIPTION OF ACTIVITIES

1. On the following page, is the Generic Plant Cost Data for 1997 start of operation dated December 31, 1991, prepared for Power Planning to support their avoided cost calculations.

DRAFT
BASE LOAD RESOURCE PLANNING
GENERIC PLANT DATA
1997 START OF OPERATION
DECEMBER 31, 1991

	(1) PC/SO2	(2) C.TURBINE	(3) C.TURBINE	(4) C.TURBINE	(5) C.TURBINE
CAPITAL COST WITH AFUDC (1990$)	1550	*900	690	670	395
CAPACITY FACTOR-%	75	80	80	80	80
FUEL COST MILLS/KWH (1997$)	20.5	NONE	26.9	26.9	40.3
HEAT RATE BTU/KWH	10,370	N/A	7,740	7,740	11,600
FIXED O&M MILLS/KWH (1997$)	6.1	2.2	1.0	1.0	0.2
VARIABLE O&M MILLS/KWH (1997$)	5.6	2.67	5.6	5.3	5.9
WHEELING COST**					
TRANSMISSION LOSSES**					

NOTES:

(1) Capital costs are based on EPRI's TAG dated 1989 (2-500 MW units).
(2) Based on adding combined cycle to the units already at Puget Power's 3 existing sites (Limited to 290 MW added capacity).
(3) Based on putting combined cycle combustion turbines at a new site or sites.
(4) Based on adding completely new combined cycle combustion turbine packages at Puget Power's existing sites (The capacity limitations have not been determined yet).
(5) Based on adding simple cycle combustion turbine packages at Puget Power's 3 existing sites (The capacity limits haven't been determined yet).
6. All numbers are nominal with accuracy of +/- 20%.
7. All plants are assumed to come on-line in 1997.
8. Coal cost is taken at $1.37/mmbtu in 1990$.
9. Natural gas cost is taken at $2.47/mmbtu in 1990$.
10. Escalation is taken at 5% per year.
11. All new combustion turbines are of the "Advanced design."
12. PC/SO2 is pulverized coal fired plants with scrubbers at the Creston site.
13. Heat rate based on the high heating value of the respective fuel.*

*Revised or added on 6/7/90

** Numbers will be identified for specific sites.

2. Below are the capital cost estimates to add combined cycle combustion turbines at Frederickson.

CAPITAL COST ESTIMATES
COMBINED CYCLE - FREDERICKSON

	Add 63,000 kw to existing <u>Comb. Turbines</u>	Add 123,000 GE Frame 7EA <u>CC Comb. Turbines</u>
I. <u>Direct Construction Costs</u>		
GE Frame 7EA Combustion Turbine	N/A	$19.1 million
Steam Cycle Addition	$45.0 million	29.0
Water Treatment Facility	0.4	1.0
Cooling Tower/Circ. Water System	3.0	2.0
Misc. Civil - Site Prep. & Finish	0.2	0.4
Mechanical Installation	0.6	0.7
Electrical Installation	0.5	0.6
Startup and Testing	Included	Included
Shipping	Included	Included
Sales Tax	4.0	4.2
Total Direct Costs	$53.7 million	$57.0 million
II. <u>Indirect Costs</u>		
Engineering & Construction Mgt.	$4.0 million	$4.0 million
Permitting and Licensing	N/A	1.0
Administration, Legal, Financial	1.0	1.0
Total Indirect Costs	$5.0 million	$6.0 million
III. AFUDC	$5.0 million	$6.0 million
TOTAL EXPECTED PROJECT COSTS (in 1/91$)	$63.7 million $1011/kw)	$69.0 million ($561/kw)
RANGE OF CONSTRUCTION COSTS (+/- 20% accuracy)	$51.0 to $76.4 millions	$55.2 to $82.8 millions

FINDINGS

3. Puget Power has a comprehensive site study for the State of Washington, developed by Black & Veatch in the late 1970s. It appears to have validity for purposes of this action item.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Puget Power has not yet pursued a comprehensive study on availability of turbine equipment or feasibility for fueling the company's existing combustion turbines with synthetic gas from coal or biomass. There also remains further work to be done on Items 1, 2 and 3 above.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.6

Continue to preserve the Creston site for a coal-fired generating station.

Associated with this action item, conduct the following studies to reduce uncertainties related to coal-fired generation:

- Continue to monitor new coal related technology developments such as fluidized bed combustion and coal gasification.
- Determine risks associated with resources that have long lead times.
- Monitor scientific literature and proposed legislation related to global climate change.

DESCRIPTION OF ACTIVITIES

The Creston Site was reserved for a coal-fired generating station. See comments under Action Item 5.6 for monitoring development of fluidized bed combustion and coal gasification.

Puget Power has met with Black & Veatch and Stone & Webster to help assess, among other things, the risks associated with resources that have long lead times.

Puget Power has been monitoring scientific literature and proposed legislation related to global warming. A summary report follows below:

GLOBAL CLIMATE CHANGE (GLOBAL WARMING)

SUMMARY REPORT

The so-called greenhouse effect is a natural atmospheric phenomenon where the warming of the earth's surface makes the planet habitable. Only about one-third of the solar energy reaching the earth is reflected back to space directly; the rest is absorbed by the atmosphere and the earth's surface and reemitted as infrared radiation. Relatively small amounts of trace gases, including carbon dioxide (CO_2), methane, nitrous oxide, chlorofluorocarbons, and even water vapor, absorb some of this infrared radiation, heating the atmosphere. Steady increases of some greenhouse gases because of human activity have caused the current concern that the natural climate balance might be upset, resulting in unprecedented global warming near the earth's surface.

Atmospheric concentrations of greenhouse gases are increasingly well known. Neither the available climate record nor the limited capabilities of the climate models permit a reliable forecast of the implications of continued accumulations of greenhouse gases in the atmosphere. Neither do they permit an assessment as to whether the increase from 1890 to 1990 in global average temperature can be attributed to greenhouse gases. However, it is possible that some positive rate of warming will accompany continued accumulation of greenhouse gases in the atmosphere.

A variety of Federal policy initiatives will be required to achieve large reductions in U.S. greenhouse gas concentrations. Such policy actions will have to include both regulatory "push" and market "pull" mechanisms including performance standards, tax incentive programs, carbon-emission or energy taxes, labeling and efficiency ratings, and research, development, and demonstration activities. To achieve lasting reductions, government signals (e.g., pricing and regulatory policies) need to be consistent and reinforcing.

Any congressional action of the global climate change issue must take into account the negotiations of the United Nations Intergovernmental Negotiating Committee for a Framework Convention on Climate Change and the work of the Intergovernmental Panel on Climate Change. Proceeding on a unilateral basis to stabilize or reduce greenhouse gas emissions, in the absence of an international agreement applicable to all nations emitting greenhouse gases and with an effective enforcement mechanism, could place U.S. industry at a competitive disadvantage in world markets and could harm the nation's economy.

FINDINGS

Other factors have brought into question the continued preservation of the Creston site by Puget Power. These factors include the company's ongoing costs, Washington Water Power's interest in withdrawing, and the ability to build a plant on the Creston site.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

It no longer appears attractive for Puget Power to continue preserving the Creston site. If the region is not interested in assuming the site, it will probably be terminated.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.7

Monitor research and development progress in nuclear power.
Encourage development of programs for conveying information about nuclear power to customers and the general public.

DESCRIPTION OF ACTIVITIES

Research and development activities in the U.S. have been divided into three design categories - evolutionary light water reactors, (evolutionary LWRs), advanced LWRs and advanced non-LWRs.

Evolutionary LWRs are improved designs of the current 1300 MWe class of boiling water (BWRs) and pressurized water reactors (PWRs). These reactors have been under development since the early 1980s and incorporate the proven design features of today's worldwide LWRs, as well as improved operability, capacity factor, safety, reliability and reduced occupational exposure and costs. In 1987, Tokyo Electric announced its decision to fund two evolutionary 1300 MW BWRs. Evolutionary PWRs are also available for construction in the 1990s.

Advanced LWR designs are being developed by several groups in consortia. These designs include:

1) The 600 MWe simplified BWR being developed by General Electric, Bechtel and Massachusetts Institute of Technology with participation by the Department of Energy (DOE) and Electric Power Research Institute (EPRI);

2) The 600 MWe advanced PWR being developed by Westinghouse, Avondale Shipyards, Bechtel and Burns & Roe with participation by DOE and EPRI;

3) The 140 MWe Safe Integral Reactor (SIR) being developed by Combustion Engineering, UK Atomic Energy Agency and Rolls Royce.

These advanced LWR designs incorporate passive safety systems, simpler cooling systems and modular construction. These features are expected to result in stabilized licensing requirements, reduced construction costs and schedule, and improved reactor safety. Development of ALWR designs began in late 1989 with the goal of receiving design certification from the NRC in 1994. Commercial operation of the first ALWRs is expected in the early 2000s.

Two advanced non-LWRs are currently being developed. One of these is the liquid metal reactor being developed by General Electric under DOE sponsorship. The LMR design incorporates both passive reactor control and passive core cooling. The LMR plant design consists of three 155 MWe reactor modules which are small enough to be shop fabricated and shipped by rail or large truck. The LMR would use metallic fuel and liquid sodium coolant. The metallic fuel "breeds" producing more fissionable isotopes than it consumes, thereby extending existing uranium resources by a hundred-fold. LMRs also offer the potential for dramatic reductions in long-term high-level nuclear wastes. Conceptual design for the LMR is scheduled for completion by 1991 but commercial availability is unknown at this time.

The other non-LWR being developed is the modular high-temperature gas-cooled reactor (MHTGR). A MHTGR conceptual design has been completed by GA Technologies with funding from DOE and assistance from Gas-Cooled Reactor Associates. The power plant would use four MHTGR modules to provide a generating capacity of 538 MWe. To form the reactor core, small grains of nuclear fuel particles are coated with multiple layers of heat resistant ceramics and then bonded to form fuel rods that are sealed into graphite blocks. The result is a reactor that can operate at high temperatures but still remains well below the failure point of the fuel particles even with depressurization and loss of cooling. The Department of Energy (DOE) approved a DOE budget of $165 million for financial year 1991 for the design of a 350 MWT Modular High Temperature Gas Reactor (MHTGR) for DOE's New Production Reactor (NPR) for tritium production for nuclear weapons. $17 million of this budget is designated for development of the commercial version of the MHTGR. It is expected that experience with this modified military reactor will contribute significantly to the development of a commercial version of the MHTGR.

FINDINGS

Designs of the Evolutionary Light Water Reactors (Evolutionary LWR's) are progressing. It is expected that these designs will be submitted to the Nuclear Regulatory Commission for certification in late 1992.

Overall interest and activity in promotion of nuclear power is low in the area served by Puget Power. However, Puget Power continues to monitor and encourage public information on nuclear issues.

Locally, the Trojan plant, operated by Portland General Electric, has received media coverage related to the extended period of maintenance at the plant, the economic feasibility of bringing the Trojan plant to operating status and the loss of a significant power resource in the region.

In addition, there is the ongoing citizen criticism of Trojan and expectation that another initiative will appear on the Oregon election ballot to close the plant until a suitable high-level waste site can be assured.

The Committee for Energy Awareness (CEA) has sponsored tours of nuclear experts visiting media in the Pacific Northwest. These visits usually result in modest exposure of the issue in the media.

The announcement of a breakthrough in fusion technology by a team of European scientists renewed interest from the media. While there has not been significant inquiry from local journalists, the story did get good play in both print and broadcast as well as editorial comment.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Tokyo Electric Power Company has recently ordered the construction of two Evolutionary Boiling Water Reactors of the 1300 MWe class. These reactors have been under development since the early 1980s and incorporate the proven design features of today's worldwide LWR's as well as improved operability, capacity factor, safety, reliability and reduced occupational exposure and costs.

The Department of Energy has initiated characterization studies of the Yucca Mountain site in Nevada for the permanent high-level waste (spent fuel) repository. These studies may take as long as 7 to 10 years to complete. DOE is considering construction of temporary monitored retrievable storage if it becomes impossible to construct the high-level waste repository in time to accept spent fuel from the operating nuclear plants which will have reached spent fuel storage capacity by about 2010.

2.0 SUPPLY ALTERNATIVES

ACTION ITEM 2.8

Continue plant modernization activities and cost-effective energy efficiency improvements.

DESCRIPTION OF ACTIVITIES

COLSTRIP & CENTRALIA REPORT
PERFORMANCE UPDATE
JUNE 30, 1991

I. COLSTRIP 1 AND 2

1. PERFORMANCE - The average combined heat rate for both units in 1988 was 11,422 btu/kWh, improving to 11,021 in 1989 and 10,909 in 1990. This represents a total improvement over the two year period of 513 btu/kWh, which translates to approximately $1.2 million savings to Puget Power in fuel costs over the two-year period. There would be other savings in O&M and/or equipment replacement costs, which are nearly impossible to quantify.

2. BOILER CLEANING - The inside of the tubes of both boilers were cleaned of scale during 1990, resulting in removal of over 6 tons of iron, one ton of copper and lesser amounts of nickel, zinc, magnesium and silica. The affect should be more efficient boiler operation and fewer tube failures.

3. PLANT LOAD LIMITATION STUDY - A study to develop a recommended plant load for both units was completed in 1990. The study showed that both units are boiler limited. Reductions in boiler efficiency and turbine efficiencies through the years require the boiler to fire harder than design for maximum generation. The current load limit recommendations are based on boiler maximum continuous capacity energy input. Currently, this criteria limits Unit 1 to 335 MW gross and Unit 2 to 344 MW gross, resulting in lowering the outage rate, improving availability and increasing net energy output.

   A water induction event in July 1989 is believed to have sufficiently damaged the high pressure section of the turbine to reduce its efficiency by about 2.5%. An HP/IP turbine overhaul in the spring of 1991 should gain back this loss, allowing the above load limitations to be increased somewhat, based on improving the efficiency of the steam cycle.

4. TURBINE PACKING LEAKAGE TESTS - Results of the packing leakage tests revealed that Unit 1 and Unit 2 turbines have internal leakage rates of approximately 7 to 8.5% of reheat flow. Design leakage is 2.0% of reheat flow. Unit 1 and Unit 2 IP turbine efficiencies are approximately 81% and 87.5% respectively. Design IP efficiency at full load is 91%. Unit 2's packing was replaced during the 1990 overhaul. However, this packing has been rubbed out significantly in the short time it has been in service. This problem was corrected during this year's planned major overhaul.

5. SPARE SCRUBBER REHEATER PANEL - The stainless steel reheater bundle that was purchased in 1990 has been in service since November 1990. Inspections are showing that the bundle is holding up in the environment. More detailed inspections were conducted during this year's Unit 2 annual outage with encouraging results. It is hoped this will be the solution to most of the severe problems with the scrubber reheaters since initial plant operation.

6. PLANT COMPUTER UPGRADE - Conversion of inputs from the Unit 2 data logger to the new plant computer started in January 1991 and was completed in the spring.

II. COLSTRIP 3 & 4

1. PERFORMANCE - The average combined heat rate for 1988 was 10,427 btu/kWh, compared to 10,543 for 1989 and 10,716 for 1990. This represents a total combined deterioration in heat rate over the two years of 289 btu/kWh, which translates to approximately $0.6 million in increased fuel cost to Puget Power over the same period. During this period, most of the efforts to improve performance were concentrated on Units 1 & 2, since this appeared to be where efforts would result in the quickest and greatest returns. Fortunately, Units 3 & 4 have already gained most of this efficiency loss back, since for the year-to-date through March 1991, the combined heat rate for both units was 10,468 btu/kWh. With the new computer system now on line, as soon as the software packages are completed and in place, the plants' performances will be tracked on a real time basis. More details are outlined in #5 below.

2. BOILER CHEMICAL CLEANING - The inside of the tubes of both boilers were chemically cleaned in 1990, yielding over 11 tons of iron, almost 2 tons of copper and lesser amounts of nickel, zinc, calcium, magnesium and silica. As a result, the boilers should operate more efficiently and experience fewer tube failures.

3. BOILER WATER CIRCULATING PUMP (BWCP) PROBLEMS - A significant reduction in BWCP differential pressure has been observed on both units. At full load Unit 3's BWCP differential pressure is running at about 23 psi and Unit 4 is running at 27 psi, compared to design of about 40 psi. The data indicates some degradation in the system, caused by either reduced BWCP performance, wear on ring header flow distribution orifices or a combination of both factors. This problem was resolved during this year's scheduled spring overhaul.

4. SMOKELESS IGNITORS - Combustion Engineering completed the design for the new smokeless warm-up guns which were installed on Unit 4 during the annual overhaul this spring. The new design should help reduce opacity to acceptable levels during startup of a cold boiler.

5. PERFORMANCE MONITORING - The continuous performance software was placed into service on the new plant computer during January 1991 on Unit 3. The performance program calculates unit and equipment efficiency numbers every 5 minutes. Efforts are continuing to work on this program to design useful display screens for the operators and retrieval logs for the personal computer network.

6. STANDARD OPERATING PROCEDURE REVISION - A review committee, representing the Engineering, Operations, I & C and the Training department has been established to expedite review of all plant operating procedures. Thus far, the Service Water, Seal Oil, Circulating Water and Bottom Ash systems have been reviewed, rewritten and issued for executive approval.

7. NEW ROTOR AND ROTOR REWIND - Efforts are underway to purchase and install a new main generator rotor for Unit 4 by the spring overhaul of 1993. This will be followed by a rotor rewind complete with new retaining and zone rings forged with the latest materials and design for installation in Unit 3 by spring 1994. This will solve the problems of stress corrosion cracking of the retaining rings and tooth top cracking of the rotor and leave one spare rotor in storage for both Units 3 and 4.

III. CENTRALIA

1. PERFORMANCE- The net combined heat rate for the two units in 1988 was 10,494 btu/kWh, compared to 10,474 in 1989 and 10,512 in 1990. This translates to a net fuel savings to Puget Power for the two year period of approximately $5,300. This is a very small savings compared to the total dollars spent for fuel over the two year period. It should be noted that the potential for improvement compared to design heat rate is small.

2. NEW SECTOR PLATES FOR AIR PREHEATERS - New adjustable hot-end sector plates were installed on the air preheaters on Unit 2 in 1989 and on Unit 1 in 1990. This has the affect of reducing the air crossover from the primary air to the flue gas sectors, resulting in more efficient primary fan operation and a slightly better plant heat rate, everything else being equal.

3. REPLACE GENERATOR ROTOR RETAINING RINGS ON UNIT 1 - Two independent inspections conducted during 1989 found evidence of excessive pitting due to corrosion on both Unit 1 main generator rotor retaining rings. Pitting was evident to a lesser extent on the zone rings. Such stress-corrosion pitting usually leads to the formation of cracks, which in some cases have led to catastrophic failures. Failure of a retaining ring usually necessitates rewinding the generator stator and rotor, plus repair of stator core iron, structural parts, and the rotor shaft itself. Westinghouse's recommendation is to replace both generator rotor retaining rings and all five rotor zone rings. The material would be upgraded from 18Mn/5Cr to 18Mn/18Cr. The new alloy is resistant to stress corrosion cracking. Forgings were purchased in 1990 and will be installed in 1992.

4. COOLING TOWER UPGRADE - Prompted by deterioration identified during tower inspections, an engineering evaluation of tower conditions was completed in 1988 on Unit 2. Tower replacement is required at this time due to reduced effective section sizes caused by surface rot and a 40% decrease in wood strength. Some tower members are now stressed at three times their allowable capacity. There is essentially no factor of safety remaining and localized column buckling is expected to begin soon. Construction was completed in 1991 during Unit 2's eight week spring overhaul. Unit 1 towers are scheduled to be replaced during the planned four week overhaul in 1992.

5. PULVERIZER AIR FLOW CONTROLS & INSTRUMENTATION UPGRADE The air flow controls for the eight pulverizers of Unit 1 were all converted to the Bailey Net 90 System in 1989 and 1990. Associated instrumentation was upgraded as well. Evaluation of the modified air flow controls and instrumentation indicated substantial savings. Displays, trends, and logs provide plant personnel immediate and long term documentation for optimizing pulverizer operation and maintenance. Air flow adjustment through the old controls had to be done manually and could not be done automatically because of limitations in the old Hagan system. As a result, pulverizer air flow was frequently not uniform and tended to run higher than required. The Bailey Net 90 configuration automatically adjusts air flow to setpoint. The Bailey Net 90 configuration also eliminates RTD's and Hagan Transmitters which have caused load swings and abnormal air flow indications which create a high potential for pulverizer fires. The Hagan hot and cold air damper controls are also subject to saturation which causes slow air flow control response. The new system eliminates the control saturation problem. The Bailey Net 90 configuration is scheduled to be installed on the Unit 2 pulverizers in 1991.

6. THERMAC PERFORMANCE MONITORING SYSTEM - Thermac, a performance monitoring package, is scheduled to be installed at Centralia in 1991. The Thermac system will calculate efficiency changes for all the operating parameters and individual plant components. It also includes a boiler fouling monitor which will serve as a guide to optimize sootblowing, as well as on line "what if" capability to evaluate operating changes. All information is readily accessible by the operators via pulldown menus with a "point and click" approach. When in place, this monitoring system will provide the opportunity to optimize operations from a most efficient performance point of view.

7. UPGRADE PLANT INCANDESCENT LIGHTING - There were 1180 main plant building incandescent lighting fixtures which required frequent relamping. These fixtures were replaced with more efficient high pressure sodium fixtures during this spring's scheduled annual overhaul. Half as many high pressure sodium fixtures are now supplying more light, reducing auxiliary load by 88.5 kW and reducing bulb replacement costs by $12,000 per year.

IV. HYDRO & THERMAL

Puget Power will continue to monitor both hydro and thermal maintenance data to arrive at a combination of preventive and predictive maintenance programs. The company will examine each plant and plan to bring each plant up to a consistent level of monitoring and control. This will be a multi-year effort and a sequenced plan of action is being formulated. Puget Power has taken a staged approach to achieve the desired objective which is to maximize availability of generating units at the lowest cost for maintenance.

Steps concluded to date are:

1. **The development of a system to codify various operations and maintenance activities.** Each of the five major hydro generating plants are in various stages of implementation. White River and Electron plants have completed initial phases of implementation while Baker River is currently undergoing the data gathering phase. Snoqualmie plant will be delayed pending completion of relicensing activities.

   Each plant: White River, Electron, Lower Baker, Upper Baker, Snoqualmie and other company-owned generation has begun or will begin to implement the system by delineating all O&M activities and assigning staff-hour requirements and material needs to these activities either from direct experience or estimates. The activities are then scrutinized for various reasons and attempts will be made to achieve homogeneity among like tasks at each plant. The procedures used to perform the various O&M activities will likewise be examined. Activities requiring inordinately high amounts of labor or materials will be reviewed for appropriateness, equipment replacement or process revision to reduce costs. The implementation of the system is presently done manually and will by the end of 1991, utilize computer aids to reduce record keeping, schedule activities and provide additional analysis capability.

2. **Thermal sites, mainly the four combustion turbines and Crystal Mountain diesel, are assembling a maintenance plan much like the one being developed at the hydro plants.** Puget Power operates eight combustion turbines built by three separate manufacturers. These units are not run continuously and demand for their operation is caused by different factors including local area support, Puget Power's system needs, and territorial requirements. The company has chosen to categorize all O&M activity and as with the hydro plants, assign labor and material requirements to each. This will allow Puget Power to provide sufficient staffing to complete all necessary O&M activity.

3.0 TRANSMISSION AND DISTRIBUTION

ACTION ITEM 3.1

Continue to pursue transmission access and strengthen the existing transmission system.

Engage in efforts to broaden regional transmission access. These efforts include the intertie to B.C. Hydro and the participation in the Third AC line to California.

DESCRIPTION OF ACTIVITIES

BPA/Puget Power N.W. Washington Transmission Project (formerly B.C. Hydro Intertie)

The BPA and Puget Power have agreed to a new Plan of Service for a joint project in Whatcom and Skagit Counties. This joint project is intended to meet the following objectives:

- Increase transfer capacity both inter-regionally between Canada and northwestern Washington and within the Puget Sound region
- Improve local and regional reliability

Third AC Intertie and California/Oregon Transmission Project (formerly Third AC line to California)

The facilities required for an additional 500 kV AC line to California are divided into two major projects. The first project, which has been called the Third AC Intertie, is comprised of facilities located in Oregon. Facilities for the second project, which has been named the California/Oregon Transmission Project (COTP), will be located in Northern California. The projects will connect to each other and the present facilities of the Pacific AC Intertie at a new substation called Captain Jack, which is located near the southern Oregon border. Concurrently, Puget Power has committed to an ownership share if BPA offers a non-Federal participation in the Third AC Intertie.

FINDINGS

BPA/Puget Power N.W. Washington Transmission Project

BPA and Puget Power undertook a joint technical review of various transmission alternatives intended to meet the objectives of the N.W. Washington Transmission Project. The final plan calls for a combination of existing facility upgrades and new construction. Bonneville will replace the 230 kV line on its right of way between its Custer substation and Puget Power's Sedro Woolley substation with a new 230 kV double circuit, which may be constructed to 500 kV standards. From BPA's Bellingham substation, Puget Power will rebuild the BPA Bellingham #2 115 kV line and loop the Bellingham-Kendall 115 kV line in and out of the BPA Bellingham substation. A 300 MVA 230-115 kV transformer will be installed at BPA's Bellingham substation.

BPA will become the lead for the NEPA environmental review process that was originally begun by the Department of Energy under Puget Power's Presidential Permit application. The Department of Energy agreed to suspend that application at Puget Power's request because of BPA's plans to take the lead on the environmental review. The company will file permit applications for its portion of the project. These permit applications will trigger a local environmental review under SEPA.

Scoping hearings for the environmental review process are scheduled for late January 1992, with one hearing in Whatcom County and one hearing in Skagit County. The project is scheduled for completion in mid-1996.

Third AC Intertie & California/Oregon Transmission Project

There is substantial regional utility and environmental support for the construction of an additional 500 kV AC line for the Pacific AC Intertie. These two groups both recognize the advantage of further utilizing the seasonal load diversity between the Pacific Northwest and the Pacific Southwest.

Both of the new construction projects are required to upgrade the power transfer capacity of the Pacific AC Intertie from its present 3200 MW rating to a 4800 MW rating. All of the system and design engineering studies have been completed, equipment is being ordered and construction has been started in several locations. Construction is expected to be completed in November of 1993.

Aside from work related to construction of the project, there are two primary activities that are receiving attention. First, there is some local opposition to the construction of part of the new line in Eugene, Oregon. BPA is the lead agency for construction of the Third AC Intertie, so it will conduct the local permit hearings; the expectation is for a positive outcome.

The second non-construction activity involves determining which utilities will actually have an ownership interest in the new line. BPA is in the process of conducting an Environmental Impact Statement. This process will be used to determine whether it should allow non-Federal participation in a 725 MW share of the Third AC Intertie. BPA singled out this option as a preferred alternative in the Environmental Impact Statement. As part of this Environmental Impact Statement process, BPA solicited the region's utilities and received requests for 1070 MW at an offering price of $215/kW. Puget Power has committed to a 400 MW share if non-Federal ownership is offered, under a Memorandum of Understanding that defines the structure of such a share. As BPA finishes its Environmental Impact Statement process, it will develop an allocation methodology to address current over-subscription. Puget Power's actual involvement in the process will be to actively pursue its requested amount.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

BPA/Puget Power N.W. Washington Transmission Project

With the joint technical study completed, future work depends on the outcome of the environmental review process. As mentioned, the project is scheduled for completion in mid-1996.

Third AC Intertie & California/Oregon Transmission Project

It appears that local opposition to the Third AC Intertie in Eugene, Oregon will not threaten the entire project and resolution should be attainable. On the question of non-Federal ownership, Puget Power needs to continue its efforts to ensure that the preferred alternative is offered. The project is scheduled for completion in November of 1993.

3.0 TRANSMISSION AND DISTRIBUTION

ACTION ITEM 3.2

Explore the feasibility for using targeted conservation programs to reduce T&D system requirements in high load growth areas.

DESCRIPTION OF ACTIVITIES

As part of the Northwest Power Pool Coordinating Council, Puget Power has agreed to reduce demands upon the cross mountain transmission system under certain emergency conditions. The strategy involves shedding load throughout the service area at the transmission system level. In order to provide advance notification of an impending curtailment need, Puget Power is developing an early warning system to alert large commercial and industrial customers. The system will solicit their voluntary participation in load relief efforts.

A focus group was formed to suggest and apply techniques for estimating the impacts of demand-side measures on the T&D capacity requirements in a specific high load growth area. The team also reviewed Pacific Gas & Electric's integrated resource planning approach.

In order to save energy at the distribution level, a pilot project was initiated to purchase 25 kVA overhead distribution transformers with energy efficient amorphous steel cores.

FINDINGS

Load shedding programs at the transmission level have been installed to reduce up to 15% of the demand on the cross mountain transmission system during emergency conditions. However, the impact on customers can be severe. Puget Power will continue to pursue a load shedding strategy at the distribution feeder level, since this method could shed load more selectively. Currently the manually operated distribution system would respond too slowly to meet emergency curtailment requirements. Puget Power is gaining operational experience from a series of pilot projects related to the development of automated distribution management systems. Eventually, distribution management technologies will allow Puget Power to manage the load fast enough to handle emergency situations while being selective enough to minimize the impact on customers.

By targeting conservation efforts in specific high load growth areas, Puget Power will reduce the peak loads. Since the T&D system must be sized to handle peak loads, a strategy to invest in conservation measures to offset T&D construction costs is being considered. As distribution management capabilities improve, peak shaving strategies like load management and time-of-use rates may also be applied in areas where high load growth is expected. As a result, Puget Power may be able to defer some planned construction of new T&D capacity in the future. For this reason, demand-side management planning will be considered as part of T&D capacity planning. It is doubtful, however, that it is possible to defer T&D construction plans in high load growth areas that already have overloaded substations and feeders. Targeted conservation programs and load control programs have a lead time of a few years. The list of demand-side measures recommended for the specific area of the study is not applicable in other areas. An area-specific process is being developed that will review load growth projections, distribution of customer classes, T&D system design, supply-side options, marginal capacity costs and produce a list of recommended demand-side alternatives.

Randomly selected transformers from each shipment have been electrically tested as part of the incoming inspection process. The test results indicate that the no-load energy losses (those losses directly affected by the type and design of the core) are only 35% of the losses for comparable conventional silicon steel core transformers. Amorphous transformers will be tracked to determine their reliability on distribution system.

CONCLUSIONS AND IDENTIFICATION FUTURE WORK

Demand-side measures must be evaluated based on the requirements of specific areas. These measures must be matched to specific customer classes, load forecasts and T&D system constraints. Programs to reduce losses in the distribution system may have a significant impact on capacity requirements. Emerging distribution management technologies will allow Puget Power to increasingly exploit peak shaving measures. Conservation programs tailored to address the constraints in specific areas will reduce load growth and future T&D capacity requirements. The evaluation of demand-side management measures will be closely linked to T&D capacity planning efforts so that demand-side resources can be targeted to the needs of a region in order to build a reliable power delivery system at least overall cost.

3.0 TRANSMISSION AND DISTRIBUTION

ACTION ITEM 3.3

Continue to seek energy efficiency improvements in the Transmission and Distribution systems.

DESCRIPTION OF ACTIVITIES

Expansion planned and budgeted for construction in 1990 did not all get built because of permitting delays. No new transmission line miles were added to the system during 1990. Additions of 230 KV transmission were only partially completed as budgeted for 1990.

Puget Power is forming a Distribution Planning Group this year to work with the several divisions in the company for a more efficient distribution system. They will pay close attention to feeder loading and arrangements, load balancing of feeders and substations, and VAR requirements.

A pilot project was initiated in 1990 to purchase 200 25 kVA amorphous core distribution transformers annually. The purpose of the project is to obtain actual operating experience with this new transformer technology. Similar purchases will be made over a four-year period.

The amorphous design utilizes a type of steel in the magnetic core of the transformer that is very energy-efficient. Electrical tests performed independently by the manufacturer and by Puget Power on these units have substantiated this claim. The no-load energy losses (those losses directly affected by the type and design of the core) are only 35% of the losses for comparable conventional silicon steel core transformers. All of the amorphous core transformers purchased in 1990 have been installed and are being tracked to determine their reliability on Puget Power's distribution system. No failures have occurred to date nor have any problems in application been reported.

A purchase order for the second year's 200 25 kVA transformers has been placed for delivery of 40 units a month beginning in October 1991. The initial purchase cost and the total owning cost for both this and the 1990 order are higher than for similar silicon steel transformers. The total owning cost reflects the capital and operating costs borne by the ratepayers over the life of the device. The lowest total owning cost is normally the determining factor in selecting which transformers are purchased, as it represents the least cost to the ratepayer. The value of no-load energy losses used in the total owning cost formula was verified during the first quarter of 1991.

Separately from the four-year project, a portion of the 1991/1992 purchases of three-phase pad-mounted transformers will be of the amorphous core design. This decision was based primarily on economics. The total owning costs for certain sizes of this type of transformer are less than that for silicon steel units.

All of the amorphous transformers -- pad-mounted as well as overhead -- received during 1991 and 1992 will be tested and tracked in the same manner as the 1990 overhead units.

FINDINGS

The future holds no great promise for timely completion of planned transmission expansion to meet load. However, the rebuilding of transmission to larger conductors is being completed. Expansion of distribution and completion of new substations have kept pace with load growth.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The larger projects planned awaiting construction permits are:

- Talbot Hill-Berrydale 230 KV line and 230-115 KV transformer at Berrydale.
- Interconnections with BPA in Whatcom County improving import from BC Hydro.
- Completion of 230 KV line to March Point and 230-115 KV transformer at MP.
- Completion of 230 KV line, White River-Cowlitz, and Southwest to St. Clair, and 230-115 KV transformer at St. Clair.
- A 230-115 KV transformer at BPA/Bellingham or Puget Power/Bellingham substation.

Losses for the total transmission and distribution system is holding around seven percent based on annual GPI (Generation, Purchase and Interchange) compared with total energy billed to consumers.

An example of actual kilowatt loss improvement is that by completing the March Point 230 KV line and transformer, system losses will be reduced by approximately 2500 KW at a winter system peak load of 3970 MW. At the same time the system reactive losses are reduced by a hefty 25 MVAR.

3.0 TRANSMISSION AND DISTRIBUTION

ACTION ITEM 3.4

Initiate studies with others of potential voltage stability problems in the Puget Sound Basin.

DESCRIPTION OF ACTIVITIES

The Puget Sound area utilities and BPA have developed the voltage dependent load models for each distribution substation in the region. This activity was initiated to resolve the uncertainties of how area bus voltages would respond following a major cross-cascades line outage.

A second system test was performed by Puget Sound area utilities on February 26, 1991. As in the January 3, 1991 test, this was also intended to validate the technical assumptions that are being made in voltage stability studies.

The Puget Sound area utilities have agreed to install Under Voltage Load Shedding (UVLS) relays to mitigate the potential voltage stability condition. This problem is most likely to occur during heavy winter. Studies are continuing to determine the settings of these relays.

BPA and the area utilities have completed the studies required to determine the non-site specific capacitive MVAR requirement of the Puget Sound area system prior to 1993. The utilities have also identified a set of system reinforcement options and submitted their finding to the Puget Sound Area Electric Reliability steering committee.

The R&D work with the University of Washington on dynamic load representation for voltage stability studies is complete. The goal of this research project was to understand the effects of dynamic loads on MVAR requirements of the system following a major cross-mountain line(s) outage.

The Electric Power Research Institute (EPRI) RP1208 project is undergoing tests at Ontario Hydro. A 1993 heavy winter base case developed by the Puget Sound Area utilities is being used as a test case to study the voltage stability problem.

A contract has been signed with General Electric (GE) to study the voltage stability problem using a recently developed methodology by GE. A 1993 heavy winter power flow and stability data was sent to GE in early June for this purpose.

FINDINGS

The aggregate Puget Sound area loads as determined by the EPRI LOADSYN program was found to be about 56% resistive (constant impedance) load during heavy and normal winter conditions. Power flow simulation studies showed that this voltage dependence of loads produced a significant load reduction during a major outage.

During the February 26, 1991 test, Puget Power's system load dropped 3.5% following the intended outage of Coulee - Raver 500 kV lines and switching of one 329 MVAR reactor at Raver. This load drop was due to voltage sensitivity of various types of loads in the area served by Puget Power. The largest voltage drop occurred in the central divisions and were approximately 4%. The voltage drop in Northern, Western and Southern Divisions was approximately 2%. Power flow simulation studies for the January 3 and February 26, 1991 system tests reasonably predicted the voltage response and the load reduction for the Coulee - Raver 500 kV double line outage.

The research and development work by UW and EPRI indicate that load dropping can be used to mitigate voltage stability problem in the Puget Sound Region. However, these studies have also shown that the rate of change of voltage (dv/dt) has a significant impact on the effectiveness of load shedding to arrest an impending voltage stability event.

Studies have shown that the Puget Sound Area is capacitive VAR deficient by about 1000 MVAR by the winter of 1993. These studies were not site-specific and did not as of yet determine an optimal location for capacitor placement.

CONCLUSIONS AND IDENTIFICATION FOR FUTURE WORK

The system voltage tests have helped remove some of the major technical uncertainties. During these tests the Load Tap Changers (LTC) restored load and substation voltages to near predisturbance level within 2-3 minutes.

From the system test and power flow simulation results, the aggregate Puget Sound area load is slightly more resistive than the amount determined by the EPRI LOADSYN program. Because of this significant voltage sensitivity of loads, the voltage collapse scenario for this region would most likely develop after the LTC action following a major disturbance.

Based on the two system tests and the simulation work that followed, reactive requirement measurement study method (Q-V curve analysis), with constant MVA load model can be used to judge the relative merits of various reinforcement options being proposed to solve the Puget Sound Area voltage stability problem.

The research and development work has clearly identified the need to review the proposed UVLS settings with a mid/long term dynamic simulation program like the RP1208. This activity is currently continuing.

4.0 REGIONAL INVOLVEMENT

ACTION ITEM 4.1

Participate in regional studies and analyses as appropriate, including:

Evaluate regional Direct Services Industries top quartile service relative to firm and non-firm requirements.

DESCRIPTION OF ACTIVITIES

BPA's power sales contracts with its direct service industry (DSI) customers provide that the top quartile of their load is to be served with other than firm energy. BPA implements this service through its rate schedules and through annual operating plans for DSI service.

Over the past few years, the DSIs have requested increasingly higher quality of service to their top quartile loads. BPA has provided this higher quality service, as the revenues from these sales are higher than from BPA's other alternatives. This service has included "borrowing" of firm energy from future years through earlier draft of reservoirs and providing the DSIs a first priority on surplus firm power supplies. However, increasing the quality of DSI service decreases reduces the amount of firm power capability available to Puget Power and other utilities through the Pacific Northwest Coordination Agreement (PNCA) and in the wholesale power market. Further, Industrial Replacement Energy (IRE) agreements between BPA and the DSIs which allow continued service to the top quartile loads, even when direct nonfirm service is not available, tend to place the DSI loads in competition with the firm loads of Puget Power and other utilities for limited and costly spot market power supplies.

In various PNCA forums, Puget Power is insisting that the DSI loads be afforded no special priority for borrowing of firm energy. Puget Power also monitors development of BPA's annual DSI operating plan and raises issues which may effect future firm power service to Puget Power. Further, Puget Power is monitoring the development of new IRE agreements and will attempt to ensure that they treat DSI load as "last added" to ensure that regional firm loads receive first call on lower priced spot market energy. Puget Power is also monitoring BPA's plans to renegotiate the DSI power sales agreements and will raise its issues in these forums. Further, Puget Power will ensure that the DSI top quartile load is treated appropriately in a proposed regional energy sharing agreement which is being developed for implementation during periods of region-wide energy insufficiency. The proposal is currently referred to as the "Share the Shortage" Agreement.

As of June 30, 1991, several issues relative to quality of service to DSI top quartile loads have arisen in connection with the aforementioned regional Share the Shortage Agreement proposal and in connection with regional efforts to provide enhanced spring streamflows for migrating salmon.

FINDINGS

Both programs mentioned above are expected to decrease the availability of energy for DSI loads.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

BPA has agreed to conduct a public process to evaluate a DSI proposal to assure a particular level of service to top quartile loads. Puget Power will participate in this process and provide comments to ensure that the DSI loads share appropriately in the burdens of these programs.

4.0 REGIONAL INVOLVEMENT

ACTION ITEM 4.2

Participate in regional studies and analyses as appropriate, including:

Explore Columbia Storage Power Exchange (CSPE) options.

DESCRIPTION OF ACTIVITIES

The Columbia Storage Power Exchange (CSPE) is an arrangement through which various utilities in the Northwest purchase shares of the downstream power benefits to which Canada is entitled pursuant to the 1961 Treaty relating to cooperative development of the Columbia River Treaty. Power from this arrangement will undergo a phased expiration over the period 1998-2003. Absent other arrangements, the downstream power benefits, as they are determined pursuant to the Treaty, will be then be delivered to Canada. Also related to the Columbia River Treaty, efforts were made to renew the Pacific Northwest Coordination Agreement, which expires in 2003. This agreement provides for coordinated planning and operation of all major Northwest hydroelectric projects to maximize firm energy production.

FINDINGS

Puget Power is involved with other owners and purchasers of power from the non-Federal Mid-Columbia projects in a cooperative effort to renegotiate various treaty-related contracts which expire concurrently with the termination of the CSPE sale. These negotiations will determine Puget Power's obligation to participate in the return of downstream power benefits to Canada, if any.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Although it is quite possible that Canada will have firm power resources available for sale to the U.S. utilities, Canada's willingness to renew the sale of its downstream power benefits is uncertain at this time. However, Puget Power and other non-Federal utilities will continue to pursue this and other mechanisms for purchase of low-cost resources from Canada.

4.0 REGIONAL INVOLVEMENT

ACTION ITEM 4.3

Participate in regional studies and analyses as appropriate, including:

Continue efforts to ensure long-term supply from Mid-Columbia generating plants.

DESCRIPTION OF ACTIVITIES

Puget Power continues to work closely with the Mid-Columbia Public Utility Districts to foster a cooperative environment for contract extension discussions. Preliminary discussions have already begun with Grant County PUD for the extension of both the Priest Rapids and Wanapum power purchase agreements. Douglas and Chelan County PUD have expressed an interest in contract extensions but feel that discussions would be more fruitful at a later date. Puget Power and the other power purchasers continue to cooperate with the Mid-Columbia Public Utility District's ongoing capital improvement plans by providing engineering review and financing assistance. In addition, new relicensing regulations tend to favor the granting of a new license to the utility who originally paid for the project. Puget Power and the other purchasers may be in a good negotiating position with the option to file on the projects in the event existing contracts are not extended.

FINDINGS

Grant County PUD completed the first draft of an extension agreement in 1991. Upon review by its Commission, the preliminary discussions of the Priest Rapids and Wanapum Power Sales Agreements will likely begin in the Fall of 1991. Chelan and Douglas PUDs have not made any proposals regarding contract extensions to date.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Set a timetable with Grant PUD for negotiation of new contracts or extension of the existing Wanapum and Priest Rapids Power Sales Contracts.

Review, analyze and discuss/negotiate the extension agreements with respect to Wanapum and Priest Rapids.

Continue to work closely with the Mid-Columbia Districts to foster a cooperative environment for contract extension discussions.

4.0 REGIONAL INVOLVEMENT

ACTION ITEM 4.4

Participate in regional studies and analyses as appropriate, including:

Continue to participate in regional power and economic planning.

DESCRIPTION OF ACTIVITIES

Representatives from Puget Power routinely attend meetings of the Pacific Northwest Utilities Conference Committee, the Northwest Regional Power Planning Council, the Intercompany Pool, the Northwest Power Pool and the Bonneville Power Administration (BPA). These organizations exist to, among other things, provide a forum where constructive regional power planning can take place. Puget Power's representatives have provided valuable insight in many of these forums as well as receiving constructive comments from other members.

FINDINGS

Participation in regional studies and analyses provides benefits to Puget Power and Puget Power's customers as well as to other regional utilities.

Participation in these activities has proven to be an effective and efficient means to exchange thoughts and ideas, and to achieve high quality results.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Participation in regional activities has resulted in lower costs to ratepayers. BPA's 1991 rate case initially proposed an increase in wheeling rates of approximately 40%. Through utility participation in BPA's rate case many valuable thoughts were exchanged which resulted in a reduction of the proposed 40% increase to approximately 16%.

Puget Power must continue to actively participate in regional activities.

5.0 LEADING INDICATORS AND MONITORING

ACTION ITEM 5.1

Assess quarterly the economic growth and determine customer load growth demands. Issue reports and interpret this economic development relative to future energy resource availability needs.

DESCRIPTION OF ACTIVITIES

Weather-adjusted system sales grew 3.0% during the first three quarters of 1991. This is nearly identical to the 2.9% growth rate observed the previous year. The sales forecast continued to perform well, with weather-adjusted sales exceeding forecast sales by only 0.3% during the first three quarters of 1991.

Sales and Customer Growth

While the growth rate for residential sales remains nearly unchanged from last year, commercial sales growth has accelerated while industrial sales growth has slowed. During the first three quarters of 1991 weather-adjusted residential sales grew at a 1.9% rate, nearly identical to the 1.8% rate observed the previous year. Use per customer has continued to decline in 1991. Following the trend of recent years, use per customer will decline by about 200 kWh this year.

The commercial sales growth rate nearly doubled, increasing from 3.2% to 6.0%. This acceleration of growth has not been concentrated in one or two commercial business types; rather, it has occurred throughout the commercial sector. This acceleration of commercial sales growth reflects the increase in demand for commercial services caused by the rapid population growth of recent years.

The industrial sales growth rate during the first three quarters was only 1.3%. In 1990 industrial sales grew at a 4.7% rate. The two primary causes of this drop have been the closure of a steel plant and reduced electricity consumption by petroleum refineries during the third quarter. Transportation equipment continues to account for over half of industrial sales growth. Other industries showing significant sales increases include food processing, chemicals and paper & allied products. While customer additions during the first three quarters fell from 20,656 last year to 16,817 this year, they remain well above the average experienced over the past ten years.

Forecast Tracking

The sales forecast continued to perform well, with forecast sales exceeding weather-adjusted sales by only 0.3% during the first three quarters of 1991. The forecast of customer additions remains low, with actual customer additions exceeding forecast additions by 1,887. This error has been declining in recent months with the slowing of the local economy.

5.0 LEADING INDICATORS AND MONITORING

ACTION ITEM 5.2

Track success with competitive bidding using acquired energy and capacity costs and on-line dates.

DESCRIPTION OF ACTIVITIES

Puget Power completed its first competitive bidding evaluation process in February 1990 and issued another Request for Proposals in September 1991. In total, Puget Power has contracted for ten non-utility projects representing 443 average megawatts of energy.

Five of the projects are generation resources. Puget Power has initiated a program to track the development of each of the generation projects. In addition to regular correspondence and conversations, Puget Power meets with each developer monthly to review the status of their project.

The success of the development efforts for the five generation projects varies. The 17 average megawatt Wheelabrator Pierce Waste-to-Energy Facility was terminated due to eroding political support in Pierce County. The 10 aMW Trans-Pacific Geothermal project has been experiencing some delays. The other three projects, the 143 aMW Encogen cogenerator, the 48 aMW addition to the March Point cogenerator, and the 215 aMW Tenaska cogenerator are all in the very early stages of development and seem to be progressing on schedule.

The first competitive bid also resulted in contracts signed for 10 aMW of conservation due to be delivered by 1993. However, there is some uncertainty about these resources because conservation anticipated for delivery in 1991 has not yet been received.

FINDINGS

Bid submissions totalled more than 1200 aMW, indicating that there is a market for non-utility resources. However, the real measure of the success of competitive bidding is whether bid projects can be developed on time and deliver power at the bid price over the contract term. So far, the results of the competitive bidding are inconclusive.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

It is too early to evaluate the success of Puget Power's competitive bidding efforts. Initial results of the bid are mixed.

Puget Power is continuing with its programs to monitor the progress of the competitive bid projects. This monitoring program may result in changes to future competitive bid solicitations.

5.0 LEADING INDICATORS AND MONITORING

ACTION ITEM 5.3

Develop indicators for measuring success in negotiating power purchases with others.

DESCRIPTION OF ACTIVITIES

The responses to Action Items 2.3, 5.2, and 6.1 discuss the status of competitive bid resources.

A successful power purchase contract with another utility would require that:

- The purchase is consistent with integrated resource planning goals.
- The price is competitive with alternatives, including bid resources, and is relatively stable.
- The supplier is experienced and can provide performance guarantees.
- Any required wheeling is available on appropriate terms.
- The power is supplied under the terms and conditions of the contract over the entire purchase period.

FINDINGS

As the regional surplus of the 1980's diminishes, so does the opportunity for long-term utility purchases. Indications are that the window of opportunity has, for now, passed for attractive, cost-effective, long-term utility purchases. Puget Power executed only one utility contract, the 300 MW seasonal exchange agreement with Pacific Gas & Electric Company, since the previous integrated resource plan.

For Puget Power's existing purchase contracts, the supplying utilities have consistently met contractual obligations.

Careful drafting of contractual terms is critical to ensure the original intent of the utilities is maintained, especially for long-term contracts.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Although the current long-term power market does not favor purchases, Puget Power should continue to monitor the market and include utility purchases as an option in its integrated resource plan.

More study is required regarding the comparative risks of utility purchases versus non-utility purchases. One important issue that should be investigated further is the additional cost to the purchasing utility of carrying reserves for bid projects. Puget Power's existing contracts have been successful. However, the final evaluation of each contract can only be done after the contract expires.

5.0 LEADING INDICATORS AND MONITORING

ACTION ITEM 5.4

Monitor regional natural gas prices. Track natural gas purchases and costs.

DESCRIPTION OF ACTIVITIES

The Fuels & Joint Project Administration (F& JP) staff has been in frequent contact with natural gas suppliers and transportation companies and follows natural gas prices and availability on an ongoing basis. (See Action Plan Item 2.4).

New reporting arrangements have been set up between F&JP and Puget Power's Purchasing department to record all fuel purchases. This reporting includes amounts of natural gas purchased, prices and suppliers. These reports are submitted quarterly. If fuel purchases become more frequent, the reporting will be adjusted.

FINDINGS

Gas prices are presently at their lowest point in several years. How long this situation will last is uncertain. Transporters and suppliers have told Puget Power that the demand for natural gas, particularly for power generation, will increase. Deregulation of the gas industry will continue to affect suppliers and transportation companies and purchasers.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Activities related to natural gas market analysis will be expanded. In addition, Puget Power is evaluating its present relationship with gas Local Distribution Companies (LDCs) who deliver gas currently to Fredonia and Frederickson.

5.0 LEADING INDICATORS AND MONITORING

ACTION ITEM 5.5

Monitor technological progress and innovations related to end-uses.

DESCRIPTION OF ACTIVITIES

Customer Programs constantly reviews new products designed to improve the efficiency of end-use. Some recent examples include:

- Helped to create a market for the highest efficiency water heaters in the marketplace by requiring an "Energy Factor" of .95 in the company's program, and incorporating the higher efficiency "plastic" water heater products as they become available.
- Worked closely with window manufacturers to develop high efficiency window products to meet ventilation requirements in multi-family construction.
- Designed a refrigerator efficiency program around products exceeding the 1990 Federal standards.
- Piloted innovative lighting improvements, especially compact fluorescents and motion sensors.
- Developed pilot for low flow showerheads to test models with highest customer satisfaction and acceptance.
- Piloted power conditioning/surge suppressor equipment for equipment protection.

Customer Programs staff has been actively involved in an EPRI Committee involved in stimulating technological progress and monitoring innovations related to end-uses in the industrial sector. A specific project involves the identification of a host facility in the area served by Puget Power for a super-conductivity storage device demonstration project. Two separate projects have been displayed — one at a large waste treatment facility and the second at a large wood products plant. Numerous customers and consultants have viewed the display.

5.0 LEADING INDICATORS AND MONITORING

ACTION ITEM 5.6

Monitor technological progress and innovations related to supply resources.

DESCRIPTION OF ACTIVITIES

The company continued to participate in the Electric Power Research Institute (EPRI). The company's monitoring of EPRI research in the areas of solar, geothermal, global climate changes, energy efficiency and new nuclear power technologies and waste disposal is described under Action Item 6.3. Additionally, quarterly reports are prepared which cover activities of interest to Puget Power related to solid waste.

MUNICIPAL SOLID WASTE
UPDATE REPORT

1. RECOMP CORPORATION - Bellingham, Washington

   RECOMP, a subsidiary of Bonneville Pacific Corp., and Battelle, Pacific Northwest Laboratory announced plans for the first commercial ash glassification plant in the United States. Recomp is developing Battelle's process for converting MSW ash into glass for use as an aggregate in construction. The company has planned to demonstrate the technology at its 100-TPD waste-to-energy facility in Bellingham, Washington.

   RECOMP purchased the incineration plant in January 1990 from Thermal Reduction Co. The plant, in operation since 1974, was refitted to meet environmental standards in 1986. Now, RECOMP has expanded the plant to handle composting and recycling; and, as a bonus, is growing 320,000 pounds of mushrooms annually for sale.

   Whatcom County generates 220 tons of garbage daily and the RECOMP plant, when in full operation, will incinerate 100 tons, compost 100 tons and recycle 20 tons. All that is left over is ash, which will be transformed into glass to be used for construction materials. Thus, there will be nothing left for the landfill. The electric energy produced from incineration is used to run the plant and the surplus (about 1.8 MW) sold to Puget Power.

2. CITY OF TACOMA

Tacoma City Light's garbage-burning power plant is much cleaner in fact than it appeared in theory, says a final study of the health risks posed by the controversial facility. Data from actual stack tests show air pollutants from the incinerator will cause about two cancer deaths out of 10 million long-term residents. That is well within state and federal standards and about 100 times lower than an earlier estimate based on theoretical projections of the plant's emissions.

The study also concludes the waste-to-electricity project will meet all new standards for toxic air pollutants, and that non-cancer health effects will be minimal.

The health risks assessment was the last hurdle the project needed to clear. In May 1991, the Tacoma-Pierce County Health Department issued a permit to burn garbage, has been added to the fuel mix during the summer of 1991. The plant is designed to burn a mixture of sorted garbage, wood waste and coal, generating steam and producing up to 50 megawatts of electric power.

3. KING COUNTY

King County does not have any current plan to develop a waste-to-energy facility. However, King County has been examining a landfill gas power project at its Cedar Hills Regional Landfill for some time. The County issued a RFP for companies to submit proposals to purchase the gas and develop an electric generating project. Puget Power is the most likely purchaser of the power from such a facility and will follow the RFP process closely.

4. PIERCE COUNTY

Joe Stortini, Pierce County Executive Director, announced in May 1991 that the garbage incinerator proposal had been scrapped in favor of a new landfill to replace the Hidden Valley landfill. Hidden Valley is a federal Superfund cleanup site that the state Department of Ecology (DOE) has ordered closed.

The County and Wheelabrator had spent $2.5 million developing the incinerator proposal and negotiating the contract. The incinerator was to cost $81 million in capital and $15.54 million each year to operate, which translates to $58 per ton of solid waste. The new landfill is estimated to cost $6.1 million per year to operate and a total of $20 per ton to dispose of solid waste. The down side of a new landfill is that it can take up to 10 years to complete the siting and development process. The DOE has ordered Hidden Valley landfill to be closed by November 1991. The County may have to long-haul solid waste to a site outside the County until a new landfill can become operational.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.1

Analyze and evaluate the competitive bidding process

Evaluate the reliability and financial implications with power purchases from a large number of third party suppliers

DESCRIPTION OF ACTIVITIES

Puget Power has identified several issues of concern regarding purchases from non-utility suppliers.

1. Obligation to Customers - Puget Power places great emphasis on service to customers and operates its resources to ensure adequate supply to meet load. Non-utility projects may not share Puget Power's customer service perspective.

2. Project Cancellations - Not all planned projects will reach commercial operation, as evidenced by the termination of the Wheelabrator Pierce Waste-to-Energy project. Project cancellation, especially if the project is large, can affect Puget Power's ability to meet load.

3. Reliability - Puget Power does not have experience with the long-term reliability of non-utility projects. During a typical contractual term of 20 years, many changes to the business environment could occur. Some potential changes could make it difficult for the project to deliver power at the competitive bid price.

4. Financial Implications - Utilities with a large amount of non-utility purchases are coming under scrutiny from financial entities, especially where payments to such third party are at fixed prices. Rating agencies are increasingly viewing non-utility purchases as debt equivalents. Unless properly balanced with other considerations, this could adversely affect the company's credit rating.

5. Operating Flexibility - Thus far, Puget Power has contracted for non-utility projects which provide baseload generation. Operating concerns, especially the ability to follow variations in load, may cause Puget Power to increase emphasis on seeking dispatchable or peaking resources in the future.

In its competitive bidding process, Puget Power considered a project's ability to address some of the concerns listed above through non-price factors. Charles Rivers and Associates independently reviewed the company's process and made recommendations for improvements. The second competitive bidding RFP addresses some of these concerns more explicitly through contractual requirements designed to ensure projects reach commercial operation and operate reliably. Among the changes in the second competitive bidding process was the addition of security deposits in the prototype contract. The new generic contract also contains operating procedures that set forth more clearly how the utility interacts with the generation project.

FINDINGS

The risks associated with reliance on purchases of power from non-utility suppliers may become significant.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Some of the risks presented by purchases from non-utility suppliers can be reduced through rigorous bid evaluation and comprehensive contractual arrangements. However, it may not be possible to mitigate some risks, such as the potential effect to a utility's credit rating.

Puget Power will continue to develop its contractual arrangements and bid solicitations to address its concerns with non-utility projects.

Puget Power will study those risks that cannot be mitigated and determine an appropriate level of risk for the company.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.1

Analyze and evaluate the competitive bidding process

Prepare revised avoided cost schedules based on outcome of competitive bidding solicitation and integrated resource strategy.

DESCRIPTION OF ACTIVITIES

A new avoided cost filing was prepared for Puget Power's second competitive bid solicitation issued in September 1991. This new forecast was developed considering the price information received during Puget Power's earlier competitive processes and the load and resource situation that resulted from acquisition of bid resources.

In its second solicitation, Puget Power gave a 10% price credit conservation and renewable resources because of their low environmental effects. This credit is intended to encourage this type of resource in accordance with integrated resource planning goals.

FINDINGS

Puget Power's methodology for encouraging conservation and renewable generation resources was approved by the Commission on an experimental basis. The second solicitation is underway.

CONCLUSIONS

Puget Power's base avoided cost forecast was accepted by the Commission for the September 1991 competitive bid solicitation without much controversy. However, Puget Power's proposal for a 10% price credit for conservation and renewables, and the environmental externality issue in general, have been very controversial.

Puget Power will revise its base avoided costs again following completion of the competitive bid process in the Spring of 1992. The environmental externality issue is expected to become increasingly important and Puget Power intends to follow the issue closely. Environmental externalities will also be a subject for Puget Power's 1992 Consumer Panels.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.1

Analyze and evaluate the competitive bidding process

> Continue to work with communities and developers involved in waste-to-energy facilities.

DESCRIPTION OF ACTIVITIES

Inquiries from jurisdictions investigating waste-to-energy projects have been very infrequent recently. Some of the major cities and counties have decided to pursue other waste disposal options. The proposed Wheelabrator Pierce Waste-to-Energy Project is one example. This project was selected through Puget Power's initial competitive bid but was later canceled by the developer when county support was withdrawn.

Puget Power has received some proposals for landfill gas projects and has been discussing projects with several developers.

FINDINGS

Not many jurisdictions are pursuing waste-to-energy projects for solid waste management.

Landfill gas projects appear to be viewed more favorably.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Puget Power will continue to work with developers of waste-to-energy projects and will consider proposals for projects of this type through bidding.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.2

Seek continued involvement of Consumer Panels and Technical Advisory Committee in integrated resource planning studies.

DESCRIPTION OF ACTIVITIES

Consumer Panels

On June 5, 1990, the 1989 Consumer Panel members were asked to develop a mission related to integrated resource planning for the 1991 panel members to address. In the past, Puget Power developed the consumer panel mission regarding the integrated resource planning process as well as the related questions. Acknowledging their previous experience with the integrated resource planning process, Puget Power wanted their perspective regarding what future panel members should study related to integrated resource planning issues.

A special consumer panel letter from the Vice President of Corporate Planning was forwarded to a total of 75 panel members. These members were randomly selected from the various consumer panels throughout the area served by Puget Power. This letter included the 1989 Consumer Panel Integrated Resource Planning mission for review and requested thoughts and suggestions for the Consumer Panel's role during the next planning cycle.

FINDINGS

Summary Tabulation of 1991 Consumer Panel Integrated Resource Plan Recommendations

Major Theme	Number of Recommendations
Conservation	21
Generation Resources	11
Alternative Generation Resources	10
Rates	10
Communication	09
Policy and Planning	08
Load Shifting	04
Rebates	03
Total	76

Consumer Panels

Out of 75 solicitations, a total of 18 responses were received from the 1989 Consumer Panel members. The majority of the responses received suggested a Consumer Panel mission similar to that of two years prior. This mission called for the panel members to recommend what resources Puget Power should select for future resource acquisitions to meet the growing demand of electricity.

Taking into account their suggestions, the following Consumer Panel mission was presented to the 1991 Consumer Panels in January 1991:

> Puget Power's Integrated Resource Plan calls for the company to acquire conservation, small hydro and purchased power and strengthen the transmission system and transmission links to other systems. Puget Power is pursuing this plan. The above resources may not be sufficient to meet the growing demands of Puget Power's customers. What other options would the Panel recommend that Puget Power pursue and what criteria should be used to evaluate these options?

By June 1991 the various panels responded with a total of 76 recommendations. Details on these recommendations have been summarized in Appendix G (Public Involvement) of this document.

Technical Advisory Committee (TAC)
The first meeting of the TAC was held on June 14, 1990 kicking off the third cycle of Puget Power's Integrated Resource Planning. The schedule for this cycle of integrated resource planning called for nine TAC meetings (as opposed to the three meetings held in the second cycle). The nature of each meeting focused on a specific topic, rather than holding general meetings as done in the past. The following schedule lists the date and topic of discussion for each TAC meeting for the latest integrated resource planning cycle:

June 14, 1990	Kick-off meeting - scheduled/workplan
August 8, 1990	Sales forecast
October 8, 1990	Existing resources
November 27, 1990	Demand-side resources
January 29, 1991	Supply-side resources
March 12, 1991	Transmission
April 30, 1991	Supply-side resources
July 9, 1991	Regulatory Reform and Draft scenario analyses
October 29, 1991	Plan document and distribution schedule

FINDINGS AND CONCLUSIONS

Technical Advisory Committee (TAC)
The Technical Advisory Committee provided perspective and industry expertise on a variety of issues. This collaborative approach was found to be tremendously valuable.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.3

Continue EPRI support and encourage research in solar, geothermal, global climate changes, energy efficiency and new nuclear power technologies and waste disposal.

DESCRIPTION OF ACTIVITIES

The following are brief descriptions of EPRI R&D in five areas:

1. **Solar** – EPRI's solar program encompasses flat plate and concentrator photovoltaics (PV), solar thermal systems and wind energy. Although little opportunity exists for bulk power system photovoltaic and solar thermal energy in Washington, Puget Power will continue to support EPRI's solar program because of the possibility of exchanging solar PV energy with the Southwest.

   EPRI's goal is to establish flat plate and concentrator PV in distributed generation situations where the technology is competitive while improving cell and systems technology to broaden their application. EPRI is also testing PV cells and modules through the PVUSA consortium.

   However, the Pacific Northwest appears to have valuable wind energy resources that can be tapped by advanced, variable speed wind machines being developed by EPRI. Puget Power has been very active in supporting and encouraging national and regional wind energy research and demonstration. The company is investigating the feasibility of a commercial wind plant at a site in Central Washington.

   A Puget Power employee chaired EPRI's Storage and Renewables Task Force in 1991 and the company is the only electric utility represented on the Advisory Board of the National Energy Renewable Energy Laboratory in Golden, Colorado.

2. **Geothermal** – EPRI has supported geothermal binary cycle improvement, chemical analysis of steam and gasses and slim hole exploration techniques. However, geothermal energy technology is now established and research is now being directed to exploration and confirmation of the geothermal resource at specific sites by commercial operators.

3. **Global Climate Change** – The U.S. government has a large program of climate research in place, projected to exceed $300 million in 1991. With limited resources available, EPRI's research provides a complementary program in specific areas including an integrating framework, macroeconomics modeling, climate change and response models, and effects modeling. An Institute-wide planning framework to address the issue of global warming has been developed. The Environment Division leads this research which is divided into six segments.

   Five of these, an integrating framework, macroeconomic modeling, climate modeling, effects modeling, and carbon cycle manipulation (mitigation), will be undertaken initially to provide input into national and international assessment decisions. At the same time, the information gained from these analyses can be used effectively for the industry to develop plans for responding to either policy initiatives, or adaptation to change. The sixth component, utility planning, will provide analysis directly supporting electric utility planning needs.

4. **Energy Efficiency** – Full use of the most efficient end-use technologies would allow significant reduction in electricity consumption. Consumers in all three energy sectors - residential, commercial, and industrial – have been slow to adopt such advanced equipment. EPRI is working with manufacturers to get more energy efficient technologies on the market, and EPRI is providing marketing analysis and software to help utilities market energy services for efficiency and load management.

5. **Nuclear Waste and Spent Fuel Storage** – EPRI is working closely with DOE to help resolve issues of High Level Waste (HLW) Disposal and Spent Fuel Storage. The first draft of HLW Performance Assessment Methodology report has been completed and has substantially contributed to the DOE HLW program. Spent fuel pool storage and advanced dry storage issues are being addressed, including development of multi-purpose casks to address the lack of compatibility between DOE transportation casks and utility spent fuel storage systems.

Solar

FINDINGS

EPRI has been instrumental in lowering the cost of solar photovoltaic systems from over $1.00/kWh to less than 30¢/kWh. Wind energy is now close to being competitive with other forms of generation.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Solar photovoltaics may provide grid connected bulk power in certain geographic areas of the country early in the next century. However, the greater role for PV is supplying distributed energy to remote or inaccessible loads. Additional research, mass production and competition will likely make wind generated electricity competitive in the mid-1990's.

Geothermal

FINDINGS

Commercialization of geothermal energy is now more dependent on confirming resources at specific sites than on developing new technology. Puget Power accepted a geothermal bid which resulted from the 1989 RFP and sites are under commercial development.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

Future efforts by EPRI will consist of monitoring worldwide geothermal activities and progress to report to its member utilities.

Global Climate Change

FINDINGS

EPRI's macroeconomic research has indicated that costs for control and mitigation strategies are very large, therefore further refinement of consequences is appropriate for policy-makers.

Biomass accumulation and cycling of carbon is under investigation. Early results indicate that some approaches may be attractive for long-term management.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The majority of EPRI's program is in the early stages of research. Implementation of EPRI products may occur in two to three years. More likely five to ten years will be required.

Energy Efficiency

FINDINGS

EPRI has worked with appliance manufacturers to develop and commercialize several technologies with higher efficiencies than were otherwise available.

EPRI has also sponsored demonstrations and trained utilities in the applications of new and existing electrotechnologies and process optimization techniques that reduce energy consumption, increase productivity and/or improve product quality and aid U.S. industrial competitiveness.

EPRI continues to develop new technologies and applications with high efficiency characteristics and to create advanced demand-side planning tools and techniques that allow utilities to improve their program design and achieve higher customer participation rates for their energy efficiency programs.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

EPRI's work in developing high efficiency technologies has given the impetus to other manufacturers to join the high efficiency band wagon.

Future work is to continue to develop and commercialize other higher efficiency space heating and cooling, and water heating equipment in all customer sectors. More efficient technologies are also under development for the pulp and paper, aluminum and municipal water and sewage treatment industries.

Nuclear Waste and Spent Fuel Storage

FINDINGS

Horizontal Concrete Silo Storage -	Currently used by one utility for storing fuel; two others have purchased but not yet installed systems.
Fuel Consolidation -	One utility received NRC license approval, and implemented a two-to-one consolidation ratio for in-pool storage.
Metal Cask Dry Storage -	One utility (the first in the U.S.) received a license from the NRC and is dry storing fuel.
High Level Waste Siting -	An interim report: "Demonstration of a Risk-Based Approach to High-Level Waste Repository Evaluation" (NP-7057) has been issued, documenting progress to date.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The focus of spent fuel storage efforts continues on cost-effective, proven capabilities and systems for on-site handling and storage.

High level waste efforts continue towards expanding and refining EPRI's probability-based decision methodology for repository site assessment.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.5

Continue development and use of new analytical tools and planning approaches.

DESCRIPTION OF ACTIVITIES

Monitor new analytical tools, methodologies and planning approaches that could benefit the integrated resource planning process. Compare to existing approaches and revise where appropriate.

FINDINGS

Scenario planning continues to be a valuable tool when conducting the integrated resource planning analyses. This approach has been considered successful because of the interactive and interdisciplinary procedures used in the scenario development process.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The collaborative process will continue to be an integral part of Puget Power's planning approach to address the issues and concerns of various interested parties.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.6

Explore opportunities to use rate design to support conservation and power supply objectives.

DESCRIPTION OF ACTIVITIES

The Rates department, in conjunction with Market Research department, held customer focus groups to explore the degree that customers receive price signaling from rates. The groups were limited to residential customers. The topics included: how much do customers know about the rate structure versus the total bill, do customers know how to interpret rates and make the calculations necessary to receive the price signal, and what types of alternative rate designs are of interest to customers.

FINDINGS

It is evident that customers respond to energy prices suggesting that the free market and pricing strategies have a role in the promotion of conservation. However, more detailed and quantitative research is necessary in order to develop a better understanding of the requisite balance between Puget Power sponsored conservation programs and free market pricing. It is evident that more specific rate options must be proposed in order to determine whether Puget Power can improve its customer service.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

The company is extensively re-examining rate design to support conservation. A Rate Design Collaborative group has been established, made up of parties representing customer groups, environmental organizations, governmental and regulatory agencies. Also, a Customer Rate Design Task Force, made up of primarily residential customers, have been established. They will evaluate rate design issues, and results from these group efforts will be incorporated into the rate design case the company will file with the Commission in April 1992.

6.0 PLANNING AND EVALUATIONS

ACTION ITEM 6.7

Continue to work with the WUTC to remove disincentives which inhibit electric utility integrated resource planning.

DESCRIPTION OF ACTIVITIES

In May of 1989, the Washington Utilities and Transportation Commission ("Commission" or WUTC) issued a Notice of Inquiry (NOI) to identify and eliminate barriers to integrated resource planning. The purpose of this inquiry was to examine the current regulatory structure with three specific goals in mind:

1. determining whether the regulatory structure adequately "align(s) utilities' pursuit of profits with integrated resource planning";

2. determining if and how the regulatory structure should recognize utilities' increasing reliance on generating resources that are not constructed by the regulated utilities; and

3. complying with the legislature's mandate (see Chapter 2, Laws of 1990, House Bill 2198) that utilities consider policies "to improve the efficiency of energy" and "protect a company from a reduction of short-term earnings" due to such increased efficiency.

FINDINGS

An outcome of the NOI was the determination that regulatory barriers did exist to discourage the utility from maximizing the pursuit of integrated resources, particularly from demand-side management.

CONCLUSIONS AND IDENTIFICATION OF FUTURE WORK

In April 1991, the Commission approved the resulting Periodic Rate Adjustment Mechanism (PRAM) on a three-year experimental basis. The PRAM reduced the disincentives associated with implementing the company's integrated resource plan. Under the PRAM, Puget Power will have an annual rate adjustment which will allow timely recovery of power purchase contract costs and variations in weather-related energy costs. A distinctive attribute of the PRAM is the "decoupling" of base revenues from kilowatt-hour sales. Base revenues, which are revenues that cover base costs, are now determined by the number of customers served rather than the number of kilowatt-hours sold.

Regulation needs to continually evolve to keep pace with the changes and challenges of serving growing customer demands. Although important changes have been made, additional regulatory adjustments are needed to support integrated resource planning. Conservation still has risk associated with added investment. For example, conservation investments are not owned by the company; therefore, cannot be used to secure first mortgage bonds. This diminishes the company's financing flexibility for conservation. Other risks grow as conservation increases. For instance, there is no legislative or regulatory mechanism, as there is for operating assets, under which the company would be reimbursed for its conservation investment when an end-use is switched to a new energy supplier (e.g., space and water heating converted from electricity to natural gas). Further evolution in utility regulation is needed to respond to other elements of the Integrated Resource Plan. This includes establishing rate adjustment mechanisms for adding investments in company-owned generating plant, and for adjusting rates to account for changes in cost of capital during the three-year cycle between general rate cases.

Business Environment Considerations

This appendix discusses key issues the company considers in its planning efforts. These considerations are addressed by category: regulatory change, supply-side issues, transmission and distribution challenges and environmental considerations. Conservation issues are addressed in Appendix D.

Shifts in State Utility Regulation

The previous resource plan included a postscript outlining the need for evolution in the regulatory process in order for the company to carry out its least-cost integrated resource plan. It was noted that traditional rate regulation did not provide for prompt and full recovery in rates for the costs of ambitious conservation programs and power purchases - two key components of Puget Power's resource planning. It was also noted that traditional regulation did not address the revenues which were lost on sales through the dampening effect of vigorous conservation.

Regulatory Experiment

Over the past two years, under the direction of the Washington Utilities and Transportation Commission (Commission), Puget Power and other interested parties addressed regulatory barriers to least-cost integrated resource planning. This collaborative effort focused on developing a rate adjustment mechanism for prompt cost recovery of purchased power and conservation investments.

In several key areas, traditional regulation impeded Puget Power's pursuit of integrated resource planning. Under traditional regulation, each kilowatt-hour the company sold added to earnings, and each kilowatt-hour saved reduced earnings. This was at odds with the least-cost integrated resource planning focus, particularly for conservation (see Appendix D for detail on conservation efforts). An additional concern was prompt recovery for purchased power contracts. Efforts to address these barriers focused on the following issues:

- Delays in recovery of conservation investments
- Conservation carrying costs were borne by the shareholders
- Conservation measures led to lost sales which negatively effected company revenues
- Delays in cost recovery of contracts implemented between general rate cases

WUTC Notice of Inquiry

In May 1990, the WUTC issued a Notice of Inquiry (NOI) to examine the current regulatory structure based on three goals:

- Determine whether the existing regulatory structure aligns the utilities' pursuit of profits with integrated resource planning.

- Determine if the regulatory structure should recognize the utilities' increasing reliance on generated resources that are not constructed by the regulated utility, and how that recognition should be accomplished.

- Comply with the Legislature's mandate to consider policies "to improve the efficiency of energy" and "protect a company from a reduction of short-term earnings" due to such increased efficiency.

The WUTC also asked for proposals to address four regulatory issues:

- Cost and revenue adjustment mechanisms
- Purchased power mechanisms
- Conservation cost recovery mechanisms
- Incentive approaches for demand-side and supply-side resources

Periodic Rate Adjustment Mechanism

On April 1, 1991, the WUTC adopted, with modification, Puget Power's Periodic Rate Adjustment Mechanism (PRAM) proposal on a three-year experimental basis. Under the PRAM, an annual rate adjustment will allow timely recovery of power purchase contract costs and variations in weather-related energy costs. In addition, for the first time, Puget Power will immediately earn a return on, and recover the carrying costs associated with, investments in conservation which are included in rate base and amortized over ten years.

The PRAM divides all costs into two categories in order to determine an allowed amount to cover costs of service. For the purposes of this mechanism, these costs are broken down between resource and base costs.

Resource costs: These costs are those associated with conservation and power supply, and are adjusted annually, truing up differences between actual and estimated costs. They include conservation investment and a return on that investment, variable fuel costs, purchased power costs both for existing and new contracts, and wheeling expense costs. Generating plant costs are only nominally included in resource costs but, unlike other resource costs, are left at historical levels and not adjusted annually.

Base costs: These are the remaining costs of operating the utility, such as administrative and general expenses, taxes, customer service, and all other non-generating investment. Revenues for base costs will be derived by multiplying the number of customers served in a year, by a base cost per customer.

A distinctive attribute of the PRAM is the "decoupling" of base revenues from kilowatt-hour sales. Base revenues, which are revenues that cover base costs, are now determined by the number of customers served rather than the number of kilowatt-hours sold. This breaks the connection between base revenues and kilowatt-hour sales. Although customers will be billed on a kilowatt-hour basis, the base revenues Puget Power is allowed to keep will be determined by the number of customers served. This "decoupling" lays the foundation for even greater conservation savings through company programs.

The PRAM covers a 12-month estimating period from October through September of each year. The company will file for rates annually under the mechanism each June 1, using estimated costs. Some of the estimates will be "trued-up" for actuals in the subsequent filing. Examples of trued-up items include contract costs, hydro conditions, secondary sales rates, and the number of customers served.

Demand-Side Incentives

The Commission also established incentives for 1991 to encourage the company to pursue increased conservation savings. These incentives are helpful in focusing limited company resources to achieve specified goals. Allowance for similar incentives in the future could also help support the development of low-cost, environmentally acceptable renewable resources.

The incentives for demand-side resources are based on the achievement of specific levels of cost-effective conservation, control of costs, and measurements that assure conservation remains in place through 1994.

Achieve Conservation: Puget Power receives financial rewards or penalties based on its ability to achieve targeted levels of conservation in 1991.

Control Costs: Puget Power receives financial rewards or penalties based upon whether the company's average actual costs achieve targeted average costs.

Measurement: The company receives a sliding scale bonus incentive of 10% of the 1991 reward for conservation achieved (excluding the cost control incentive) if verification in 1994 confirms the measures financed with 1991 conservation expenditures are still in place and operational.

Continued Progress in Utility Regulation

Regulation needs to continually evolve to keep pace with the changes and challenges of serving growing customer demands. As part of the 1992-1993 integrated resource planning process, Puget Power will work cooperatively to pursue regulatory changes that:

- Support integrated resource planning for acquiring resources that are reliable, cost-effective, and environmentally and publicly acceptable
- Protect the obligation to serve customers
- Enhance the ability to remain competitive
- Support a resource diversity strategy that mitigates various financial and resource risks

Although important changes have been made, additional regulatory adjustments are needed to support integrated resource planning. Conservation still has risk associated with added investment. For example, conservation investments are not owned by the company; therefore, cannot be used to secure first mortgage bonds. This diminishes the company's financing flexibility for conservation. Other risks grow as conservation increases. For instance, there is no legislative or regulatory mechanism, as there is for operating assets, under which the company would be reimbursed for its conservation investment when an end-use is switched to a new energy supplier (e.g., space and water heating converted from electricity to natural gas). Further evolution in utility regulation is needed to respond to other elements of the Integrated Resource Plan. This includes establishing rate adjustment mechanisms for adding investments in company-owned generating plant, and for adjusting rates to account for changes in cost of capital during the three-year cycle between general rate cases.

Supply-Side Considerations

Mid-Columbia Contract Renewal

The Mid-Columbia agreements for purchased power begin expiring from 2005 through 2018. Puget Power has begun preliminary discussions with Grant County Public Utility District regarding the agreements for purchased power at Priest Rapids and the Wanapum projects. The extension of these agreements will continue to play an important role in the power supply of the company, other purchasers, and the public utility districts.

Columbia Storage Power Exchange / Canadian Entitlement

The Columbia Storage Power Exchange (CSPE) was originally created to facilitate power purchases under the Canadian Entitlement Agreement by various utilities in the Pacific Northwest. This power represents Canada's share of the increased power generation which occurs in the United States due to water releases from reservoir projects built at the headwaters of the Columbia River in Canada pursuant to the Columbia River Treaty. Puget Power is a major purchaser of this power. Purchase of Canadian Entitlement (Entitlement) power through the CSPE will phase out over the period 1998-2003.

As power purchases from the CSPE phase out, the United States will be obligated to begin delivering the Canadian Entitlement power to Canada. This power delivery obligation will continue for the foreseeable future. Two major issues regarding the return of Entitlement to Canada need resolution. Those issues are the total magnitude of the Entitlement owed to Canada, and the allocation of the obligation among the U.S. hydroelectric projects which are downstream from the Canadian reservoirs. Puget Power and other utilities have expressed an interest in renewing the purchase of Entitlement power. However, Canada's interest in renewing deliveries is uncertain at this time.

Hence, Northwest utilities, including Puget Power, are currently working with the U.S. treaty entity (as defined in the Columbia River Treaty) to review the methodologies used to calculate the magnitude of the Entitlement power delivery obligation. In addition, negotiations are currently underway to determine the allocation of the return obligation among the various downstream projects.

Pacific Northwest Coordination Agreement (PNCA)

The Pacific Northwest Coordination Agreement (PNCA) is a complex agreement that is used to optimize the planning and operation of the regional hydroelectric system as though it were operated by a single utility. (Detail on the PNCA is provided in Appendix C.) The present PNCA terminates in 2003.

The PNCA was also a prerequisite for implementing the Columbia River Treaty and the Columbia Storage Power Exchange (CSPE) sale. An extension to the coordination agreement will need to be negotiated at the same time as the discussions regarding Canadian Entitlement are taking place. Owners of major hydroelectric projects and Northwest utilities, including Puget Power, are currently discussing changes necessary to renew the PNCA.

Share-the-Shortage Agreement

The Northwest regional utilities, including BPA, the generating public utilities and investor-owned utilities, have been working together to develop a Share-the-Shortage Agreement. The agreement would specify procedures for utility responses to energy deficits.

The proposed Share-the-Shortage Agreement would be implemented in three phases, depending upon the severity of the energy deficit. Under Phase 1, any party in a deficit situation would request offers of sale from parties with surplus energy. Parties could then enter into agreements for the sale of such energy on terms mutually agreeable to them.

If a party's deficit situation is not remedied under Phase 1, Phase 2 would be implemented. Under Phase 2, each party in a deficit situation would have to take actions that would help meet the load in its service area, including, for example, activating voluntary load curtailment programs with its customers and cutting sales to interruptible loads. If, after taking such actions, a party continues to be in a deficit situation, it could request offers of sale as under Phase 1. Parties with surplus energy would be allocated, on a pro rata basis, a portion of each deficit party's shortage. The proposed agreement provides incentives to parties with surplus energy to offer the entire amount of their allocations for sale to parties in a deficit situation. Agreements between parties for the sale of surplus energy will be on terms mutually agreeable to them.

Announcement by the government of the four Northwest states of the need for energy use curtailment of at least 5% throughout the region would implement the third phase of the proposed agreement. Under Phase 3, each party, whether it is in a deficit situation or not, would be obligated to take curtailment actions. Parties that continue to be in a deficit situation could request offers of sale from parties with surplus energy. As under Phase 2, parties with surplus energy would be allocated a portion of each deficit party's shortage. The proposed agreement is close to being finalized and Puget Power will continue to actively participate in the development of this important regional contract.

Capacity and Peaking

Northwest utilities have traditionally planned for new supply on an energy basis. Because of the large surplus of hydroelectric capacity, the region is usually considered energy constrained and not capacity constrained. However, as the regional surplus runs out, and as more non-power restrictions are placed on the hydro base, capacity is becoming more of an issue along with peak resource deficiencies.

Electric Reliability Plan: Concerns about meeting peaks during extreme weather conditions in the Puget Sound region have resulted in the Puget Sound Area Electric Reliability Plan, a cooperative capacity effort by Puget Power, Seattle City Light, Snohomish PUD, Tacoma Public Utilities, and the Bonneville Power Administration. The Puget Sound Area Electric Reliability Plan has examined alternative strategies for meeting extreme peak loads. Among these strategies are a new cross-Cascade transmission line, load management programs, conservation programs, fuel switching, combustion turbine use during peaks, and capacitors for voltage support. The preferred strategy developed in this plan to meet extreme peak loads through 2003 recommended use of accelerated conservation and load management programs and voltage support.

The extreme cold weather events in 1989 and 1990 have underscored the need for adequate resources for high peaking periods. If another extreme winter were to occur between now and operating year 1993-1994, Puget Power would face a peak resource deficiency. In operating year 1993-1994, forecasted peak load and resources are nearly equal. However, by the operating year 2009-2010, the forecasted peak deficiency increases to a value of over 3440 MW. The company is also forecasting large energy deficits for that period. The resources added to meet those energy deficits will also reduce the peak deficit.

Puget Power will continue the use of peaking studies to determine appropriate actions for meeting peaking needs. For example, transmission and distribution planning, in support of the Growth Management Act, is used to determine facility needs. Peak demand and supply-side resource studies will be conducted concerning development of appropriate methodology and criteria, and evaluation of all peaking resources, including the capacity value of conservation programs. Based on these studies, strategies to meet peaking requirements may be modified.

The company currently uses its low-cost, simple cycle combustion turbines and short-term purchases to meet peaking requirements. Additional simple cycle combustion turbines remain an attractive alternative. Also, one of the company's rate schedules for industrial and commercial customers allows for interruptions during extreme peaks. Recently, a 300 MW seasonal exchange agreement was signed with Pacific Gas & Electric for power from California and the desert Southwest. Puget Power will examine its ability to support further exchanges given these peaking challenges.

The company is also concerned about capacity shortages due to localized transmission constraints. For the future, it will be necessary for the company to acquire resources to meet both energy and capacity needs. Resource alternatives will be evaluated with capacity contributions playing a larger role in acquisition decisions. See Appendix E for more detail on peaking issues.

Hydroelectric Project Opportunities

Small hydro development and increased generation from owned and contracted resources are two major issues regarding hydroelectric projects. Small hydro development appears to be promising from both a cost and environmental perspective. There are a number of potential sites for small hydro development which the company could pursue itself. Another option could be development by others (who have necessary permits) from whom Puget Power could purchase power or acquire the completed project. Puget Power will continue to evaluate the feasibility of developing these options as opportunities arise.

Available generation from owned and contractual resources can potentially be increased through plant efficiency improvements and through increasing the capacity of existing facilities. Puget Power is investigating increasing the capacity at three of its existing hydroelectric projects. These improvements require approval from the Federal Energy Regulatory Commission. The renewal of licenses of existing projects will be pursued.

Small Resources

Resource size was an important consideration in this planning process. In the short term, small resources appear to match more closely the moderate deficits anticipated near the end of the decade. The benefits of smaller resources may often outweigh their potential higher costs. Smaller resources can provide:

- Increased adaptability to uncertain loads
- Easy integration into the transmission system
- Efficient integration of smaller cogeneration projects to the host facility, which can also help mitigate the risk of losing a host facility
- Reduction of overall risk from project cancellation or outages

In determining an appropriate size to be considered as a small resource, the company evaluated the benefits and shortcomings of various sizes. One perceived shortcoming is that as the size of generating equipment decreases, the efficiency of that equipment also declines. However, overall energy efficiency (considering steam and electric output) can actually be greater for small cogeneration facilities because they can more easily thermally integrate with the host facility. Taking factors such as these into account, the company has selected about 70 MW or less as the appropriate defining criteria for small resources. At the 70 MW size, a number of vendors offer cogeneration equipment that is close to the efficiency of the large machines. This size preference was also expressed in the company's second competitive bid request.

Natural Gas Prices and Availability

Many new electric utility and non-utility generation projects are using natural gas as a fuel. Natural gas is perceived to be low cost and has relatively few environmental affects. De-regulation of prices and transportation, and drilling incentives have made gas more attractive. Presently, gas prices are at their lowest point in many years, and supplies and reserves are estimated to be plentiful. Natural gas is also seen to be a preferred fuel for many utilities who are required to modify their thermal plants to meet Phase I and Phase II SO_2 emissions limits of the Federal Clean Air Act Amendments of 1990.

However, there are risks associated with increasing dependence on any fossil fuel or limited resource. Based on experiences with gas in the 1970's, questions still remain about potential supply interruptions, severe price variability, and problems with deliverability. Given the price uncertainty associated with any type of fossil fuel and the growing demand anticipated for natural gas, continued analysis of the price and supply risks associated with natural gas is appropriate.

Many major regional gas pipelines in both the U.S. and Canada are planning or are in the process of expanding their pipeline systems. However, these expansion projects are designed to meet firm (contracted) natural gas requirements by buyers. The viability of a spot gas market in times when gas demand is high cannot be guaranteed even with these expanded systems. Purchasers of gas will have to work closely with producers and transporters to work out supply arrangements. Also important will be the regulatory changes in these industries now being shaped by recent and proposed regulations from the FERC. These changes will affect the deliverability and price of natural gas supplies.

The relative prices of fuel substitutes and the health of the U.S. economy will continue to be the primary drivers of natural gas prices. Technological change, which increases energy efficiency in the long run, will dampen demand somewhat and increase supply as new techniques for gas recovery are implemented.

Puget Power's resource diversity strategy strives to reduce fuel risks by avoiding over dependence on any one type of new resource added to the system. The use of conservation, renewable resources, including small hydro generation, and clean coal would help to mitigate the potential risks of natural gas usage. Puget Power will continue to monitor natural gas as an attractive resource to meet future customer needs.

Natural Gas Utilization

In recent years, Puget Power has experienced increasing and significant numbers of customers converting from electricity to natural gas for single-family space and water heating. Overall electric space and water heat saturation company-wide are down because virtually all new single family construction in areas where natural gas is available is being built with natural gas space and water heat. More recently, other appliances (cooking and drying) are also being converted to natural gas.

The Northwest Power Planning Council and others including BPA, individual utilities, gas companies and regulatory agencies are studying and evaluating "fuel-switching" as a possible option for meeting future electrical load growth. Some of the issues include availability and future costs of fuel alternatives, reliability, infrastructure support, and overall efficiency of the application.

However, consistent with recommendations from the Technical Collaborative Group, the company determined that conservation programs designed to encourage customer fuel switching are not appropriate at this time.

Puget Power's conservation programs are operated with attention given to existing and anticipated levels of conversion activity, and to current new construction fuel choice decisions for major end-uses. Puget Power's programs specifically attempt not to interfere with the market place decision being made by consumers. This depends on reliable market research as to which customer segments, which end-uses, and which geographic areas within the service area are being affected. All of these variables are changing.

At the same time, Puget Power has recognized potential areas where natural gas is not currently being used, but may be used in the future. Examples include both new and retrofit multi-family housing, and manufactured housing. In other parts of the country, unlike the Pacific Northwest region, both of these market segments use natural gas more frequently for space and water heating.

Puget Power will continue to work with the Technical Collaborative Group on issues and analysis related to natural gas utilization.

Transmission & Distribution Challenges

BPA/Puget Power Northwest Transmission Project

BPA and Puget Power have agreed to a new Plan of Service for a proposed joint transmission project in Whatcom and Skagit Counties. This project is intended to meet the objectives of both increasing transfer capacity with Canada and the Puget Sound region and improving local and regional capacity. The final plan calls for a combination of existing facility upgrades and new construction. The plan must now go through environmental review processes; if no delays are encountered in those reviews, the project is scheduled for completion in mid-1996.

Puget Sound Voltage Stability

Abnormally cold winters load up the transmission lines because of extra-high demand for electricity. Should a failure of a cross-Cascade 500 kV transmission line occur during peak demand, voltage could dip too low to handle the inrush of power in the remaining lines, resulting in voltage collapse, or voltage instability.

The Puget Sound Electric Reliability Plan presents alternative strategies for preventing voltage instability. These strategies consist of proposed and contingency actions involving conservation, transmission, capacitors for voltage support, load management, fuel switching, combustion turbines, and load curtailment. Implementation of these measures will depend on load growth, environmental effects, cost and also the effect each strategy will have towards a solution to the problem.

Third AC Intertie and California/Oregon Transmission Project

There is substantial support from regional utilities for the construction of an additional 500 kV AC line for the Pacific AC Intertie. These utilities recognize the advantage of further utilizing the seasonal load diversity between the Pacific Northwest and the Pacific Southwest. BPA has been the lead in coordinating this effort.

The facilities required for this additional line to California are divided into two major projects. The first project, called the Third AC Intertie, is comprised of facilities located in Oregon. Facilities for the second project, which has been named the California/Oregon Transmission Project, will be located in Northern California. The projects will connect to each other and the present facilities of the Pacific AC Intertie at a new substation called Captain Jack, which is located near the southern Oregon border. Both of the new construction projects are required to upgrade the power transfer capacity of the Pacific AC Intertie from its present 3200 MW rating to a 4800 MW rating. All of the system and design engineering studies have been completed, equipment is being ordered and construction has been started in several locations. Construction is expected to be completed in November, 1993.

BPA is in the process of conducting an Environmental Impact Statement. During this process it will be determined whether non-Federal participation will be allowed in a 725 MW share of the Third AC Intertie. As part of this process, the BPA solicited the region's utilities and received requests for 1070 MW at an offering price of $215,000/MW. BPA will develop an allocation methodology to address current over-subscription. Puget Power has committed to a 400 MW share if non-Federal ownership is offered under the BPA's current definition of such a share.

Electric and Magnetic Fields

In 1987 Puget Power established a task force to monitor ongoing research in the field of extremely low frequency electric and magnetic fields (EMF), and to recommend appropriate responses for customers and employees who have questions on the subject. The company provides free measurement services and information to customers who express concern about these fields, including material from the BPA, the Electric Power Research Institute (EPRI) and Carnegie-Mellon University. When questions arise on new facilities and substations, Puget Power measures and estimates fields and meets with groups to review its findings and the current status of research. As well, the Company has established and implemented an employee education program. Puget Power believes that it has an obligation to provide its customers with access to credible sources of information on EMF.

Currently, most scientists agree that there is no scientific evidence of a cause and effect relationship between power frequency EMF (extremely low frequency EMF) and health effects. In September of 1991, a panel of the Science Advisory Board of the Environmental Protection Agency (EPA) said in a report letter that "the conclusion of causality is currently inappropriate because of limited evidence of an exposure-response relationship and the lack of a clear understanding of biologic plausibility." The report also said: "There is insufficient evidence from the human epidemiology data and from animal/cell experiments to establish cause-and-effect relationships between low-frequency electric and magnetic field exposure and human health effects and cancer."

The panel recommended further research, which Puget Power supports through its membership in EPRI. The ten million dollars per year that EPRI sets aside for EMF research by independent scientists should provide a clearer understanding of the issue.

Regional Transmission

Puget Power is currently connected to a regional transmission system in place to take advantage of the hydro resources in the Northwest as well as other resources as far away as Eastern Montana and Southern California. Large quantities of electric power is transmitted, or delivered, over this 500 kV network of transmission lines, making possible purchases of electrical energy from generating plants hundreds or thousands of miles away.

System Efficiencies/Distribution Management

A Puget Power focus group was formed to suggest and apply techniques for estimating the effects of demand-side measures on the company's transmission and distribution system. The study was the company's initial effort to formulate a process to assess the effect of demand-side measures on transmission and distribution capacity requirements in specific high load growth areas.

By targeting conservation efforts in such high growth areas, it is possible that peak loads can be reduced. Since the transmission and distribution system must be sized to handle peak loads, a strategy to invest in conservation measures to defer transmission and distribution construction costs is currently under consideration. The effect of peak shaving strategies like load management and time-of-use rates were also examined as part of the study.

A ten-year load forecast was prepared for 13.5 square miles of high load growth in the Northeast King County area. The load data for the study area revealed a capacity shortage on the transmission and distribution system (two substations, ten feeders and one transmission line were operating over design limits on the peak day).

Initial estimates suggested 27 MW of peak capacity could be released by demand-side management programs if targeted for the area under study. This represents about one half of the load growth projected for the study area by the year 2000. Since the programs will take a few years to provide significant benefits, the focus group doubts that it is prudent to defer transmission and distribution proposed construction plans or the proposed improvements in transmission line routing. However, the results of this preliminary study indicate the possibility of some new transmission and distribution capacity construction deferral near the end of the decade.

The focus group recommended a list of potential demand-side measures for the study area. While the recommended measures may seem appropriate for the area under study, the focus group could not validate the measures appropriateness in other areas. At the recommendation of the focus group an area-specific process is being developed that will review load growth projections, distribution of customer classes, transmission and distribution system design, supply side options, and marginal capacity costs which will result in a list of recommended demand side alternatives for areas throughout the company's service area.

Siting/Permitting

It is increasingly more difficult to build new or rebuild existing transmission lines. Because of delays in obtaining construction permits, the transmission system is not keeping pace with the demand for electrical energy. The challenge of the 1990's is to clear the siting/permitting hurdles for the timely expansion of the transmission system.

The Growth Management Act (GMA) is expected to be an important vehicle for planning additions of all kinds of utilities - water, sewer, gas, as well as electricity. When ten and twenty year plans are approved by county and city authorities, it is hoped that permitting new facilities becomes a much smoother process.

Additionally, Puget Power will increase its efforts to work with customer groups, special interest groups, and governmental agencies to address important issues such as required system enhancements, aesthetics, growth management, potential health issues, and environmental considerations. For example, a Citizen Advisory Committee was recently formed to provide comment on a project proposed for a growing residential area.

Environmental Considerations

Federal Clean Air Act Amendments

The Federal Clean Air Act, passed in 1970, was amended in 1990 with extensive new regulations designed to significantly reduce major pollutants nationwide. The key provisions posing challenges to electric utilities are the acid rain regulations in Title IV of the Act. The acid rain provisions are designed to reduce sulfur dioxide emissions by 10 million tons per year by the year 2000.

The legislation has set up a unique way of achieving this goal. Utilities are given a number of allowances (tons of SO_2 that are acceptable to emit) that they may 'use' either to operate its own power plants or to trade or sell to others. By allowing utilities to determine how best to use these allowances to meet the new standards, the Environmental Protection Agency is anticipating the use of economic decision making by electric utilities and others to trade off between several alternatives. These include installing pollution equipment, selling or using allowances to continue to operate existing plants, or shutting down older, less efficient polluting plants. The combined effect of this decision making process is expected to reduce SO_2 emissions by the desired level by the year 2000.

The passage of the Federal Clean Air Act Amendments (Amendments) of 1990 poses many challenges for electric utilities. Consideration must be given to how to meet the new environmental regulations within the same context as operating existing resources and planning for new generation resources.

Puget Power owns a portion of the Colstrip coal-fired plants in Montana (50% ownership in Units 1 and 2 and 25% in Units 3 and 4). Gases from these plants are "scrubbed" for air pollution control. Concentrations of SO_2 and particulate emissions are reduced by more than 90 percent. As a whole the Colstrip units will receive sufficient SO_2 allowances to attain or surpass the limits set by the Amendments for the year 2000.

The Centralia coal-fired plant (in which Puget Power has a 7% ownership) will not meet the required emission level for sulfur dioxide by 2000. Options to attain compliance are presently being analyzed. The Centralia Plant is one of the sites being investigated by the National Parks Service as a potential source of sulfates associated with visibility impairment at national parks in the region.

Regulations to implement the Amendments are still being finalized by the Environmental Protection Agency. This uncertainty restricts any formulation of acid rain control provisions by the company at this time. However, the issue of compliance planning, with respect to the 1990 Amendments, will need to be addressed in the next Integrated Resource Plan. The Amendments are not only important to consider for existing resources, but also for any new thermal generation projects that have the potential to emit sulfur dioxide or nitrogen oxides.

In the future, Puget Power expects additional regulations from both the state and federal governments regarding other environmental issues. These may include CO_2 emissions or toxins as yet unspecified. Internationally, CO_2 controls and reductions incentives are currently being debated by organizations including the United Nations. Possible controls or incentives that are being discussed include international agreements on CO_2 limits, an allowance trading system similar to that in place for SO_2 in the U.S., and a potential 'carbon tax' in fuels.

Global Climate Policy

The so-called greenhouse effect is a natural atmospheric phenomenon where the warming of the earth's surface makes the planet habitable. Only about one-third of the solar energy reaching the earth is reflected back to space directly; the rest is absorbed by the atmosphere and the earth's surface and re-emitted as infrared radiation. Relatively small amounts of trace gases, including carbon dioxide (CO_2), methane, nitrous oxide, chlorofluorocarbons, and even water vapor, absorb some of this infrared radiation, heating the atmosphere. Steady increases of some greenhouse gases because of human activity have caused the current concern that the natural climate balance might be upset, resulting in unprecedented global warming near the earth's surface.

It is well documented that there have been increases in atmospheric concentrations of some greenhouse gases from human activities. Although theories indicate that such increases should influence climate, it is not possible today to detect such an effect or to predict when changes might become clearly observable, given the known natural variability in climate. However, it is possible that some positive rate of warming will accompany continued accumulation of greenhouse gases in the atmosphere.

Puget Power continues to support research and development of national energy policies that address global environmental issues. The company recognizes that electric power can play a role in reducing greenhouse gas emissions and in mitigating the potential effects of global climate change. That role, however, is not clearly defined because it is not currently possible to detect or accurately predict the climatic effects of increased atmospheric concentrations of greenhouse gases such as CO_2. The company also believes that any policy aimed at mitigating possible effects should include multi-national actions, consideration of all important gases and particles, and the flexibility to be responsive to potential changes.

In 1988, an intergovernmental panel on climate change was established under the guidance of the United Nations environmental program. The purpose of the group is to study the various aspects of possible climate change resulting from greenhouse gases. In November 1991, a global energy charter was agreed to by a coalition of representatives from the United Nations. The purpose of the charter is to promote a global energy strategy that supports the use of energy efficient and environmentally sound technologies.

A formal treaty may be ready for signature in June 1992 at an international meeting in Rio de Janeiro. This treaty would be a legally binding obligation for reducing greenhouse gases (i.e. CO_2). There are currently varying degrees of commitment among the industrialized nations on stabilizing CO_2 emissions.

Endangered Species Act

Listings under the Endangered Species Act continue to create uncertainties in resource planning. Current and potential future listings, including fish and wildlife, could significantly affect resource options. An example of how regional utilities are addressing this issue is their development of a recovery plan for salmon runs.

In November 1991, the National Marine Fisheries Service (Fisheries Service) listed the Snake River Sockeye as an endangered species pursuant to the federal Endangered Species Act. Additionally, the Fisheries Service has proposed listing the Fall Chinook and the Spring/Summer Chinook as threatened species. In response to these actions, the Northwest Power Planning Council has recently developed a comprehensive fishery enhancement program through amending the region's Columbia River Basin Fish and Wildlife Program to improve the survival of native salmon and steelhead. This plan combines a certain amount of springtime flow enhancement with other measures including habitat and hatchery enhancement and harvest reduction. Specifically, the Northwest Power Planning Council's plan includes the following:

- Regular auditing of hatchery performance
- Reducing the harvest of Fall Chinook Salmon to 55 percent of the annual run from a recent high of 77 percent
- Increasing water storage behind dams during winter months for release during spring juvenile fish migrations

Puget Power and other regional utilities participated in the development of this plan through the Pacific Northwest Utilities Conference Committee, and are beginning to implement the spring flow augmentation portion of the plan in 1992. In a formal letter, the governors of the four Pacific Northwest states say that the plan distributes the burden of recovery efforts equally, with a sensitivity to preserving the economy. Meanwhile, the Fisheries Service will prepare a recovery plan, and recently appointed a recovery team to coordinate the effort. The Northwest Power Planning Council forwarded its amendment to the team.

It is hoped that this regionally developed recovery plan can be used by the Fisheries Service as a model for any salmon recovery plan required pursuant to the Act, and possibly avert further listings of fish stocks as endangered or threatened. Puget Power and the other regional utilities believe it is important that measures included in any recovery plan provide a demonstrable benefit to the fish stocks in question.

The recovery plan will affect the Mid-Columbia projects from which Puget Power purchases power on a long term basis, and will further reduce the flexibility of the regional hydroelectric system. Although the full affects are unknown at this time, the recovery plan will probably shift an amount of the company's generation from winter periods into the spring when it is not needed for system loads. This will increase the potential for spill at the Mid-Columbia projects. In addition, any affects on the Bonneville Power Administration (BPA) will likely be passed on to Puget Power through direct power purchases, and through the Residential Exchange program.

Puget Sound Growth Management Policy

Puget Power is monitoring progress of the implementation of the 1990 Washington State Growth Management Act. The company is also coordinating its planning efforts with local governments in response to the Act. The extent of the Growth Management Policy's affect on building new or upgrading existing transmission and distribution facilities is uncertain at this time, and may not be determined even by the policy's July 1993 effective date. Therefore, rather than speculate the future effects, Puget Power will monitor progress on this issue.

Environmental Externalities

Puget Power includes a number of environmental issues in its resource planning process. Environmental concerns serve to place many levels of constraints upon the resource selection process. They constrain choice of resource candidates, limit potential utilization of some resources, impose direct and indirect costs at various levels, and introduce uncertainties relating to resource costs and availability.

In electric resource planning and acquisition activities across the nation, there have been numerous attempts to quantify environmental externalities (effects, including environmental benefits, not already accounted for in the direct costs of resources). There is currently no agreement on a single best method. This is largely due to the complexity involved in quantitatively capturing relationships between causes and effects. There is also disagreement on the degree to which utilities and regulators should define such social costs and benefits, or whether this is a legislative function.

Such an arbitrary assignment of costs would introduce further uncertainty into the resource planning process, possibly distorting the relative attractiveness of resources. Also, this process would make some viable resources less economical, further constraining feasible resource options.

Numerous environmental effects are already captured in the siting and permitting process. Others may be applied in one jurisdiction but not another; for example, Montana has a 15% severance tax on coal. Puget Power will monitor the treatment of environmental externalities by other states with which the company has power exchanges. The environmental externalities issue is also being addressed by Consumer Panels.

Beyond this, Puget Power has addressed environmental externalities through competitive bidding and integrated resource planning. Both processes give preference to resources with lower environmental effects. A 10% price credit is given to conservation and renewable resources (e.g., hydro, wind and geothermal) in the evaluation process for competitive bidding and the scenario analyses for the integrated resource plan. For competitive bidding, this approach was approved by the Commission on an experimental basis. Also, preference is given to high efficiency cogeneration over other thermal processes.

It now appears that sufficient quantities of conservation and renewable resources may exist to meet a major part of the company's resource needs through the end of this decade. In addition, the company remains optimistic that its efforts now will spur development so that these resources will be more readily available beyond the turn of the century.

The issue of environmental externalities is also being pursued at the state level. Governor Gardner, in Executive Order 90-06 signed in November 1990, appointed the Washington State Energy Office to lead a study and make recommendations on the environmental costs of energy development. Puget Power will continue to monitor and provide comment on this activity.

Electric Vehicles

Puget Power tracks advances in the electric vehicle industry. Supportive legislation and increased battery performance make acceptance of electric vehicles within certain sectors a very real possibility. While a one hundred mile driving range is a limiting factor, many households and companies have vehicles used exclusively for local driving that could be powered by electricity. Before this happens though, the purchase price of electric vehicles must drop by about 30% to match their combustion turbine counterparts.

Two important new pieces of legislation should help produce less expensive and more efficient electric vehicles. First, in 1990, the California Air Resources Board essentially mandated that electric vehicles make up two percent of statewide new vehicles sales in 1998, and the share rises to ten percent by 2003. Most of the Northeast states are considering the same program. This major stimulus has triggered increased research both in the U.S. and abroad, and will provide incentives for electric vehicle producers to lower prices.

The second legislative effort involves federal support of the U.S. Advanced Battery Consortium. The cost of this research is too high for any single corporation, and this cooperative effort is believed to hold great promise. Other pending legislation would finance research, demonstration programs and tax incentives.

From a planning perspective, widespread use of electric vehicles in the area Puget Power serves could increase load up to five percent by the middle of the next decade. Additionally, more research funding may result in significant breakthroughs, further increasing load growth. Puget Power has an electric vehicle for company use which will provide the company with increased exposure to this emerging technology. As well, Puget Power is supporting development of a hybrid vehicle at Western Washington University; the car will run on both electricity and natural gas, and solar panels to trickle feed the batteries.

Existing Resources

The estimated energy from Puget Power's existing conservation and generation resources, along with the load forecast, formed the starting point of Puget Power's integrated resource planning process. While the company expects to acquire a substantial amount of new resources, it is anticipated that existing resources will provide a significant amount of supply, even at the end of the planning term.

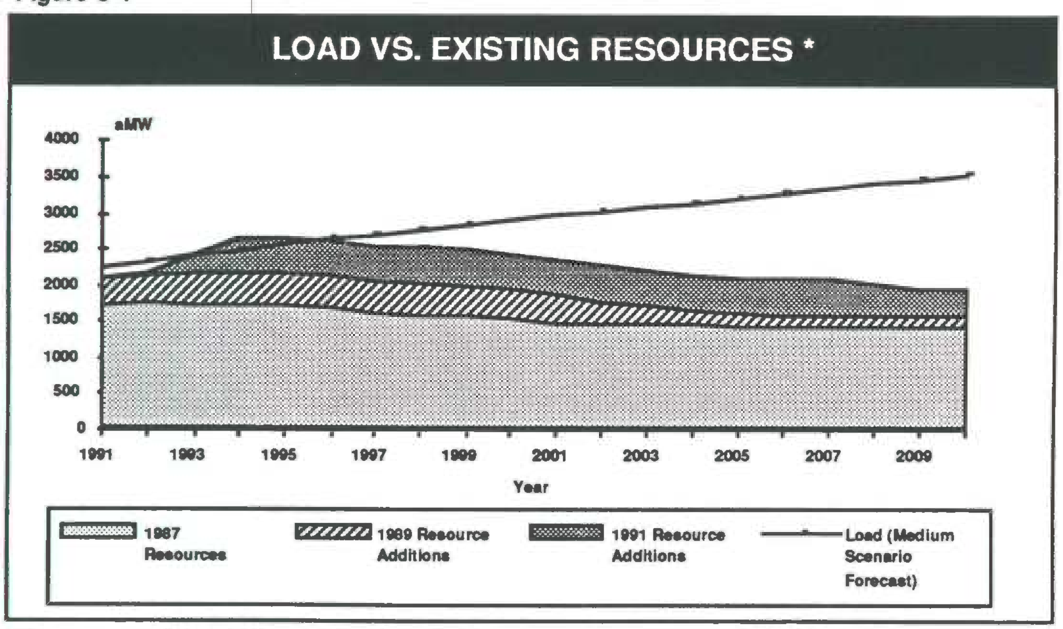
Generally, Puget Power plans for existing conservation and generation resources to operate over their economic lives, and purchased power over their contractual terms. As part of its ongoing planning process, Puget Power monitors issues which may affect the continued operation of its existing resources, as well as purchased power contracts.

This appendix discusses the company's current generation, including conservation and power purchases and examines some uncertainties facing these resources.

Figures C-1 and C-2 show Puget Power's forecast of firm energy and capacity from existing conservation and generation resources plotted against load under medium forecast conditions. For planning purposes, existing resources include:

- Existing conservation, generation & contract resources
- Future conservation and generation resources currently under contract

Figure C-1



* Existing resources are those resources currently in use or resources that are being developed under contract.

Energy Resources

Existing resources, as shown on the previous page in Figure C-1, are projected to create an energy surplus of 144 aMW in year 1994, and 85 aMW in year 1995. By year 2010, a combination of load growth and loss of resources cause a deficit of about 1600 aMW. Puget Power will need to acquire additional firm resources to meet this deficiency.

The energy supplied from existing resources decreases from 2661 aMW in year 1995 to 1950 aMW in year 2010, for a total projected decrease of 711 aMW. As set forth in Table C-1 below, the contributions from hydro (including Mid-Columbia contracts), combustion turbines and coal resources are expected to be relatively constant over this same period. Table C-1 does not reflect the loss of hydro resources on the Mid-Columbia River for the salmon recovery plan. This loss is not shown since the listing occurred late in the planning process.

Also, since future conservation potential estimates are not included as an existing resource, only historical conservation contributions are shown in Table C-1. Most of the changes in existing resources occur in utility and non-utility contracts. Existing utility contracts are expected to decrease by 510 aMW by year 2010. This is the result of contract expirations and scheduled decreases in resource deliveries.

The one category showing a significant increase in the existing resource mix is Non-Utility Generation (NUG). Puget Power has contracts for future projects which are expected to produce an additional 537 aMW by year 1994. Major contributors to this total are the March Point Cogenerator at the Texaco Refinery, the Encogen Cogenerator at Georgia Pacific in Bellingham, the Sumas Energy Cogenerator at Sumas, and the Tenaska Cogenerator at the BP America Refinery in Ferndale.

Table C-1

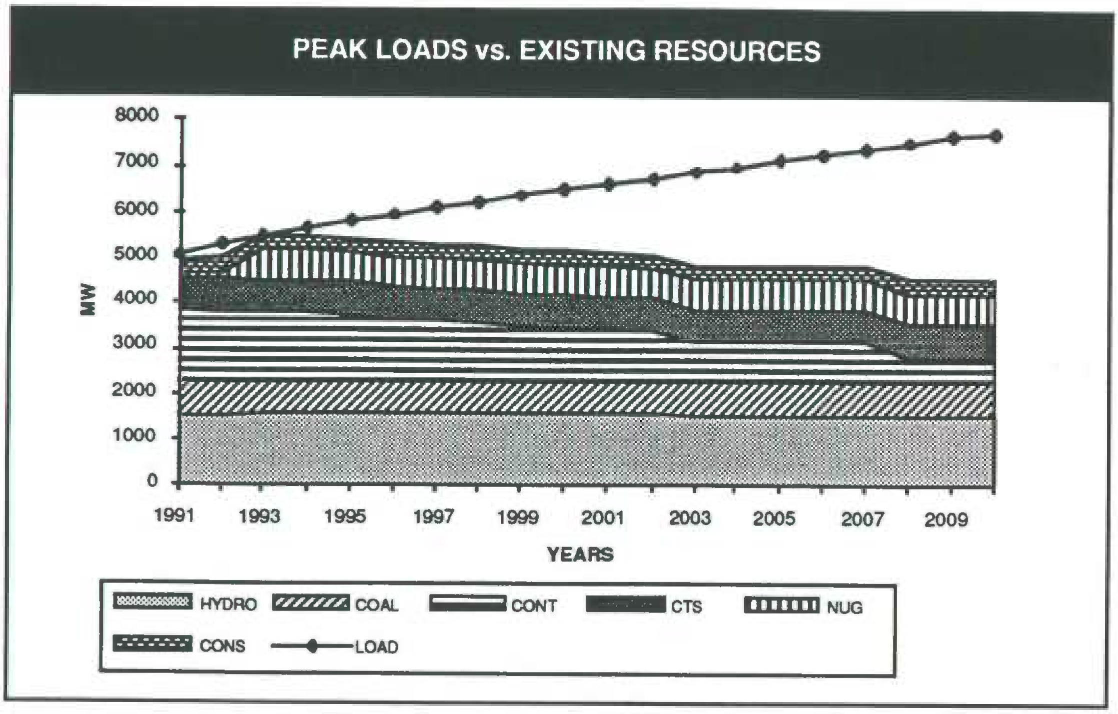
CONTRIBUTION TO FIRM ENERGY RESOURCES

	1991		2010		Change	
	aMW	%	aMW	%	aMW	%
Conservation*	112	5%	112	5%	0	0%
Hydro**	803	35%	713	35%	-90	0%
CTs	53	2%	53	3%	0	1 %
Coal	582	26%	582	28%	0	2%
Utility Contracts	628	28%	118	6%	-510	-22%
Non-Utility	89	4%	483	23%	+394	+19%
Total	2,267		2,061		206	

* Only historical conservation contributions are shown.

** Hydro loss in response to endangered species listing is not shown since this occurred late in the planning process.

Figure C-2



Peak Resources

As shown in Figure C-2, Puget Power is faced with a peak resource deficiency. However, as contracted non-utility cogenerators come on-line, this deficiency decreases such that in operating year 1993-94, Puget Power's forecast peak load and resources are nearly equal. The peak deficiency increases over the remainder of the forecast period to a value of over 3000 MW in operating year 2009-2010.

Table C-2 shows the contribution to peak supply by resource type. As could be expected, the changes for capacity mirror the changes for energy. The contributions to peak from hydro, combustion turbines, and coal categories are nearly constant over the next 10 years. The expected decreases from utility contracts are compensated by increases in NUG contracts. Included with the Table C-2 resources is Puget Power's existing seasonal exchange contract with Pacific Gas & Electric.

Table C-2

CONTRIBUTION TO FIRM PEAK RESOURCES

	1991		2010		Change	
	MW*	%	MW*	%	MW*	%
Conservation**	268	5%	268	6%	0	+1%
Hydro	1,532	31%	1,297	31%	-235	0
CTs	733	15%	733	18%	0	+3%
Coal	718	15%	718	17%	0	+2%
Utility Contracts	1,593	32%	500	12%	-1093	-20%
Non-Utility	98	2%	656	16%	+558	+14%
Total	4,942		4,172		+258	

* Capacity net of reserve requirements
**Only historcial conservatrion contributions are shown.

Puget Power recently obtained firm wheeling from the Bonneville Power Administration for the Pacific Gas & Electric agreement which will contribute 300 MW over winter peak periods beginning in January 1992.

CONSERVATION

Puget Power began offering energy conservation programs to customers in 1978. Since that time, a broad spectrum of strategies have been developed to capture conservation opportunities from all customer sectors.

From the inception of Puget Power's conservation programs through 1990, approximately 95 aMW (112 aMW through year 1991) of conservation have been acquired. This was accomplished through the following efforts:

	aMW
Residential Retrofit	32
Water Heat Strategies	29
Residential New Construction	2
Commercial/Industrial Retrofit & New Construction	32
Total	95

An additional description of existing conservation and plans for future programs are presented in Appendix D -"Conservation Potential". The balance of this appendix will focus on supply-side resources.

HYDRO

The majority of Puget Power's hydroelectric power comes from five long-term purchase agreements for portions of the output from Wells, Rocky Reach, Rock Island, Priest Rapids and Wanapum hydroelectric projects on the Columbia River. The remainder of the power included in the hydro category is produced by owned hydroelectric facilities and contracts associated with the Pacific Northwest Coordination Agreement.

Mid-Columbia Contracts

The Columbia River is operated for electric power generation according to the provisions of the Pacific Northwest Coordination Agreement (PNCA). The PNCA provides for coordinated planning and operation of all major Northwest hydroelectric projects. Primary objectives of the PNCA are as follows:

- Maximize firm energy production from the hydroelectric system
- Assure that planned quantities of firm energy are available even during adverse streamflow conditions,
- Coordinate reservoir operations.

Through utilization of reservoirs, the PNCA allows parties to shape energy over time to meet their seasonal load needs. The PNCA is a necessary and important agreement for realization of diversity benefits between utilities and river systems in the Northwest, and realization of benefits from Canadian storage reservoirs constructed pursuant to the Columbia River Treaty.

The PNCA was signed in 1964 and expires in 2003. Recognizing the value of hydroelectric coordination, Puget Power and other parties to the PNCA have already begun efforts to renew the agreement prior to its expiration. As part of this effort, Bonneville Power Administration (BPA) is conducting a public process called the System Operations Review (SOR), which allows input from fishery, recreational, transportation, irrigation, and other users of the Columbia River.

Contracts from the Mid-Columbia projects form the backbone of Puget Power's power supply. They are the company's lowest priced resources and are among the most flexible. Each of the purchase contracts contain similar provisions that allow the Public Utility District (PUD) project owners to withdraw power sold to others to meet their internal load growth until a specified limit is reached.

As shown in Table C-3, for all projects except Rock Island, the PUDs have already reached their maximum withdrawal limit and Puget Power's share will be constant for the remainder of the contracts.

Salmon Listings Affect Hydro

Water use on the Columbia River is facing increasing scrutiny. In November 1991, the National Marine Fisheries Service (Fisheries Service) listed the Snake River Sockeye as an endangered species pursuant to the federal Endangered Species Act. Additionally, the Fisheries Service has proposed listing the Fall Chinook and the Spring/Summer Chinook as threatened species.

In response to these actions, the Northwest Power Planning Council has recently developed a comprehensive fishery enhancement program (see Appendix B for more details on this plan). Puget Power and other regional utilities participated in the development of this plan, and will begin to implement the spring flow augmentation portion of the plan in 1992.

It is hoped that this regionally developed recovery plan can be used by the Fisheries Service as a model for any salmon recovery plan required pursuant to the Act, and possibly avert further listings of fish stocks as endangered or threatened. Puget Power and the other regional utilities believe it is important that measures included in any recovery plan provide a demonstrable benefit to the fish stocks in question.

The recovery plan will affect the Mid-Columbia projects from which Puget Power purchases power on a long term basis, and further reduce the flexibility of the regional hydroelectric system. Although the full affects are unknown at this time, the recovery plan will probably shift an amount of the company's generation from winter periods into the spring when it is not needed for system loads.

Table C-3

MID-COLUMBIA CONTRACT DATA

Project	Puget Power's Current Firm Share aMW*	Puget Power's Minimum Firm Share aMW*	Contract Expires	License Expires
Wells	110	110	8/2018	6/2012
Rocky Reach	226	226	10/2011	7/2006
Rock Island	271	170	6/2012	1/2029
Priest Rapids	39	39	10/2005	11/2005
Wanapum	46	46	10/2009	11/2005

* Values based upon critical streamflow conditions.

This will increase the potential for spill at the Mid-Columbia projects. In addition, any affects on the Bonneville Power Administration (BPA) will likely be passed on to Puget Power through direct power purchases, and through the Residential Exchange program.

Puget Power's Hydro

The company's hydroelectric projects supply 149 aMW of firm power under critical streamflow conditions. However, three of Puget Power's owned hydroelectric plants are in the Federal Energy Regulatory Commission (FERC) licensing/relicensing process. The schedule for receiving decisions from FERC on these projects is difficult to predict. Additionally, there is a potential for FERC to order the operating criteria changed in ways that could lower or modify the power output from these facilities.

The FERC license for the Snoqualmie Falls Project expires on December 31, 1993. In May of 1991, Puget Power filed with FERC a Draft Application for relicense. Following review and comment by the public and interested agencies, Puget Power filed the final license application in November 1991. The relicense application includes a proposed increase in project capacity from 41 MW to approximately 73 MW.

Unlike Puget Power's other hydroelectric facilities, the White River project has not historically operated under a FERC license. This is because the project was developed before federal licenses were required for operation. FERC requested that all owners of these older plants undergo licensing for operation. Puget Power agreed to do that and submitted a license application in late 1983.

The new application includes the existing plant and a 14 MW addition in the pipeline from the diversion dam to Lake Tapps. Based on best estimates, a license is expected to be issued for the White River Project by January 1, 1993.

Another of Puget Power's hydroelectric projects, Nooksack Falls, is also currently undergoing Federal Energy Regulatory Commission (FERC) licensing. This license was filed in February 1983 and the expected licensing date cannot be determined at this time. In the application, Puget Power is requesting to upgrade the project from 2 MW to 8 MW. All of these hydro project improvements require FERC approval.

COMBUSTION TURBINES

Puget Power installed three pairs of combustion turbine units (CTs) in the early 1980s to meet rapidly increasing peak load needs and for energy production during periods of low streamflows. These units are dual fuel, operating on either natural gas or oil.

The firm energy expected from these combustion turbines is that amount required for testing and 200 hours per year of operation for peaking. Puget Power does not currently expect to operate these units to supply long-term firm energy.

Puget Power's combustion turbines have been used both for peaking and for short-term energy production over the past several years, most recently during the cold snap in December of 1990. At that time, the units were run on both oil and natural gas to meet the record-setting peak load.

UTILITY CONTRACTS

Puget Power has numerous power purchase, sale and exchange contracts with other utilities. The previously discussed Mid-Columbia purchase contracts provide the greatest amount of power. Table C-4 shows the changes in existing contracts over the next 10 years. The Columbia Storage Power Exchange (CSPE) contract decreases are not caused by contract expiration. The Columbia River Treaty, the basis for CSPE, provides that Canada will construct three large storage reservoirs on the headwaters of the Columbia River. Additionally, these reservoirs will be operated to maximize power benefits according to plans developed jointly between Canada and the United States. In return, Canada is entitled to one-half of the increased power generated at U.S. plants resulting from the regulation of water by the Canadian storage reservoirs.

Shortly after the signing of the Treaty, Canada determined that it had no immediate use for its share of the downstream power benefits and offered to sell them to U.S. utilities. Hence, the CSPE, a non-profit corporation, was formed to purchase Canada's share of power benefits and in turn resell that power to Northwest utilities. Puget Power signed up for 17.5% of the Canadian benefits.

The amount of power purchased by CSPE and resold to the utilities declines over the 30-year term of the agreement as the value of river regulation diminishes due to larger Northwest area loads and thermal installations. In the year 2003, the Canadian benefits under the Treaty will be recalculated.

If Canada elects to keep its half of the downstream benefits, the U.S. will need to supply the power previously obtained under the treaty. In addition to losing energy resources, Puget Power also loses much of its operating flexibility with expiration of these various contracts. Puget Power currently uses CSPE, Supplemental Capacity, the Mid-Columbia purchase contracts and company-owned hydroelectric facilities to follow short-term fluctuations in system load. These contracts and resources have the ability to be increased or decreased in real time without serious economic effects.

The Supplemental Capacity agreement expires within 10 years and the CSPE contract is decreasing significantly. With these changes, the hydroelectric system will take on more of the burden of following load fluctuations. However, the regional hydroelectric system has gradually been losing flexibility as more non-power constraints (e.g., recreational uses, flood control, irrigation, and water for fish) are imposed and as regional loads increase.

Table C-4

Changes in Existing Contracts
From 1991-92 to 1999-2000

Contract	Peak MW	Energy aMW
*Supplemental & Entitlement Capacity	-86	0
*Hanford Exchange	-80	-68
BPA NR Contract (to avoid demand charges, no power taken over peak periods.)	0	-36
CSPE	-128	-37
Snohomish Conservation Transfers	+9	+4
*Centralia-Grays Harbor PUD	-53	-43
TOTAL LOSS	-338	-180

* Contracts expire during the next 10 years

NON-UTILITY CONTRACTS

In 1989, non-utility contracts supplied less than 0.2% of Puget Power's load. The few projects that were operating were mostly hydroelectric. The resource mix for non-utility contracts is projected to shift dramatically toward natural gas as the four cogenerators currently under contract come on-line.

Table C-5 shows the breakdown by fuel type of currently contracted Non-Utility Generators projects.

Table C-5

NUG PROJECTS BY FUEL TYPE

	Number of Proj.	Capacity* MW	% of Total
Natural Gas	4	655	90%
Municipal Solid Waste	3	26	4%
Hydroelectric	8	40	5%
Geothermal	1	10	1%

* Based on nameplate ratings

Natural Gas Cogenerators

Natural gas-fired cogenerators make up the largest percentage of NUG currently under contract. The first of these projects, the 80 MW Phase I March Point Cogenerator at the Texaco refinery, began operation in September 1991.

The other three projects have not yet begun construction. The Sumas Energy Cogenerator (110 MW) now has a planned on-line date of late 1992, about two years after the original date forecasted in the contract. Encogen (160 MW), selected through the company's first competitive bid, and Tenaska (245 MW) projects are in the initial licensing phase and should have adequate time to meet their scheduled on-line dates in 1993.

Municipal Solid Waste (MSW)

Puget Power currently purchases the output from three municipal-solid-waste projects: the 2.5 MW Skagit County facility, the 2.0 MW ReComp of Washington project and the 23 MW Spokane Regional Waste-to-Energy Project. Another project, the 17 aMW Wheelabrator Pierce Project was canceled by the county prior to construction. The Wheelabrator project was contracted through the company's competitive bidding process.

Hydroelectric

Puget Power has contracted for the output from eight small hydro projects totaling 22 aMW. Eighty percent of this total is from three projects: Twin Falls at 8 aMW, Weeks Falls at 2 aMW and Koma Kulshan at 6 aMW. All three projects currently have 35-year contracts.

Geothermal

Puget Power's 1989 competitive bidding process provided the opportunity to acquire the company's first geothermal resource. The 10 aMW project, to be developed by Trans-Pacific Geothermal Corporation, will be located in Northern California. Since the final generation potential of the site is expected to be greater than 10 aMW, Puget Power contracted for the first right to future expansions.

Coal-fired Generation

Puget Power's existing coal-fired resources are planned to provide future base load generation. Table C-6 shown on the following page, lists the company-owned coal-fired generation facilities. In addition, the company has power purchase contracts with Montana Power Company for 94 MW of Colstrip 3 & 4 and with Grays Harbor County PUD for 52 MW of Centralia.

Table C-6

OWNED COAL-FIRED GENERATION	Project Capacity MW	Puget Share %	Puget Capacity MW
Colstrip 1	330	50%	165
Colstrip 2	330	50%	165
Colstrip 3	700	25%	175
Colstrip 4	700	25%	175
Centralia	1,313	7%	92
TOTAL			772

A number of uncertainties arise with respect to coal-fired facilities. The primary issue being potential requirements that may result from the 1991 federal Clean Air Act Amendments.

In the long-term, the current acid rain legislation would not be met by the Centralia plant in the year 2000 when an emissions limit of 1.2 lbs. of SO_2 per million BTUs is expected by year 2000, which is half of the current emission level. Steps required to meet this limit, including fuel switching, fuel blending, or flue gas treatment, is unknown at this time, but is expected to increase the operating cost of the facility.

The Federal Parks Service is investigating the effects of Centralia emissions on visibility in the national parks in Western Washington, including North Cascades, Olympic and Mount Rainier. The results of this study could potential influence the Best Available Retrofit Technology (BART) requirement on the plant. The finding, if any, of Centralia effects should be available in late 1992 or early 1993.

The Colstrip coal-fired facilities are all fully scrubbed plants, with emissions being reduced to regulated levels by treating all flue gases in wet limestone scrubbers. Unit 4 may have some emission problems due to the revised Clean Air Act. Base years for determining total emissions under the Act were during unit startup, a period of low capacity factor.

Conservation Potential

Summary

This appendix identifies the methods and findings of Puget Power's 1991 estimation of the conservation potential within its service territory by the year 2010. The basic methodology adopts as closely as possible the methodology used by the Northwest Power Planning Council (Power Council) as identified in several variants of their draft 1991 Northwest Conservation and Electric Power Plan (NPPC 1991).

The Power Council methodology is utilized with data specific to the Puget Power service territory. Sources for the specific Puget Power data include information developed by the Puget Power forecasting models, Puget Power sponsored customer surveys, and Puget Power conservation program information. These estimates are used by the Puget Power resource planners in their least-cost planning efforts.

The estimates of conservation potential presented in this appendix are what Puget Power considers achievable conservation potential and are based on the Power Council (NPPC 1991) estimates of achievable potential. The estimates of achievable potential take into account real-world limitations to achieving full technical conservation potential. These limitations include prior actions, quality of installation, incompatibility of the measure with the building, unforeseen technical problems, and consumer preferences.

These estimates of conservation potential attempt to take into account (and thus not include) conservation motivated by changes in electricity and other competing fuel prices and other market and regulatory forces. The end-use forecasting models employed by Puget Power are the means used to control for such naturally occurring or regulatory actions. The forecasting models allow for fuel switching in response to fuel prices, incorporate technology curves for response to improving technology, and include the impacts of future state and federal building and appliance standards. Therefore, the baseline estimates of energy use and fuel saturation by end-use do not reflect present day conditions, but rather the conditions as they are expected to exist in the year 2010. The conservation resource is estimated for three economic scenarios of Medium Low, Medium, and Medium High.

It is important to emphasize the baseline from which the conservation estimates are made. For example, by using the year 2010 as the baseline, most appliances stocks have turned over and the average energy use in 2010 is reflective of the stock that will be installed over the next 20 years. However, this year 2010 baseline may be much different from a baseline developed from the average currently being purchased. Another example is that there are a fixed number of buildings in existence today. However, not all of these buildings will still be in existence in 2010. Conservation potential is only estimated for those buildings expected to still be in existence in 2010. Figure D-1 illustrates the conservation and fuel switching incorporated within Puget Power's forecasting models compared to the conservation estimates contained within this appendix. The impacts identified below the "0" line are included within the forecasting models while the impacts above the "0" line are the conservation potentials identified in this appendix.

Figure D-1

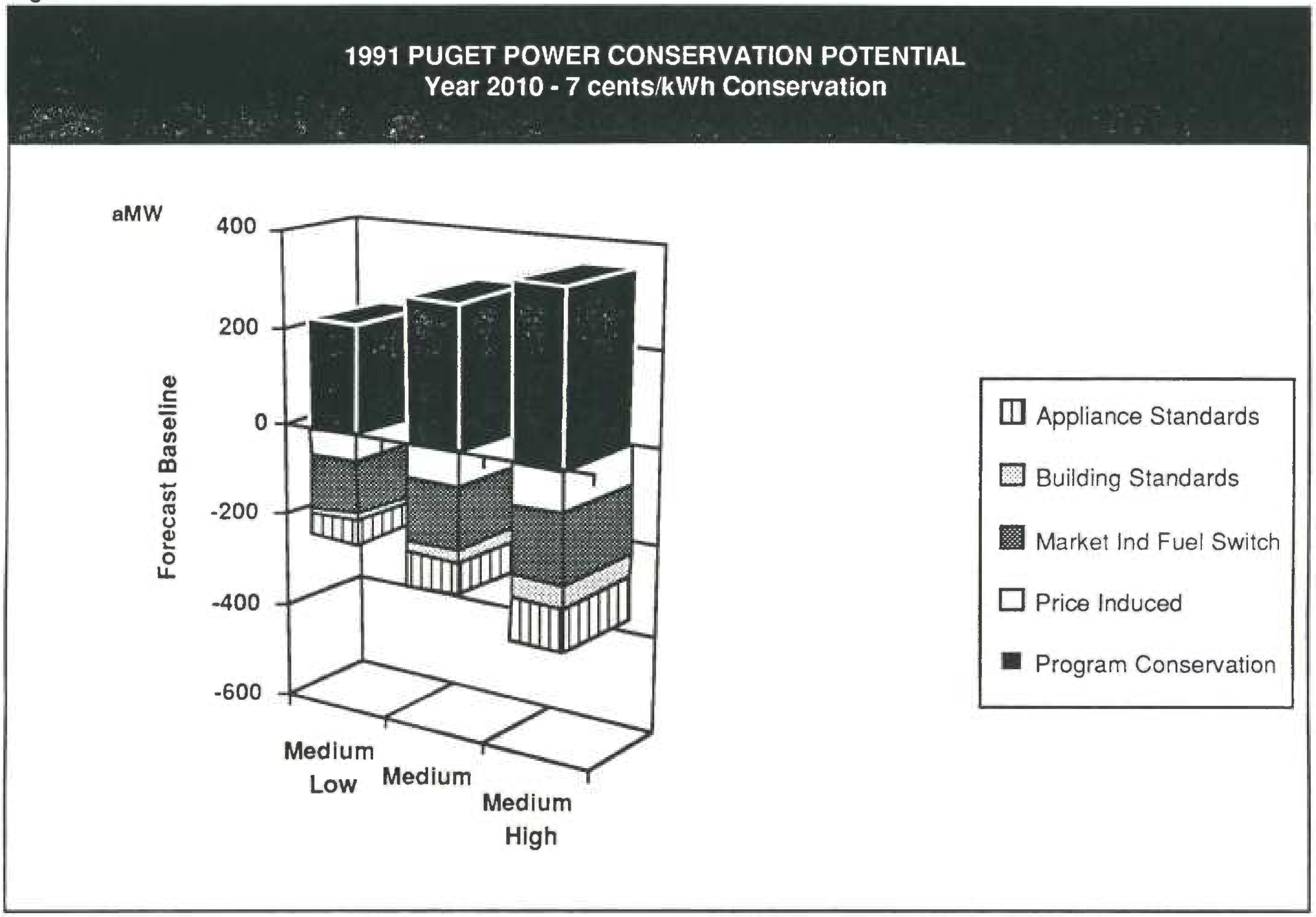

1991 PUGET POWER CONSERVATION POTENTIAL
Year 2010 - 7 cents/kWh Conservation
aMW
400
200
0
-200
-400
-600
Forecast Baseline
Medium Low
Medium
Medium High
Appliance Standards
Building Standards
Market Ind Fuel Switch
Price Induced
Program Conservation

Figure D-2

TOTAL CONSERVATION POTENTIAL BY THE YEAR 2010 FOR THE MEDIUM LOW SCENARIO

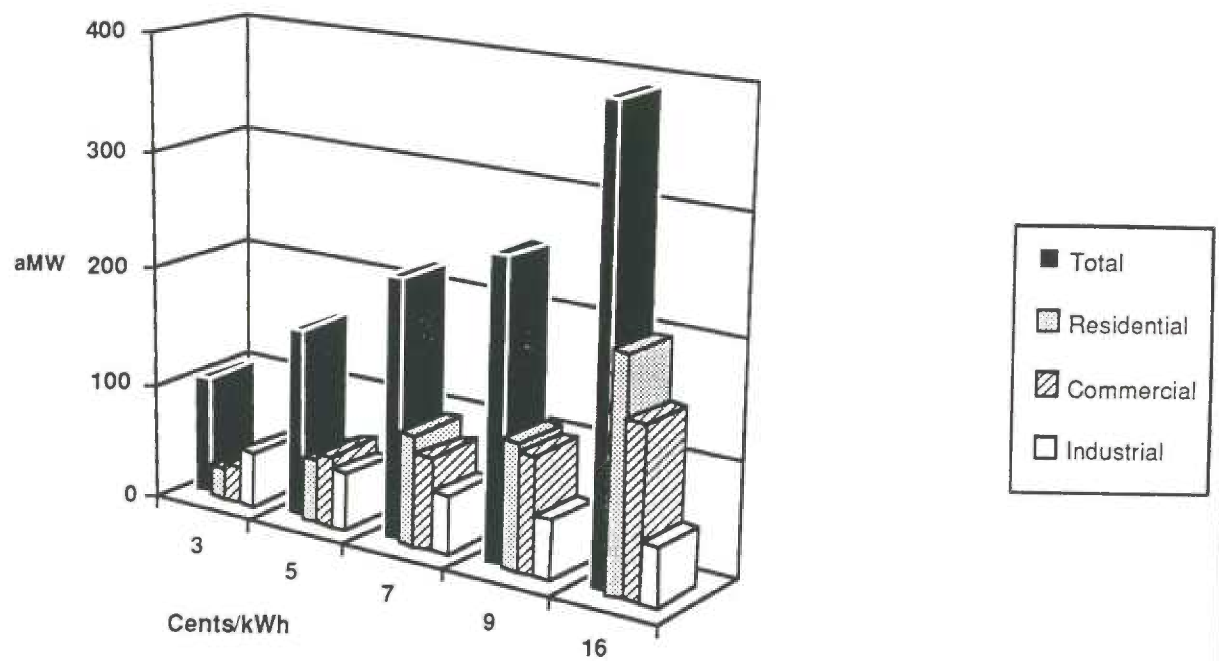


Figure D-3

TOTAL CONSERVATION POTENTIAL BY THE YEAR 2010 FOR THE MEDIUM SCENARIO

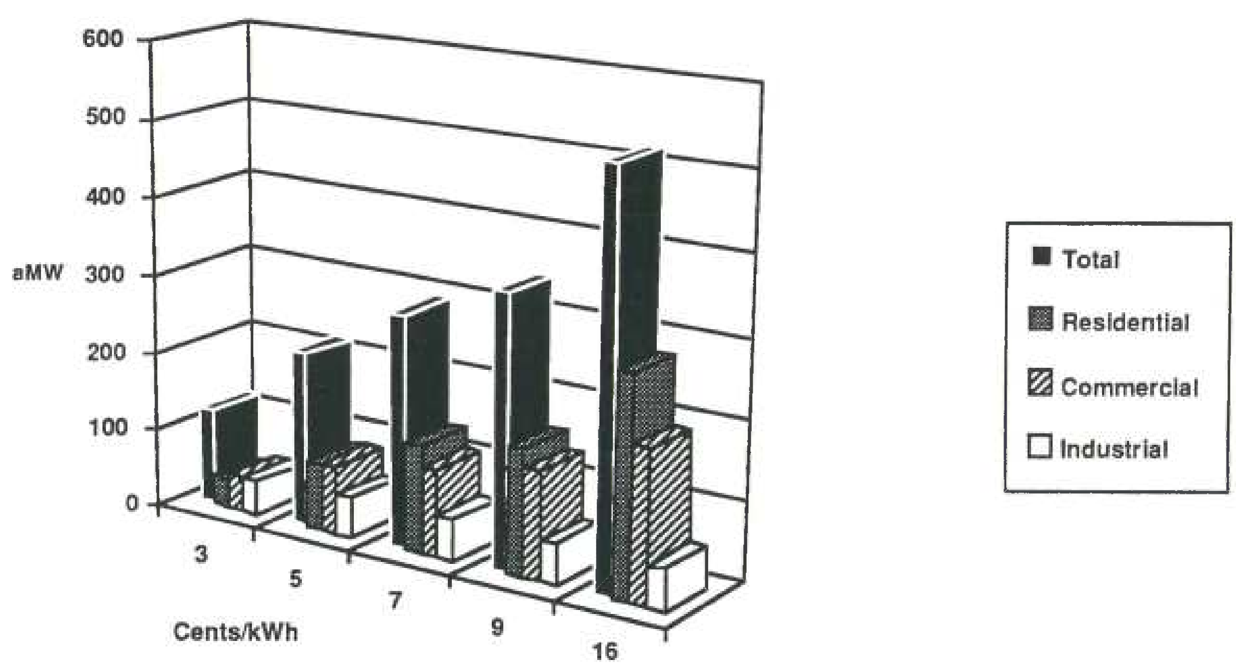
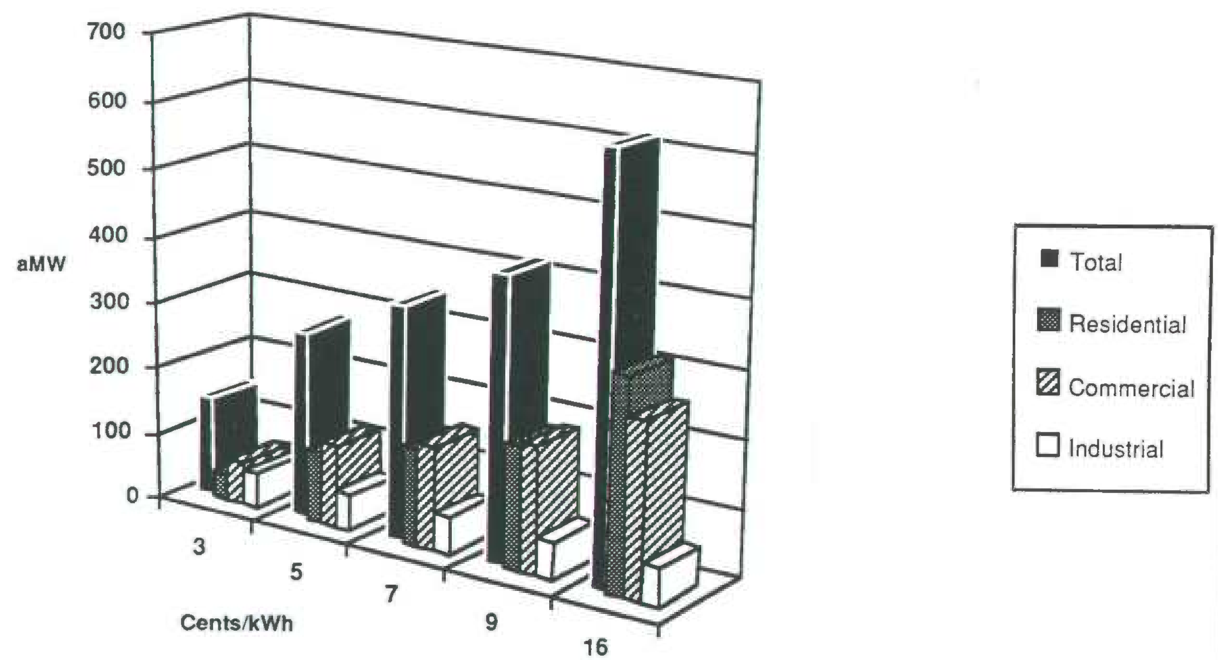


Figure D-4

TOTAL CONSERVATION POTENTIAL BY THE YEAR 2010 FOR THE MEDIUM HIGH SCENARIO



Summary of Findings

Figures D-2 through D-4 show the conservation potential under the three economic conditions of Medium Low, Medium, and Medium High, respectively, for the residential, commercial, and industrial sectors. The graphs show that conservation potential in the industrial sector is the lowest cost. However, the conservation potential in the residential and commercial sectors are the dominant elements of the supply curves after the 3 cent/kWh cost level.

Tables D-1 through D-3 show the conservation potential at the program level under the three economic conditions for the 3, 5, 7, 9, and 16 cent/kWh levels. For the 7 cent/kWh level, conservation potential ranges from 223 aMW for the Medium Low scenario to 352 aMW for the Medium High scenario. As one would expect, conservation potential for programs directed at new construction vary significantly by economic scenario.

Comparison to 1989 Estimates

The estimates of conservation potential presented in this appendix and the conservation potential identified in the 1989 Least-Cost Plan are not directly comparable. Economic and demographic projections have changed since the 1989 Least-Cost Plan, resulting in some minor differences. A major component of the difference is the federal appliance standards and the new state of Washington building code. The conservation savings resulting from these new standards were part of the 1989 Least-Cost Plan but were removed from this appendix since they now have a certainty of being achieved. If no methodological changes had been made since 1989, one would expect the conservation potential estimated in this appendix to be smaller. However, significant changes in methodology have been incorporated for this appendix resulting in conservation potential estimates that are 30 percent to 60 percent higher than the 1989 levels. Estimates of conservation potential in the industrial sector have nearly doubled and estimates within new commercial and new multi-family buildings are also much higher.

Table D-1

TOTAL CONSERVATION POTENTIAL BY THE YEAR 2010
MEDIUM LOW SCENARIO
(aMW)

Sector/Program	3 cent/kWh	5 cent/kWh	7 cent/kWh	9 cent/kWh	16 cent/kWh
Res - Exist SF Space Heat	6.0	6.6	7.0	7.7	36.5
Res - Exist MF Space Heat	9.5	15.2	16.3	16.3	18.3
Res - Refrig & Freezers	0.6	0.6	3.5	6.2	19.9
Res - Lighting	0.0	0.0	7.1	7.1	7.1
Res - Hot Water	8.3	28.2	54.7	56.2	89.7
Res - Hot Wat Heat Pmp Ht Rec	0.0	0.0	0.0	7.1	7.1
Res - New SF Space Heat	0.0	0.3	0.6	0.8	1.4
Res - New MF Space Heat	0.0	0.0	2.3	2.3	8.7
Res - New Mobile Home Space Heat	1.0	1.9	2.6	2.6	3.9
Res - Clothes Dryer	0.9	0.9	0.9	0.9	5.7
Commercial - Existing	6.7	14.6	23.6	35.2	42.1
Commercial - New	13.7	26.1	31.8	37.3	44.2
Commercial - Remodel	10.2	19.4	23.6	27.8	59.3
Industrial	47.3	48.6	49.4	49.4	49.4
TOTAL	104.1	162.5	223.3	256.7	393.3

Table D-2

TOTAL CONSERVATION POTENTIAL BY THE YEAR 2010
MEDIUM SCENARIO
(aMW)

Sector/Program	3 cent/kWh	5 cent/kWh	7 cent/kWh	9 cent/kWh	16 cent/kWh
Res - Exist SF Space Heat	6.0	6.6	7.0	7.7	36.5
Res - Exist MF Space Heat	9.5	15.2	16.3	16.3	18.3
Res - Refrig & Freezers	0.8	0.8	4.6	7.0	19.6
Res - Lighting	0.0	9.5	9.5	9.5	9.5
Res - Hot Water	10.3	35.2	68.1	70.0	111.8
Res - Hot Wat Heat Pmp Ht Rec	0.0	0.0	0.0	16.3	16.3
Res - New SF Space Heat	0.0	2.0	4.7	7.3	15.4
Res - New MF Space Heat	0.0	0.0	3.0	3.0	11.5
Res - New Mobile Home Space Heat	8.0	14.2	20.1	20.2	29.6
Res - Clothes Dryer	1.8	1.8	1.8	1.8	8.5
Commercial - Existing	6.7	14.6	23.6	35.2	42.1
Commercial - New	25.3	48.3	58.8	69.1	81.8
Commercial - Remodel	11.6	22.1	26.9	31.6	67.6
Industrial	43.3	50.7	51.5	51.5	51.5
TOTAL	123.2	221.1	296.1	346.7	520.1

Table D-3

TOTAL CONSERVATION POTENTIAL BY THE YEAR 2010
MEDIUM HIGH SCENARIO
(aMW)

Sector/Program	3 cent/kWh	5 cent/kWh	7 cent/kWh	9 cent/kWh	16 cent/kWh
Res - Exist SF Space Heat	6.0	6.6	7.0	7.7	36.5
Res - Exist MF Space Heat	9.5	15.2	16.3	16.3	18.3
Res - Refrig & Freezers	0.0	0.0	0.4	3.6	13.0
Res - Lighting	0.0	12.5	12.5	12.5	12.5
Res - Hot Water	11.9	56.5	78.4	80.6	128.6
Res - Hot Wat Heat Pmp Ht Rec	0.0	0.0	0.0	23.8	23.8
Res - New SF Space Heat	0.0	0.0	6.2	12.4	31.6
Res - New MF Space Heat	0.0	0.0	3.4	3.4	12.8
Res - New Mobile Home Space Heat	6.1	10.8	15.4	15.4	22.6
Res - Clothes Dryer	5.3	5.3	5.3	5.3	14.0
Commercial - Existing	6.7	14.6	23.6	35.2	42.1
Commercial - New	42.7	81.7	99.4	116.9	138.3
Commercial - Remodel	12.9	24.7	30.0	35.3	75.4
Industrial	51.6	53.0	53.9	53.9	53.9
TOTAL	152.7	281.1	351.7	422.1	623.3

Conservation Compared to Sales

Total electricity sales in the year 2010 is expected to be over 3,100 aMW, based on Puget Power's Medium scenario. This forecast represents just over 1,000 aMW of new load over 1991 sales levels. At the 7 cent/kWh level, the total estimated conservation potential is 35 percent of this future load growth. Conservation at the 16 cent/kWh level is 60 percent of load growth. These conservation potentials represent a major portion of Puget Power's future load growth.

Introduction

Conservation supply curves are used to estimate the amount of conservation available at a given cost in Puget Power's service area through the year 2010. A supply curve portrays the amount of conservation potential in average megawatts (aMW) available at different price levels, expressed in levelized cents/kWh. The costs shown in the conservation supply curves are the full capital and installation costs of obtaining conservation resources. When actually obtaining this potential conservation resource, Puget Power may share the cost with other parties such as the Bonneville Power Administration (BPA) and/or a customer. Program administrative costs are not included because it is anticipated that administrative costs will be less than the portion of capital costs incurred by BPA and/or the customer.

The cost of a conservation measure is levelized over the expected lifetime of the measure using Puget Power's fixed charge rate. Costs are expressed in cents/kWh and include the direct capital and installation cost of the measure. Table D-4 lists the fixed charge rates from each of the economic scenarios used to levelize investments over various lifetimes.

Conservation supply curves were developed for 14 categories, or combinations of customer sectors and end-uses, as identified below. Most reflect existing Puget Power programs; some do not, and are being considered in future program plans.

- Existing Single Family Space Heat
- Existing Multi-Family Space Heat
- New Single Family Space Heat
- New Multi-Family Space Heat
- New Mobile Home Space Heat
- Residential Refrigerators & Freezers
- Residential Hot Water
- Residential Hot Water Heat Pump Heat Recovery
- Residential Lighting
- Residential Clothes Dryers
- Existing Commercial
- Remodel Commercial
- New Commercial
- Industrial

The resulting conservation estimates were reviewed with respect to program feasibility. An ongoing effort will be made to refine the conservation estimates based on experience, including evaluation of existing programs and recent experience with new programs.

Table D-4

FIXED CHARGE RATES			
Years	Medium Low FCR	Medium FCR	Medium High FCR
5	.2789	.2694	.2619
10	.1758	.1698	.1624
12	.1597	.1542	.1497
15	.1445	.1395	.1317
20	.1308	.1263	.1180
25	.1240	.1196	.1110
30	.1203	.1160	.1071
35	.1182	.1140	.1048
40	.1170	.1128	.1034
45	.1163	.1122	.1026
50	.1159	.1118	.1022
55	.1157	.1116	.1019
60	.1156	.1114	.1017
65	.1155	.1114	.1016

Two important factors need to be remembered when reviewing these estimates of conservation potential. The first is that they are based on "average" conditions and the second is the assumption that measures are implemented in least-cost order. As with any average, there is a range of actual costs and conservation levels both higher and lower than the ones identified in this appendix. For example, the existing single family home weatherization program is based on three different typical buildings. The average energy use for this group of buildings is taken from the forecasting model output for the year 2010. An assumption is made that the least-cost measures are implemented first with the conservation potential being the remaining, more expensive measures. In reality, there are a great variety of homes in the marketplace and it is not necessarily true that least-cost order is the same for all. The second point is that it is likely that several measures as a group are installed at one time in one house while no measures are installed in another instead of the least-cost measure installed in every eligible home first before a second measure is installed. These deviations from reality should not have a large impact on the overall size of the available conservation resource.

Residential Conservation

Introduction

The method used to develop conservation potential estimates for the residential sector is based on a combination of methodology and data from the Northwest Power Planning Council 1991 Electric Power Plan and data from the Puget Power residential sector forecasting model, customer surveys, and conservation program results. Eleven separate program analyses were conducted to develop the residential sector conservation estimates.

The eleven programs include:

- Existing Single Family Space Heat
- Existing Multi-Family Space Heat
- Refrigerators
- Freezers
- Lighting
- Hot Water
- Hot Water Heat Pump Heat Recovery
- Clothes Dryers
- New Single Family Space Heat
- New Multi-Family Space Heat
- New Mobile Home Space Heat

Figures D-5 through D-7 show the amount of conservation potential available for major groupings of the programs under the economic scenarios of Medium Low, Medium, and Medium High. Cost levels are provided at the 3, 5, 7, 9 and 16 cent/kWh levelized price levels. The Puget Power Resource Plan includes programs at approximately the 7 cent/kWh level. The space heat and water heat programs provide most of the conservation potential within the Puget Power service territory. Appliance programs are expensive, but provide significant levels of potential in the more robust economic scenarios. The Figures D-5, D-6 and D-7 conservation potential under the Medium High scenario is 60 percent higher than the potential under the Medium Low scenario and 20 percent higher than the Medium scenario at the 7 cent/kWh level.

Figure D-8 illustrates that the hot water measures provide the most conservation potential at the 7 cent/kWh category for the Medium scenario. The hot water measures provide 50 percent of the residential conservation potential distantly followed by new mobile home and existing multi-family space heat, respectively. Differences in conservation potential estimates by economic scenario are due to different estimates of construction activity and electricity saturation estimates between the three economic scenarios.

Figure D-5

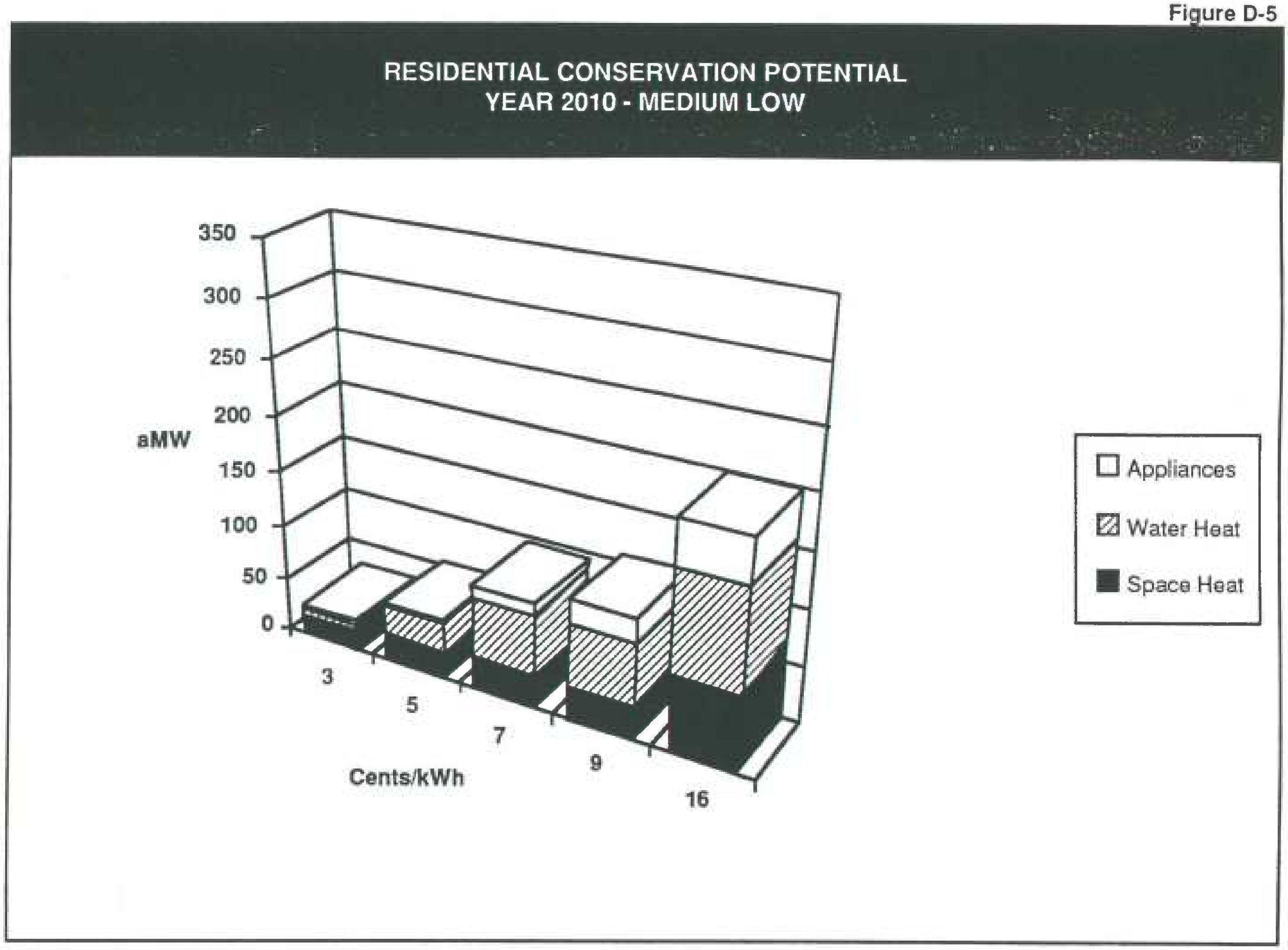

RESIDENTIAL CONSERVATION POTENTIAL
YEAR 2010 - MEDIUM LOW
350
300
250
200
150
100
50
0
aMW
3
5
7
9
16
Cents/kWh
Appliances
Water Heat
Space Heat

Figure D-6

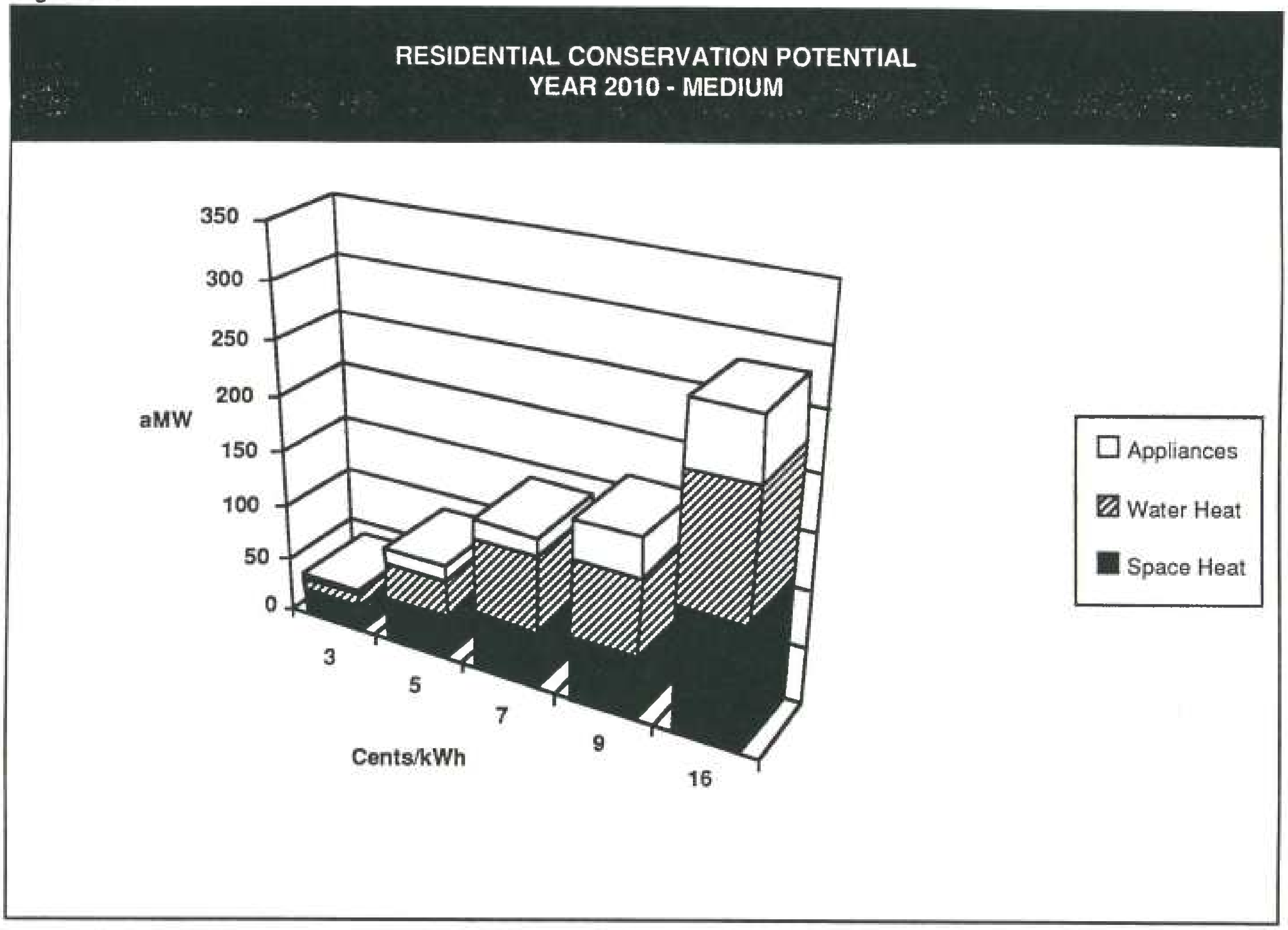

RESIDENTIAL CONSERVATION POTENTIAL
YEAR 2010 - MEDIUM
350
300
250
200
150
100
50
0
aMW
3
5
7
9
16
Cents/kWh
Appliances
Water Heat
Space Heat

Figure D-7

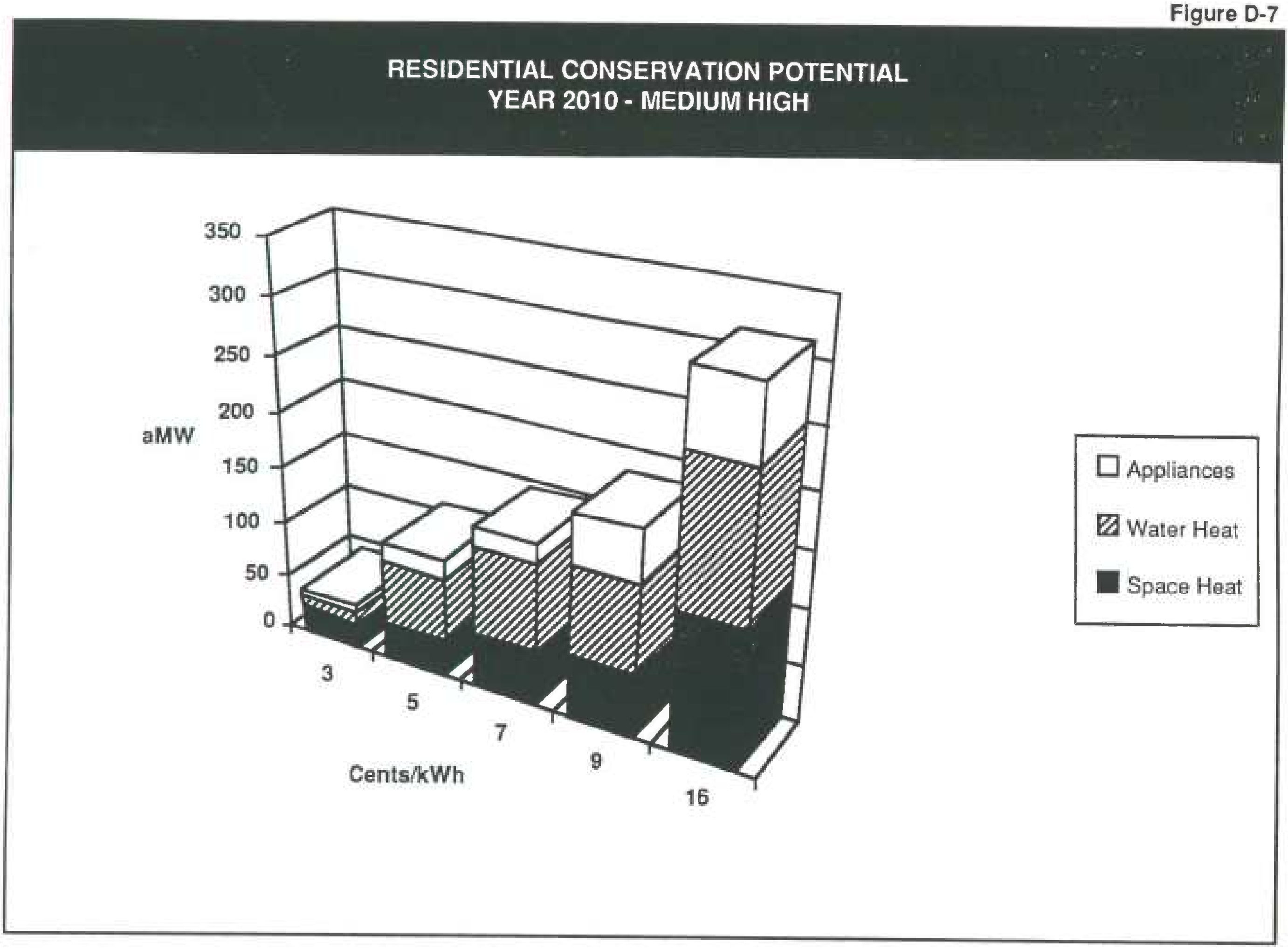
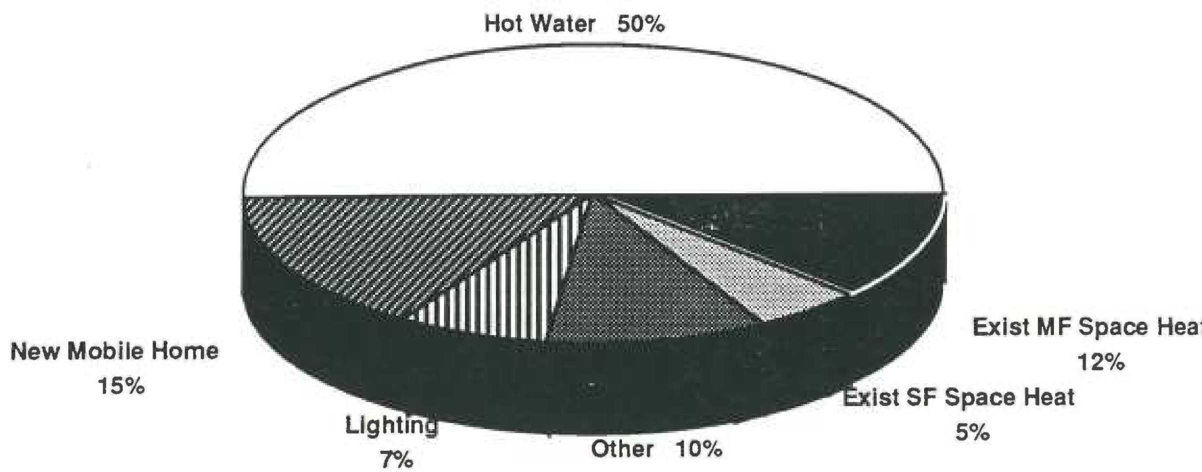

RESIDENTIAL CONSERVATION POTENTIAL
YEAR 2010 - MEDIUM HIGH
350
300
250
200
150
100
50
0
aMW
3
5
7
9
16
Cents/kWh
Appliances
Water Heat
Space Heat

Figure D-8

RESIDENTIAL CONSERVATION PROGRAMS
YEAR 2010 - MEDIUM SCENARIO (7 cents/kWh)



Residential Space Heat - Existing Single Family

The methodology used to develop the estimates of conservation potential for this program category is similar to that used by both the Power Planning Council and BPA. These approaches use three typical building designs to estimate the retrofit potential for single family homes. The costs and savings of conservation measures multiplied by the number of eligible homes are the primary determinants of the amount of conservation that is available from the supply curves. The savings estimates are based on engineering models and the cost estimates are based on information provided by BPA and regional utilities on the costs they have incurred in recent years to weatherize homes. Both savings and costs are the same as used by the Power Council for the Seattle zone.

Typical Homes

Tables D-5 through D-7 list the measures, estimated energy savings, and costs assuming standard operating conditions for the three typical homes used in the analysis. The first is an 850-square-foot, single-story house built over an unheated basement. The second is a 1,350-square-foot house over a vented crawl space. The third is a 2,100-square-foot, two-story house with a heated basement.

Table D-5

TYPICAL EXISTING PRE-1982 SINGLE FAMILY HOME
850 SQUARE FEET

	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	22.20	18,868	0	50	.1118	0.00
Ceiling R0-R19	374	374	13.88	11,795	7073	50	.1118	5.50
Walls R0-R11	978	604	10.28	8,735	3060	50	.1118	20.53
Crawl Space R0-R19	1,607	629	7.15	6,079	2656	50	.1118	24.63
Ceiling R19-R30	1,735	128	6.58	5,593	486	50	.1118	27.39
ACH .6-.5	1,954	100	5.84	4,965	403	10	.1698	39.19
Crawl Space R19-R30	1,854	119	6.32	5,368	225	50	.1118	55.00
Ceiling R30-R38	2,047	93	5.71	4,854	111	50	.1118	37.14
Windows R3	2,218	171	5.49	4,669	185	50	.1118	96.13
Windows R2.6	3,545	1,327	3.92	3,334	1335	50	.1118	103.38
Door Wood-Metal	4,783	562	3.13	2,658	332	30	.1160	182.66
Windows R-5	4,221	676	3.52	2,990	344	50	.1118	204.37

Table D-6

TYPICAL EXISTING PRE-1982 SINGLE FAMILY HOME 1,350 SQUARE FEET	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	22.55	30,440	0	50	.1118	0.00
Ceiling R0-R19	594	594	14.18	19,143	11297	50	.1118	5.47
Walls R0-R11	1,362	768	10.61	14,322	4821	50	.1118	16.57
ACH .6-.5	2,664	100	6.36	8,587	661	10	.1698	23.90
Crawl Space R0-R19	2,361	999	7.43	10,035	4287	50	.1118	24.24
Ceiling R19-R30	2,564	203	6.85	9,248	787	50	.1118	26.83
Ceiling R30-R38	2,812	148	6.23	8,406	181	50	.1118	85.04
Windows R3	3,082	270	6.01	8,107	299	50	.1118	93.91
Windows R2.6	5,187	2,105	4.38	5,907	2200	50	.1118	99.51
Door Wood-Metal	6,819	561	3.70	4,991	347	30	.1160	174.45
Windows R-5	6,258	1,071	3.95	5,338	569	50	.1118	195.75
Crawl Space R19-R30	7,683	864	3.45	4,657	334	50	.1118	269.03

Table D-7

TYPICAL EXISTING PRE-1982 SINGLE FAMILY HOME 2,100 SQUARE FEET	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	14.87	31,230	0	50	.1118	0.00
Ceiling R0-R19	308	308	12.13	25,465	5765	50	.1118	5.56
ACH .6-.5	1,710	100	8.00	16,802	1140	10	.1698	13.86
Walls R0-R11	1,505	1,197	8.74	18,360	7105	50	.1118	17.52
Ceiling R19-R30	1,610	105	8.54	17,942	418	50	.1118	26.12
Ceiling R30-R38	1,787	77	7.95	16,705	97	50	.1118	82.56
Windows R3	2,358	571	7.64	16,054	651	50	.1118	91.22
Windows R2.6	6,807	4,449	5.37	11,270	4784	50	.1118	96.72
Door Wood-Metal	9,633	562	4.61	9,691	357	30	.1160	169.87
Windows R-5	9,071	2,264	4.78	10,048	1222	50	.1118	192.68

Table D-8

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR EXISTING SINGLE FAMILY HOMES - ALL SCENARIOS		
House Size Distribution:		
	850 sf	30.3%
	1,350 sf	38.9%
	2,100 sf	30.8%
# Homes w/Electric Heat in 2010 (pre 1982 Stock)		102,289
# Homes Weatherized to Date		57,338
Forecast Energy Use Modification		99.7%
Wood Heat Adjustment		81.0%
Pre-1982 Stock Elec Space Heat Use (kWh/Home)		11,380
Transmission/Distribution Adjustment		1.075
Maximum Market Saturation		85%
% Homes Weatherized Independently		25%
% Homes Partially Weatherized (Puget)		25%
% Conservation Available From Partially Weatherized Homes		40%
1982 - 1990 HOUSING STOCK		
# Homes w/Electric Heat 1982-1990		56,475
1982-1990 Stock Elec Space Heat Use (kWh/Home)		9,685

The measures included in the typical home analyses were as follows:

- Ceiling insulation increased from R-0 to R-19 (each typical home).
- Ceiling insulation increased from R-19 to R-30 (each typical home).
- Ceiling insulation increased from R-30 to R-38 (each typical home).
- Wall insulation increased from R-0 to R-11 (each typical home).
- Crawl space insulation increased from R-0 to R-19 (850 and 1,350 typical homes).
- Crawl space insulation increased from R-19 to R-30 (850 and 1,350 typical homes).
- Infiltration measures to reduce air changes per hour from .6 ACH to .5 ACH (each typical home).
- Single pane glass to storm windows (each typical home).
- Storm windows to replacement R-2.6 windows (each typical home).
- R-2.6 windows to R-5 windows (each typical home).
- Replace wood doors with metal doors (each typical home).

Key Variables

Table D-8 lists key variables, many of which are unique to the Puget Power service territory, used to calculate the conservation potential. The distribution of housing size is based upon the Puget Power 1983 Residential End-Use Survey. The number of electrically heated pre-1982 vintage homes and 1982-1990 vintage homes comes from the Residential Forecast Model output. The number of homes weatherized to date comes from Puget Power conservation program information. The Forecast Energy Use Modification Factor is based on a similar factor employed by the Power Council (NPPC 1991).

The wood heat adjustment factor comes a wood heat survey by Puget Power (Puget 1983) Baseline energy use for the pre-1982 stock and the 1982-1990 stock is based on Residential Forecast Model output modified by the wood heat adjustment factor. The transmission /distribution factor is a Puget Power estimate.

The maximum market saturation level, the percentage of homes weatherized independently, and the percentage of conservation still available from partially weatherized homes are Power Council estimates (NPPC 1991). The estimate of the percentage of homes that have participated in Puget Power weatherization programs but which have been only partially weatherized, is based on an analysis of billing information on participants in the Puget Power programs (Cullen 1987).

Methodology

The conservation potential is a summation of the potential of each of the individual conservation measures. The conservation potential by individual measures was calculated using the following formula:

Measure Potential= Measure Savings per Home for pre-1982 Stock

* # of Eligible pre-1982 Unweatherized Homes
+ (# of Homes Weatherized Independently
+ # of Homes Partially Weatherized by Puget Power)
* Remaining Conservation Potential for pre-1982 Stock
+ Measure Savings per Home for 1982-1990 Stock
* # of Eligible 1982-1990 Homes)
* Transmission & Distribution Adjustment
* Maximum Market Saturation
* Forecast Energy Use Modification
* Wood Heat Adjustment

Levelized costs were developed at the measure level for each typical home. These costs and associated savings for each typical building were merged with a size distribution weight and sorted in least-cost order. Calibration to baseline energy use was performed by assuming least-cost measures would be implemented first.

Residential Space Heat - Existing Multi-Family

The methdology used to develop the estimates of conservation potential for existing multi-family homes is consistent with the methodology used for existing single family homes. It is similar to the Power Council and BPA methodologies in that it is based on the same typical building for estimating energy savings and costs.

Typical Multi-Family Unit

Table D-9 lists the measures, estimated energy savings, and costs assuming standard operating conditions for the representative multi-family home used in the analysis. The multi-family design is a three-story apartment buildings with four 840 square-foot units on each floor.

Table D-9

TYPICAL EXISTING PRE-1982 MULTI-FAMILY HOME								
	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	9.33	7,841	0	50	.1118	0.00
Ceiling R0-R19	140	140	6.51	5,470	2371	50	.1118	6.14
Ceiling R19-R30	161	21	6.30	5,296	174	50	.1118	12.55
Walls R0-R11	462	301	4.61	3,873	1423	50	.1118	22.00
Floors R0-R19	677	215	3.67	3,081	792	50	.1118	28.23
Ceiling R30-R38	693	16	3.62	3,044	37	50	.1118	44.97
ACH .4-.3	864	129	3.01	2,532	428	10	.1698	47.61
Floors R19-R30	735	42	3.52	2,960	84	50	.1118	52.00
Windows R3	1,036	172	2.81	2,363	169	50	.1118	105.85
Windows R2.6	2,378	1,342	1.39	1,168	1195	50	.1118	116.79
Door Wood-Metal	3,201	140	.98	823	63	30	.1160	239.79
Windows R-5	3,061	683	1.05	886	282	50	.1118	251.89

The measures included in the typical multi-family unit analysis were as follows:

- Ceiling insulation increased from R-0 to R-19.
- Ceiling insulation increased from R-19 to R-30.
- Ceiling insulation increased from R-30 to R-38.
- Wall insulation increased from R-0 to R-11.
- Floor insulation increased from R-0 to R-19.
- Floor insulation increased from R-19 to R-30.
- Infiltration measures to reduce air changes per hour from .4 ACH to .3 ACH.
- Single pane glass to storm windows.
- Storm windows to replacement R-2.6 windows.
- R-2.6 windows to R-5 windows.
- Replace wood doors with metal doors.

Key Variables

Table D-10 lists key variables, many of which are unique to the Puget Power service territory, used to calculate the conservation potential. The number of electrically heated pre-1982 and 1982-1990 vintage multi-family units comes from Residential Forecast Model output. The number of units weatherized to date comes from Puget Power conservation program information. Baseline energy use for the pre-1982 stock and the 1982-1990 stock comes from Residential Forecast Model output. The transmission/distribution factor is a Puget Power estimate. The maximum market saturation level is a Power Council estimate (NPPC 1991). The demolition adjustment factor for 1982-1990 vintage stock is estimated from Residential Forecast Model output.

Table D-10

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR EXISTING MULTI-FAMILY HOMES - ALL SCENARIOS	
# Units w/Electric Heat in 2010 (pre 1982 Stock)	72,328
# Units Weatherized to Date	15,815
Electric Space Heat Use in 2010 (kWh/unit)	4,282
Transmission/Distribution Adjustment	1.075
Maximum Market Saturation	85%
1982 - 1990 HOUSING STOCK	
# Units w/Electric Heat (1982-1990 Stock)	62,080
Electric Space Heat Use in 2010 (kWh/unit)	3,449
Demolition Adjustment	91.5%

Methodology

The conservation potential is a summation of the potential of each of the individual conservation measures. The conservation potential by individual measures was calculated using the following formula:

Measure Potential= (Measure Savings per Unit for pre-1982 Stock

* # of Eligible pre-1982 Unweatherized Units
+ Measure Savings per Unit for 1982-1990 Stock
* # of Eligible 1982-1990 Units
* Demolition Adjustment)
* Transmission & Distribution Adjustment
* Maximum Market Saturation

Levelized costs were developed at the measure level. These costs and associated savings were sorted in least-cost order. Calibration to baseline energy use was performed by assuming least-cost measures implemented first.

Residential Refrigerators and Freezers

All of the measures included in the conservation estimates are beyond the 1993 Federal standard. They are generally high-cost measures with only modest levels of conservation potential available until after the 9 cent/kWh cost level. The Puget Power methodology is essentially the same as the methodology used by the Power Council for refrigerators and freezers (NPPC 1991).

Representative Appliances

Tables D-11, D-12 and D-13 list the measures and costs used in the analysis for refrigerators, upright freezers, and chest freezers, respectively. The key data used in this analysis is from the U.S. Department of Energy (DOE) proceedings on refrigerator and freezer efficiency improvements (DOE 1988). The DOE analysis is based on an 18-cubic-foot automatic defrost refrigerator with a top-mounted freezer, a 15-cubic-foot manual defrost upright freezer, and a 17 cubic-foot chest freezer. The savings estimates include the interaction of appliance efficiency improvements with space heating requirements.

Table D-11

REFRIGERATORS

	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Unit)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	947	0	18	.1395	0.0
Door Foam & Compressor EER 5.0	11	11	787	160	18	.1395	10.21
Improved Foam Insulation	19	7	745	42	18	.1395	25.16
Compressor EER 5.3	32	13	714	31	18	.1395	61.51
Eff Fans, 2" Door Insul w/improved foam	82	51	637	77	18	.1395	95.79
Adaptive Defrost, Evac Panels	185	103	515	122	18	.1395	122.67

Table D-12

UPRIGHT FREEZERS

	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Unit)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	777	0	18	.1395	0.0
Compressor EER 5.0	15	15	606	171	18	.1395	12.04
Improved Foam Insulation	23	8	544	62	18	.1395	17.71
Compressor EER 5.3	36	13	511	33	18	.1395	54.06
Door Insul 2" & Better Foam	64	28	453	58	18	.1395	66.25
Evacuate Panel	115	51	343	110	18	.1395	63.63

Table D-13

CHEST FREEZERS

	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Unit)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	600	0	18	.1395	0.0
Compr EER 5.0, Lid Foam Insul	11	11	475	125	18	.1395	13.42
Improved Foam Insulation	16	5	442	33	18	.1395	21.15
Compressor EER 5.3	29	13	415	27	18	.1395	71.87
2.5" Lid, Better Foam Insul	54	26	370	45	18	.1395	84.69
Evacuated Panel, 2.5" Sides	107	52	315	55	18	.1395	141.21

Key Variables

Table D-14 lists key Puget Power service area specific variables used for estimating conservation potential for residential sector refrigerators and freezers. Variables are presented for the three economic scenarios of Medium Low, Medium, and Medium High. Most of the values for the variables were obtained from the Residential Forecast Model output. These include:

- Electric space heat saturation.
- Number of units by the year 2010.
- Energy use per unit in the year 2010.

The maximum market saturation level and the space heat interaction values are Power Council estimate (NPPC 1991). The transmission/ distribution factor is a Puget Power estimate.

Methodology

The methodology for estimating the conservation potential is a simple one. The conservation potential by individual measures were calculated using the following formula:

Measure Potential = Measure Savings per Unit
* # of Units in 2010
* Transmission & Distribution Adjustment
* Maximum Market Saturation
* Space Heat Interaction

Levelized costs were developed at the measure level. These costs and associated savings were sorted in least-cost order. Calibration to baseline energy use was performed by assuming least-cost measures implemented first.

Table D-14

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR RESIDENTIAL REFRIGERATORS & FREEZERS

Transmission/Distribution Adjustment	1.075		
Maximum Market Saturation	85%		
	Single Family	**Multi-Family**	**Mobile Home**
MEDIUM LOW SCENARIO			
Electric Space Heat Sat (2010)	31.2%	96.6%	91.1%
REFRIGERATOR VARIABLES			
# Units By 2010	522,600	265,327	66,360
Energy Use in Year 2010 (kWh)	792	589	792
Space Heat Interaction	.80	.80	.80
FREEZER VARIABLES			
# Units by 2010	304,284	32,759	39,974
Energy Use in Year 2010 (kWh)	717	444	656
Space Heat Interaction	.844	.517	.545
MEDIUM SCENARIO			
Electric Space Heat Sat (2010)	29.5%	96.8%	91.2%
REFRIGERATOR VARIABLES			
# Units By 2010	719,280	314,413	98,805
Energy Use in Year 2010 (kWh)	682	554	682
Space Heat Interaction	.80	.80	.80
FREEZER VARIABLES			
# Units By 2010	408,551	38,757	59,274
Energy Use in Year 2010 (kWh)	605	408	529
Space Heat Interaction	.853	.516	.544
MEDIUM HIGH SCENARIO			
Electric Space Heat Sat (2010)	28.0%	96.9%	91.3%
REFRIGERATOR VARIABLES			
# Units By 2010	1,028,040	330,877	89,880
Energy Use in Year 2010 (kWh)	593	545	593
Space Heat Interaction	.80	.80	.80
FREEZER VARIABLES			
# Units By 2010	572,104	40,930	54,065
Energy Use in Year 2010 (kWh)	505	396	547
Space Heat Interaction	.86	.516	.544

In reviewing the conservation potentials by economic scenario as presented in Tables D-1 through D-3, it can be seen that the conservation potential for refrigerators and freezers decreases with each more robust economic scenario. This is despite the fact that the number of eligible refrigerators and freezers increase. The reason for this decrease lies in the results from the forecasting model. In Table D-14, it is shown that the forecasting model predicts a lower average energy use for the baseline condition with each more robust economic scenario. This lowering baseline average energy use has the effect of indicating that market induced conservation for refrigerators and freezers grows significantly according to the robustness of the economic scenario. Since market induced savings (as identified by the forecasting models) are not included in the conservation potential estimates, overall conservation potential becomes smaller.

Residential Lighting

Efforts to conserve energy in the residential lighting sector have focused on replacing the traditional incandescent bulbs with compact fluorescent bulbs. Compact fluorescent bulbs are commercially available and use significantly less energy per bulb. However, acceptance of compact fluorescent bulbs has been slow for a variety of reasons including high cost, lack of general availability, inability to fit in all fixtures. According to the Power Council (NPPC 1991), a new lighting technology is being developed that overcomes many of the shortfalls of compact fluorescent bulbs. If this technology becomes commercially available, it should provide a capability for more applications and correspondingly larger conservation potential.

At this time, conservation potential is estimated only for compact fluorescent bulbs. The Puget Power methodology is essentially the same as the methodology used by the Power Council (NPPC 1991). Energy savings are based on data collected for Pacific Power & Light Company in a study examining the potential for retrofitting compact fluorescents into existing homes.

Key Variables

Table D-15 lists the key variables used to calculate the conservation potential. Variables are presented for the three economic scenarios of Medium Low, Medium, and Medium High. Most of the values for the variables were obtained from the Power Council (NPPC 1991).

Table D-15

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR RESIDENTIAL LIGHTING

Transmission/Distribution Adjustment	1.075	
Maximum Market Saturation	85%	
Space Heat Interaction	.50	(applied to electric space heat share only)
# Bulbs per home	3	
Measure Cost (1990$)	$10	
Gross Measure Savings (kWh/Yr.)	42	
Measure Life	12	

	Single Family	Multi-Family	Mobile Home
MEDIUM LOW SCENARIO			
Electric Space Heat Sat (2010)	31.2%	96.6%	91.1%
# Homes By 2010	435,500	262,700	63,200
MEDIUM SCENARIO			
Electric Space Heat Sat (2010)	29.5%	96.8%	91.2%
# Homes By 2010	599,400	311,300	94,100
MEDIUM HIGH SCENARIO			
Electric Space Heat Sat (2010)	28.0%	96.9%	91.3%
# Homes By 2010	856,700	327,700	85,600

These include:

- Maximum market saturation
- Space heat interaction
- Number of bulbs per home
- Measure cost
- Measure savings
- Measure life

The transmission/distribution factor is a Puget Power estimate. The estimates of electric space heat saturation and number of homes by 2010 come from the Residential Forecast Model output.

Methodology

The conservation potential was calculated using the following formula:

Measure Potential = Measure Savings per Unit
* # of Homes in 2010
* Number of Bulbs per Home
* Transmission & Distribution Adjustment
* Maximum Market Saturation
* Space Heat Interaction

Residential Water Heat

The Puget Power methodology is essentially the same as the methodology used by the Power Council for residential water heat (NPPC 1991). Table D-16 lists the water heat measures considered within this analysis. Assumptions about all the measures but faucet aerators (Byers 1991) are from the Power Council (NPPC 1991).

Key Variables

Table D-17 lists key Puget Power service area specific variables used for estimating conservation potential for residential sector water heat measures. Variables are presented for the three economic scenarios of Medium Low, Medium, and Medium High. Many of the values for the variables were obtained from the Residential Forecast Model output. These include:

- Electric water heat saturation.
- Number of water heaters in the year 2010.
- Energy use per water heater in the year 2010.

The estimate of maximum marked saturation was obtained from the Power Council (NPPC 1991). The saturation estimates for clothes washers and dishwashers is from the Puget Power Residential Characteristics Survey (Puget 1989). The transmission/distribution factor is a Puget Power estimate.

Table D-16

RESIDENTIAL WATER HEAT CONSERVATION MEASURES

	1990$ Measure Costs	Percent Savings From Base Usage	Measure Life	FCR	Levelized Cost (Mills/kWh)
Faucet Aerators	$ 5	4.2%	12	.1542	4.79
Showerhead, New (3.0-2.3)	15	10.1%	10	.1698	6.51
Showerhead, Existing (4.5-2.3)	80	24.7%	10	.1698	14.19
Efficient Clothes & Dishwasher	46	6.6%	10	.1698	30.60
Efficient Tank	70	7.6%	12	.1542	36.41
Bottom Board	10	.8%	12	.1542	51.66
Water Saver	197	8.1%	20	.1263	79.52
Horiz Axis Clothes Washer	200	9.2%	10	.1698	95.64

Table D-17

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR RESIDENTIAL WATER HEAT

Transmission/Distribution Adjustment	1.075
Maximum Market Saturation (Except Existing Showerheads)	85%
Maximum Market Saturation (Existing Showerheads)	40%

	Single Family	Multi-Family	Mobile Home
MEDIUM LOW SCENARIO			
Electric Water Heat Saturation (2010)	51.0%	96.2%	90.9%
Energy Use in 2010 (kWh)	4,582	2,742	3,590
# Elec Water Heaters in 2010	222,149	252,849	57,455
% Homes with Clothes Washers in 2010	95..0%	53.0%	84.0%
% Homes with Dishwashers in 2010	75.0%	75.0%	58.0%
MEDIUM SCENARIO			
Electric Water Heat Saturation (2010)	45.7%	96.4%	92.3%
Energy Use in 2010 (kWh)	4,569	2,741	3,582
# Elec Water Heaters in 2010	274,166	300,155	86,859
% Homes with Clothes Washers in 2010	95..0%	53.0%	84.0%
% Homes with Dishwashers in 2010	75.0%	75.0%	58.0%
MEDIUM HIGH SCENARIO			
Electric Water Heat Saturation (2010)	40.6%	96.2%	92.1%
Energy Use in 2010 (kWh)	4,581	2,755	3,596
# Elec Water Heaters in 2010	347,734	315,280	78,855
% Homes with Clothes Washers in 2010	95..0%	53.0%	84.0%
% Homes with Dishwashers in 2010	75.0%	75.0%	58.0%

Methodology

Savings for measures are calibrated to the forecast model by calculating the savings as a percent savings from the baseline usage. The baseline usage comes from the Residential Forecast model output. The conservation potential was calculated using the following formula:

Measure Potential= (Savings from New Showerheads

* # of New Homes by 2010 With Electric Water Heat
+ Savings from Existing Showerheads
* # of Existing Homes by 2010 With Electric Water Heat
* Market Saturation Rate for Existing Showers
+ Savings from the Water Saver Measure
* # of Homes by 2010 With Electric Water Heat
+ Savings from Efficient Tanks
* # of Homes by 2010 With Electric Water Heat
+ Savings from Bottom Boards
* # of Homes by 2010 With Electric Water Heat
+ Savings from Efficient Clothes and Dishwashers
* # of Homes by 2010 With Electric Water Heat
* (Saturation of Clothes Washers
+ Saturation of Dishwashers) / 2
+ Savings from Horizontal Axis
* # of Homes by 2010 With Electric Water Heat
* Saturation of Homes with Clothes washers)
* Transmission & Distribution Adjustment
* Maximum Market Saturation

Residential Hot Water Heat Pump Heat Recovery

This program promotes a measure that reduces electricity consumption by recovering the waste heat in air exhausted for the home using a heat pump to heat the hot water. The best of these systems has achieved coefficients of performance of 2.5 in actual field testing (NPPC 1991). The methodology used to develop the estimates of conservation potential is the same used by the Power Council (NPPC 1991). Homes identified as appropriate for the technology are homes with three or more occupants that replace either a 52 or 80 gallon tank. The Power Council assumes that the technology is only appropriate for single family and manufactured homes and for only about 50 percent of these homes (NPPC 1991). Table D-18 lists the assumptions regarding the hot water heat pump heat recovery conservation measure.

Table D-18

RESIDENTIAL HOT WATER HEAT PUMP HEAT RECOVERY CONSERVATION MEASURES

	1990$ Measure Costs	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Hot Water Heat Pump Heat Recovery	$1,200	2,184	10	.1698	86.79

Residential Hot Water Heat Pump Heat Recovery Conservation Measures

Key Variables

Table D-19 lists key Puget Power service area specific variables used for estimating conservation potential for the residential sector hot water heat pump heat recovery measure. Variables are presented for the three economic scenarios of Medium Low, Medium, and Medium High. Many of the values for the variables were obtained from the Residential Forecast Model output. These include:

- Electric water heat saturation.
- Number of water heaters in the year 2010.
- Energy use per water heater in the year 2010.

The values for maximum market saturation and maximum market share were obtained from the Power Council (NPPC 1991). The transmission/distribution factor is a Puget Power estimate.

Methodology

The conservation potential was calculated using the following formula:

Measure Potential = Measure Savings per Unit

* # of Single Family and Manufactured Homes in 2010
* Maximum Market Share
* Transmission & Distribution Adjustment
* Maximum Market Saturation

Table D-19

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR RESIDENTIAL HOT WATER HEAT PUMP HEAT RECOVERY

Transmission/Distribution Adjustment	1.075	
Maximum Market Saturation (Except Existing Showerheads)	85%	
Maximum Market Share	50%	

	Single Family	Mobile Home
MEDIUM LOW SCENARIO		
Electric Water Heat Saturation (2010)	51.0%	90.9%
Energy Use in 2010 (kWh)	4,582	3,590
# Elec Water Heaters in 2010	222,149	57,455
MEDIUM SCENARIO		
Electric Water Heat Saturation (2010)	45.7%	92.3%
Energy Use in 2010 (kWh)	4,569	3,582
# Elec Water Heaters in 2010	274,166	86,859
MEDIUM HIGH SCENARIO		
Electric Water Heat Saturation (2010)	40.6%	92.1%
Energy Use in 2010 (kWh)	4,581	3,596
# Elec Water Heaters in 2010	347,734	78,855

Residential Dryers

The Power Council does not identify any technical potential for this conservation category (NPPC 1991). rather, the Council identifies some measures as widely used and others as advanced technologies to be considered as having promising potential.

After reviewing year 2010 levels of energy use by dryers from the forecasting model, it appeared that within the framework of the Puget Power forecast, the now commercially available measures identified by the Power Council as widely used are not being widely adopted within Puget Power's service area. Therefore, these widely available measures are included in the Puget Power estimates.

Puget Power also is following the advanced technologies of heat pump/microwave clothes dryers. Puget Power believe these emerging technologies may have significant future conservation potential.

Key Variables

Table D-21 lists key Puget Power service area specific variables used for estimating conservation potential for the residential clothes dryer measures. Variables are presented for the three economic scenarios of Medium Low, Medium, and Medium High. Many of the values for the variables were obtained from the Residential Forecast Model output. These include:

- Electric space heat saturation.
- Number of homes in the year 2010.
- Clothes dryer energy use in the year 2010.

The values for maximum market saturation and maximum market share were obtained from the Power Council (NPPC 1991). The transmission/distribution factor is a Puget Power estimate.

Table D-20

RESIDENTIAL CLOTHES DRYERS

	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Unit)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	988	0	10	.1698	0.0
Automatic Termination	0	0	933	55	10	.1698	0.0
1" Cabinet Insulation	11	11	914	19	10	.1698	91.45
Recycle Exhaust	61	50	859	55	10	.1698	143.59

Table D-21

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR RESIDENTIAL DRYERS			
Transmission/Distribution Adjustment		1.075	
Maximum Market Saturation (Except Existing Showerheads)		85%	
	Single Family	**Multi-Family**	**Mobile Home**
MEDIUM LOW SCENARIO			
Electric Space Heat Saturation (2010)	31.2%	96.6%	91.1%
# Units By 2010	396,697	182,288	52,184
Energy Use In 2010 (kWh)	1,130	771	824
MEDIUM SCENARIO			
Electric Space Heat Saturation (2010)	29.5%	96.8%	91.2%
# Units By 2010	555,644	255,257	81,284
Energy Use In 2010 (kWh)	1,131	771	824
MEDIUM HIGH SCENARIO			
Electric Space Heat Saturation (2010)	28.0%	96.9%	91.3%
# Units By 2010	807,525	241,974	73,839
Energy Use In 2010 (kWh)	1,131	771	824

Methodology

The conservation potential was calculated using the following formula:

Measure Potential = Measure Savings per Unit
* # Homes in 2010
* Transmission & Distribution Adjustment
* Maximum Market Saturation

Residential Space Heat - New Single Family

As with existing single family homes, the methodology used to develop the estimates of conservation potential for this program category is similar to that used by the Power Council and BPA. These approaches used three typical building designs to estimate the retrofit potential for single family homes. The costs and savings of conservation measures are the primary determinants of the amounts of conservation that is available from the supply curves. The savings estimates are based on engineering models and the cost estimates are based on information provided by BPA and regional utilities on the costs they have incurred in recent years to weatherize homes. Both savings and costs are the same as used by the Power Council for the Seattle zone.

Typical Homes

Tables D-22 through D-24 list the measures, estimated energy savings, and costs assuming standard operating conditions of the three typical homes used in Table D-22.

Table D-22

TYPICAL NEW SINGLE FAMILY HOME 1,344 Square Feet	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	5.3	7,155	0			0
Wall R11 to R19	466	4.4	5,925	1,230	70	.1114	39.26
Floor R11 to R19	292	4.0	5,327	598	70	.1114	50.60
Vault R19 to R30	105	3.8	5,138	189	70	.1114	57.57
Wall R19 ADV to R21 ADV	144	3.7	4,956	182	70	.1114	81.99
Window R2.5 to R3.0	273	3.0	4,003	313	60	.1114	90.38
Attic R30 to R38 STD	131	3.6	4,807	149	70	.1114	91.11
Floor R19 to R30	438	3.0	4,316	491	70	.1114	92.44
Wall R21 ADV to R26 ADV	594	2.5	3,414	589	70	.1114	104.51
Attic R38 to R49 ADV	378	2.3	3,081	333	70	.1114	117.63
Vault R30 to R38	160	2.2	3,001	80	70	.1114	207.26
Window R3.0 to R5.0	1,360	1.5	1,980	556	60	.1114	253.48
Wall R26 ADV to R40 DSW	1,173	1.9	2,536	465	70	.1114	261.41
Floor R30 to R38	530	1.4	1,840	140	70	.1114	392.31
Attic R49 ADV to R60 ADV	353	1.3	1,765	75	70	.1114	487.74

Table D-23

TYPICAL NEW SINGLE FAMILY HOME 1,848 Square Feet	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	6.0	11,008	0			0
Wall R11 to R19	745	4.9	8,972	2,036	70	.1114	37.92
Floor R11 to R19	159	4.7	8,634	338	70	.1114	48.75
Vault R19 to R30	60	4.6	8,518	116	70	.1114	53.60
SLAB R5 to R10	76	4.5	8,392	126	70	.1114	62.51
Wall R19 ADV to R21 ADV	231	4.4	8,081	311	70	.1114	76.97
Window R2.5 to R3.0	344	3.9	7,190	429	60	.1114	83.10
Attic R30 to R38 STD	147	4.3	7,903	178	70	.1114	85.58
Floor R19 to R30	238	4.1	7,619	284	70	.1114	86.84
Wall R21 ADV to R26 ADV	952	3.3	6,169	1,021	70	.1114	96.62
SLAB R10 to R15	62	3.3	6,110	59	70	.1114	108.90
Attic R38 to R49 ADV	2,169	3.1	5,711	399	70	.1114	110.64
Vault R30 to R38	93	3.1	5,660	51	70	.1114	188.97
Window R3.0 to R5.0	1,720	2.2	4,077	778	60	.1114	229.10
Wall R26 ADV to R40 DBW	1,877	2.6	4,855	805	70	.1114	241.63
Floor R30 to R38	287	2.2	3,992	85	70	.1114	349.90
Attic R49 ADV to R60 ADV	397	2.1	3,899	93	70	.1114	442.37

Table D-24

TYPICAL NEW SINGLE FAMILY HOME
2,356 Square Feet

	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	4.5	10,603	0			0
Wall R11 to R19	596	3.8	9,061	1,542	70	.1114	40.05
Floor R11 to R19	102	3.8	8,854	207	70	.1114	51.06
Vault R19 to R30	71	3.7	8,725	129	70	.1114	57.04
SLAB R5 to R10	24	3.7	8,687	38	70	.1114	65.45
Wall R19 ADV to R21 ADV	185	3.6	8,451	236	70	.1114	81.23
Attic R30 to R38 STD	157	3.5	8,270	181	70	.1114	89.89
Floor R19 to R30	153	3.4	8,095	175	70	.1114	90.60
Window R2.5 to R3.0	484	3.2	7,523	572	60	.1114	87.69
Wall R21 ADV to R26 ADV	761	2.9	6,744	779	70	.1114	101.23
SLAB R10 to R15	20	2.9	6,726	18	70	.1114	115.14
Attic R38 to R49 ADV	456	2.7	6,313	413	70	.1114	114.42
Vault R30 to R38	108	2.7	6,256	57	70	.1114	196.35
Wall R26 ADV to R40 DBW	1,501	2.4	5,637	619	70	.1114	251.29
Window R3.0 to R5.0	2,424	1.9	4,584	1,053	60	.1114	238.55
Floor R30 to R38	185	1.9	4,532	52	70	.1114	368.68
Attic R49 ADV to R60 ADV	424	1.9	4,435	97	70	.1114	452.97

The Council assumed no wood heating and used a constant thermostat setting of 65 degrees Fahrenheit for the whole house to represent a combination of higher temperatures when the house is occupied and the occupants active, and a lower nighttime setback. Also, the Council assumed the existence of efficient appliances in the new homes reflecting appliances that would be in place for most of the life of the house.

The measures included in the typical home analyses were as follows:

- Attic insulation, standard construction, increased from R-30 to R-38 (each typical home).
- Attic insulation, advanced framing, increased from R-38 to R-49 (each typical home).
- Attic insulation, advanced framing, increased from R-49 to R-60 (each typical home).
- Vault insulation increased from R-19 to R-30 (each typical home).
- Vault insulation increased from R-30 to R-38 (each typical home).
- Wall insulation increased from R-11 to R-19 (each typical home).
- Wall insulation, advanced framing, increased from R-19 to R-21 (each typical home).
- Wall insulation, advanced framing, increased from R-21 to R-26 (each typical home).
- Wall insulation, advanced framing, increased from R-26 to R-40 double wall (each typical home).
- Floor insulation increased from R-11 to R-19 (each typical home).
- Floor insulation increased from R-19 to R-30 (each typical home).
- Floor insulation increased from R-30 to R-38 (each typical home).
- Slab insulation increased from R-5 to R-10 (1,848 and 2,356 typical homes).
- Slab insulation increased from R-10 to R-15 (1,848 and 2,356 typical homes).
- R-2.5 windows to R-3 windows (each typical home).
- R-3 windows to R-5 windows (each typical home).

Table D-25

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR NEW SINGLE FAMILY HOMES		Medium Low	Medium	Medium High
Size Distribution:				
	1,344 sf	62.0%	62.0%	62.0%
	1,848 sf	32.0%	32.0%	32.0%
	2,356 sf	6.0%	6.0%	6.0%
# Units w/Electric Heat in 2010 (post 1990)		3,464	44,482	107,252
Forecast Energy Use Modification		99.7%	99.7%	99.7%
Baseline Energy Use (kWh/unit)		7,930	7,409	6,947
Transmission/Distribution Adjustment		1.075	1.075	1.075
Maximum Market Saturation		85%	85%	85%

Key Variables

Table D-25 lists key variables, many of which are unique to the Puget Power service territory, used to calculate the conservation potential. The distribution of housing size is based upon the Puget Power 1989 Residential Characteristics Survey (Puget 1989). The number of electrically heated post-1990 vintage homes built through the year 2010 comes from the Residential Forecast Model output. The Forecast Energy Use Modification Factor is based on a similar factor employed by the Power Council (NPPC 1991). Baseline energy use in the year 2010 is based on Residential Forecast Model output. The transmission/distribution factor is a Puget Power estimate. The maximum market saturation rate is a Power Council estimate (NPPC 1991).

Methodology

The conservation potential is a summation of the potential of each of the individual conservation measures. The conservation potential by individual measures were calculated using the following formula:

Measure Potential =Measure Savings per Home

* # of new electrically heated homes through 2010
* Transmission & Distribution Adjustment
* Maximum Market Saturation
* Forecast Energy Use Modification

Levelized costs were developed at the measure level for each typical home. These costs and associated savings for each typical building were merged with a size distribution weight and sorted in least-cost order. Calibration to baseline energy use was performed by assuming least-cost measures implemented first.

Reviewing Tables D-1 through D-3 reveals significant differences in conservation potential from new single family homes by economic scenario. As shown in Table D-25, notable differences by economic scenario exist in the number of electrically heated homes. These differences are a function of not only more housing starts with each more robust economic scenario, but also different electric space heat saturation as predicted by the forecasting models.

Residential Space Heat - New Multi-Family

The methodology used to develop the estimates of conservation potential for existing multi-family homes is consistent with the methodology used for existing multi-family homes. It is similar to the Power Council methodology in that it is based on the same typical building for estimating energy savings and costs (NPPC 1991).

Typical New Multi-Family Homes

Table D-26 lists the measures, estimated energy savings, and costs assuming standard operating conditions for the representative multi-family home used in the analysis. The Power Council chose a single multi-family building design to represent new multi-family construction in buildings larger than four-plexes. Each unit was 840 square feet.

The measures included in the typical multi-family unit analysis were as follows:

- Attic insulation increased from R-30 to R-38.
- Attic insulation, advanced framing,increased from R-38 to R-49.
- Attic insulation, advanced framing, increased from R-49 to R-60.
- Wall insulation increased from R-11 to R-19.
- Wall insulation increased from R-19 to R-22.
- Wall insulation increased from R-22 to R-26.
- Wall insulation, double wall construction, increased from R-26 to R 40.
- Floor insulation increased from R-19 to R-30.
- Floor insulation increased from R-30 to R-38.
- Vault insulation increased from R-30 to R-38.
- R-2.5 windows to R-3 windows.
- R-3 windows to R-5 windows.

Table D-26

TYPICAL NEW MULTI-FAMILY HOMES

	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	1.84	1542	0			0.00
Wall R11 to R19	213	1.45	1217	325	70	.1114	67.92
Wall R19 to R22	52	1.38	1163	54	70	.1114	99.79
Attic R30 to R38	20	1.25	1051	19	70	.1114	109.08
Floor R19 to R30	99	1.27	1070	93	70	.1114	110.31
Window R2.5 to R3.0	149	1.09	913	138	60	.1114	111.89
Wall R21 to R26	213	.89	748	165	70	.1114	133.77
Attic R38 to R49 ADV	60	.84	707	41	70	.1114	151.65
Vault R30 to R38	61	.81	683	24	70	.1114	263.39
Wall R26 to R40 DBW	420	.63	531	152	70	.1114	286.34
Window R3.0 to R5.0	743	.39	327	204	60	.1114	377.43
Floor R30 to R38	1,786	.36	304	23	70	.1114	540.67
Attic R49 ADV to R60 ADV	56	.35	297	7	70	.1114	829.02

Key Variables

Table D-27 lists key variables used to calculate the conservation potential. The number of electrically heated post-1990 vintage units built through the year 2010 comes from the Residential Forecast Model output. The Forecast Energy Use Modification Factor is based on a similar factor employed by the Power Council (NPPC 1991). Baseline energy use in the year 2010 is based on Residential Forecast Model output. The demolition adjustment factor is estimated from Residential Forecast Model output. The transmission/ distribution factor is a Puget Power estimate. The maximum market saturation rate is a Power Council estimate (NPPC 1991).

Methodology

The conservation potential is a summation of the potential of each of the individual conservation measures. the conservation potential by individual measures were calculated using the following formula:

Measure Potential = Measure Savings per Unit
* # of new electrically heated units through 2010
* Demolition Adjustment
* Transmission & Distribution Adjustment
* Maximum Market Saturation

Levelized costs were developed at the measure level. These costs and associated savings were sorted in least-cost order. Calibration to baseline energy use was performed by assuming least-cost measures implemented first.

Residential Space Heat - New Mobile Homes

As shown in Tables D-1 through D-3, the conservation potential from residential space heat in new mobile homes is small. In each of the three economic scenarios, it represents less than one percent of the conservation potential. The methodology used to develop the estimate of conservation potential is similar to that used in the other residential space heat categories.

Table D-27

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR NEW MULTI-FAMILY HOMES

	Medium Low	Medium	Medium High
# Units w/Electric Heat (post 1990 stock)	120,691	159,567	177,211
Demolition Adjustment	95.0%	95.0%	95.0%
Energy Use in 2010 (kWh)	1,400	1,400	1,400
Transmission/Distribution Adjustment	1.075	1.075	1.075
Maximum Market Saturation	85%	85%	85%

The approach used for new mobile homes consisted of two typical building configurations to estimate the conservation potential. Both the savings and costs are the same as used by the Power Council for the Seattle zone (NPPC 1991).

Typical New Mobile Homes

Tables D-28 and D-29 list the measures, estimated energy savings, and costs assuming standard operating conditions for the two representative mobile homes used in the analysis. The mobile homes are essentially a single-wide at 924 square feet and a double-wide at 1,568 square feet. The base case characteristics are derived from information obtained from a BPA-sponsored study of current construction practices in the Northwest's manufactured housing industry and data on the energy features most common models sold by manufactures participating in BPA's residential construction demonstration program.

Key Variables

Table D-30 lists key variables used to calculate the conservation potential. The distribution of mobile home size is based upon the Puget Power 1989 Residential Characteristics Survey (Puget 1989). The number of electrically heated post-1990 vintage mobile homes built through the year 2010 comes from the Residential Forecast Model output. The Forecast Energy Use Modification Factor is based on a similar factor employed by the Power Council (NPPC 1991). Baseline energy use in the year 2010 is based on Residential Forecast Model output. The demolition adjustment factor is estimated from Residential Forecast Model output. The transmission/distribution factor is a Puget Power estimate. The maximum market saturation rate is a Power Council estimate (NPPC 1991).

Table D-28

**TYPICAL NEW MOBILE HOME
924 SQUARE FEET**

	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	9.0	8,289	0	45	.1122	0.00
Floor R7 to R11 Cut-In	83	83	7.8	7,229	1,060	45	.1122	8.17
Attic R14 to R19 BLWN	109	26	7.6	7,044	185	45	.1122	14.67
Vault R14 to R22 BLWN	164	55	7.3	6,728	316	45	.1122	18.17
Attic R19 to R30 BLWN	221	57	7.1	6,544	184	45	.1122	32.33
Floor R11 to R22 Cut-In	461	240	6.3	5,837	707	45	.1122	35.43
Vault R22 to R30 BLWN	516	55	6.2	5,692	145	45	.1122	39.59
Vault R30 to R38 BLWN	570	54	6.0	5,567	125	45	.1122	45.09
Attic R30 to R38 BLWN	612	42	6.0	5,499	68	45	.1122	64.47
Floor R22 to R33 Cut-In	852	240	5.5	5,121	378	45	.1122	66.27
Wall R11 to R19	1,449	597	4.6	4,208	913	45	.1122	68.25
Wall R19 to R21 ADV	1,544	95	4.4	4,069	139	45	.1122	71.33
Window R1..2 to R2.5	2,967	1,423	2.7	2,533	1,536	45	.1122	96.69
Window R2.5 to R3.0	3,182	215	2.5	2,325	208	45	.1122	107.88
Attic R38 to R49 BLWN	3,239	57	2.5	2,289	36	45	.1122	165.26
Window R3.0 to R5.0	4,146	907	2.0	1,882	407	45	.1122	232.59
Floor R33 to R44 Cut-In	4,386	240	2.0	1,828	54	45	.1122	463.88

Methodology

The conservation potential is a summation of the potential of each of the individual conservation measures. The conservation potential by individual measures were calculated using the following formula:

Measure Potential =Measure Savings per Unit

* # of new electrically heated mobile homes through 2010
* Demolition Adjustment
* Transmission & Distribution Adjustment
* Maximum Market Saturation
* Forecast Energy Use Modification Factor

Levelized costs were developed at the measure level for each typical mobile home. These costs and associated savings for each typical mobile home were merged with a size distribution weight and sorted in least-cost order. Calibration to baseline energy use was performed by assuming leas- cost measures implemented first.

Table D-29

TYPICAL NEW MOBILE HOME
1,568 SQUARE FEET

	1990$ Cumulative Measure Costs	1990$ Measure Costs	Annual Use (kWh/Sq. Ft.)	Annual Use (kWh/Yr.)	Gross Measure Savings (kWh/Yr.)	Measure Life	FCR	Levelized Cost (Mills/kWh)
Base Case	$ 0	$ 0	8.8	13,812	0	45	.1122	0.00
Floor R7 to R11 Cut-In	141	141	7.6	11,976	1,836	45	.1122	8.02
Attic R14 to R19 BLWN	200	59	7.4	11,549	427	45	.1122	14.42
Vault R14 to R22 BLWN	269	69	7.1	11,145	404	45	.1122	17.83
Attic R19 to R30 BLWN	399	130	6.8	10,721	424	45	.1122	32.00
Floor R11 to R22 Cut-In	806	407	6.1	9,499	1,222	45	.1122	34.76
Vault R22 to R30 BLWN	875	69	5.9	9,315	184	45	.1122	39.14
Vault R30 to R38 BLWN	944	69	5.8	9,153	162	45	.1122	44.45
Attic R30 to R38 BLWN	1,038	94	5.7	8,995	158	45	.1122	62.09
Floor R22 to R33 Cut-In	1,446	408	5.3	8,338	657	45	.1122	64.82
Wall R11 to R19	2,031	585	4.7	7,417	921	45	.1122	66.29
Wall R19 to R21 ADV	2,123	92	4.6	7,276	141	45	.1122	68.10
Window R1..2 to R2.5	4,528	2,405	2.9	4,595	2,681	45	.1122	93.63
Window R2.5 to R3.0	4,890	362	2.7	4,232	363	45	.1122	104.08
Attic R38 to R49 BLWN	5,020	130	2.6	4,149	83	45	.1122	163.47
Window R3.0 to R5.0	6,553	1,533	2.2	3,433	716	45	.1122	223.47
Floor R33 to R44 Cut-In	6,961	408	2.1	3,339	94	45	.1122	453.02

Table D-30

KEY VARIABLES FOR ESTIMATING CONSERVATION POTENTIAL FOR NEW MOBILE HOMES

	Medium Low	Medium	Medium High
Size Distribution:			
924 sf	15.0%	15.0%	15.0%
1,568 sf	85.0%	85.0%	85.0%
# Units w/Electric Heat in 2010 (post 1990 stock)	4,260	32,520	24,810
Forecast Energy Use Modification	97.6%	97.6%	97.6%
Energy Use in 2010 (kWh)	12,000	12,000	12,000
Transmission/Distribution Adjustment	1.075	1.075	1.075
Maximum Market Saturation	85%	85%	85%

Commercial & Industrial

Introduction

As shown in Tables D-1 through D-3, the Commercial sector accounts for about one-third in the Medium Low scenario to nearly one-half in the Medium High scenario of the conservation potential at the 7 cent per kWh level. Conservation potential for the Industrial sector is smaller but still a significant, low-cost conservation resource. Figure D-9 illustrates the share of the conservation potential at the seven cent per kWh level for the Commercial/ Industrial sectors provided by the existing commercial, remodel commercial, new commercial, and industrial programs.

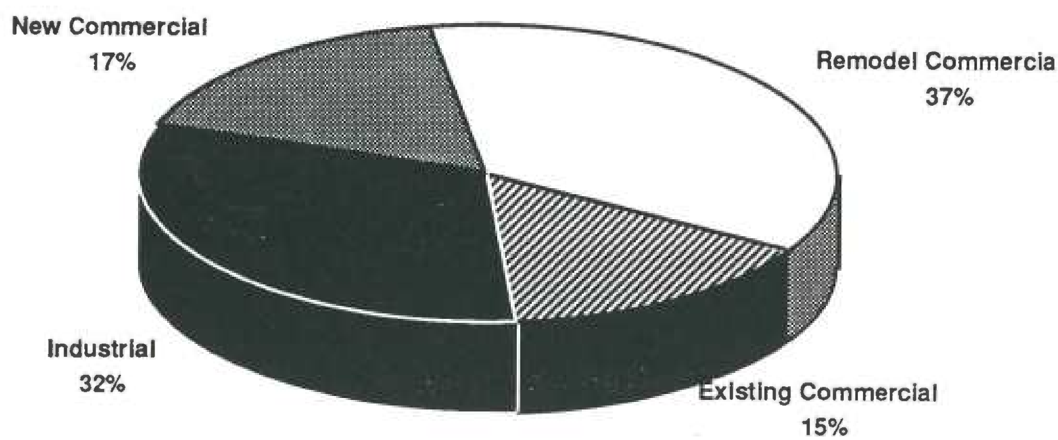
The methodology used to develop the conservation estimates for the Commercial Sector is based on a combination of Power Council (NPPC 1991) and Puget Power data and estimates. The total conservation potential is based on a Power Council methodology that relies on engineering analysis of typical commercial buildings. This analysis provides an estimated savings percentage per building by end-use. Buildings are disaggregated by vintage with stock built in 1982 or earlier representing existing buildings. Building stock available for remodel is all stock built before 1993. New construction is stock built after 1992. These savings estimates are applied to electricity use estimates by building type and end-use from the Commercial Sector Forecasting model.

The methodology used by the Power Council for the commercial sector is in a state of transition. The engineering analyses for new buildings has been completely updated. However, the engineering analyses for existing buildings are becoming outdated with the new analyses only partially complete. For existing buildings, percentage savings by building type and end-use for the office and retail building types are based on new analyses.

For the other existing building types, the percentage of energy savings by building type and end-use are based on the old analyses. However, the specific measures and associated costs are based on the new analyses of office and retail buildings. In other words, the total energy savings by buildings other than office and retail are based on the old analyses, but these savings are distributed among the specific measures identified in the new analyses for office and retail buildings.

Figure D-9

COMMERCIAL / INDUSTRIAL CONSERVATION PROGRAMS
YEAR 2010 - MEDIUM SCENARIO (7 cents/kWh)



The methodology used to develop the conservation estimates for the Industrial Sector is the same for both the Power Council and Puget Power. Both methodologies rely on a supply curve model developed for the Bonneville Power Administration.

Figures D-10 through D-12 show the amount of conservation potential available from the three commercial sector categories and the industrial sector. At the seven cent per kWh category, the largest conservation potential for the Medium Low economic scenario is from the industrial sector. However, for the Medium and Medium High scenarios, the largest conservation potential is found within the commercial new construction category.

Commercial Buildings - Existing

As stated above, the methodology for estimating conservation potential from existing commercial buildings is in a period of transition from old to new analyses. The method for estimating the conservation potential is by building type and end-use and utilizes information from Puget Power's Commercial Sector Forecasting model for estimates of square footage, energy use per square foot, and electric saturation by end-use. This information is applied to information from the Power Council on changes in end-use energy intensity as a result of implementing conservation measures.

The Power Council performs its analysis at the building level with packages of conservation measures installed. Two packages of measures are analyzed; the first are measures costing less than 11 cents per kWh and the second are measures costing less than 15 cents per kWh. End-use interactions are accounted for by the methodology.

Figure D-10

COMMERCIAL & INDUSTRIAL CONSERVATION
YEAR 2010 - MEDIUM LOW SCENARIO

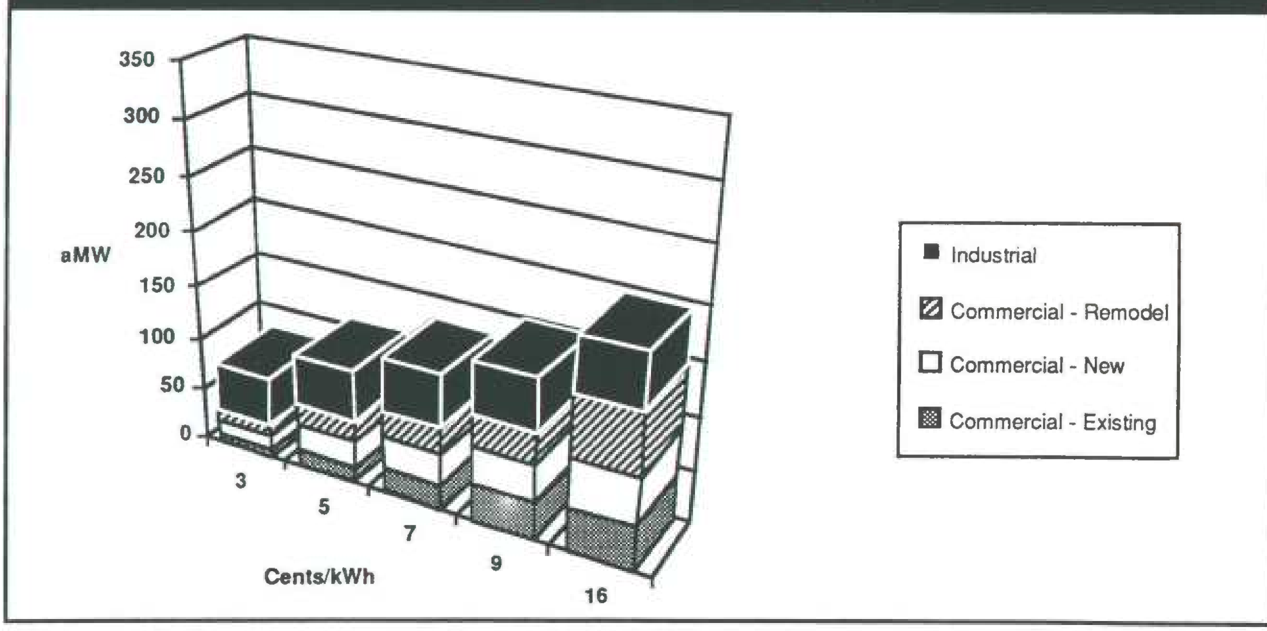


Figure D-11

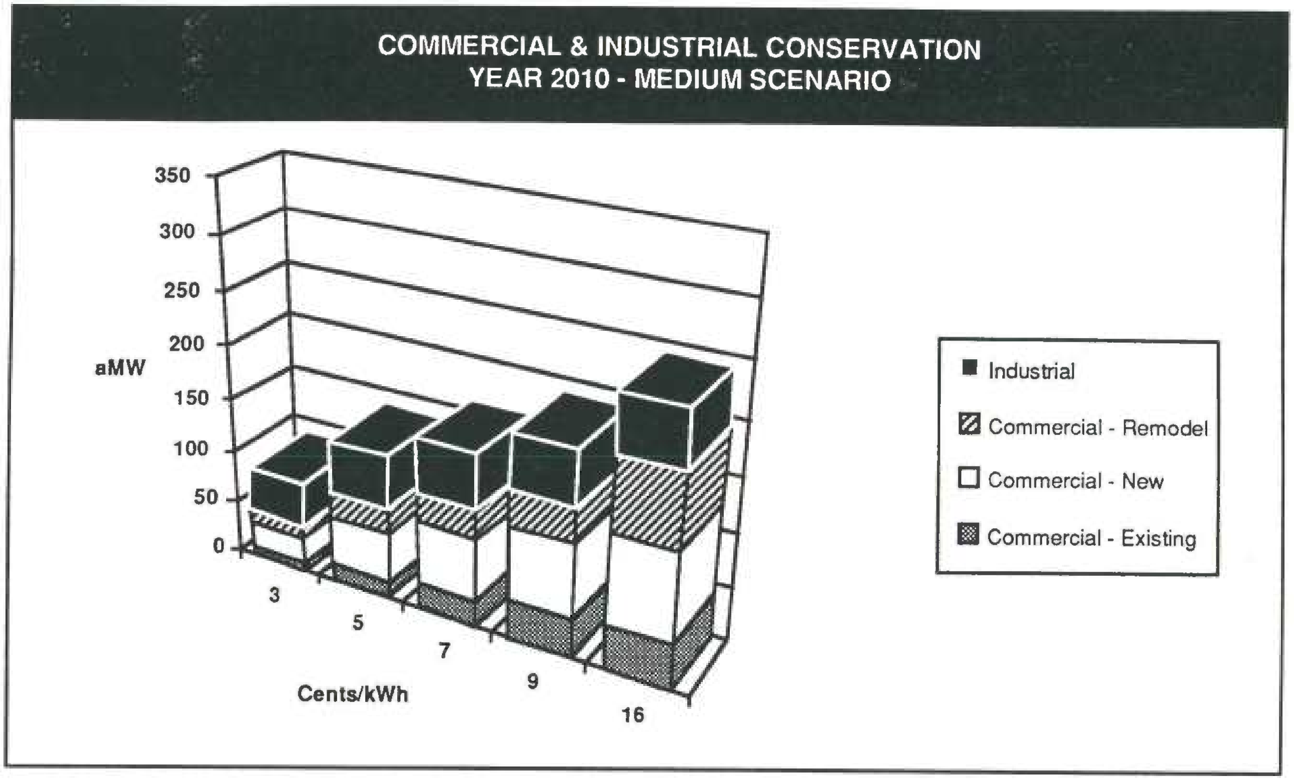

COMMERCIAL & INDUSTRIAL CONSERVATION
YEAR 2010 - MEDIUM SCENARIO
350
300
250
200
150
100
50
0
aMW
3
5
7
9
16
Cents/kWh
Industrial
Commercial - Remodel
Commercial - New
Commercial - Existing

Figure D-12

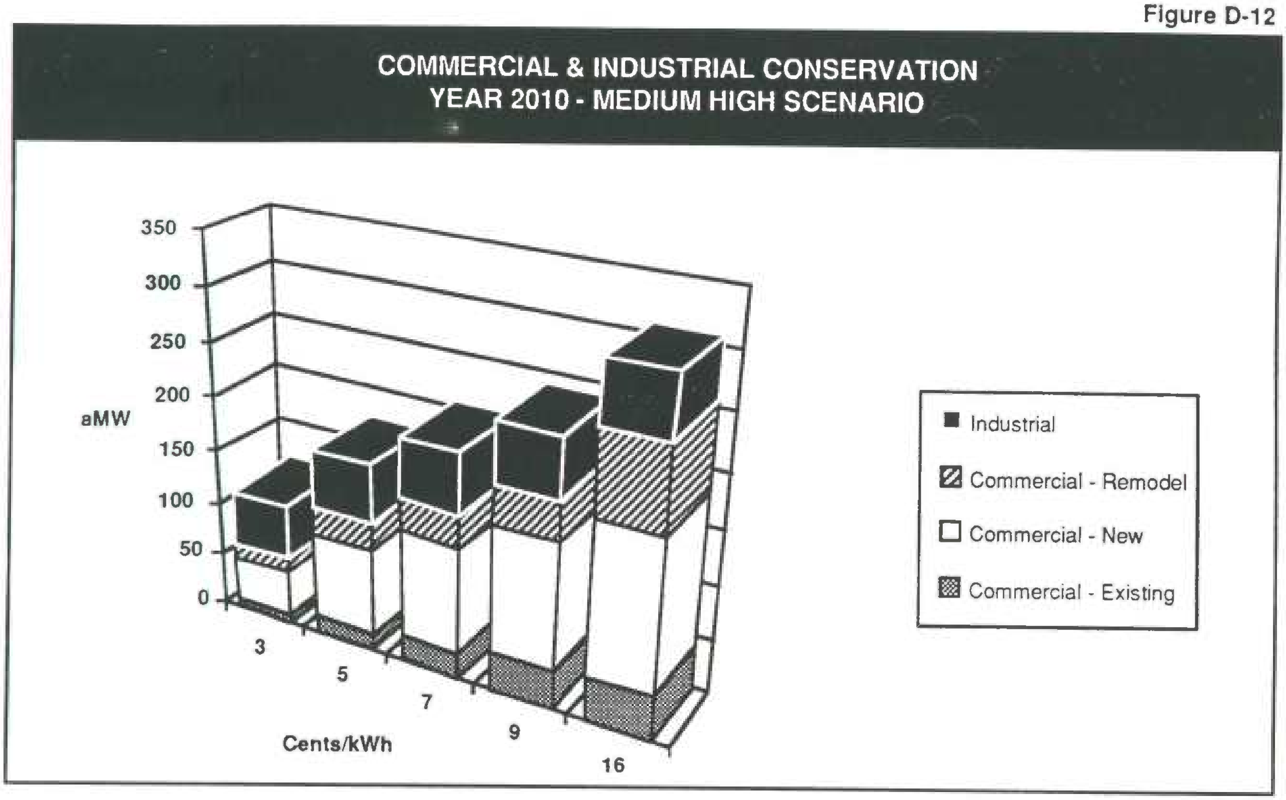

COMMERCIAL & INDUSTRIAL CONSERVATION
YEAR 2010 - MEDIUM HIGH SCENARIO
aMW
350
300
250
200
150
100
50
0
3
5
7
9
16
Cents/kWh
Industrial
Commercial - Remodel
Commercial - New
Commercial - Existing

Table D-31

END-USE ENERGY INTENSITY VALUES BY CONSERVATION COST PACKAGE											
Cost	End-Use	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Hotel	Miscellaneous
11 cent/klWh	Heat	.52	.80	.45	.57	.85	.63	.81	.86	.90	.87
	Cool	.45	.80	.35	.57	.85	.63	.81	.86	.90	.87
	Aux	.97	.80	.77	.57	.85	.63	.81	.86	.90	.87
	Water	.92	.80	.93	.87	.85	.63	.81	.86	.90	.87
	Cook	1.00	.80	1.00	1.00	.85	.63	.81	.86	.90	.87
	Refr	1.00	.80	1.00	.58	.85	.63	.81	.86	.90	.87
	Light	.54	.80	.56	.86	.85	.63	.81	.86	.90	.87
	Other	1.00	.80	1.00	1.00	.85	.63	.81	.86	.90	.87
15										.90	.87
cent/kWh	Heat	.36	.80	.45	.57	.85	.63	.81	.86	.90	.87
	Cool	.18	.80	.35	.57	.85	.63	.81	.86	.90	.87
	Aux	.97	.80	.77	.57	.85	.63	.81	.86	.90	.87
	Water	.92	.80	.93	.87	.85	.63	.81	.86	.90	.87
	Cook	1.00	.80	1.00	1.00	.85	.63	.81	.86	.90	.87
	Refr	1.00	.80	1.00	.58	.85	.63	.81	.86	.90	.87
	Light	.51	.80	.56	.86	.85	.63	.81	.86		
	Other	1.00	.80	1.00	1.00	.85	.63	.81	.86		

Table D-31 lists the Power Council estimates by building type and end-use of end use energy intensity as a result of implementing conservation measures at the 11 cent and 15 cent per kWh level. An intensity value of 1.0 would indicate no change to the baseline energy use. Table D-32 lists the energy use per square foot values (kWh/sq. ft) by building type and end-use for existing buildings in 1982 and for those same buildings in 2010. These values are obtained from the output of Puget Power's Commercial Sector Forecasting model. Also obtained from the Puget Power's forecasting model is the square footage and electric saturation rates for the year 2010 found in Table D-33.

Table D-32

ENERGY USE PER SQUARE FOOT VALUES BY END-USE EXISTING COMMERCIAL BUILDINGS FOR 1982 AND 2010 (kWh/sq. ft.)

Building	EUI Year	Heat	Cool	Aux	Water	Cook	Refr	Light	Other
Office	1982	11.8	2.1	2.3	2.2	0.1	0.1	7.4	0.1
Office	2010	11.2	1.4	1.8	2.0	0.1	0.1	5.8	0.2
Retail	1982	9.1	3.0	3.5	0.3	0.2	0.8	8.3	0.1
Retail	2010	8.7	2.2	2.3	0.3	0.2	0.7	7.1	0.2
Restaurant	1982	18.7	1.9	12.6	7.4	5.0	9.0	10.0	0.1
Restaurant	2010	17.9	1.9	8.5	6.8	4.6	6.9	7.6	0.1
Grocery	1982	10.9	0.1	5.4	0.8	2.3	22.8	15.2	0.0
Grocery	2010	10.4	0.1	3.5	0.7	2.1	20.7	12.9	0.0
Warehouse	1982	4.4	0.0	0.5	0.1	0.0	0.7	3.0	0.1
Warehouse	2010	4.2	0.0	0.3	0.1	0.0	0.6	2.6	0.2
School	1982	5.9	0.0	0.5	0.8	0.1	0.3	5.7	0.1
School	2010	5.7	0.0	0.5	0.7	0.1	0.3	5.1	0.1
College	1982	5.9	0.0	0.5	0.8	0.1	0.3	5.7	0.1
College	2010	5.7	0.0	0.5	0.7	0.1	0.3	4.7	0.1
Health	1982	8.3	0.7	2.4	2.2	0.8	1.0	9.1	0.3
Health	2010	7.9	0.5	1.7	2.0	0.7	0.9	7.9	0.6
Hotel	1982	9.6	2.1	3.1	5.2	2.0	0.8	3.9	0.1
Hotel	2010	9.2	1.5	1.9	4.6	1.8	0.7	2.3	0.1
Military	1982	8.3	0.6	1.6	0.9	0.1	0.1	5.7	0.1
Military	2010	7.9	0.4	1.2	0.8	0.1	0.1	5.1	0.1
Misc	1982	7.8	0.6	1.6	0.9	0.1	0.1	7.0	0.5
Misc	2010	7.5	0.4	1.2	0.8	0.1	0.1	6.4	0.9

As with all the residential programs, the estimates of conservation potential in the commercial sector have a maximum market saturation rate and a transmission and distribution factor applied to them. The maximum saturation rate is 85 percent and is a Power Council estimate (NPPC 1991). The transmission and distribution factor is 1.075 and is a Puget Power estimate.

Table D-33

TOTAL SQUARE FOOTAGE AND ELECTRIC SATURATION BY END-USE
EXISTING COMMERCIAL BUILDINGS IN THE YEAR 2010

Building	Square Footage (thousands)	Electric Saturation							
		Heat	Cool	Aux	Water	Cook	Refr	Light	Other
Office	22,440	59.1%	90.7%	83.7%	83.6%	51.5%	73.2%	99.9%	99.9%
Retail	16,560	67.9%	61.9%	55.0%	43.7%	11.2%	36.2%	99.7%	99.7%
Restaurant	3,460	64.2%	75.6%	75.4%	43.8%	32.3%	82.6%	99.8%	99.8%
Grocery	5,220	61.5%	82.2%	73.9%	61.7%	19.8%	73.5%	99.9%	99.9%
Warehouse	24,340	54.1%	0.0%	42.0%	68.5%	0.0%	67.8%	99.9%	99.9%
School	19,050	55.3%	0.0%	65.0%	46.8%	52.8%	63.7%	99.9%	99.9%
College	3,506	56.1%	0.0%	99.0%	90.2%	94.1%	99.0%	99.9%	99.9%
Health	7,190	59.4%	76.4%	68.9%	20.0%	54.2%	71.2%	99.9%	99.9%
Hotel	4,789	66.6%	86.8%	91.0%	45.8%	9.3%	98.5%	99.9%	99.9%
Military	2,829	56.4%	42.0%	65.9%	69.5%	69.4%	69.4%	99.5%	99.5%
Misc.	13,140	55.0%	76.7%	69.9%	63.8%	55.0%	67.6%	99.8%	99.8%

Methodology and Example Calculation

Conservation potential is calculated at the end-use level for each building type at the 11 cent per kWh level and at the 15 cent per kWh level. The total savings from all end-uses and building types are combined for the two cost levels and then distributed along a weighted range of costs incremented by type of measure. Table D-34 lists the measures and associated weights for existing commercial buildings.

As an example of the calculations employed, following is the calculation for the 11 cent per kWh conservation package for the space heat end-use in existing office buildings.

Potential =year 2010 EUI
- measure intensity
* year 1982 EUI)
* square footage
* electric saturation
* maximum market saturation
* transmission & distribution factor

Potential =(11.2 - .52 * 11.8) * 22,440 * .591 * .85 * 1.075

Potential = 61,366.5 MWh or 7 aMW at 11 cents/kWh

Table D-34

CONSERVATION MEASURES AND ASSOCIATED COSTS AND WEIGHTS EXISTING COMMERCIAL BUILDINGS

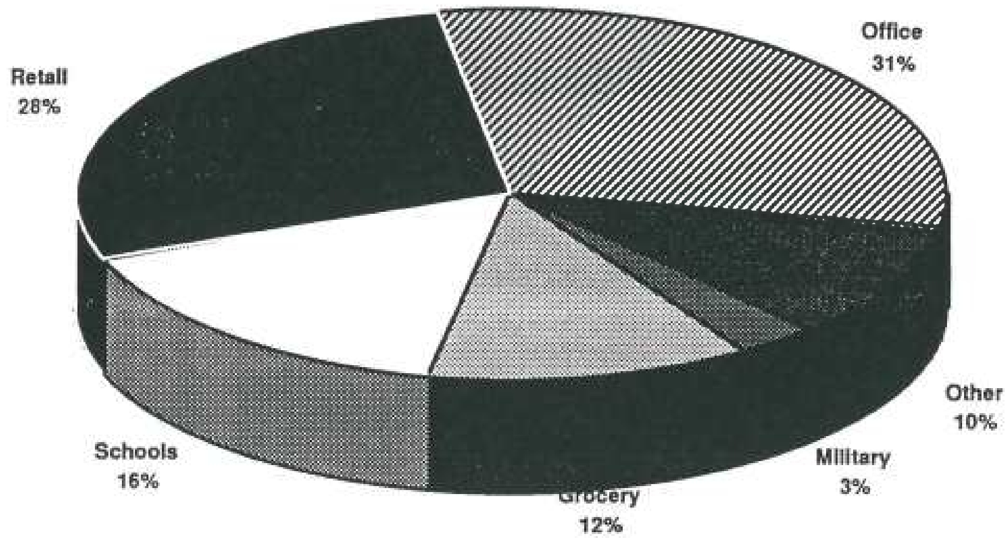
Measure	Weighted Savings (kWh/ft2)	Cost (cents/kWh)
Reduce Minimum Outside Air	.20	.3
Temp Reset, Multi Zone	.20	.3
Roof Insulation R-6 to R-19	.03	1.5
Reduce Min. Out. Air	.10	1.8
Roof Insulation	.16	2.0
T-8 EEM Bal & Parab. Fixt	.65	3.5
Roof Insulation	.15	3.6
Tank Insulation	.00	3.9
DHW Tank Insulation	.01	4.1
T-8 Elec. (Sales)	.54	6.4
T-8 Add Electronic Ballasts	.12	6.5
T-8 Elect. (Storage)	.04	6.6
T-8 & Elect. Ballast	.23	6.6
Daylight Photocell Dimming	.05	7.4
Variable Air Volume	1.13	8.1
Low-e Glass	.24	9.6
Caulking & Weather	.00	9.9
Optimum Start timer	.10	11.3
Daylight Dimming	.05	11.7
Heat Pump @ AC repl.	.40	11.7
Economizer	.12	13.3

The Power Council does not have the military building type whereas Puget Power does. The estimates of conservation potential for military structures uses the Power Council energy intensity factors for office buildings.

Nearly 60 percent of the conservation potential in existing commercial buildings can be found in the Office and Retail building types. Figure D-13 illustrates the share of conservation potential by commercial building type. There are no differences in these shares by economic scenario.

Figure D-13

CONSERVATION POTENTIAL BY BUILDING TYPE
EXISTING BUILDINGS - MEDIUM SCENARIO



Commercial Buildings - New

The underlying engineering analyses used to estimate the end-use energy intensity values after applying conservation measures to new construction have recently been updated for all building types by the Power Council (NPPC 1991). As with existing buildings, the method for estimating the conservation potential is by building type and end-use and utilizes information from Puget Power's Commercial Sector Forecasting model for estimates of square footage, energy use per square foot, and electric saturation by end-use. This information is applied to information from the Power Council on changes in end-use energy intensity as a result of implementing conservation measures.

The Power Council performs its analysis at the building level with packages of conservation measures installed. Two packages of measures are analyzed; the first are measures costing less than 11 cents per kWh and the second are measures costing less than 15 cents per kWh. End-use interactions are accounted for by the methodology.

Tables D-35 and D-36 list the Power Council estimates by building type and end use of end-use energy intensity as a result of implementing conservation measures at the 11 cent and 15 cent per kWh levels, respectively. The base intensity values represent new construction energy intensity levels compared to the 1982 EUI values of Table D-32.

An intensity value of 1.0 would indicate no change to the baseline 1982 energy use. Tables D-37 through D-39 list the square footage and electric saturation rates for new construction by economic scenario up through the year 2010. These values are obtained from the output of Puget Power's Commercial Sector Forecasting model.

As with all the residential programs, the estimates of conservation potential in the commercial sector have a maximum market saturation rate and a transmission and distribution factor applied to them. The maximum saturation rate is 85 percent and is a Power Council estimate (NPPC 1991). The transmission and distribution factor is 1.075 and is a Puget Power estimate.

Table D-35

NEW CONSTRUCTION END-USE ENERGY INTENSITY VALUES
11 Cent/kWh CONSERVATION COST PACKAGE

Cost	End-Use	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Hotel	Miscellaneous
Base	Heat	.55	.53	.13	.23	.41	.46	.48	.55	.39	.40
	Cool	.66	.74	1.00	.13	1.00	1.00	.87	1.00	1.00	.76
	Aux	.97	1.00	1.00	1.00	1.00	1.00	.99	.88	1.00	.93
	Water	.99	.37	.99	.11	1.00	1.00	.80	.30	.32	.81
	Cook	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Refr	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Light	.79	.97	1.00	.88	.94	1.00	.93	.99	1.00	.86
	Other	1.00	1.00	.85	1.00	1.00	1.00	.95	.92	.76	.91
11 cent/kWh	Heat	.45	.35	.12	.24	.31	.39	.41	.61	.44	.35
	Cool	.39	.58	.69	.08	.37	1.00	.78	1.00	1.00	.54
	Aux	.95	1.00	1.00	1.00	1.00	1.00	.95	.85	.84	.92
	Water	.99	.36	1.00	.11	1.00	1.00	.80	.30	.32	.81
	Cook	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Refr	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Light	.28	.70	.58	.76	.35	1.00	.66	.58	.51	.47
	Other	1.00	1.00	.85	1.00	1.00	1.00	.96	.92	.79	.91

Table D-36

NEW CONSTRUCTION END-USE ENERGY INTENSITY VALUES
15 Cent/kWh CONSERVATION COST PACKAGE

Cost	End-Use	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Hotel	Miscellaneous
15 cent/kWh	Heat	.43	.35	.12	.25	.30	.38	.40	.61	.44	.34
	Cool	.22	.58	.69	.07	.37	1.00	.73	1.00	1.00	.48
	Aux	.95	1.00	1.00	1.00	1.00	1.00	.95	.85	.84	.92
	Water	.99	.36	1.00	.11	1.00	1.00	.80	.30	.32	.81
	Cook	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Refr	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Light	.28	.70	.58	.74	.35	1.00	.66	.58	.51	.47
	Other	1.00	1.00	.85	1.00	1.00	1.00	.96	.92	.79	.91

Table D-37

TOTAL SQUARE FOOTAGE AND ELECTRIC SATURATION BY END-USE
NEW COMMERCIAL BUILDINGS IN THE YEAR 2010
MEDIUM LOW SCENARIO

Building	Square Footage (thousands)	Electric Saturation Heat	Cool	Aux	Water	Cook	Refr	Light	Other
Office	37,410	61.8%	87.8%	83.8%	83.6%	51.6%	73.3%	100.0%	100.0%
Retail	17,840	68.5%	59.1%	55.1%	43.7%	11.2%	36.3%	99.9%	99.9%
Restaurant	3,552	66.4%	73.1%	75.5%	43.8%	32.4%	82.8%	100.0%	100.0%
Grocery	5,290	63.0%	78.6%	74.0%	61.7%	19.8%	73.5%	99.8%	99.8%
Warehouse	21,710	56.2%	0.0%	42.0%	68.5%	0.0%	67.9%	100.0%	100.0%
School	8,610	56.7%	0.0%	65.1%	46.8%	52.9%	63.9%	100.0%	100.0%
College	3,720	57.1%	0.0%	99.1%	90.2%	94.2%	99.1%	100.0%	100.0%
Health	11,200	63.1%	73.1%	69.0%	20.0%	54.2%	71.3%	100.0%	100.0%
Hotel	7,070	67.2%	84.1%	91.1%	45.8%	9.3%	98.6%	100.0%	100.0%
Military	310	57.5%	55.3%	66.1%	69.5%	69.6%	69.6%	99.9%	99.9%
Misc.	15,120	56.6%	74.0%	70.0%	63.8%	55.1%	67.7%	100.0%	100.0%

Table D-38

TOTAL SQUARE FOOTAGE AND ELECTRIC SATURATION BY END-USE
NEW COMMERCIAL BUILDINGS IN THE YEAR 2010
MEDIUM SCENARIO

Building	Square Footage (thousands)	Electric Saturation Heat	Cool	Aux	Water	Cook	Refr	Light	Other
Office	66,610	61.3%	87.6%	83.8%	83.6%	51.6%	73.3%	100.0%	100.0%
Retail	35,490	68.1%	58.8%	55.2%	43.7%	11.2%	36.3%	99.9%	99.9%
Restaurant	6,973	66.0%	72.8%	75.5%	43.8%	32.4%	82.8%	100.0%	100.0%
Grocery	10,410	61.5%	82.2%	73.9%	61.7%	19.8%	73.5%	99.8%	99.8%
Warehouse	42,880	55.9%	0.0%	42.0%	68.5%	0.0%	67.9%	100.0%	100.0%
School	22,100	56.1%	0.0%	65.1%	46.8%	52.9%	63.9%	100.0%	100.0%
College	7,330	56.6%	0.0%	99.1%	90.2%	94.2%	99.1%	100.0%	100.0%
Health	19,310	62.8%	72.8%	69.0%	20.0%	54.2%	71.3%	100.0%	100.0%
Hotel	11,770	66.4%	83.8%	91.1%	45.8%	9.3%	98.6%	100.0%	100.0%
Military	1,920	56.9%	56.2%	66.1%	69.5%	69.6%	69.6%	99.9%	99.9%
Misc.	27,290	56.3%	73.8%	70.0%	63.8%	55.1%	67.7%	100.0%	100.0%

Table D-39

**TOTAL SQUARE FOOTAGE AND ELECTRIC SATURATION BY END-USE
NEW COMMERCIAL BUILDINGS IN THE YEAR 2010
MEDIUM HIGH SCENARIO**

Building	Square Footage (thousands)	Electric Saturation							
		Heat	Cool	Aux	Water	Cook	Refr	Light	Other
Office	112,500	60.9%	87.4%	83.8%	83.6%	51.6%	73.3%	100.0%	100.0%
Retail	57,800	67.5%	58.6%	55.2%	43.7%	11.2%	36.3%	99.9%	99.9%
Restaurant	11,040	65.5%	72.6%	75.5%	43.8%	32.4%	82.8%	100.0%	100.0%
Grocery	16,500	62.5%	77.9%	74.0%	61.7%	19.8%	73.5%	99.8%	99.8%
Warehouse	69,350	55.7%	0.0%	42.0%	68.5%	0.0%	67.9%	100.0%	100.0%
School	46,870	55.7%	0.0%	65.1%	46.8%	52.9%	63.9%	100.0%	100.0%
College	13,640	56.2%	0.0%	99.1%	90.2%	94.2%	99.1%	100.0%	100.0%
Health	33,100	62.5%	72.6%	69.0%	20.0%	54.2%	71.3%	100.0%	100.0%
Hotel	20,170	65.4%	83.6%	91.1%	45.8%	9.3%	98.6%	100.0%	100.0%
Military	6,420	56.5%	57.2%	66.1%	69.5%	69.6%	69.6%	99.9%	99.9%
Misc.	47,510	56.1%	73.6%	70.0%	63.8%	55.1%	67.7%	100.0%	100.0%

Methodology and Example Calculation

Conservation potential is calculated at the end-use level for each building type at the 11 cent per kWh level and at the 15 cent per kWh level. The total savings from all end-uses and building types are combined for the two cost levels and then distributed along an energy savings weighted range of costs by type of measure. Table D-40 lists the measures and associated weights for new commercial buildings.

As an example of the calculations employed, following is the calculation for the 11 cent per kWh conservation package for the space heat end-use in new office buildings.

Potential = 1982 EUI
* current new construction intensity
- conservation program measure intensity
* 1982 EUI)
* new construction square footage
* new construction electric saturation
* maximum market saturation
* transmission/distribution factor

Potential =(11.8 * .55 - .45 * 11.8) * 35,490 * .681 * .85 * 1.075

Potential =26,059.3 MWh or 3 aMW at 11 cents/kWh for the Medium scenario

The Power Council does not have the military building type whereas Puget Power does. The estimates of conservation potential for military structures uses the Power Council energy intensity factors for office buildings.

Table D-40

CONSERVATION MEASURES AND ASSOCIATED COSTS AND WEIGHTS NEW COMMERCIAL BUILDINGS					
Measure *	Weighted Savings (kWh/ft2)	Cost (cents/kWh)	Measure *	Weighted Savings (kWh/ft2)	Cost (cents/kWh)
Anti-Sweat Timer	.16	.5	T-8 w/Elect. Ballast	.13	5.2
Hot Gas Defrost	.09	.6	MCS Package	.04	5.6
Heat Pump	.20	1.4	Very Low-e Windows	.20	6.2
Heat Pump	.32	1.5	R-35 Roof Insul.	.01	6.7
Daylight Dimming	.05	1.6	Daylight Dimming	.01	6.7
MCS Package	.11	1.6	T-8 w/Elect. Ballast	.11	6.7
Occupancy Sensors	.03	1.9	Very Low-e Windows	.01	7.2
Heat Pump	.02	2.0	MCS Package	.21	7.3
MCS Package	.25	2.0	Day. Dim. Elec. Bal.	.15	7.8
E.L. Exit Signs	.00	2.8	R-19 Wall Insul.	.02	7.9
E.L. Exit Signs	.00	2.9	MCS Package	.04	8.0
E.L. Exit Signs	.01	3.0	Heat Pump	.02	8.2
E.L. Exit Signs	.02	3.0	R-19 Ceiling Insul.	.01	8.2
E.L. Exit Signs	.01	3.1	R-19+R-5 Wall Insul.	.02	8.4
Effic. Evap Fans	.07	3.1	Add R-5 Wall Insul.	.01	8.5
E.L. Exit Signs	.00	3.1	Daylight Dimming	.01	8.6
E.L. Exit Signs	.01	3.3	VSD on Pumps&Fans	.01	9.2
Occupancy Sensors	.18	3.4	R-19 Roof Insul.	.01	9.2
E.L. Exit Signs	.01	3.5	R-25 to 30 Roof	.01	9.2
MCS Package	.19	3.8	Variable Speed Drive	.01	9.4
Ambient/Task System	.02	3.9	Add R-5 Wall Insul.	.07	9.5
Mech. Subcooling	.03	3.9	T-8 w/Elec. Ballast	.04	10.0
Ref. Case Covers	.05	4.0	T-8 & Elect. Ballast	.08	10.0
E.L. Exit Signs	.02	4.0	T-8 & Elect. Ballast	.05	10.6
R-19+R-5 Wall Insul.	.02	4.0	Halogen I.R. Lamps	.16	10.8
Very Low-e Windows	.04	4.0	Window U=0.59	.05	12.2
Ambient/Task Light.	.01	4.3	Halogen IR Lamps	.02	13.5
Ambient/Task Light.	.21	4.5	R-30 to 38 Roof	.01	13.7
Ambient/Task Light.	.19	4.5	R-19-R-25 Roof Insul.	.00	13.9
Halogen IR Lamps	.05	4.8	R-19 to R-25 Ceil.	.01	14.0
Halogen IR Lamps	.01	5.2	Economizer	.10	14.7

* The multiple listing of identical measures indicates that the measure can be placed in several different types of buildings.

As with existing commercial buildings, despite similar methodology, the conservation potential that could be anticipated by comparing Puget Power's commercial sector electricity sales to regional commercial sector electricity sales are lower for Puget Power. The two estimates rely on the same percentage savings of electricity use. However, the primary difference lies in forecast model result differences between the Power Council model and Puget Power model of electricity use per square foot and end use electricity saturations.

Figures D-14 through D-16 illustrate the share of conservation potential by new building type for each of the economic scenarios. Although the amount of conservation potential varies by economic scenario, the share among the building types varies only slightly. For each of the economic scenarios, over half of the conservation potential in new commercial buildings can be found in office and retail buildings. Additionally, the office building category is dominant with over 45 percent of the conservation potential. Retail is a distant second with about 16 percent with warehouse and health providing significant shares.

Commercial Buildings - Remodel

The underlying engineering analyses used to estimate the end-use energy intensity values after applying conservation measures for remodeling are the same as those used for new construction. These values have recently been updated for all building types by the Power Council (NPPC 1991). As with existing buildings and new construction, the method for estimating the conservation potential is by building type and end-use and utilizes information from Puget Power's Commercial Sector Forecasting model for estimates of square footage, energy use per square foot, and electric saturation by end-use. This information is applied to information from the Power Council on changes in end-use energy intensity as a result of implementing conservation measures through remodeling.

The Power Council performs its analysis at the building level with packages of conservation measures installed. Two packages of measures are analyzed; the first are measures costing less than 11 cents per kWh and the second are measures costing less than 15 cents per kWh. End-use interactions are accounted for by the methodology.

Figure D-14

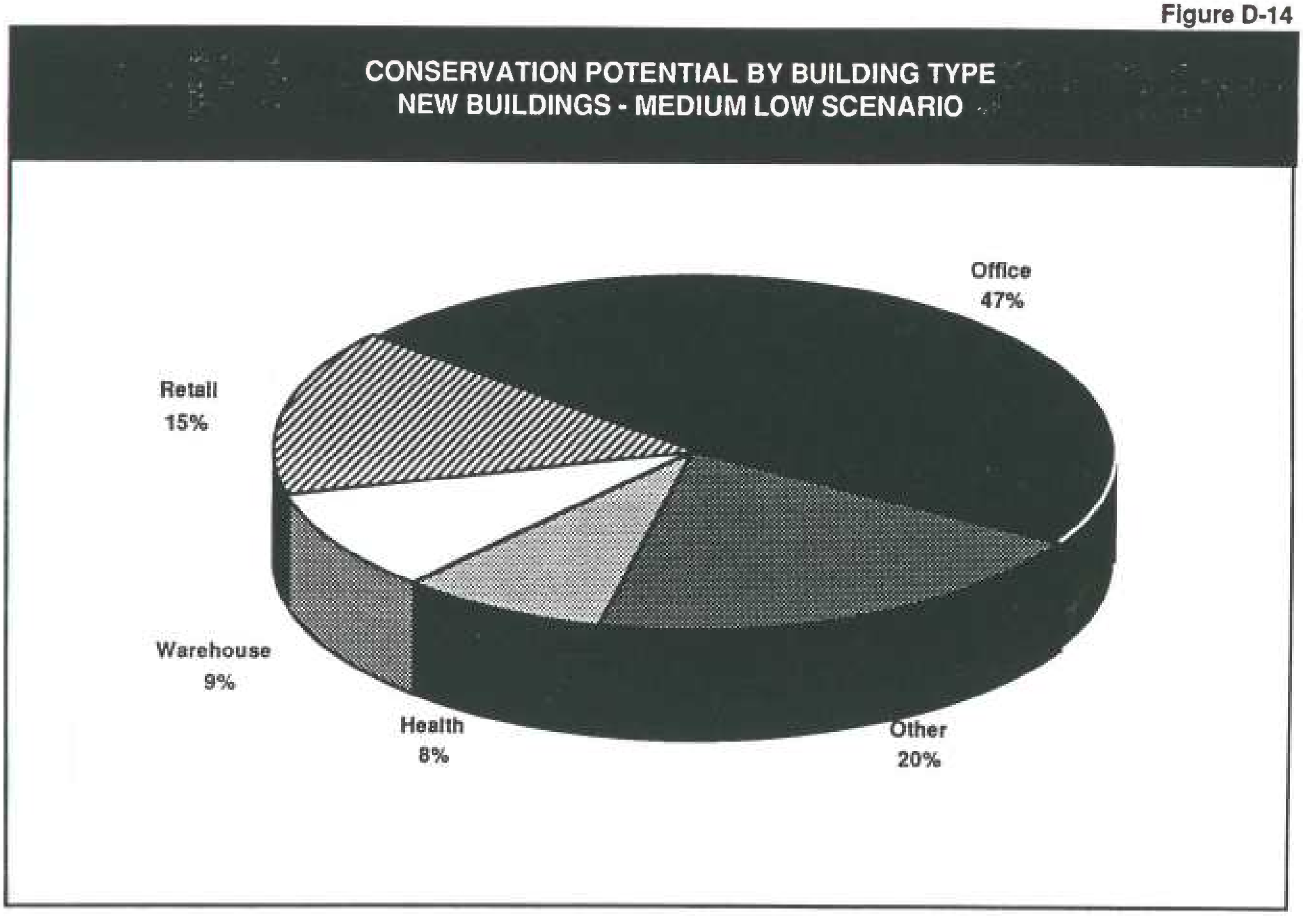


Figure D-15

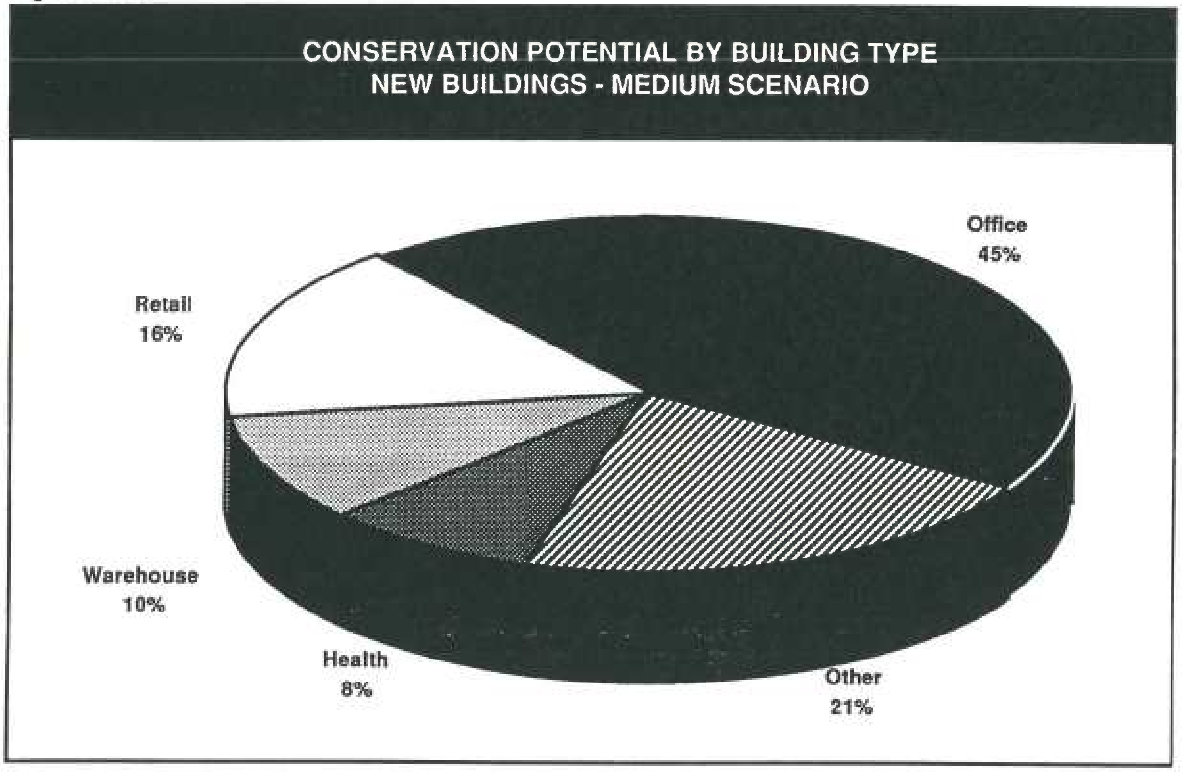
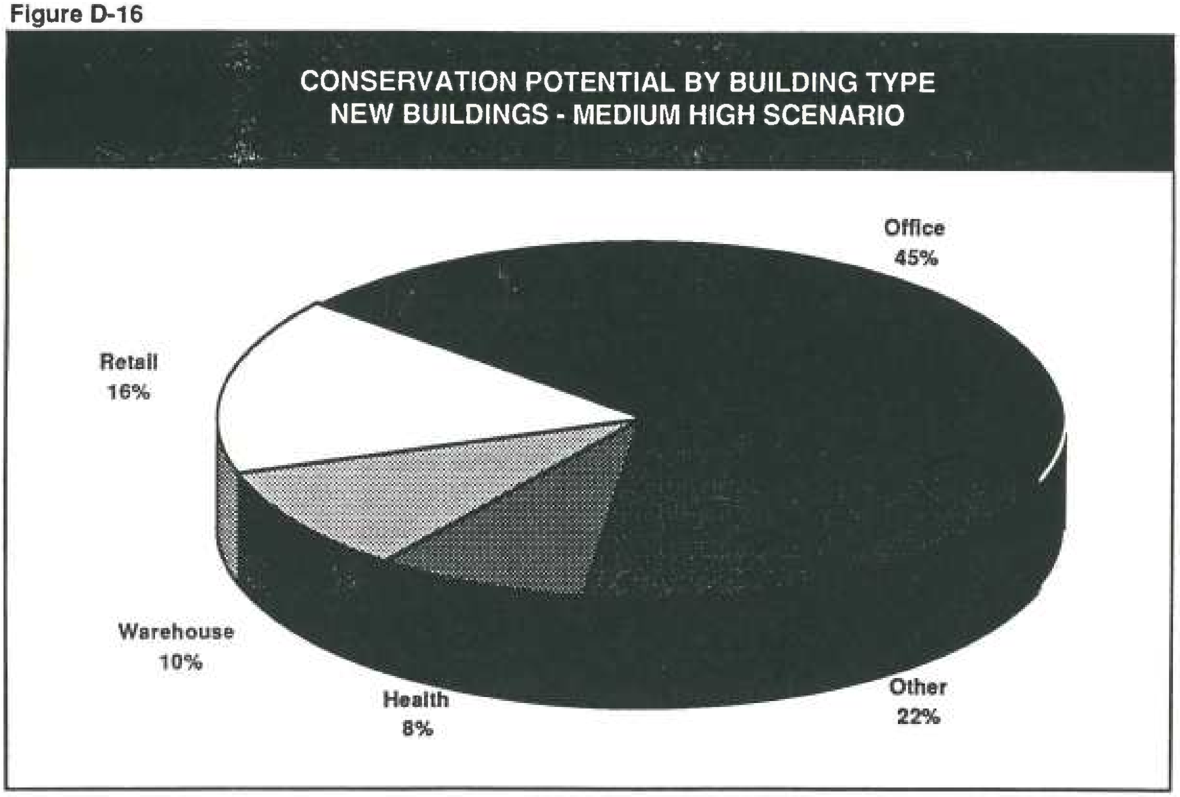


Figure D-16



Tables D-41 and D-42 list the Power Council estimates by building type and end use of end-use energy intensity as a result of implementing remodel conservation measures at the 11 cent and 15 cent per kWh levels, respectively. The base intensity values represent energy intensity levels after retrofitting existing buildings compared to the 1982 EUI values of Table D-32. An intensity value of 1.0 would indicate no change to the baseline 1982 energy use.

The stock of buildings available for remodel include all floorspace in existence as of 1992. The Power Council assumes two percent of this floorspace is available for renovation each year for a maximum of 36 percent over the forecast period. Table D-43 lists the available floorspace by building type for remodelling. The electric saturations by building type and end-use are assumed to be the same as for new construction as identified in Table D-39.

Methodology and Example Calculation

Conservation potential is calculated at the end-use level for each building type at the 11 cent per kWh level and at the 15 cent per kWh level. The total savings from all end-uses and building types are combined for the two cost levels and then distributed along a weighted range of costs incremented by type of measure. For remodelling, the measures and associated weights are considered the same as those for new commercial buildings. These are identified in Table D-40.

As an example of the calculations employed, the following is the calculation for the 11 cent per kWh conservation package for the space heat end-use in a remodeled office building.

Table D-41

REMODEL END-USE ENERGY INTENSITY VALUES
11 Cent/kWh CONSERVATION COST PACKAGE

Cost	End-Use	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Hotel	Miscellaneous
Base	Heat	.52	.80	.45	.57	.85	.63	.81	.86	.90	.87
	Cool	.45	.80	.35	.57	.85	.63	.81	.86	.90	.87
	Aux	.97	.80	.77	.57	.85	.63	.81	.86	.90	.87
	Water	.92	.80	.93	.87	.85	.63	.81	.86	.90	.87
	Cook	1.00	.80	1.00	1.00	.85	.63	.81	.86	.90	.87
	Refr	1.00	.80	1.00	.58	.85	.63	.81	.86	.90	.87
	Light	.54	.80	.56	.86	.85	.63	.81	.86	.90	.87
	Other	1.00	.80	1.00	1.00	.85	.63	.81	.86	.90	.87
11 cent/kWh	Heat	.45	.35	.12	.24	.31	.39	.41	.61	.44	.35
	Cool	.39	.58	.69	.08	.37	1.00	.78	1.00	1.00	.54
	Aux	.95	1.00	1.00	1.00	1.00	1.00	.95	.85	.84	.92
	Water	.99	.36	1.00	.11	1.00	1.00	.80	.30	.32	.81
	Cook	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Refr	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Light	.28	.70	.58	.76	.35	1.00	.66	.58	.51	.47
	Other	1.00	1.00	.85	1.00	1.00	1.00	.96	.92	.79	.91

Table D-42

REMODEL END-USE ENERGY INTENSITY VALUES
15 Cent/kWh CONSERVATION COST PACKAGE

Cost	End-Use	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Hotel	Miscellaneous
15 cent/kWh	Heat	1.00	1.00	.85	1.00	1.00	1.00	.96	.92	.79	.91
	Cool	.43	.35	.12	.25	.30	.38	.40	.61	.44	.34
	Aux	.22	.58	.69	.07	.37	1.00	.73	1.00	1.00	.48
	Water	.95	1.00	1.00	1.00	1.00	1.00	.95	.85	.84	.92
	Cook	.99	.36	1.00	.11	1.00	1.00	.80	.30	.32	.81
	Refr	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Light	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.95
	Other	.28	.70	.58	.74	.35	1.00	.66	.58	.51	.47

Table D-43

TOTAL SQUARE FOOTAGE AND SHARE AVAILABLE FOR REMODELING
1992 BUILDING STOCK

Building	Square Footage (thousands)	Available Square Footage (thousands)
Office	79,990	28,796
Retail	51,040	18,374
Restaurant	9,737	3,505
Grocery	14,590	5,252
Warehouse	65,020	23,407
School	55,670	20,041
College	11,840	4,262
Health	20,850	7,506
Hotel	11,780	4,241
Military	12,120	4,363
Miscellaneous	39,560	14,242

Potential = (1982 EUI

* intensity after existing stock retrofit
- remodel program measure intensity
* 1982 EUI)
* 1992 stock
* .36
* new construction electric saturation
* maximum market saturation
* transmission & distribution factor

Potential =(11.8 * .52 - .45 * 11.8) * 79,990 * .36 * .681 * .85 * 1.075

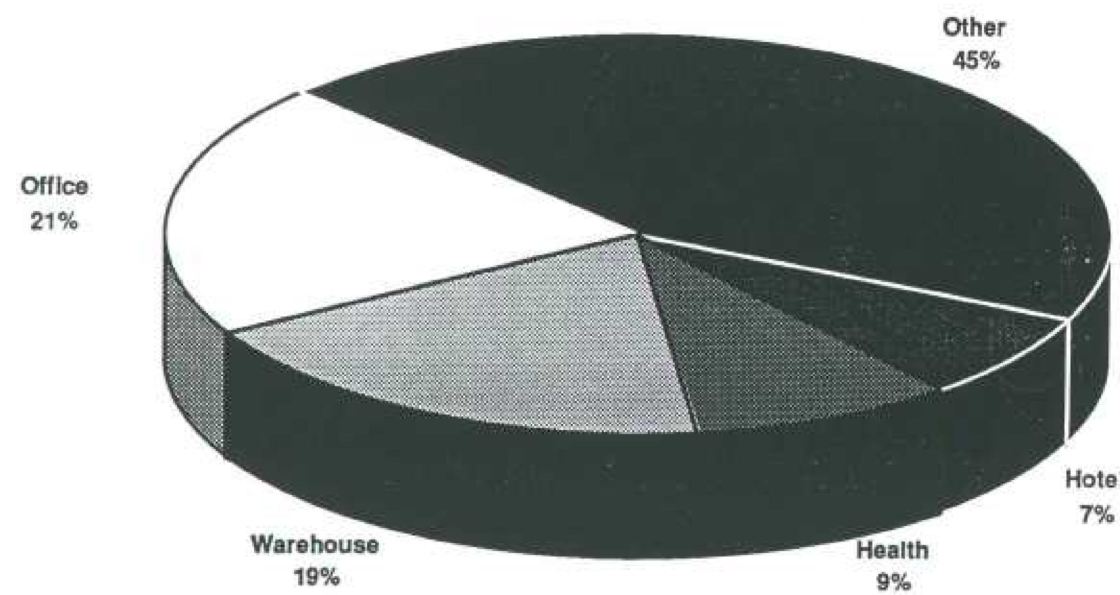
Potential =14,801 MWh or 1.7 aMW at 11 cents/kWh for the Medium scenario

The Power Council does not have the military building type whereas Puget Power does. The estimates of conservation potential for military structures uses the Power Council energy intensity factors for office buildings.

Figure D-17 illustrates the share of conservation potential by building type for remodeling in the Medium scenario. There are only small differences between economic scenarios. As with retrofit in existing buildings and new construction, office buildings hold the largest conservation potential. However, the dominance of office buildings for conservation potential is not as large with remodeling. Significant potential exists within all the building types.

Figure D-17

CONSERVATION POTENTIAL BY BUILDING TYPE
REMODELING - MEDIUM SCENARIO



Industrial

The model for estimating the conservation potential for the industrial sector is identical for both the Power Council and Puget Power. This model was developed for BPA to estimate non-aluminum industrial conservation potential. As described by the Power Council (NPPC 1991), the model used to derive conservation estimates investigates conservation measures based on seven specific end-uses. These end uses are called service demands. An energy conservation measure is a specific equipment replacement or operating change that reduces the energy used in a particular service demand. The seven service demands include:

- Lighting
- Air conditioning
- Process heating
- Compressed air
- Pumping
- Refrigeration
- Motors

Figure D-18 illustrates the conservation potential by service demand for the industrial sector. Lighting is the largest category of measures followed closely by pumping measures. These shares by measure type are nearly identical by economic scenario.

The data used for each measure includes the cost of the measure and the cost of the incumbent equipment replaced by the measure. Annual operating and maintenance costs for each measure are also used. The energy savings for a measure are characterized as a percentage reduction that can be achieved by substituting the measure for the incumbent equipment. The energy savings for each measure depend on the annual operating hours for each industry and the percentage of time during plant operating hours that the measure is actually saving energy.

Figure D-18

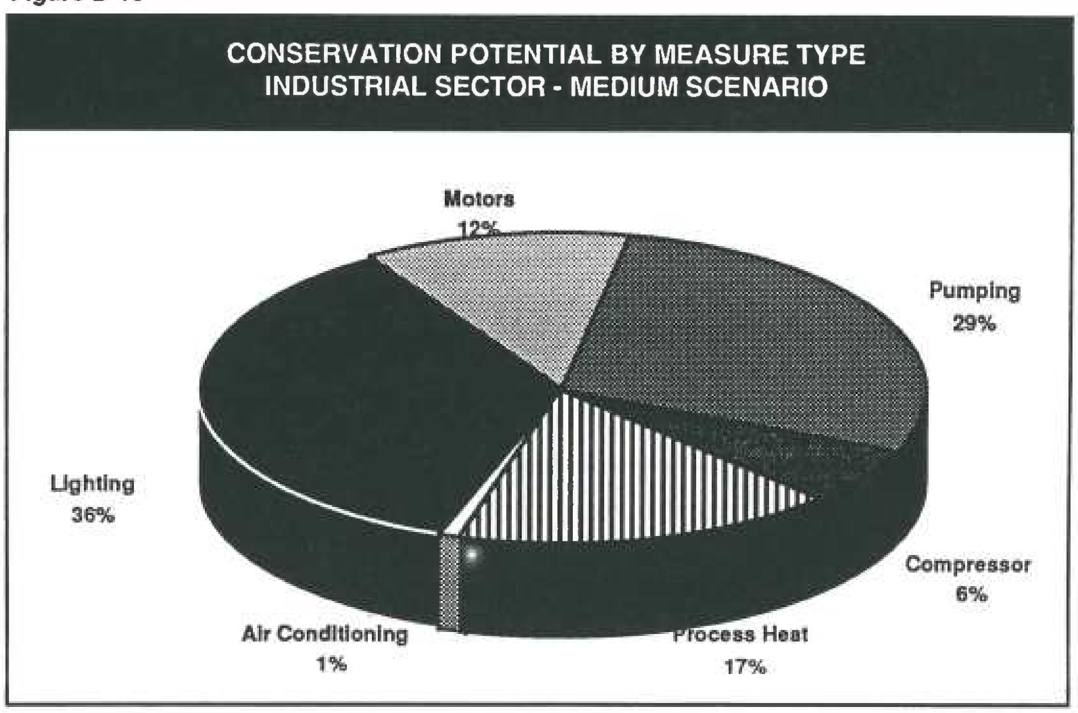


Table D-44

CONSERVATION MEASURES AND ASSOCIATED COSTS AND SAVINGS
INDUSTRIAL SECTOR

Measure	Cost (cents/kWh)	Savings (MWa)	Measure	Cost (cents/kWh)	Savings (MWa)
60 W Inc. to 22 W Fluor & Controls	.01	1.2	ECM 407 with compressor controller	.32	0.9
Replace 60 W Inc. with 22 W Fluor	.01	1.1	Reduce Air Infilt & Reduce Cond Press	.32	0.1
Downsized Pump (10 to 5 HP)	.01	1.3	Reduce press & leak, eng nozzles, Air	.40	0.6
VSD, Oversized Piping	.01	0.8	Reduce op press, eng nozzles,leak red	.41	0.5
Comp Air Reduce Operating Pressure	.02	0.1	Flow Restr Nozzles, Downsize Pump	.43	1.4
Refrig Condense Press - reset switch	.02	0.0	Pump VSD	.46	1.9
Refrig Suction Pressure - manual	.03	0.0	Comp Air Use outside air intake	.52	0.1
Insulate Steam Pipes	.04	10.0	Flow Restr Nozzles, VSD	.54	1.2
Refrig Screw Compressor Full Load	.04	0.0	Effic motor 1-5 HP from Std Motor	.60	0.0
Trim pump impeller	.06	1.6	Refrig Suction Pressure - controller	.64	0.0
Reduce Air nfilt & Screw C Full Load	.06	0.0	Economizer on AC System	.71	0.7
Reduce Air Infilt & Increas Suct Press	.07	0.0	Effic motor 51-125 HP from Std Motor	.74	0.5
Flow Restr Nozzles, Trim Impeller	.08	1.3	96 W Fluor to Elec Ballast & Centr	.95	2.4
Comp Air Nozzles, Medium Savings	.08	0.1	Comp Air Leak Reduce	.97	0.4
Flow restricting nozzles	.15	1.1	150 W Inc to 35 W HPS & Controls	1.08	1.4
Convert MV to Met Halide	.15	0.5	Effic motor 5.1-20 HP from Rewind	1.13	1.3
Refrig Condense Press - auto control	.15	0.1	Convert 96 W Fluor to Elec Ballast	1.23	1.9
Refrig Reduce Air Infiltration	.16	0.0	Replace 150 W Inc with 35 W HPS	1.24	1.4
Convert MV to Met Halide & Controls	.19	0.7	82 W Fluor to Elec Ballast & Contr	1.41	3.6
Compressor Controller	.23	0.4	Effic motor 21-50 HP from Rewind	1.41	1.3
Convert MV to HPS	.24	1.8	Effic motor > 125 HP from Std Motor	1.45	0.2
Convert MV to HPS & Controls	.25	2.0	Convert 82 W Fluor to Elec Ballast	2.15	2.4
Effic motor 5.1-20 HP from Std Motor	.29	0.7	Effic motor 1-5 HP from Rewind	2.68	0.1
Refrig Condense Press - exist control	.30	0.1	Oversized Piping	3.18	7.1
Lighting Controls	.30	0.4	Effic motor 51-125 HP from Rewind	3.33	1.6
Effic motor 21-50 HP from Std Motor	.31	0.6	Effic motor > 125 HP from Rewind	6.34	1.0
Reduce press & leak, nozzles, control	.32	0.8			

Table D-44 lists the measures and the associated cost and conservation potential that come from the industrial supply curve model. All of the measures are inexpensive and it is believed that significant additional potential exists in this sector. Both BPA and the Power Council are working toward revising industrial conservation potential estimates.

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Supply Alternatives

Introduction

Under medium forecast conditions, Puget Power is expected to have a short-term firm energy surplus extending from operating years 1993-94 through 1995-96. By year 2010, the load is forecasted to exceed existing resources by about 1600 aMW. If any of Puget Power's contracted non-utility cogenerators fail to reach commercial operation, the deficit would be higher and occur years earlier. The demand-side energy alternatives available to apply toward this shortfall are presented in Appendix D. This appendix discusses the supply-side alternatives.

Many changes have taken place regarding supply-side opportunities since the previous Integrated Resource Plan was prepared in 1989. There has been a tightening in the long-term power market. This results as more utilities reach load and resource balance with energy deficits forecasted by the late 1990's. Puget Power conducted its first and second competitive solicitation of non-utility generators, and major environmental issues such as electromagnetic fields, Endangered Species Act, Clean Air Act Amendment, and environmental externalities have come to the forefront.

Loads & Resources - Energy

Puget Power's most recent load forecast (referred to as LTF92) is higher than the forecast used for the previous Integrated Resource Plan (LTF89). Table E-1 below shows the overall change in system load between these two medium case forecasts. Puget Power's load forecasting methodology is discussed in Appendix H.

Table E-1

SYSTEM LOAD FORECAST CHANGE SINCE PREVIOUS INTEGRATED RESOURCE PLAN (Energy - aMW)

Year	LTF92	LTF89	Change
1991	2,243	2,190	+53
1992	2,335	2,244	+91
1993	2,415	2,303	+112
1994	2,493	2,367	+126
1995	2,576	2,417	+159

Since the previous Integrated Resource Plan, Puget Power has contracted over 430 aMW of new firm supply from a variety of sources as shown in Table E-2. The resource additions in Table E-2 would be even greater if the savings from Puget Power's own conservation programs were shown as resources rather than load reductions.

Table E-2

FIRM RESOURCE CONTRACTS SIGNED SINCE 1989 INTEGRATED RESOURCE PLAN

	Type	Energy (aMW)	On-Line Year	Term (Years)
1. Purchases Through Utilities				
Conservation Transfers with Area PUDS and BPA	Conservation	6	1990	20
2. Purchases Through Competitive Bidding				
Abacus Resource	Conservation	4	1993	12-20
NW Energy Services	Conservation	1	1993	12
Puget Energy Services	Conservation	3	1993	10
Sycom Corporation	Conservation	1	1993	10
WA State Energy Office	Conservation	1	1993	10
Encogen	Gas Cogen	143	1993	15
Trans-Pac Geothermal	Geothermal	10	1993	30
Wheelabrator Pierce*	Municipal Waste	17	1994	20
3. Purchases Following Competitive Bidding				
March Point Phase II	Gas Cogen	48	1993	18
Tenaska	Gas Cogen	215	1993	20
Subtotal		449		
Project Cancellations		17		
Total		**432**		

Utility Purchases

Now that the regional surplus of the 1980's is diminishing, the long-term market for utility purchases is considerably tighter. The previous Integrated Resource Plan directed Puget Power to investigate conservation transfers with other utilities. The power purchase contract between Puget Power and Snohomish County PUD, Lewis PUD and Mason PUD was executed under this directive. It is unlikely that Puget Power will be able to arrange additional conservation transfers in the near future because no other utility has expressed interest in this type of transaction.

PURPA Purchases Prior to Competitive Bidding

Puget Power acquired the Sumas Energy 90 aMW and March Point Phase I 75 aMW cogeneration projects under the Public Utilities Resource Power Act of 1978 (PURPA). The resource were obtained at the company's then current avoided costs and prior to the first competitive bid solicitation.

Purchases Through Competitive Bid

In June 1989, Puget Power issued its first Request For Proposals (RFP) seeking 100 aMW of new supply from conservation or generation resources. In response to the RFP, Puget Power received 41 proposals representing over 1200 aMW of potential resources.

Following review of the proposals, Puget Power selected the seven projects indicated in Table E-2. The contracts were signed in 1990, and an eighth project, the 17 aMW Wheelabrator Pierce Municipal-Solid-Waste project, was also selected but has since been cancelled by the developer.

The projects are currently in the early stages of development, although the Trans-Pac Geothermal project has been experiencing some delays. Puget Power did elect to take more than the 100 aMW target amount when the award group was selected in February 1990; 163 aMW was selected, although the total changed later for two contracts as described below.

On August 16, 1991, Encogen and Puget Power agreed upon a contract amendment that raises the cogeneration project's expected average generation to 143 aMW. This offsets the loss of the 17 aMW Wheelabrator Pierce Municipal-Solid-Waste project which was cancelled.

Post-1989 Competitive Bid Acquisitions

After the formal process was complete for the first competitive bid, a number of bidders not selected requested the opportunity to improve their proposals. At this same time, Puget Power was also receiving unsolicited proposals from new developers wanting to sell power.

Since there was a need for additional power, the company decided to discuss the new projects and improved proposals with the developers. In order to better compare projects, Puget Power met with each developer and asked them a set of questions intended to gather information very similar to that required during the first competitive bid process. The responses were evaluated to determine the maturity and quality of each project. The prices for these new projects were no longer measured against Puget Power's avoided costs but rather against the prices of the award group from the first competitive bid.

As a result of these meetings and the evaluation process, two cogeneration projects, March Point Phase II for 48 aMW and Tenaska for 215 aMW were signed under contract for delivery in 1993.

Energy Load and Resources Forecasts

Taking into account all of the changes, Puget Power's current forecast of energy loads and existing resources are listed in Table E-3. As can be seen, Puget Power has significant resource needs, especially over the long-term.

Table E-3

Energy Loads and Resources (aMW)

Year	Load	Resources*	Diff.
1991	2243	2110	-133
1992	2335	2182	-153
1993	2415	2409	-6
1994	2493	2637	144
1995	2576	2661	85
1996	2649	2620	-29
1997	2714	2558	-156
1998	2778	2522	-256
1999	2844	2497	-347
2000	2911	2445	-466
2001	2972	2353	-619
2002	3031	2280	-751
2003	3091	2221	-870
2004	3154	2156	-998
2005	3216	2116	-1100
2006	3281	2097	-1184
2007	3345	2092	-1253
2008	3412	2020	-1392
2009	3480	1950	-1530
2010	3546	1950	-1596

* The resource column assumes all contracted non-utility projects except Wheelabrator Pierce municipal-solid-watse project, will be completed. The loss of any individual non-utility generation project would have a great effect on the adequacy of Puget's power supply.

Supply Opportunities - Energy

Puget Power's past Integrated Resource Plans have recommended utility purchases as a cost-effective source of supply. Puget Power will remain active in the power market, but indications are that the window of opportunity has, for now, passed for attractive, cost-effective, long-term utility purchases.

Puget Power's supply opportunities considered for this Integrated Resource Plan are listed in Table E-4. The determination of who is to develop, own and operate the resources is one of the primary uncertainties connected with the new supply. Most of the resources below could be developed by Puget Power, outside developers, or in the case of major regional resources, by a group of utilities. Each resource type is briefly described in Exhibit B.

Table E-4

SUPPLY-SIDE RESOURCE OPTIONS

RENEWABLE RESOURCES	THERMAL RESOURCES
Biomass	**Natural Gas**
Geothermal	Cogeneration
Basin and Range Sites	Combustion Turbine Combined-Cycle
Cascades Sites	Combustion Turbine Simple-Cycle
Hydro	Fuel Cell
Municipal Solid Waste	
Ocean	**Coal**
Marine Biomass	Atmospheric Fluidized Bed Combustion
Ocean Current	Integrated Gasification Combined-Cycle
Ocean Thermal	Pressurized Fluidized Bed Combustion
Salinity Gradient	Pulverized Coal/SO_2 Scrubbers
Wave Power	
Tidal Power	
Solar	**OTHER RESOURCES**
Parabolic Trough	
Parabolic Trough w/CCCT	**Nuclear**
Parabolic Trough w/Gas Backup	Advanced Light Water Reactor
Photovoltaic	
Wind	

Table E-5 ranks the supply-side alternatives for which generic costs were calculated based on levelized cost estimates (excluding wheeling charges). In addition to total levelized resource cost, Table E-5 includes such information as lead times and capacity factors. The data used to develop the levelized cost for supply-side alternatives were based on EPRI's Technical Assessment Guide and the 1991 Regional Plan. Where applicable, the resource information was calibrated to incorporate Puget Power's operating experience and knowledge. Other assumptions and references for generation resources are provided in Exhibit A on page E12.

Levelized Resource Cost Calculation

The levelized costs used in this appendix were calculated using a spreadsheet which takes the annual costs, calculates the present value and then levelized the costs. A short-hand, but equivalent calculation is outlined in Table E-6.

In this short-hand method, a fixed charge rate (FCR) is used. The fixed charge rate equals the present value of the fixed costs of an asset (depreciation or amortization, cost of money, property taxes, federal income taxes an insurance), levelized over its useful life and expressed as a percentage of original investment.

Table E-5

PRELIMINARY SUPPLY-SIDE RESOURCE CANDIDATES
LEVELIZED RESOURCE (LR) COSTS
(Mills/kWh 1991$'s)

Resource	Lead Time (Years)	Capacity Factor (%)	Capital Cost ($/kW)	FCR+ (%)	Levelized Capital*	Fixed O&M	Variable O&M	Fuel	Total LR Costs**
1	*4*	68	1343	12.8	28.9	2.4	7.4	0.0	39
2	*4*	64	1550	12.8	35.5	2.4	7.4	0.0	45
3	*4*	80	670	13.2	12.6	1.4	5.7	35.6	55
4	*4*	62	2224	12.8	52.5	2.4	7.3	0.0	62
5	*4*	90	2224	13.5	38.2	18.5	9.2	0.0	66
6	*2*	80	395	13.1	7.4	1.6	6.6	53.5	69
7	*4*	30	1100	13.1	54.8	5.3	11.7	0.0	72
8	*8*	75	1550	13.5	31.9	9.1	8.4	27.6	77
9	*6*	70	2000	13.2	42.9	8.0	7.3	23.2	81
10	*8*	70	2027	13.5	44.7	7.9	11.5	23.1	87
11	*10*	70	1910	13.5	42.1	28.1	2.1	16.0	88
12	*8*	70	2125	13.5	46.9	6.3	9.2	26.2	89
13	*4*	70	2230	13.5	49.2	5.3	10.6	39.5	105
14	*2*	35	2680	13.5	118.0	4.5	10.5	0.0	133

Resource Column Legend:

1. Small Hydro, White River
2. Small Hydro, Nooksack
3. Combustion Turbine, combined cycle (Cogen)
4. Small Hydro, Thunder Creek
5. Geothermal
6. Combustion Turbine, simple cycle
7. Wind
8. Pulverized Coal/SO_2 scrubbers
9. Coal (integrated gasification combined cycle)
10. Coal (pressurized fluidized bed combustion)
11. Nuclear (advanced light water reactor)
12. Coal (atmospheric fluidized bed combustion)
13. Fuel cell
14. Solar (parabolic trough)

\+ *Fixed Charge Rate (FCR) equals the present value of the fixed costs of an asset (depreciation or amortization, cost of money, property taxes, federal income taxes and insurance), levelized over its useful life and expressed as a percentage of original investment.*

* *Levelized Capital* $= \frac{(FCR)*(Capital\ Cost)*(1000)}{(Capacity\ Factor)*(8760)}$

** *The Total Levelized Resource (LR) Costs column represents the per kWh cost. The total LR costs are reported in nominal dollars. These costs are at the busbar and do not include any wheeling. They are ranked from least expensive at resource 1 to most expensive at resource 14. Total LR Costs equals the sum of Levelized Capital, Fixed O&M, Variable O&M and Fuel.*

Table E-6

LEVELIZED RESOURCE COST
EXAMPLE CALCULATION

STEP 1:

Levelized Capital = (Capital costs per kW * FCR)/(hours per year * Capacity factor)

STEP 2:

Levelizing operating costs = first year costs * levelizing factor

LEVELIZING FACTOR CALCULATION:

Levelizing factor = present value of future costs * capital recovery factor

$= [(1+e) / (i-e)] * [1-((1+e)^n / (1+i)^n)] * [i (1+i)^n / ((1+i)^n -1)]$

where:

i = discount rate (percent per year/100)
e = inflation rate (percent per year/100)
n = useful life of the investment (years)

<u>COAL PLANT EXAMPLE OF TOTAL LEVELIZED COST</u>:

STEP 1:

Capital cost = $1550/kW
FCR = 13.53%
Hours per year = 8760
Capacity factor = 75% (amount of year plant is used)

Levelized capital $= \frac{(1550 * .1353) * 1000}{8760 * .75}$ **= 31.9 mills/kWh**

STEP 2:

first year operating costs = 27.3 mills/kWh (includes fuel, O&M)
i = 10.41%
e = 5%
n = 30 years

27.3 mills/kWh $* [1.05 / (.1041-.05)] * [1-((1.05)^{30} / (1.1041)^{30})] * [.1041(1.1041)^{30} / ((1.1041)^{30}-1)]$

= 27.3 * 19.41 * .778 * .1097 = **45.2 mills/kWh**

TOTAL LEVELIZED RESOURCE COST = 31.9 + 45.2 = 77.1 mills/kWh (see resource #8 in Table E-5)

Efficiency Improvements at Existing Projects

The available generation from owned and contractual resources can be increased through plant efficiency improvements. Puget Power has, from time to time, undertaken such improvements on its wholly owned combustion turbines and hydroelectric facilities whenever they have been cost-effective. To a lesser degree, Puget Power can influence decisions regarding efficiency improvements at jointly-owned coal resources through participation on the owner committees and at the Mid-Columbia hydroelectric projects through the purchasers committees.

Company-Developed Resources

Puget Power is investigating increasing the capacity at three of its existing hydroelectric projects. At the Snoqualmie Falls Project, Puget Power is investigating expanding the generating capacity of the plant from 41 MW to approximately 73 MW. More energy would also result from the increase in the project's ability to capture high flow events.

The White River Project is in the licensing process with a new 14 MW turbine added to the diversion canal into Lake Tapps. Currently, the water flows unimpeded into the lake and the energy is dissipated without any benefit.

Another of Puget Power's hydroelectric projects, Nooksack Falls, is also currently undergoing Federal Energy Regulatory Commission (FERC) licensing. In the application, Puget Power is requesting to upgrade the project from 2 MW to 8 MW. All of these hydro project improvements require FERC approval. The schedule for receiving decisions from FERC on these projects is difficult to predict.

The Snoqualmie, White River and Nooksack projects that are listed are expansions of existing facilities. Small hydro development and increased generation from owned and contracted resources are two major issues regarding hydroelectric projects. Small hydro development appears to be promising from both a cost and environmental perspective. There are a number of potential sites for small hydro development which the company could pursue itself.

Puget Power seeks to maintain a balanced resource portfolio that is consistent with its resource planning guidelines. Part of this strategy includes development or ownership of additional resources by the company. Resources such as small hydro are particularly attractive. Several small hydro developers have or are seeking licenses for projects which appear to be promising from both a cost and environmental perspective. Puget Power has the opportunity to acquire these projects or buy power from them. Also, there are a number of potential sites for small hydro development which the company could pursue. Puget Power will continue to evaluate the feasibility of developing these options as well as other resources as opportunities arise.

Utility Purchases

Utility purchases were recommended as a source of supply by both previous Integrated Resource Plans and Puget Power successfully negotiated several long-term contracts under those directives. However, lately the long-term power market has tightened considerably. Northwest utilities are no longer offering attractive long-term sales contracts . Utilities that still have surplus power available for sale are located further away from Puget Power's system, and potential purchases would depend upon obtaining rights to long wheeling paths.

Although the busbar costs of these sales contracts may be attractive, the value to Puget Power is substantially reduced by wheeling costs and transmission losses. Puget Power will continue to remain active in the power market but indications are that the window of opportunity has, for now, passed for attractive utility purchases.

Conservation Transfers

Puget Power's last Integrated Resource Plan called for Puget Power to pursue conservation transfers. Many, if not most, conservation transfers require BPA participation. The existing conservation transfer from Snohomish PUD, Lewis County PUD, and Mason County PUD works because BPA and Snohomish PUD agreed to provide the energy saved to Puget Power. No other utility (including BPA) is currently expressing interest in additional conservation transfers.

Non-Utility Purchases / Competitive Bidding

A significant amount of supply-side energy resources being added over the next few years are non-utility projects. These projects offer competitive prices and transfer some development risks away from the utility. Although Puget Power has had small non-utility projects on its system since the early 1980's, the 80 MW March Point Cogeneration Company project became the first large, non-utility project on Puget Power's system when it came on-line in the fall of 1991.

As the utility's reliance on this type of resource grows, some issues and risks associated with this industry need to be considered. They include:

- Obligation to serve
- Contracted project cancellations
- Financial impacts
- Loss of operating flexibility

These considerations are discussed further in the following paragraphs.

Obligation To Serve - Puget Power, and utilities in general, are granted exclusive access to customers in an area and in exchange, have an obligation to serve those customers. The developer, on the other hand, has no such obligation. The project is developed to make money and presumably if conditions prevents the plant from being cost-effective, the developer would likely shut it down. Fortunately, payment is not rendered if the project does not generate, which should align the developer's interest with those of Puget Power. However, there is still the potential for an unexpected event to cause the project to become uneconomic and cease operation.

Contracted Project Cancellations - Related to the above issue regarding Puget Power's obligation to serve is the concern that not all projects under contract will reach commercial operation. Currently, these resources are included in the existing resources forecast. If Puget Power knows a project is in trouble, it can be removed from the planning stage, but there may not be sufficient warning to arrange for an alternate supply.

Financial Impacts - There is also concern about the financial market's assessment of non-utility contracts. Rating agencies are increasingly viewing non-utility purchases as debt equivalents. Unless properly balanced with other considerations, this could adversely affect the company's credit rating.

Loss Of Operating Flexibility - All of the non-utility projects for which Puget Power has contracted thus far have been for baseload generation. Although baseload generation is lowest cost, Puget Power may begin requiring dispatch rights on non-utility projects or may implement a solicitation for seasonal or peaking resources to address operating concerns.

The WUTC issued a rule in the summer of 1989 that implemented competitive bidding for new resources by investor owned utilities in Washington state. Puget Power's first solicitation resulted in contracts for 163 aMW (less 17 aMW for a canceled municipal solid waste project) of new conservation and generation, see Table E-2). An important test will be whether the selected projects come on-line and produce power over their contract terms. Nonetheless, these contracts were 85-95% of avoided costs and Puget Power gained valuable insights into the non-utility conservation and generation markets.

The cost and availability of non-utility generation is difficult to predict in general. Projects use different technologies and fuel supply and within each project type there can be different efficiencies, equipment sizes, steam balances, etc. Rather than develop specific cost and availability estimates for each type of resource that could be supplied through competitive bidding, Puget Power has elected to base its forecast of non-utility generation in this planning cycle on gas-fired cogeneration using combustion turbine equipment. Currently, gas-fired cogeneration is the predominant resource type in the non-utility generation market.

The quantity of non-utility generation is also highly uncertain. Under current market conditions, proposals are being received for a large number of megawatts, and some of these proposals appear to be viable resources. However, most of these proposals are fueled by natural gas which could potentially have supply constraints in the next decade (primarily in the pipeline system).

For this reason, Puget Power places an upper limit on the amount of natural gas-fueled generation in the planning process. In the last planning cycle a limit of 1000 aMW was assumed.

Since then, Puget Power has either contracted or is in negotiations for nearly 600 aMW of new gas-fueled generation. For planning purposes, it is believed that limiting the amount of new gas-fired generation to 1000 aMW, for a total of 1600 aMW of natural gas-fueled generation is an appropriate level. This constraint would cover all gas-fueled generation whether developed by Puget or non-utility developers. Puget Power's view of the current non-utility market by fuel type is discussed below:

Municipal Solid Waste - The one waste-to-energy project responding to Puget Power's previous RFP was cancelled after being awarded a power purchase contract. While waste-to-energy development activity in the area Puget Power serves is currently very low, this resource type may be re-examined as garbage disposal problems become more acute.

Gas-Fired Cogeneration - Adequate gas-fired cogeneration opportunities appear to exist to meet Puget Power's resource needs in the foreseeable future. All developers obtain their combustion turbine equipment from the same suppliers for about the same price. What distinguishes the better gas-fired projects are long-term firm fuel supply arrangements for primary supply, backup and transportation.

Wood-Fired Cogeneration - The forest products industry seems to have excess hog fuel at present but mills are unwilling or unable to commit this fuel supply to a cogeneration project on a long-term basis.

Geothermal - The hot spots for geothermal development seem to be Southern Oregon and Northern California. The availability and cost of wheeling to the company will be a major deciding factor whether these project can be acquired.

Coal-Fired Cogeneration - Adequate coal fuel and cogeneration sites exist to meet Puget Power's entire resource requirement for the foreseeable future. However, at least for the near-term, licensing concerns and the Clean Air Act Amendment of 1991 may seriously limit, if not eliminate, coal as a fuel type.

The technology of choice for coal-fired generation is still undetermined in the marketplace. Some are pursuing fluidized bed technologies while others look to pulverized coal with scrubbers. Either way, these projects seem marginally viable at the avoided costs ceiling. Integrated Gasification Combines Cycle (IGCC) is another emerging technology that can use coal as its fuel source. IGCC is attractive due to its lower emissions. This resource would be viable and cost-effective in a future of heightened environmental awareness.

Loads and Resources - Peak

Northwest utilities have traditionally planned for new supply on an energy basis. Because of the large surplus of hydroelectric capacity, the region is usually considered energy constrained and not capacity constrained. However, as the regional surplus runs out, capacity is becoming more of an issue.

Set forth in Table E-7, is a forecast of Puget Power's peak load. This peak load forecast was developed based upon the energy load forecast assuming the load factor and temperature experienced over Puget Power's last major peak load event in December 1990. The peak load was grown at the same percentage rate as the energy load forecast. The load would have been approximately 4700 MW instead of 4615 MW if conservation were excluded.

Included with company resources are the 300 MW exchange contract with Pacific Gas & Electric that began in January 1992 and the 80 MW Shuffleton Steam Plant. Shuffleton is an aging plant and may require some upgrades to remain as a peaking resource.

Table E-7

Peak Load and Resources (MW)

Op-Year	Load	Surplus/ Resources	Deficit
1991-92	4,805	4,673	- 132
1992-93	4,976	4,788	-188
1993-94	5,144	5,170	26
1994-95	5,315	5,156	-159
1995-96	5,479	5,134	-345
1996-97	5,625	5,032	-593
1997-98	5,762	4,980	-782
1998-99	5,900	4,963	-937
1999-00	6,040	4,883	-1157

Peak-Supply Opportunities

Available peaking alternatives include demand-side programs, utility purchases or exchanges, non-utility peaking purchases, or company-developed plant. Peaking resources are like insurance: they do not get used very often, but must be available when the need arises. The other part of the analogy is equally important; the company pays for peaking whether supplies are used or not. Assuming peaking supply could be built for 300 $/kW, meeting the 132 MW deficit in 1991-92 would cost approximately $40 million in capital alone.

One area that will continue to be investigated is demand-side peak management. Puget Power currently has in place one direct program for peak. Approximately 45 MW of industrial and commercial customers are on rate schedules that allow interruption during extreme peaks. Most other demand-side management programs focus on the automatic or remote control of specific end-uses.

In the past, Puget Power has constructed simple cycle combustion turbines to meet peaking requirements and this option appears to still be the lowest cost for new utility-developed capacity. A new simple cycle combustion turbine could be available in about four years at a new site and about two years at a licensed site.

There also may be some other utilities that have surplus capacity available either for sale on a firm basis, or as part of a seasonal exchange. The potential for seasonal exchanges with the summer peaking utilities of California and the desert Southwest remains high. As mentioned previously, Puget Power has already completed a 300 MW seasonal exchange contract with Pacific Gas & Electric which began January 1992. Future exchanges face this same transmission hurdle.

Capacity needs can also be met by energy storage technologies such as hydroelectric pumped storage, and batteries or compressed air energy storage. All the storage technologies are net energy users because of losses and have relatively high capital costs.

Concerns about meeting peaks during extreme weather conditions in the Puget Sound region have resulted in the Puget Sound Area Electric Reliability Plan, a cooperative capacity effort by Puget Power, Seattle City Light, Snohomish PUD, Tacoma Public Utilities, and the Bonneville Power Administration. The Puget Sound Area Electric Reliability Plan has examined alternative strategies for meeting extreme peak loads. Among these strategies are a new cross-Cascade transmission line, load management programs, conservation programs, combustion turbine use during peaks, and voltage support. The preferred strategy developed in this plan recommended use of accelerated conservation programs and voltage support to meet extreme peak loads through 2003.

The company is also concerned about capacity shortages due to localized transmission constraints. For the future, it will be necessary for the company to acquire resources to meet both energy and capacity needs. Resource alternatives will be evaluated with capacity contributions playing a larger role in acquisition decisions.

Puget Power will continue the use of peaking studies to determine appropriate actions for meeting peaking needs. Peak demand and supply-side resource studies will be conducted concerning development of appropriate methodology and criteria, and evaluation of all peaking resources, including the capacity value of conservation programs. Based on these studies, strategies to meet peaking requirements may be modified. Additionally, transmission and distribution planning, in support of the Growth Management Act, incorporates peaking requirements in determining facility needs.

Operating Considerations

In addition to the ability to meet peak loads, Puget Power's resource mix must remain flexible enough to meet load cycles. Puget Power currently follows swings in load primarily with hydroelectric resources and some contracts that allow variable deliveries such as Columbia Storage Power Exchange. These resources not only provide flexibility, at no additional cost. As load has grown and the hydroelectric system has become subject to additional non-power operating constraints, it has become more difficult to follow daily, weekly and seasonal load variations. The most common manifestation of this problem is excess power in light load periods, such as during nights and weekends.

In the future, Puget Power expects to need additional peaking or dispatchable resources. Puget Power's current planning models are based upon annual or monthly energy requirements. It is foreseen that the capacity requirement could potentially outstrip energy needs, therefore, the next cycle of integrated resource planning will include an analysis of peak resource needs.

EXHIBIT A
Resource Costing

Puget Power's planning process involves a number of analytical steps. Those described in this exhibit deal with the methods used to make a rough comparison of the costs of potential future supply resources. In addition to describing the methods used, a number of terms are explained and values for some economic assumptions are provided.

Base Year, Present Value and Levelized Cost

Resource costs do not all occur at the same point in time. This is true for a single resource which incurs annual fuel or operation and maintenance costs. This issue also comes up when comparing resources which have different starting dates. Because inflation occurs in the intervening time, it must be accounted for when comparing resources.

The rough comparison method described in this exhibit assumes all resources begin operation in the base year, which is currently assumed to be 1991. If construction cost estimates were made for resources in other years, the appropriate inflation/deflation index is used to shift those estimates to 1991 levels. Fuel and operation costs begin at 1989 levels and are increased according to assumed inflation rates. These costs are calculated for each year of the resource's operating life.

The timing of these costs can vary for different resources. For example, a hydropower facility can have a higher capital costs, but relatively low operating costs. A gas-fired combustion turbine has a relatively low capital cost, but the fuel cost can fluctuate dramatically over time.

To facilitate comparison of different streams of costs over time, two additional steps are performed: their present value is calculated and then they are levelized over their operating life.

The present value step takes into account the time value of money. A dollar is more valuable now than a year from now, because the dollar could earn interest during the year. The present value calculation makes up for the interest that could have been earned by discounting the future amount using a discount rate usually expressed as a per year percentage. The discount rate used in the calculations is an estimate of the future cost of raising money for Puget Power, which is about 10.41%.

The calculated present value of each year's cost is aggregated and results in the cumulative present value of acquiring the particular resource. This present value is then converted to a uniform series of annual costs with the same present value. This is done in the same way that that a bank lends the present value of buying a house in return for a series of mortgage payments (the mortgage payment is the levelized cost). With resources that come in different sizes, it is helpful to divide this levelized annual cost by the annual benefit (annual production in the case of a supply resource and annual savings in the case of conservation). The resulting levelized cost is usually expressed in terms of mills per kilowatt-hour (mills/kWh).

To make the calculation above, assumptions need to be made for capital, operating and fuel costs for the various resources and other economic parameters such as inflation rates for the different cost components. These and other assumptions are described below.

Assumptions & References for Generation Resources

1. Costs for all resources include AFUDC and are in 1991$. References which have costs in other year's $ were "normalized" using the Data Resources, Inc. national economic forecast.

2. Fuel costs are as follows:

   - Natural Gas $2.60/million BTU (derived from current tariffs)
   - Coal $1.45/million BTU delivered to a Western Washington site
   - Nuclear $.8547/million BTU (reference: Power Engineering - March 1990; pg. 18; "Nuclear Suppliers Prepare For The Next Generation of Orders".

3. The following references were used to provide information on generation resources:
   - Estimated Data For G.E. Simple Cycle/Combined Cycle Plants; September 1988.
   - Responses to WPPSS RFP For Combustion Turbine Project at Satsop dated Feb. 1991.
   - EPRI Technical Assessment Guide - Special Report P-6587-L Vol. 1, Rev. 6 dated September 1989.
   - Staff Draft 1991 Update of the 1986 Northwest Power Plan; dated November 1990.
   - Colstrip 3 & 4 Coal Fired Generating Plants Construction and O&M Data Reports.
   - Phone conversation with Mr. Dennis Horgan of Luz International on April 9, 1991 (solar).

4. The levelized fixed charge rates for various plant lives used for evaluating the generating resources are as follows:

Plant Life	15-Yr. Tax Life	20-Yr. Tax Life
20 years	.1451	1494
30 years	.1316	.1353
40 years		.1318
50 years		.1283

5. Capacity factor is defined as the period of time that a power producing facility operates at its rated output (kW) during a year. A base load capacity factor defines a plant that operates at least 65% of the time. Intermediate capacity factor defines a plant that operates between 30% and 65% of the time. Peak capacity factor defines a plant that operates up to 15% of the time. It is currently estimated for planning purposes that Puget Power will use simple cycle combustion turbines about 2% of the time.

6. Fixed and variable O&M, and consumables are taken from the EPRI Technical Assessment Guide (where available).

7. Total construction time was taken from the EPRI Technical Assessment Guide (where available) with one-year added for Energy Facilities Siting Evaluation Council involvement.

8. All generation resources are assumed to be 100% Puget Power owned, located within the Northwest region, and on a new site unless noted otherwise.

EXHIBIT B

New Generation Resource Descriptions

Listed below are descriptions of resources which are being considered in the current integrated resource planning cycle. These resources have been grouped under the categories of renewables, thermal, and other. Some of these resources could be constructed directly by Puget Power, by others in partnership with Puget Power or by non-utility developers.

Renewables

Small Hydroelectric

Hydroelectric power involves the production of electricity from generators driven by hydraulic turbines. This is accomplished by using dams to direct the water of a river into the pressure pipes (penstocks) and then through a turbine. At the present time, Puget Power is studying a number of specific sites for possible development:

	CAPACITY (MW)	LEVELIZED COST (Mills/kWh)
White River	14	42
Nooksack	8	48
Thunder Creek	6	65

Wind Turbine

A wind turbine captures the energy in a moving air stream to drive a generator that produces electricity. Wind machines installed in the 1970's were less reliable than modern wind machines, however, technology has moved ahead quite rapidly. There are presently 200 to 500 kW wind machines on the market that are competitive with other forms of generation under the right wind resource conditions. EPRI has, with the encouragement of Puget Power, increased its budget for wind research. Additionally, there are promising wind sites available in the Pacific Northwest.

Geothermal

Naturally occurring underground reservoirs of hot water-steam mixtures provide a resource that can be tapped for energy production. After drilling these reservoirs, the resulting water-steam mixture is directed into steam separators. Lower pressure is maintained within the separator which allows a portion of the hot water to flash into steam. In general, this amounts to about 15% to 20% of the water. The flashed steam is directed through scrubbers, to the turbine generator, and into a condenser. Residual liquid from the steam separator, together with condensate from the condenser, is returned to the reservoir by injection wells.

In the binary process, the heat from the geothermal liquid is used to vaporize another liquid in a heat exchange. The resulting gas is then run through a turbine-generator to produce electricity in a closed cycle process.

Municipal Solid Waste

A Municipal Solid Waste (MSW) power plant is based on conventional technology using a non-conventional fuel. Garbage is received and some of the non-combustibles (iron, etc.) are removed in a fuel treatment process. This material is then suitable for burning in a boiler designed with this fuel in mind. The resulting steam is used to drive a steam turbine-generator to produce electricity. Emissions control for this type of plant can be accomplished using flue gas scrubbers and bag houses.

Methane From Landfills

Over a period of years, methane is generated from deteriorating garbage in landfills. This gas can be recovered through a series of wells and a collection system. If the methane is clean or can be treated, it is usable as fuel for an internal combustion engine, a small combustion turbine or a diesel engine which would drive an electric generator.

Solar (Parabolic Trough)

In the parabolic trough design, solar energy is collected by a reflective parabolic trough that focuses the sun's energy on an in-line (parallel to the trough) receiver. The troughs are typically oriented in a north-south direction and lie horizontally. The troughs are rotated about the long axis to capture as much of the sun's energy as possible.

The receiver in the trough is a specially coated pipe inside of a glass vacuum tube. A heat transfer fluid (synthetic oil) is contained in the pipes. The fluid is heated to 735 degrees Fahrenheit and passed through a heat exchanger to create a superheated steam for a turbine generator.

This process can be supplemented with a natural gas-fired boiler to maintain constant operation during periods of high demand. For the purposes of the resource table, this supplemental firing is not included.

Sizes currently in operation are in the 14 to 30 MW range with an 80 MW plant in the planning stages. All plants are located in southern California and are utilized as peaking plants. This is a technology that could be developed in limited regions of the Northwest (e.g., southern Oregon and Idaho) but would provide lower cost energy if located in the desert southwest. This solar technology is very latitude sensitive because of its single axis tracking of the sun.

Thermal Resources

High Efficiency Cogeneration

Cogeneration is a facility designed to use one fuel resource to produce two forms of useful energy; e.g., electricity and steam. The technology involved is similar to that of a conventional steam power plant. Excess steam from an existing process is run through a condensing/extraction steam turbine which drives a generator to produce electricity.

Under the 1978 Public Utility Regulatory Policies Act (PURPA), a facility is considered cogeneration if 5% of the total energy output is devoted to thermal processes. Working with the Policy Collaborative Group (which included cogeneration developer input), Puget Power has increased the criteria for high efficiency cogeneration by expressing a preference for facilities with a minimum of 20% of the total energy output of the facility devoted to thermal processes including high efficiency turbines and boilers.

Operating experiences and technological advancements had suggested that more could be done to increase fuel use efficiencies and promote environmental protection.

Combined Cycle/Combustion Turbine

A combined cycle power plant utilizes combustion turbine-generators, heat recovery steam generators (HRSG), and a steam turbine-generator to produce electricity. Natural gas or distillate oil is fired in the combustion turbine-generator. The temperature of the exhaust is about 900 to 1000 degrees Fahrenheit. These exhaust gases are passed through the HRSG to produce steam for the steam turbine-generator. Water is injected into the combustion chamber of the combustion turbine for control of nitrogen oxide. A bypass around the HRSG is generally included for operating flexibility.

Simple Cycle Combustion Turbine

Natural gas or distillate oil is used as fuel for a combustion turbine. Ambient air is compressed in the compressor section of the combustion turbine before fuel is introduced. This air and fuel mixture is ignited and the resulting hot gases are expanded through the turbine section of the combustion turbine which drives an electrical generator. Emissions control for nitrogen oxide is accomplished by injecting water into the combustion chamber during the combustion process.

Coal Plant With SO_2 Scrubbers

The conventional coal-fired power plant utilizes pulverized coal for fuel. It is burned in a large boiler to produce 2400 psia, 1000 degrees Fahrenheit steam which drives a steam turbine-generator. Emissions control for SO_2 and particulate removal is accomplished with a flue gas desulfurization system. Nitrogen oxide control takes place in the boiler using flame temperature moderation or recirculation of flue gas through the burners.

Integrated Gasification Combined Cycle

The gasification process converts pulverized coal into an intermediate BTU gas (approximately 300 BTU/CF) for use in a combustion turbine-generator. This is accomplished by pumping pulverized coal in a concentrated slurry mixture into an entrained flow gasifier where a partial oxidation process produces the gas.

After the gas passes through a heat recovery section, the sulfur and nitrogen compounds and particulates are removed. The clean gas is then fired in the combustion turbine-generator. Resulting hot exhaust gases generate steam in the HRSGs to drive both a steam turbine-generator and steam turbine compressors in the oxygen plant. Sulfur compounds are reduced to elemental sulfur in a separate process.

Pressurized Fluidized Bed Combustion

In pressurized fluidized-bed combustion, coal is burned in a fluidized mass of bed material, usually limestone, while contained in a pressurized boiler/combustor unit. The air for fluidizing the bed and also for combustion is introduced through a distributor plate into the combustor which operates at a pressure typically between 150 psia and 300 psia. Dolomite or limestone used as the bed material is introduced separately or with the coal feed. This provides the bed material and absorbent for control of SO_2 emissions. The hot pressurized gases leaving the combustor pass through a filter to remove suspended particulates and then drive a combustion turbine-generator. Steam is generated in two parts of the process. These are in the tubes in the bed itself and in an HRSG on the combustion turbine. Both provide steam to a conventional steam turbine-generator.

Atmospheric Fluidized Bed Combustion

Atmospheric fluidized bed combustion can be categorized in two forms. These are titled "bubbling bed" and "circulating bed". In both cases, crushed coal is burned with limestone at atmospheric pressure in a boiler. Fuel is injected into the boiler and suspended by air blown in from the bottom. The difference between "bubbling" and "circulating" beds is the velocity of the air in the boiler. A bubbling bed design uses a lower air velocity than the circulating bed.

Emissions control in both cases uses limestone to capture most of the sulfur released from the coal during combustion. Particulates are captured in a series of cyclone separators followed by an electrostatic precipitator. Steam is produced inside tubes passing through the bed and/or through the hot gas stream. The steam is used to drive a conventional steam turbine- generator to produce electricity.

Fuel Cells

Fuel cell power plants are modular units composed of three major subsystems:

1) the fuel processor
2) the power section, and
3) the power conditioner

The fuel processor reforms either natural gas or light distillate fuel into a hydrogen-rich gas. Fuel cell stacks makeup the power section. Hydrogen-rich gas is mixed with ambient air in the fuel cells to produce water and electricity. Fuel cells directly transform the chemical energy of a fuel and oxidant into electrical energy without combusting the fuel. The power conditioner converts DC power to AC power compatible with a utility system. First generation fuel cells use phosphoric acid as the electrolyte. Advanced fuel cells may use a molten carbonate electrolyte or an improved phosphoric acid version.

Other Resources

Battery Storage

During off-peak times on the utilities' system, electric power is used to charge an improved lead-acid battery or an advanced battery based on either the sodium-sulfur or zinc-chlorine system. Energy from the charged batteries is then returned to the utilities' system during peak demand periods of three to five hours per day. The battery system is composed of modular units which equal an output of 5 to 20 MW.

Nuclear - Advanced Light Water Reactor

The Advanced Light Water Reactor (ALWR) is a direct descendant of existing Light Water Reactor designs. Its technical and regulatory requirements are based on those applying to existing plants. The technology is a continuation of the mainstream development of U.S. nuclear power plants, which can be available for commercial operation in the near term. ALWR have either pressurized or boiling water reactors (PWR and BWR, respectively). Both versions are expected to have similar economic and technical performance characteristics and will compete with each other for initial market penetration.
The ALWR has been designed to meet three fundamental acceptance criteria: First, it should meet or exceed current licensing requirements for a generating unit in all respects, including safety, reliability, maintainability, and compatibility with the environment. Second, it must be economically competitive with fossil-fuel-fired electricity generation.

Finally, the ALWR must provide predictable construction costs and schedule, assured licensability, predictable O&M costs, and very low risk of severe accident.

Transmission

Introduction

In the last decade, electrical transmission has assumed a vital role in providing energy to customers. With the population in the Puget Sound basin growing at a rate of 3% to 4% per year, it will be necessary for Puget Power to add transmission facilities, new distribution lines and substations in order to meet the increasing energy needs of the customers. These transmission lines will make it possible to meet the demand for reliable and cost-effective service for customers.

To meet these challenges, Puget Power has embarked on a corporate goal to build a backbone 230 kV transmission system. This transmission system, when expanded as planned, will provide Puget Power with a reliable, efficient and cost-effective system of new and rebuilt transmission facilities. This system will also allow Puget Power the flexibility to purchase the most economical energy resources and integrate current and future generation sources into the electrical system. Finally, this system will allow Puget Power to make a long-term commitment to plan and construct electrical facilities to meet the need for future growth.

The transmission system plays a key role in providing reliable electrical service. Large quantities of power are transmitted on the transmission system from the generator to the main load centers. Within the population centers, the power is redistributed on a network transmission system to the smaller load centers. Without an adequate system, the ability to deliver power during equipment failure or peak loads would be impaired.

Nationally, several issues have surfaced over the use of new and existing transmission facilities. One of these issues concerns a utility's access to other utilities' transmission systems. Also, electrical facilities themselves have become an issue from the standpoint of aesthetics, environmental effects and the health controversy of extremely low frequency electromagnetic fields (EMF). As a result, permits for construction of new transmission facilities are becoming increasingly more difficult to obtain.

A utility's investment in a transmission system is a long-term commitment for the future. These electrical facilities have at least a 40 to 50-year useful life. When constructing these facilities, the capacity of the system to meet new growth must be considered. The incremental cost of providing the additional capacity is a small percentage of the total project cost. One of a utility's most important roles is to plan and construct facilities for future growth.

Functions of Transmission

Transmission facilities have different functions that need to be addressed. They are to:

- Deliver bulk power (i.e. from Columbia River generation)
- Deliver power to load centers (within Puget Sound Basin)
- Provide reliable service (reduce outages)
- Provide an efficient operating system (quick restoration)

Each function has an important effect on whether the system provides cost-effective, reliable power to customers.

Utilities use high voltage transmission as the most economical means to transmit large quantities of electrical power. When the electrical system was initially built, the generation sources and the fuel to run them were located near the load centers. Later, to take advantage of the opportunity to use natural resources, such as hydro power from the Columbia River, 500 kV transmission was installed. This bulk power transmission system also allows power to be transferred between different regions such as from the Northwest to the Southwest, over the 500 kV Pacific Intertie.

The amount of power that can be transmitted on the electrical system at different voltage levels is shown in Table 1.

Table 1

Power Capacity of Typical Voltage Classes

Voltage kV	Capacity MW	Comments
12.5	12	Standard distribution voltage
34.5	34	Distribution voltage for rural and dense load areas
115.0	240	Subtransmission voltage to distribute power to local substations
230.0	500	Transmission voltage to distribute power to load centers and local substations
500.0	2000	Bulk power transmission from generation or between regions

The actual capacity ratings of the distribution or transmission lines are determined by voltage, conductor size, the number of conductors and operating temperature. The actual power that can be transmitted is also limited by distance. The longer lines have more losses, voltage drop, and chances of outages.

Caution should be exercised in assuming, for example, that two 115 kV lines are equivalent to one 230 kV line. The power grid is a network system of parallel 500 kV, 230 kV and 115 kV lines. In many cases, the lower voltage system cannot replace the need for higher voltage transmission lines.

The 500 kV transmission system in the Northwest is primarily owned and operated by The Bonneville Power Administration (BPA). Puget Power is a co-owner of 500 kV transmission in Montana and is negotiating ownership rights on the 500 kV Third AC Intertie to California. The primary bulk power transmission voltage used by Puget Power is 230 kV. The 230 kV transmission system is utilized primarily to distribute the power from the 500 kV transmission system to the load centers. Some generation facilities are integrated into the system at 230 kV. The 230 kV system is also used to back up the 500 kV system during maintenance or forced outage conditions. The 230 kV transmission substations, located in the load centers, are used to distribute the power to the 115 kV subtransmission system that supplies local neighborhood substations.

An adequate 230 kV transmission system is needed in order to provide reliable service. Because the 230 kV system supplies significant quantities of power, its design is such that during an outage for maintenance or the forced outage of a facility, no customer should be out of service.

A 230 kV system can also provide greater efficiencies in operation. In many cases, power could be distributed at 115 kV, but the overall system losses would be much higher, requiring additional generating facilities to deliver the same amount of power. Using 230 kV for both transmission and subtransmission, fewer lines would be needed, but the cost of a 230 kV line is not twice the cost of a 115 kV line. Thus the net result of using a higher voltage system is reduced construction costs, reduced losses and fewer facilities.

In the 1920's, when Puget Power moved from local generation to remote generation, the losses in the system were 23 percent of generation. Today, with six times the peak, hundreds of thousands of additional customers, many more uses of electricity, and hundreds of miles of additional transmission, the system losses have been reduced to 7 percent of generation. This is due to higher voltages, the use of larger conductors, technology of interconnections and the networking of transmission systems.

Transmission Initiative

Puget Power has established a corporate goal to obtain long-term transmission access to existing and new power markets, and other utility systems. This goal recognizes the importance of transmission in the energy marketplace. Puget Power can take advantage of this market and other utility transmission systems by interconnecting with its neighbors' systems and expanding its own system.

In order to accomplish this goal, a 230 kV system will have to be built from the Canadian border to the southern part of Thurston County and from the Columbia River to Kitsap County. This future system is illustrated in Figure 1. The new transmission system will consist of at least two circuits in most areas in order to provide the necessary reliability and transfer capability. Figure 2 shows the number of miles of new and rebuilt 230 kV lines that are planned for the next 10 to 15 years. If Puget Power builds as planned, it will double the miles of 230 kV transmission. Because much of this is rebuild, the total mileage of 115 kV transmission will be reduced.

Puget Power has recently negotiated power contracts with other utilities. When the resource is outside the area served by Puget Power, it is necessary to negotiate access to other utilities' transmission systems. This is the situation with the 300 MW exchange contract with Pacific Gas & Electric (PG&E), a California utility. Puget Power has been negotiating with BPA to gain access to the 3rd 500 kV AC Pacific Intertie for the seasonal transfer of power between Puget Power and PG&E.

BPA is proposing to rebuild its existing single-circuit 230 kV line between Custer Substation and Sedro Woolley to double-circuit on the existing right-of-way. To allow for future long-term transmission needs and to optimize the use of the existing corridor, consideration may be given to constructing the 230 kV double-circuit line to 500 kV standards instead, and operating it at 230 kV. Puget Power proposes to install a 230-115 kV transformer at BPA's Bellingham Substation and rebuild two 115 kV lines from its Bellingham Substation to BPA's Bellingham Substation.

Recently, contracts have been negotiated for new cogeneration projects. The contracts with the March Point and Encogen projects allow Puget Power to purchase power within the area it serves from Independent Power Producers (IPP). Transmission facilities are needed to integrate these generation sources into the electrical system.

Transmission to Serve Load

Bulk power 500 kV transmission lines have the ability to deliver power from remote generation sites to the population centers. This large quantity of power is then distributed to the load centers. This is accomplished by using 230 kV and 115 kV transmission systems. Figure 4 illustrates the typical transmission and distribution system.

At the 500 kV substation, the power is transformed to 230 kV and transmitted to the load centers. Typical existing load centers are located in the Bellingham area, the Sedro Woolley/Anacortes area, the Bellevue/Redmond area, the Renton area, the Kent Valley, the Puyallup/Sumner area, the Olympia area, and the Bremerton/Silverdale area. All these load center areas have existing 230 kV transmission substations and lines serving residential, commercial and industrial customers.

At the 230 kV substations, the power is transformed to 115 kV. The 115 kV subtransmission system delivers power to the neighborhood substations. In the urban areas, the distribution substations can serve an area of approximately one-mile radius from the substation. Typically the distribution substations served by 115 kV subtransmission lines in urban areas are approximately two miles apart. An average substation, with a transformer capacity of 25 MW (25,000 kW), serves 2,500-3,000 customers.

The load density is usually about 5 to 8 MW per square mile. In highly commercial areas such as Southcenter, Federal Way or Bellevue, the load density can be 15 to 30 MW per square mile. These commercial areas require additional distribution substations. Larger industrial developments may be served by a dedicated distribution substation. Some examples of these developments are ARCO, Texaco, Shell and Boeing.

Planning & Building For Tomorrow

Utilities face many challenges today. One challenge is planning and constructing facilities for future growth. This is not unique to the electrical utility industry but is an issue also dealt with by water, sewer, storm water, transportation and telecommunication utilities.

Importance of Planning

When planning how best to serve customers, the main concerns are what facilities should be constructed, their location and cost. The facilities required to serve existing customers can be explained and justified. When considering the energy needs of future customers, a number of factors must be considered. For example, a city or county government that wants to build a new water line will take into account the following:

- Capacity to permit future growth
- Optimal location
- Useful life
- Incremental cost of adding capacity

The water line will be constructed in the best location to serve both the existing and future customers. The facilities being installed have a 40-to 50-year useful life. Because these facilities will be used for such a significant period of time, it is even more important that the future be considered. The incremental cost to provide adequate capacity at the optimum location is relatively small compared to the total cost of the project. This will usually result in minimizing the environmental, social and cost effects.

Constructing a facility large enough to take care of future customers results in lowering the cost per customer. Although the initial cost will be high, the total future cost will be relatively low, minimizing the cost of service to all customers. In addition, good planning provides for the flexibility needed to deal with future uncertainties, such as environmental concerns which have surfaced in recent years.

Planning the Electrical System

The construction of new facilities to serve load is based on needs. When the existing facilities are old and not adequate to provide the planned level of service to customers, they must be replaced. Otherwise, some customers cannot be served during certain conditions when equipment is out of service. All utilities adopt standards for level of service and refer to them as "Reliability Guidelines". New facilities are justified based on:

- Maintenance
- Equipment failures
- Reliability of service
- Overloaded facilities

Before new facilities are constructed, their location and additional capability must be considered to provide for future growth.

The system planner will consider:

- Potential location of growth
- Current and future load densities
- Growth rates
- Technological advances
- Zoning
- Environmental effects

Also, the incremental cost of providing for future customers will be evaluated. There is a need for new facilities to maintain reliable service to existing customers as well as to provide capacity for future customers.

A number of factors must be considered in assessing the potential benefits by planning and building for tomorrow. The proposed transmission system should:

- Reduce environmental effects
- Reduce long-term costs
- Provide reliable service
- Increase system efficiency
- Avoid lost opportunities

The following is a review of the issues associated with serving future customers.

Reduce Environmental Effects

By constructing facilities for the future, environmental effects can be reduced. If facilities are built before the area is densely urbanized, more options will be available to locate the facilities in less environmentally sensitive areas. Also, if facilities are built in the current and future load centers, it will not be necessary to later add facilities; thus decreasing the total number of facilities needed. In addition, by having the optimal transmission facilities in place, the counties, cities and developers can site new development so that the effects of the facilities can be minimized.

Reduce Long-Term Costs

Costs can be minimized by constructing facilities prior to significant growth in a given area. First, the cost of the easements and right-of-ways will be less because land values will be lower in less densely populated areas. Second, when more options exist to site the facilities as close as possible to the future load centers, fewer facilities are needed. Third, fewer environmental and social effects will reduce permitting time and costs.

Provide Reliable Service

One of the key factors in assuring reliability of service is to provide alternate electrical sources, such as transmission substations which consist of several transmission line terminals. When urbanization occurs, it becomes more difficult to site additional transmission facilities and therefore provide the alternate sources. When these electrical sources are far apart, or distance increases between the load and the electrical source, more outages will occur, causing a reduction in the level of service. In extreme cases, where additional electrical facilities cannot be constructed, increased numbers and length of outages result.

Increase System Efficiency

In planning the electrical system, every attempt is made to reduce system losses. If the optimal facilities cannot be constructed, less efficient facilities will take their place, resulting in greater system losses, earlier replacement, and higher cost. Additional generating facilities are required to meet the system losses.

Avoid Lost Opportunities

When urbanization occurs, it becomes more difficult to construct new electrical facilities. Fewer alternate sites and routes are available. In some cases, the environmental and social effects preclude construction of electrical facilities. In other situations, the costs of the various options become prohibitive. These factors result in lost opportunities to provide a reliable, low-cost transmission system. It is in the best interest of Puget Power's customers to construct facilities with the capacity to meet tomorrow's load growth, using the most effective technology available for the highest system efficiency.

Transmission & Distribution (T&D) Reliability

The term "reliability" has been used to describe the ability of utility systems to provide service with minimum interruptions. Puget Power customers' definition of reliability varies based on their requirements for power. Customer needs and expectations are changing and are significantly different from those of customers 25 years ago. During this period, electronics equipment has become commonplace in homes and businesses. This equipment is susceptible to quality of power.

Power Quality

Many customers are now interested in power quality. This includes interruptions and other power variations that affect electronic equipment. The factors affecting power quality are:

- Long-term interruptions
- Momentary interruptions
- Voltage transients
- Stray voltages
- Harmonics

Long-term power outages have always created problems. Momentary outages 25 years ago were more of an annoyance than a problem; but today, computer systems stop working, VCR's will not record favorite programs and electronic clocks must be reset. Lifestyles are now suddenly affected.

Voltage transients have always existed on the power system. Transients can cause computer operating systems to malfunction, motors to drop out of service and other electronic equipment to malfunction. These transients can be created by normal switching of the power system, an outage on another part of the electrical system or a neighboring customer's equipment.

Stray voltages can cause similar operating problems for electronic equipment. Stray voltage is usually the result of improper grounding of the utility's or customer's electrical system. A classic example occurred with the company's dairy farm customers. With an improperly grounded system, the cows would receive an electrical shock when they were connected to the milking machines. This would cause milking problems and reduce overall milk production. This problem can be solved by balancing the power on the distribution system or by installing new equipment (neutral isolators) to provide proper grounding.

Harmonics is another problem that a few customers have experienced. Harmonics result when the level of frequency in which the company generates power is disturbed by the alternating currents of certain electronic equipment used by Puget Power customers. Special filters can be added to the customer's system to minimize harmonics problems.

At a customer's request, Puget Power will work with the customer to solve power quality problems. Customer service engineers have been trained and have test equipment to monitor the customer's power quality.

Reliability Planning Guidelines

Each utility has adopted reliability planning guidelines to assure an adequate level of service. These guidelines are tailored to minimize the number of interruptions a customer would experience. The Western Systems Coordinating Council (WSCC) has adopted reliability guidelines for generation and the bulk power transmission system. The WSCC is a cooperative group of utilities in the Western United States and a member of the North American Electric Reliability Council (NERC). Puget Power has developed additional guidelines which are consistent with the WSCC guidelines. These guidelines are used as evaluation criteria to determine when the electric system should be reinforced.

Puget Power's guidelines are published and updated on a regular basis. The guidelines establish:

- Allowable equipment loading
- System design requirements
- System operating voltages
- System protection requirements

Examples of the reliability guidelines are:

Transmission

- Loss of one 230 kV transmission line should not cause loss of service to customers.
- Loss of one transmission substation transformer, 230-115 kV, 115-66 kV, or 115-55 kV should not cause loss of service to customers.
- Outage of one 115 kV transmission line with two or more substations should interrupt service to customers only until transfer to an alternate source is accomplished.

Distribution

- In urban areas, loss of a distribution substation transformer serving essentially residential, small commercial and small load should cause an interruption only until load is transferred to adjacent substations.
- Loss of a distribution feeder will cause interruption of service until the load is transferred, the faulted section is isolated, or the feeder is repaired.

The planning guidelines are used to evaluate the performance of the existing and planned electrical system. The goal is to achieve the desired level of system reliability. The proposed Transmission & Distribution long-range construction plan is based on maintaining these levels of service.

Reliability Indices

The majority of the interruptions that affect utility customers are caused by outages on the distribution system. The following national statistics indicate the percentage of failures for different systems:

Distribution system	85%
Substations	9%
Transmission	4%
Generation	2%

The three leading causes of distribution system outages on the Puget Power system are trees and limbs (by far the leading cause), equipment failure and third-party contacts. Third-party contacts are situations such as underground cable digups and car/pole accidents.

Puget Power monitors and maintains records of interruption incidents and logs information such as location, timing, probable cause and duration. A number of reliability indices have been used to track reliability. Puget Power uses System Average Interruption Duration Index (SAIDI). This is the average number of outage minutes that the average customer will experience during the year. The index is calculated by dividing the total number of customer outage minutes by the total number of customers on the electrical system.

By monitoring the reliability indices on individual circuits, poorly performing circuits can be identified and component upgrades and design changes can be evaluated.

Improving Reliability

The reliability monitoring information is used to design programs to reduce customer outages. The three main areas monitored are outages caused by:

- Trees
- Storms
- Equipment failure

A number of programs have been initiated to reduce customer outages. The following is a brief description of some of the programs.

Vegetation Control

Vegetation control has a significant affect on the level of reliability. Puget Power is in the fifth year of a six-year program to control vegetation. The future plans are to trim the trees on a six-year cycle to reduce tree and limb caused outages.

Maintenance

Poles and underground cables are given special maintenance attention in the distribution system. A pole inspection program determines whether poles need replacement, stubbing or treatment. Underground equipment is inspected with infrared (IR) devices to detect equipment hot spots which would indicate equipment in the failure mode. This information is used to identify and replace the defective equipment.

Underground Cable

Puget Power, like all utilities with high molecular weight (HMW) cable, is experiencing increasing cable failures, resulting in customer outages. In 1990, approximately 1000 HMW cable failures occurred. Studies indicate that the failure rate will increase, causing additional customer outages. Figure 5 shows the increase in cable failures from 1989 to 1990. This trend is expected to continue. A program has been initiated to extend the cable life: 1) replace HMW cable, 2) inject silicon into HMW cable to extend the cable life, and 3) install surge arresters.

The company's focus is to increase reliability at the lowest cost. As a result, Puget Power is also looking at new methods of cable replacement such as wheel trenching and guided boring techniques.

Service Restoration

An important aspect of customer service is how quickly service can be restored following an outage. Puget Power is developing a "Service Order Tracking System" which will aid the service centers in identifying the location and probable cause of an outage.

Future Transmission Issues

The construction of new transmission facilities and the use of the existing transmission network have become national issues. It is increasingly more difficult to build new or rebuild existing transmission lines. Utility and non-utility parties are trying to gain access to the existing transmission network. The transmission system is not keeping pace with the demand for electrical energy. These and other issues, are in dispute and must be dealt with in the 1990s.

Following are four major issues which Puget Power must currently address:

- Access to other utility systems
- Aesthetics and environmental concerns
- EMF health concerns
- Keeping pace with growth

Access To Other Utility Systems

Puget Power has purchased power from other parties outside the area it serves and needs the flexibility to do this in the future. In order for power to be delivered to Puget Power's system, other utility transmission systems must be utilized and a contract must be negotiated for those services. In other states, cogenerators and independent power producers are trying to gain access to utility transmission systems to deliver power to prospective customers. These parties could also request the use of Puget Power's transmission system.

Aesthetics & Environmental Concerns

The continuous growth in the Puget Sound basin requires the continuous expansion of the transmission system. The aesthetics and environmental effects of transmission expansion are being scrutinized. Concern has been raised over the impact on forest and wetland areas. In some cases, people feel that by stalling or stopping the construction of roads, utilities, schools, etc., growth can be slowed or stopped. Before obtaining permits for a transmission project, these concerns must be addressed.

Electromagnetic Fields Health Concerns

Much controversy and publicity surrounds the potential health effects of extremely low frequency electromagnetic fields (EMF). Even though most experts feel that studies have not proven EMF causes cancer, many people are concerned. The researchers, equipment and appliance manufacturers, utilities and the public agree that the studies should be continued. Puget Power is supporting research through its membership in the Electric Power Research Institute. The EMF issue continues to be raised during the permitting period for transmission projects and has become a delaying factor.

Keeping Pace With Growth

If power demand continues to grow, the existing system will soon be inadequate. Puget Power's aggressive conservation programs have reduced and will continue to reduce energy needs. Even with these programs, peak growth has been approximately 100 MW per year over the last decade. Additional facilities and improvements will need to be constructed to continue to provide reliable service to customers.

At some peak winter load levels, it will be difficult to maintain service to customers. Extremely heavy winter loading can result in voltage instability. The voltage stability problem continues to be studied by Puget Power, Snohomish PUD, Seattle City Light, Tacoma City Light and BPA. A region-wide voltage instability study resulted in the Puget Sound Electric Reliability Plan (see Appendix B for details). This plan provides alternative strategies for meeting peak loads, as well as restoring voltage stability to the Puget Sound area transmission system.

The preferred strategy developed in this plan recommends the use of conservation and voltage support to meet extreme peak loads through the year 2003. Under extremely heavy winter load conditions and with the loss of a cross-Cascade 500 kV transmission line, customer loads would likely be interrupted in the Puget Sound Basin. Other areas of the country, notably Washington D.C., Texas, and Florida, experienced rolling blackouts in 1990 due to similar problems.

The utilities mentioned above have implemented remedial plans to avoid or minimize such an occurrence in the Puget Sound basin. The results of their studies will provide both near-term and long-range solutions to this problem. The issues addressed above increase the difficulty of maintaining adequate reliability and providing for future growth. The challenge of the 1990's will be to work with customers, interest groups and governmental bodies to achieve approval to build new and rebuild existing transmission lines.

EXHIBIT A

Proposed Transmission Line Projects

BPA/Puget Power Northwest Transmission Project

This project includes BPA replacing a single circuit line with a double circuit 230 kV line from their Custer substation to their Bellingham substation in Whatcom County, and from their Bellingham substation to Puget Power's Sedro Woolley substation in Skagit County. Puget Power will then rebuild an existing 115 kV double circuit transmission line from BPA/Bellingham to Puget/Bellingham substations, approximately 3.6 miles, to high capacity circuits at 115 kV.

This project is required to reinforce the transmission system in Whatcom County and provide better voltage control at Sedro Woolley and March Point substations. It will also provide Puget Power with the opportunity to purchase power from B.C. Hydro (See Figure 3). The project Plan of Service must now go through environmental review processes; if no delays are encountered in those reviews, the project is scheduled for completion in mid-1996.

Third AC Intertie and California/Oregon Transmission Project

There is substantial support from regional utilities for the construction of an additional 500 kV AC line for the Pacific AC Intertie. These utilities recognize the advantage of further utilizing the seasonal load diversity between the Pacific Northwest and the Pacific Southwest. The BPA has been the lead in coordinating this effort.

The facilities required for this additional line to California are divided into two major projects. The first project, called the Third AC Intertie, is comprised of facilities located in Oregon. Facilities for the second project, which has been named the California/Oregon Transmission Project, will be located in Northern California. This proposed line stretches over 380 miles from the California/Oregon border to the Tracy substation termination point (south of San Francisco. The projects will connect to each other and the present facilities of the Pacific AC Intertie at a new substation called Captain Jack, which is located near the southern Oregon border. Both of the new construction projects are required to upgrade the power transfer capacity of the Pacific AC Intertie from its present 3200 MW rating to a 4800 MW rating. All of the system and design engineering studies have been completed, equipment is being ordered and construction has started in several locations. Construction is expected to be completed in November, 1993.

BPA is in the process of conducting an Environmental Impact Statement. During this process it will be determined whether non-Federal participation will be allowed in a 725 MW share of the Third AC Intertie. As part of this process, the BPA solicited the region's utilities and received requests for 1070 MW at an offering price of $215,000/MW. Puget Power has committed to a 400 MW share if non-Federal ownership is offered under the BPA's current definition of such a share.

Sedro-March Point 230 kV Line

Puget Power is constructing a 24-mile 230 kV line from Sedro Woolley substation to the March Point substation. This line, along with a 230-115 kV transformer at March Point, will alleviate under-voltage conditions at Whidbey Island and improve service.

Sedro-Beverly 230 kV Line

This proposal is to construct a second 230 kV line, approximately 44 miles in length, on existing right-of-way, from Sedro Woolley substation to Beverly Park substation in Snohomish County.

This line is needed to reinforce the existing system so that power from new generating facilities can be transported to the load centers in King County.

Talbot-Berrydale 230 kV Line

This project is to construct an 8.1-mile double circuit 230 kV line on existing right-of-way from Talbot Hill substation in Renton to Berrydale substation east of Kent and install a 230-115 kV transformer at Berrydale. The 230 kV system expansion is necessary to serve the increasing load caused by growth in South King County. (See Figure 6)

Intermountain Power line (IP) 230 kV Line

This project is to rebuild 125 miles of the IP line from 115 kV to 230 kV (initial operation will be at 115 kV from the Wanapum Dam on the Columbia River to Lake Tradition substation in Issaquah. The original line was built in the 1916-1919 time period and many of the original poles have not been replaced. This line will bring power from the generating sources on the Columbia River to the load centers in Western Washington. (See Figure 7)

Novelty Hill-Newaukum 230 kV Line

This project is to construct a 40 mile 230 kV line on new right-of-way from the future Novelty Hill substation to the proposed Newaukum substation. This future 230 kV line will help serve the growing East King County area and enable Puget Power to transfer power north to south in King County. (See Figure 8)

Christopher-O'Brien 230 kV Line

This project would construct a second 230 kV line on existing double circuit steel poles between Christopher and O'Brien substations. The line will temporarily tap the BPA Covington-Tacoma 230 kV line at Christopher. This line will permit more power to be transferred north to O'Brien to serve the Kent/Auburn Valley.

Novelty Hill-Berrydale 230 kV Line

This project is to construct a 35-mile 230 kV line between the Novelty Hill and Berrydale substations. The long-range plans show that more transmission lines and substations are required in the eastern areas of King County to serve the growing loads.

Tacoma City Light Agreement

This project is to rebuild a total of about 40 miles of 115 kV line to 230 kV from White River substation to Tacoma City Light's (TCL) Cowlitz substation and from TCL's Southwest substation to Puget Power's St. Clair substation in Thurston County. Also, Puget Power would jointly build with TCL a 230 kV line 18-miles-long from Southwest substation to a new Henderson substation located about 1.1 miles west of the town of Purdy. A future 230 kV line is planned from Purdy north to the Bremerton/Silverdale area.

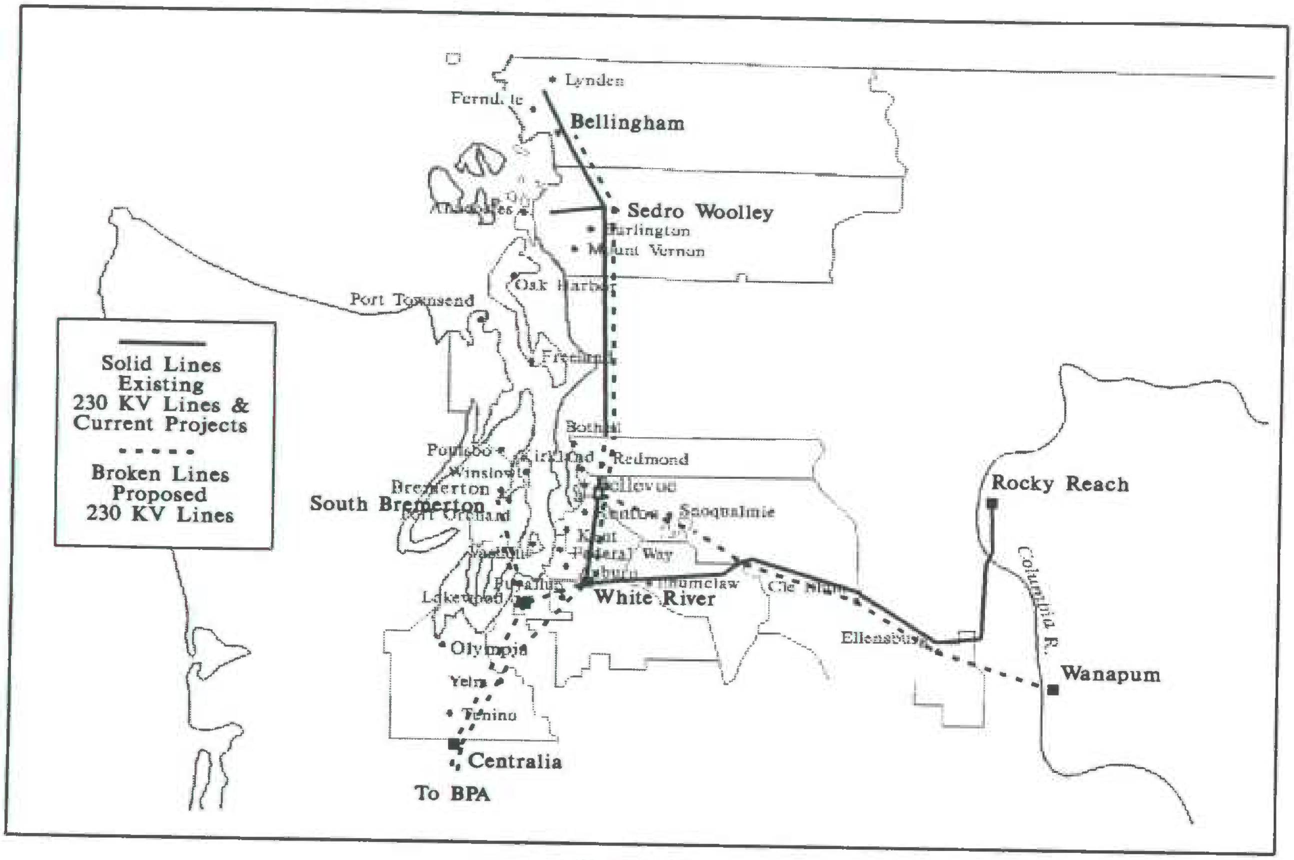
This joint project will benefit both utilities. TCL will rebuild their deteriorated Potlatch lines and the Narrows Crossing, and Puget Power will gain a new power source to Kitsap County, thereby preventing overload on the old 115 kV cross-sound submarine cable. (see Figure 9)

White River-Christopher 230 kV Line

This project is to construct a double circuit steel pole line, approximately eight miles in length, from White River substation to Christopher substation. Only one circuit will be installed initially. Also, a second White River-O'Brien 230 kV line will be constructed by rebuilding approximately 13 miles of the White River Light and Power Line to 230 kV operation. This will permit the transfer of additional power to the growing Pierce County and South King County areas.

Henderson-South Bremerton 230 kV Line

This project is to construct a 15-mile 230 kV line from Henderson substation to South Bremerton substation. The line will complete the interconnection with Tacoma City Light, bringing additional capacity to Kitsap County. It will improve reliability and help prevent the overload of the 115 kV cross-sound submarine cables serving Kitsap County.



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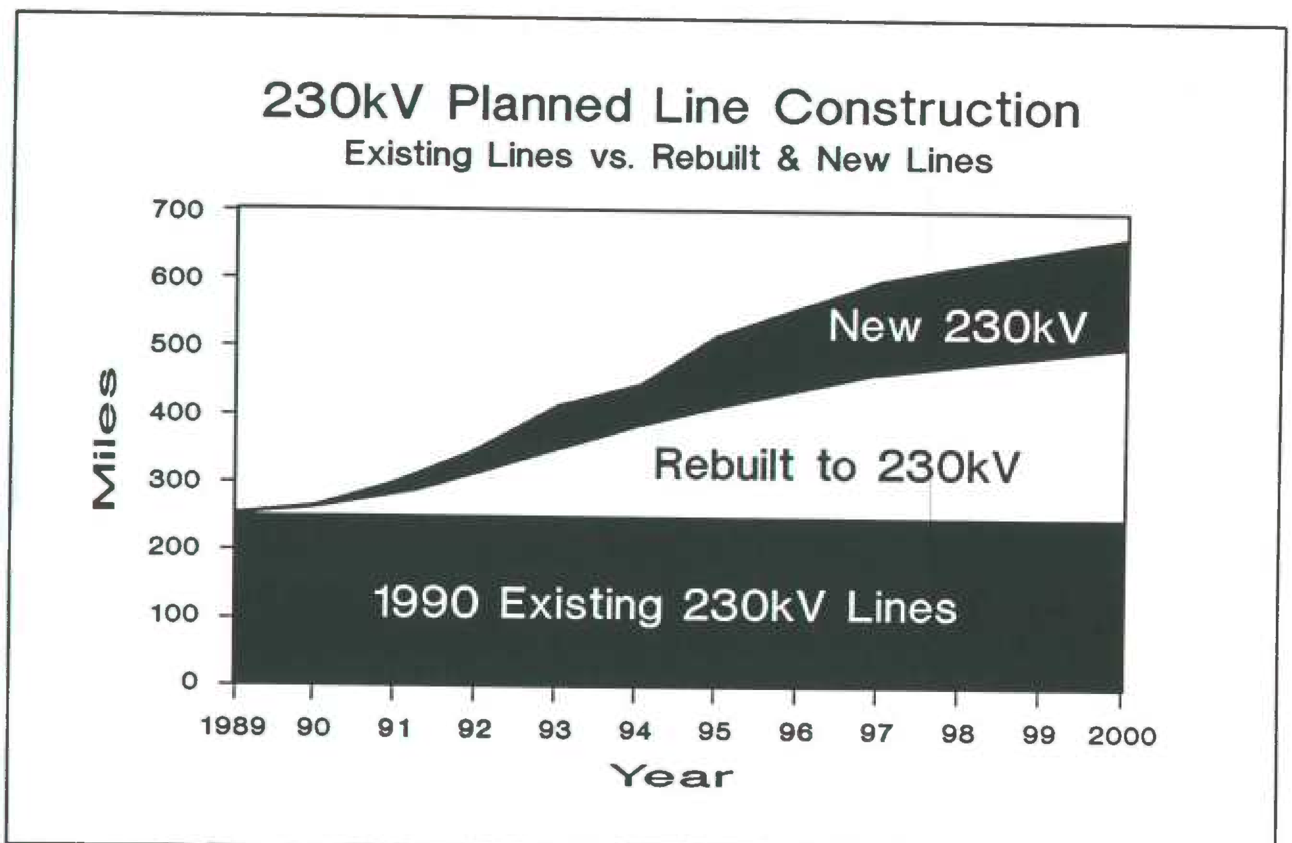

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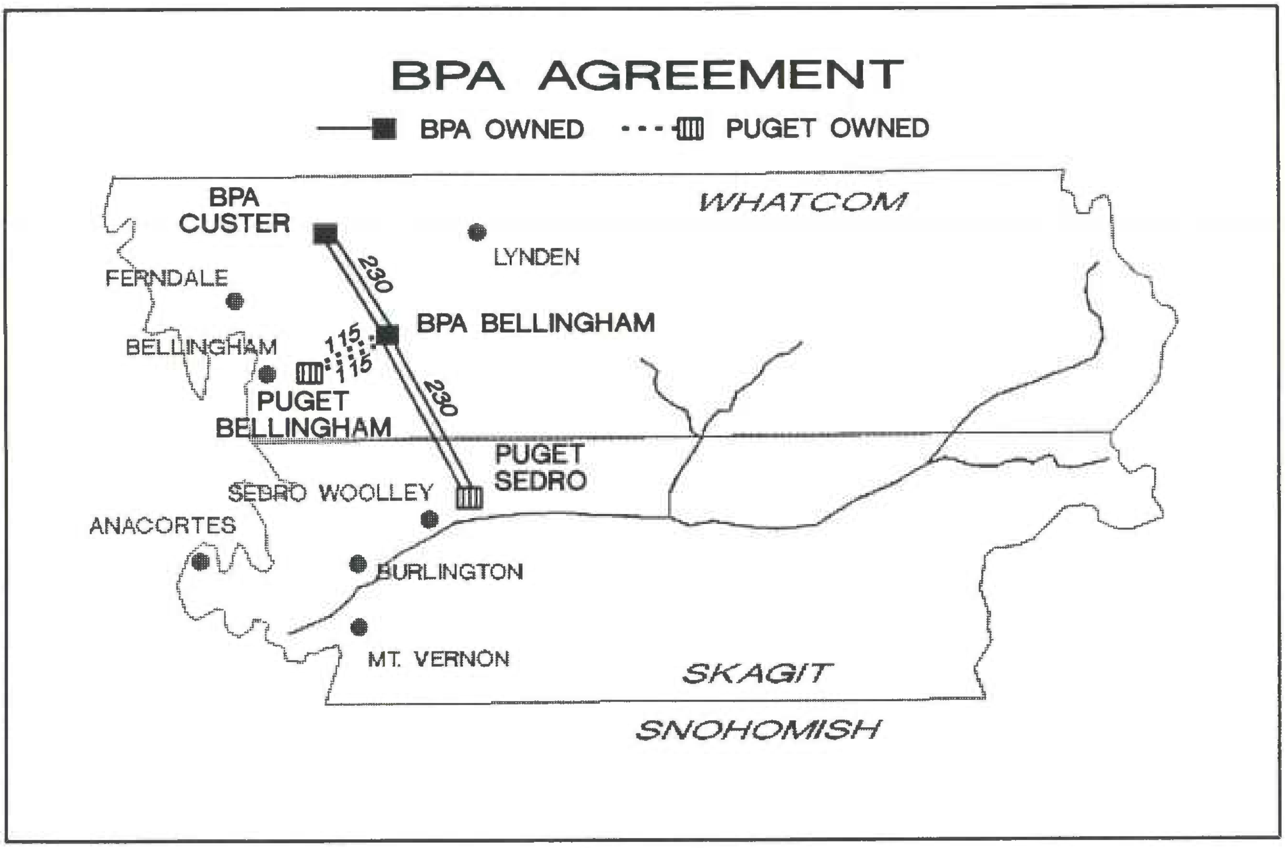

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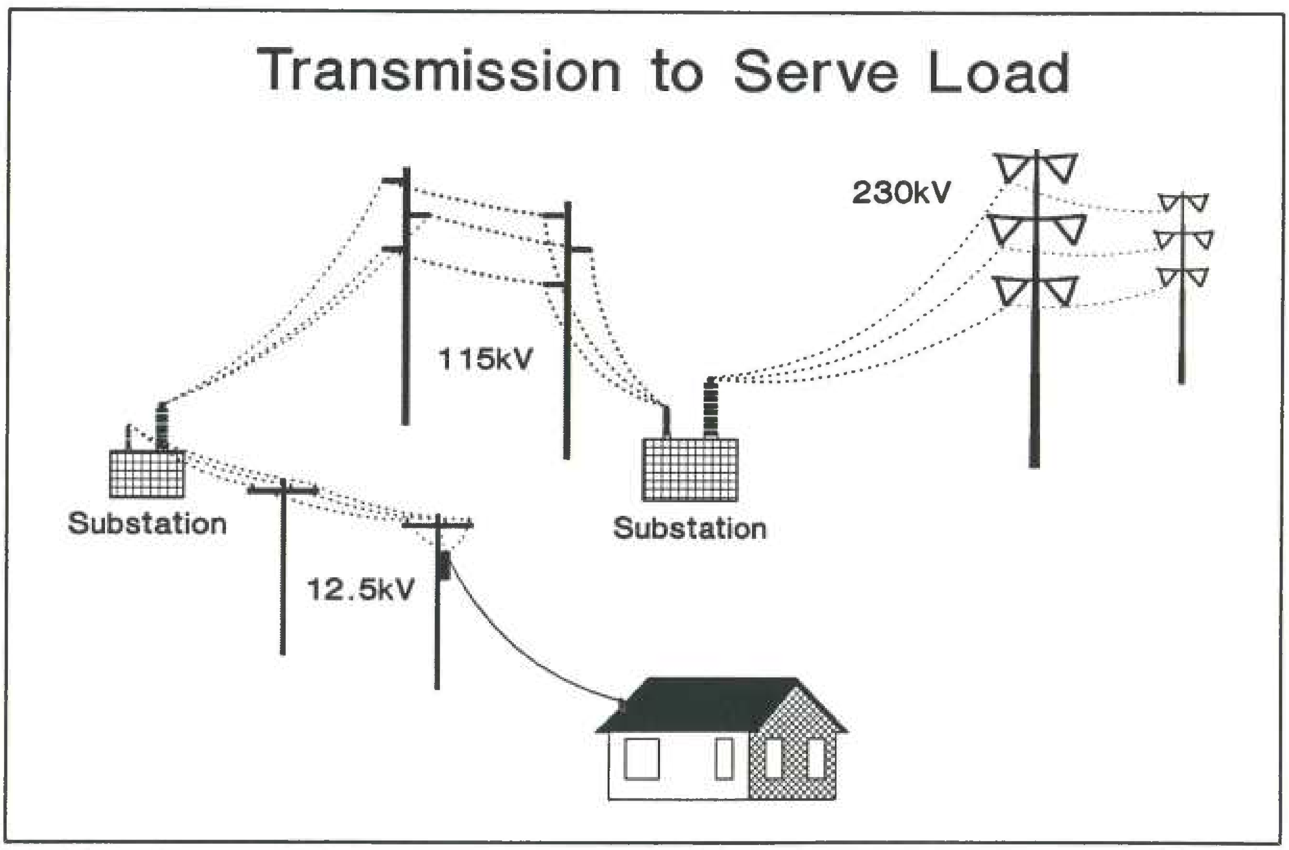


Figure 4.

Mission

Puget Power's Integrated Resource Plan calls for the company to acquire conservation, small hydro and purchased power and strengthen the transmission system and transmission links to other systems. Puget Power is pursuing this plan. The above resources may not be sufficient to meet the growing demands of Puget Power's customers. What other options would the Panel recommend that Puget Power pursue and what criteria should the company use to evaluate these options?

Background

The purpose of integrated resource planning is to develop a long-term strategy for providing reliable and reasonable-cost electricity over a wide range of possible futures. To accomplish this goal, the integrated resource plan must be flexible enough to deal with uncertainties and include specific actions to assure reliable service for customers now and in the future.

Puget Power began developing integrated energy resource plans in early 1986 to revise the company's resource planning approach in response to a changing business environment. The Washington Utilities and Transportation Commission (WUTC) guidelines require private utilities in Washington State to prepare an integrated energy resource plan every two years. Puget Power's first integrated resource plan was completed in 1987 titled, *Securing Future Opportunities, The Demand and Resource Evaluation Project*. The second integrated resource plan was completed in 1989 titled *Securing Future Opportunities 1990-1991*. Puget Power is now in its third cycle of integrated resource planning which is anticipated to be completed first quarter 1992.

Puget Power has made significant progress in attaining the objectives of the Integrated Resource Plans. During 1988 and 1989, these achievements have resulted in the acquisition of over 400 average megawatts (aMW) of power which now provides more than 10% of the current annual customer load. As part of this effort, the company has maintained an aggressive conservation program which has resulted in about 12 aMW of energy savings for 1988 and 1989. Also during 1989, Puget Power began a pilot competitive bidding process. Initially, Puget Power sought approximately 100 aMW of new resources which are expected to come on-line in mid-1993. Since there was a need for additional power, a total of 167 aMW was actually selected.

In the past two cycles of integrated resource planning, Puget Power has received strong support from Consumer Panels for conservation, small hydro, purchased power and transmission. The company's 1989 Integrated Resource Plan reflects these priorities and, as stated above, Puget Power is taking actions to acquire these resources.

Issues

For supply resources, should the company rely heavily on purchases from others? Should it construct generation resources of its own to meet some of the future requirements? If the company considers constructing and operating its own generation resources, what sources of energy (e.g., coal, natural gas, geothermal, etc.) should it consider? What other demand-side options should be considered? For example, one utility in this state charges a different hook-up fee for manufactured housing (e.g., modular homes, mobile homes, etc.). If the home is below Model Conservation Standards (MCS), the fee is about $2,000; if it is at the MCS, the owner receives an incentive payment. Another utility is encouraging its space and water heating customers to convert those loads to natural gas from electricity. Are there similar or other demand-side actions that would be appropriate for Puget Power and its customers?

Work with lighting manufactures and retailers to expand compact fluorescent light bulb shapes, sizes and wattage options.

Institute a simplified and streamlined program of door-to-door neighborhood-to-neighborhood conservation/weatherization measures.

Initiate a multi-phase load leveling program.

Provide a duplicate easy-to-read meter for use inside customers' homes to enable them to monitor their power use.

Create a credit card system (the Puget Card) for customers' use to purchase high efficiency appliances, materials, supplies, etc.

Work with other utilities to prepare educational programs and advertisements for the public to educate them on: 1) conservation, 2) renewable resources and 3) resources of high fuel conversion efficiency.

Create an annual "Award for Excellence Design" for energy efficient, cost-effective and environmentally sensitive buildings.

Propose time-of-day rates to WUTC at next rate case hearing.

Develop a customer information program to clearly explain how the new decoupling rate mechanism operates and how it will affect customers.

In response to the NOI, propose an incentive scheme in which the company is given a 30% bonus over its allowed rate of return for all measurable conservation achieved beyond its forecast. Propose inverted tail blocks rates for commercial and industrial customers.

Accelerate site selection, equipment testing and all other technical actions necessary to acquire the maximum possible least-cost supplemental resources from renewable resources, especially solar and wind.

Encourage development of on-site and community system electric power generation and storage systems.

Modify resource acquisition policies and procedures to fully develop all: 1) effective conservation strategies, 2) renewable resources, 3) high efficiency thermal, and 4) (last resort) traditional thermal generation.

After fully utilizing conservation, build renewable resource capacity especially small scale wind, hydro and solar electric.

Whidbey Island Consumer Panel

Continue to develop conservation programs.

Develop a method to gather and analyze energy efficiency data to identify inefficient buildings.

More aggressive effort to secure energy savings in new construction.

Form customer committees to explore all options for electrical power generation and communicate the findings and recommendations.

Keep pursuing rate schedules that rely on conservation and reducing power generating costs.

Communicate more clearly between electric and energy code and other energy and building codes.

Invest in electrical power utilities that have surplus generating capacity. Emphasis on acquiring major position in those ongoing commitments to alternate power generating sources (other than fossil fuel, hydro or nuclear).

Actively and continuously publicize advantages and the need for residential conservation.

Investigate pros and cons of subsidizing solar heat panels in water heaters.

Explore and develop additional generating sources.

Place more emphasis on power generation and less on purchased power.

Pursue negotiation with industry and private suppliers to develop cost-effective generation projects.

Explore and develop cost-effective hydro electric power generating sources. Inform and educate present and future Puget Power customers on need for power.

Take a lead in solving regional energy issues with NWPPC and the BPA.

Plan and license generation facilities in advance. Join interested and affected parties to seek any needed changes in state or federal laws or regulations.

Take the initiative in establishing a cooperative working relationship with environmental and conservation groups.

Mount a concerted effort to equip all residences and public facilities with low flow showerheads.

Develop a customer information program to clearly explain how the new decoupling rate mechanism operates and how it will affect customers.
Adopt a schedule of varying hook up fees dependent on conservation standards being met by the customer.

Whatcom County Consumer Panel

Redefine the goal of integrated resource planning to include a mix of resources and their costs on a long-term basis.

Delay generation acquisitions until external costs are incorporated into the integrated resource planning process.

Include in the integrated resource process, the expected costs of litigation over actual or perceived loss of property values, safety and health issues from EMF.

Establish a separate conservation department with top level status within the company solely dedicated to all aspects of the conservation program.

Fund conservation programs to avoid the cost of acquiring new thermal generation.

Develop a comprehensive program of rapid rebate for purchase of energy conservation measures and devices effected via coupons.

Require upgrade to model conservation standards when a home is sold or being constructed as a condition of service. Surcharge customers who refuse.

Request that all local building jurisdictions include a checklist of Puget Power's conservation incentive programs as a part of the building permit process.

Drastically expand (through direct selling efforts) conservation savings.

Develop a plan to encourage voluntary load curtailment as a resource during peak loads. Invest in an ongoing program of public education about energy issues.

Pursue a much more balanced portfolio of generating resources.

Undertake more acquisitions of self-owned resources.

Pursue rates that encourage conservation.

Adopt a rolling baseline rate structure for commercial/ industrial customers to encourage energy conservation.

Initiate specific conservation programs with rebate incentives for residential customers, i.e. fluorescent light fixtures and large and small appliances.

Initiate a multimedia publicity campaign to promote energy conservation, educate the public as to the benefits of conservation and publicize current Puget Power conservation programs.

Revamp the home energy audit program.

Establish Puget Power as a leader in electrical energy conservation in the Northwest.

South King County Consumer Panel

Develop a partnership with the commercial and industrial sectors to: identify opportunities for conservation, bring in latest technology and demonstrate economic advantages to conserve or make improvements in operation.

Lead a major study to find an economical method for utilizing thermal storage capacity of hot water heaters for peak load shifting and smoothing.

Quantify environmental costs into the integrated resource plan.

In concert with Washington Natural Gas, develop plans to encourage builders and developers of multi-family construction to install gas.

Implement an aggressive program to complete conservation measures for single family residences.

Participate in an evaluation of a monitoring and diagnostic program for maintenance of power producing facilities.

Thurston County Consumer Panel

Adopt a graduated rate structure for commercial and industrial customers to encourage conservation.

Institute a load shaping program by installing, on select residential and commercial accounts, centrally controlled "black boxes." A rate incentive plan should be offered to those participants.

Expand interruptible rate schedule (43 & 46).

Organize and participate in a consortium of public and private utilities to construct and operate intrastate and interstate transmission and switching facilities.

EXHIBIT A

1991 Integrated Resource Plan Consumer Panels Recommendations

Table 1 displays the recommendations tabulated by area of emphasis, followed by a summarized list of recommendations received from the 1991 Integrated Resource Plan Consumer Panels. The recommendations have been grouped by panel.

Table 1

Summary Tabulation of 1991 Consumer Panel Integrated Resource Plan Recommendations

Major Theme	Number of Recommendations
Conservation	21
Generation Resources	11
Alternative Generation Resources	10
Rates	10
Communication	9
Policy and Planning	8
Load Shifting	4
Rebates	3
Total	76

Kitsap-Jefferson Consumer Panel

On communication endeavors, define profit making in the context of how to best "align the purist of profits with least- cost planning".

Increase emphasis on implementing efficiency improvements in generation, transmission and distribution facilities.

Achieve consistency in establishing integrated Resource Plan criteria for ranking of resources.

Kittitas Consumer Panel

Expand commercial and industrial conservation programs.

Increase emphasis on implementing efficiency improvements in generation, transmission and distribution facilities.

Take an aggressive approach with other Northwest electric utilities to inform/educate the public about increasing power needs. Include environmental impacts and energy costs of electrical energy production sources.

Join with other Northwest electric power entities to begin planning the completion and activation of WPPSS plants 1 and 3.

Continue to pursue cogeneration resources through the competitive bidding process.

North King County Consumer Panel

Develop pilot wind generation installations.

Become the active leader in exploration, qualification and, if feasible, the construction of a geothermal generation pilot installation.

Implement a new innovative rate structure that offers financial incentives for conservation.

Implement a more aggressive program to encourage residential property owners (and rental property owners) to convert to other heating sources and/or weatherize to effect conservation.

Also included in Exhibit A is the mission statement, pertinent issues, suggested work plan, and fact-finding sources provided to the Consumer Panel members who reviewed the company's 1989 Integrated Resource Plan.

Technical Advisory Committee for Integrated Resource Planning

Another important source of input during Puget Power's 1990-1991 integrated resource planning process was the guidance and advice received from the Technical Advisory Committee (TAC). This committee consists of representatives of the Washington Utilities and Transportation Commission, Washington State Energy Office, Pacific Northwest Conservation Act Coalition, Attorney General's Office - Public Counsel Section and other regional energy experts. During the plan's development phase, nine meetings were held with this group which served as a sounding board on a variety of integrated resource planning and technical issues. Exhibit B provides a brief description of each integrated resource planning Technical Advisory Committee meeting.

RATE DESIGN COLLABORATIVE GROUP (RDCG)
A technical level committee formed to assist the company in the April 1992 rate design filing. The Group is composed of representatives of organizations that usually participate in the company's general rate cases, plus additional interested parties. It also included representatives from the Customer Rate Design Task Force (see below). The RDCG exchanged knowledge, theories and ideas regarding rate design, rate spread and cost of service. Additionally, this group endorsed several concepts which will be incorporated in the company's April 1992 filing.

CUSTOMER RATE DESIGN TASK FORCE (TASK FORCE)
This customer-represented group, comprised primarily of residential customers, was formed to help give the company a customer perspective on various rate related issues. These issues placed emphasis on rate design and rate spread which will be incorporated as the company prepares for the April 1992 rate design filing. The Task Force activity was coincident with the work of the RDCG, and the two groups shared and discussed viewpoints and findings. Participants included former Consumer Panel members as well as individuals who participated in Puget Power's public hearings process. The Task Force prepared a report which will used by the company in the preparation of the April 1992 filing and included in the related testimony.

Transmission and Distribution Citizen Advisory Committee:
This recent effort sought involvement of customers in the planning process for specific project proposals. The level of customer involvement depended on the specific project, and included public comments on such items as site selection criteria and alternatives as precursor to the permitting process.

Consumer Panels

Another primary area of public involvement stemmed from the company's award winning Consumer Panel program. The Consumer Panel 1991 Integrated Resource Plan mission was to address options that could be pursued by the company to meet growing customer demands. This activity began in January 1991 and resulted in 76 Consumer Panel recommendations in the areas of conservation, generation resources, alternative generation resources, rates, communication, policy and planning, load shifting, and rebates.

The Consumer Panels conducted several fact-finding exercises during the six months of recommendation development. The recommendations were then circulated throughout the communities for the purpose of obtaining feedback and consensus. During October and November 1991, the company's responses were presented to each Consumer Panel group with the final Consumer Panel document distributed in January 1992.

Additionally, Consumer Panels from years 1986 through 1991 were asked to provide input on a proposed incentive mechanism that would promote conservation, renewable resources,(e.g., hydro, wind, solar, geothermal) and high efficiency cogeneration. Another subgroup that developed from the company's Consumer Panel members was the Customer Rate Design Task Force. As noted earlier, the purpose of this task force was to work with the Rate Design Collaborative Group in the development of rate related recommendations.

Exhibit A displays the recommendations tabulated by areas of emphasis, followed by a summarized list of recommendations received from the 1991 Integrated Resource Plan Consumer Panels.

Public Involvement/ Collaborative Process

Public Involvement

Public involvement continues to be an integral part of the company's planning process. Planning activities are enhanced when the perspectives of customers and other organizations with an interest in energy issues are incorporated. One enhancement to the public involvement process has been the development of collaborative efforts on a variety of planning issues. These efforts have brought together viewpoints that were merged from parties representing customer groups, environmental organizations, governmental and regulatory agencies. Collaborative efforts played a significant role in the company's planning process, which included the following:

Policy Collaborative Group (PCG): Policy level committee which focused on the review of various planning issues. PCG activities included:

- Involvement in the debate and rate proceeding leading up to the regulatory changes the Commission adopted in the PRAM order
- Assistance in developing the incentive proposal adopted by the WUTC for demand-side resources
- Assistance in developing Puget Power's definition of high efficiency cogeneration
- Provided input to Puget Power's Integrated Resource Planning process

Technical Collaborative Group (TCG): Technical level committee which focused on demand-side management issues. TCG activities included:

- Assistance in developing general policy guidelines which served as the foundation for establishing 1991 and 1992 annual performance targets
- Assistance in developing Puget Power's 1991 and 1992 annual Performance Targets for demand-side management activities. This involved a review of technical assumptions and methodologies regarding kWh savings projections, program design issues and the treatment of various other technical matters
- Assistance in developing the company's Measurement and Evaluation Plan for demand-side activities
- Review of the company's progress in achieving targets on a monthly basis and consideration of programs additions mid-year and the treatment of events that influenced the annual performance targets
- Providing input on the development of the Conservation Potential Assessment/Supply Curves which were used in Puget Power's 1992-1993 Integrated Resource Plan

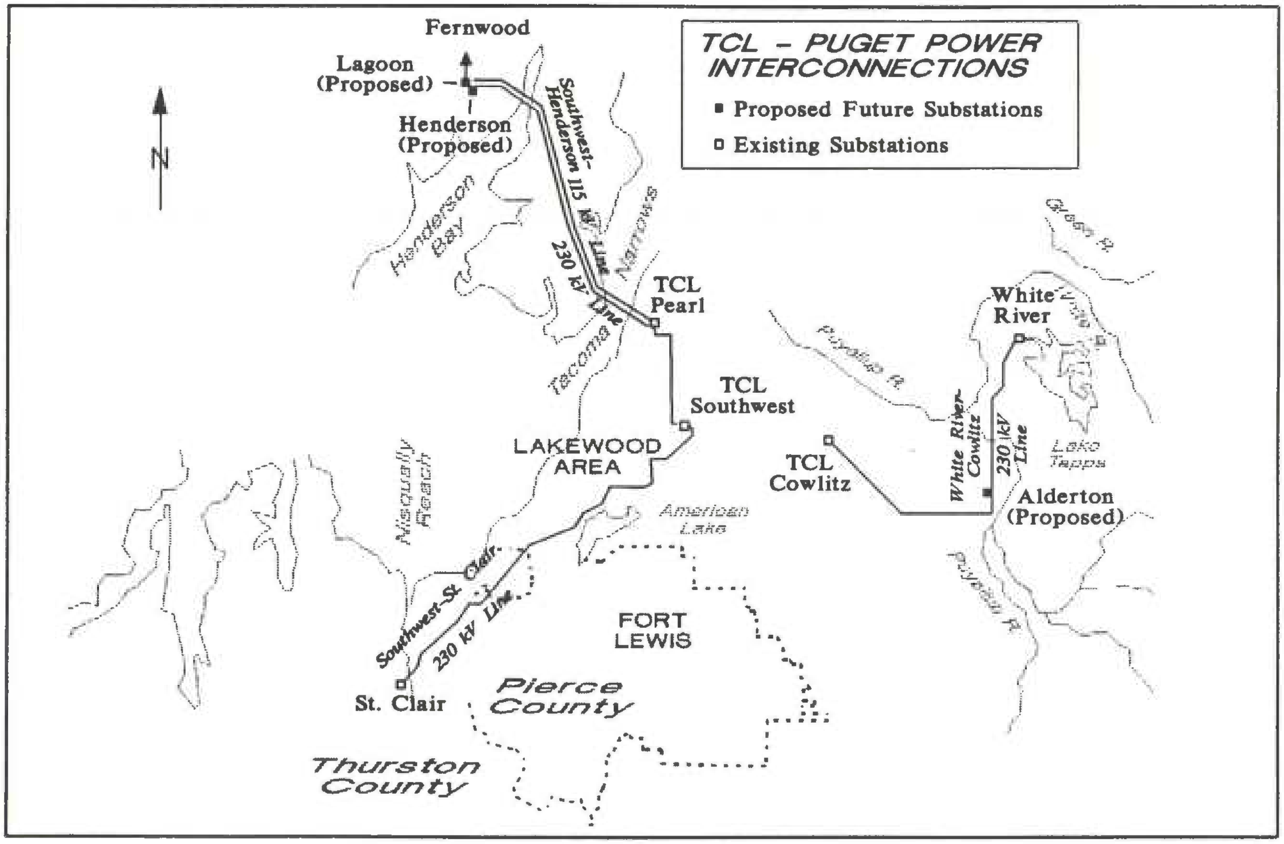
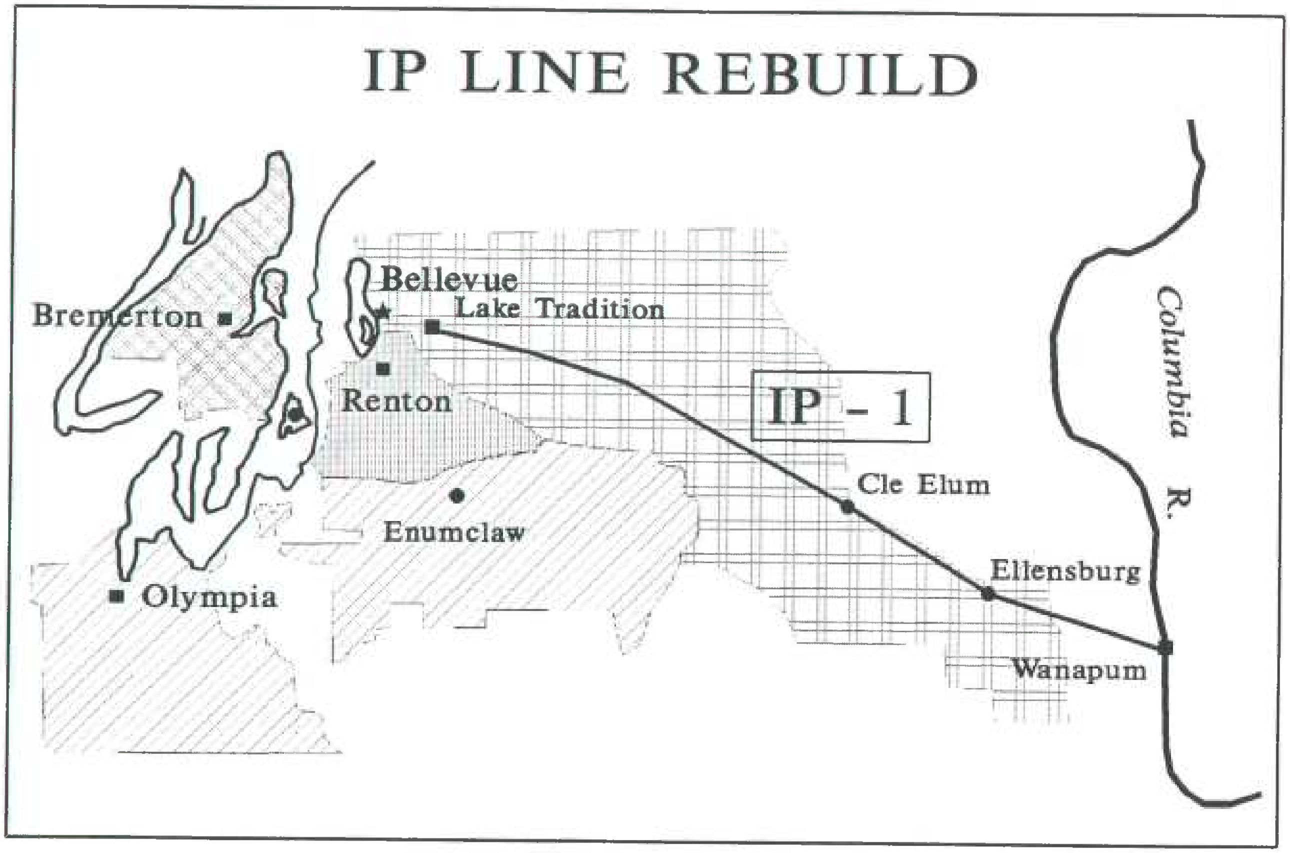

TCL - PUGET POWER INTERCONNECTIONS
Proposed Future Substations
Existing Substations
N
Fernwood
Lagoon (Proposed)
Henderson (Proposed)
Southwest-Henderson 115 kV Line
230 kV Line
Henderson Bay
Tacoma Narrows
TCL Pearl
TCL Southwest
LAKEWOOD AREA
Nisqually Reach
American Lake
Southwest-St. Clair 230 kV Line
St. Clair
FORT LEWIS
Pierce County
Thurston County
Puyallup R.
Green R.
White River
TCL Cowlitz
White River-Cowlitz 230 kV Line
Lake Tapps
Alderton (Proposed)
Puyallup R.

Figure 9.



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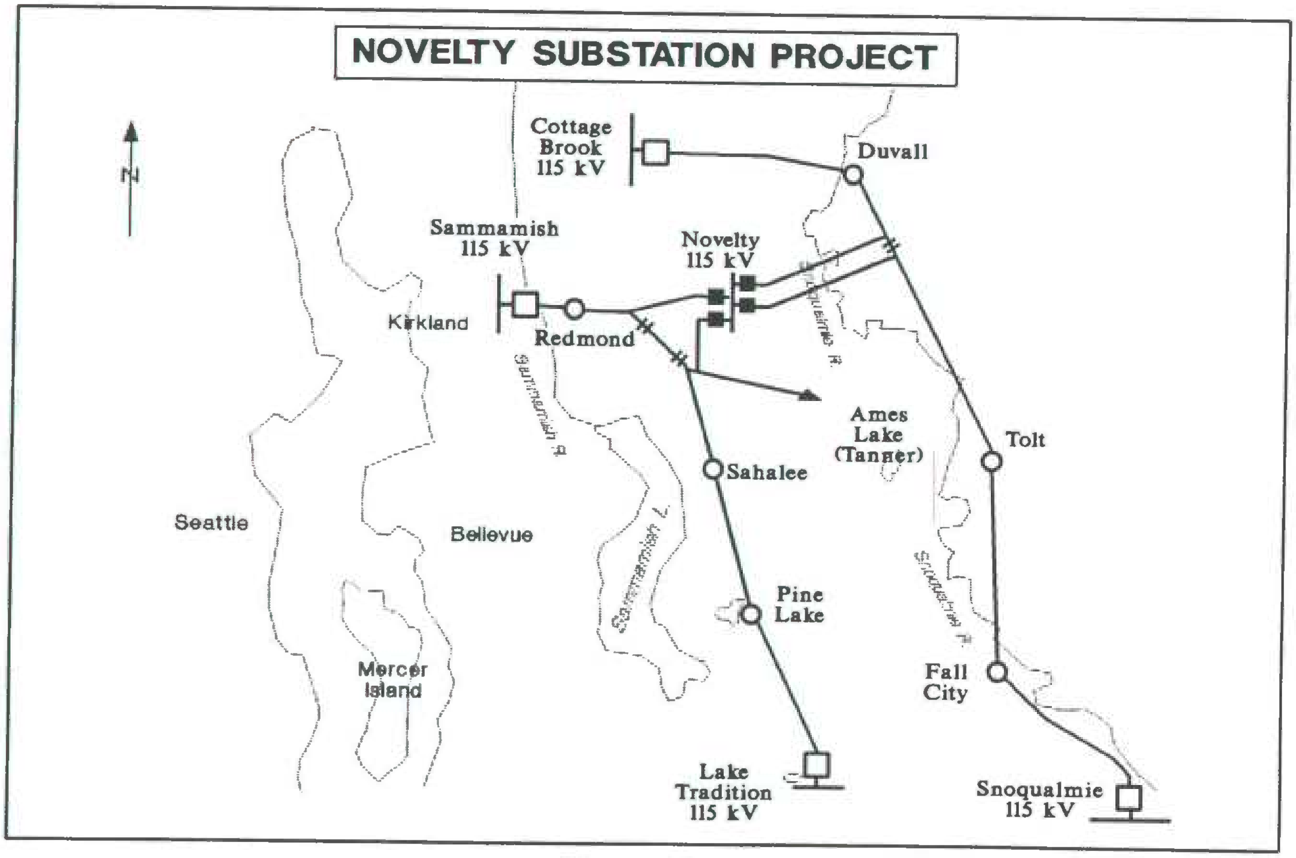

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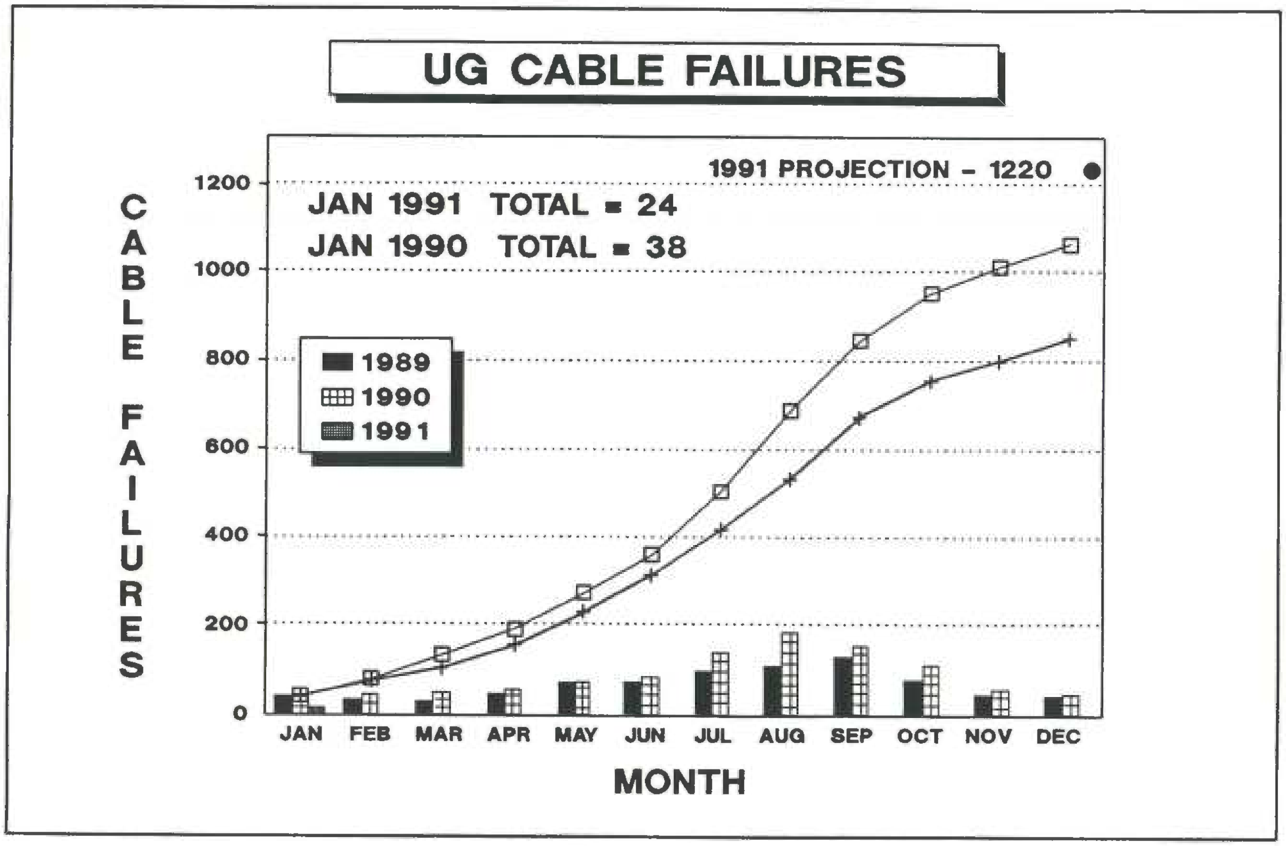

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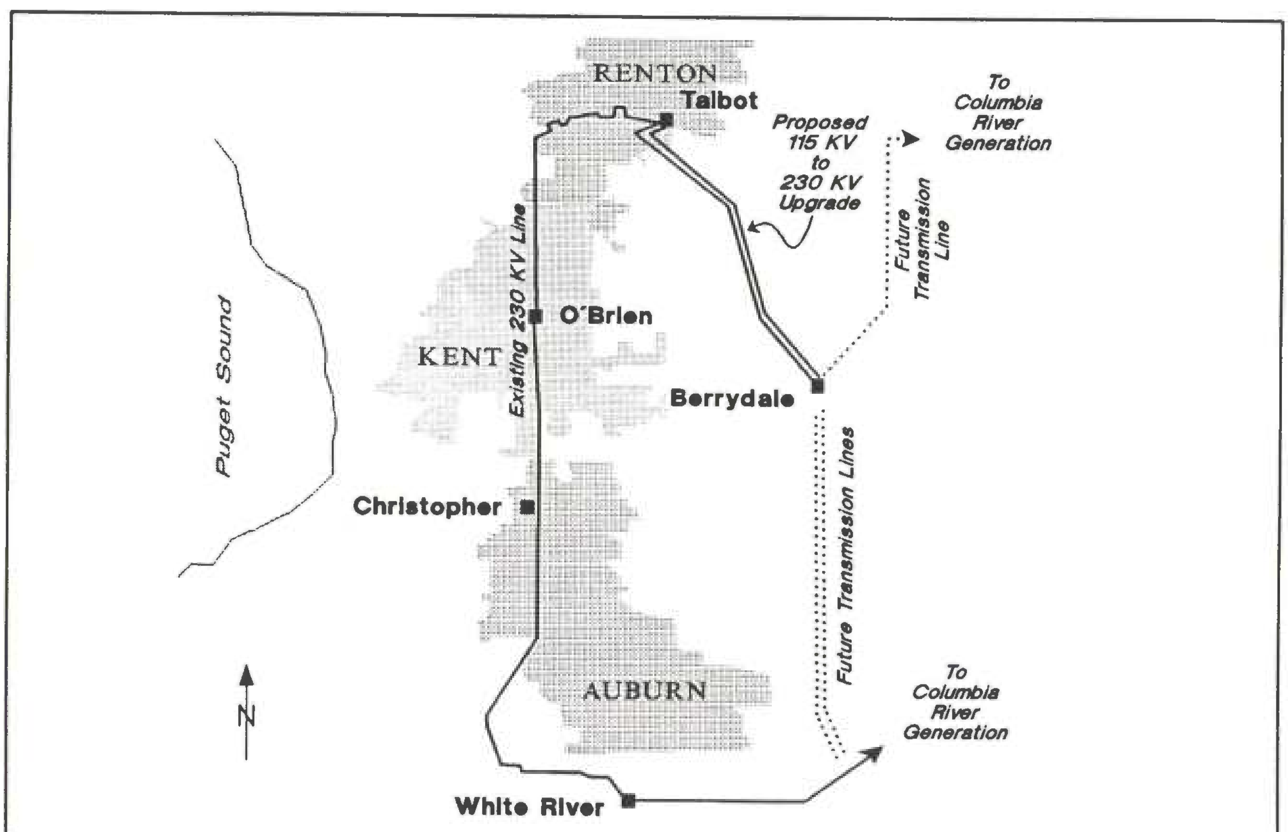


Figure 6.

How should the options be evaluated? The company has developed evaluation criteria to help choose among the various options. What criteria are important from the panel's perspective?

How should those criteria be weighted relative to each other?

The world is full of surprises. While trends are anticipated and certain things are expected to occur, it is generally the unexpected events that cause changes in behavior and the way business is dealt. The following is a list of some of the issues and uncertainties that are considered when developing an Integrated Resource Plan for future resources:

Environmental Regulation
How will this effect the choice of resources?

Natural Gas Price and Availability
How much gas will be available in the future and at what price?

Capacity Planning
In the past, Puget Power has focused integrated resource planning activities mainly on energy (average). Should more emphasis be placed on capacity (peak)?

Electric and Magnetic Fields (EMF)
How will this impact the siting of future transmission?

Costs
What are the capital and operating costs of the resource?

Advanced Technology
Is new technology evolving or available for the resource?

Siting of Future Generation or Transmission
What obstacles, if any, are involved with licensing? Are sites available and where?

Suggested Work Plan

Narrow the scope and coverage of the mission to reflect the interests of the particular group. Every Panel need not address all subjects. You might want to focus on demand-side options only, or supply-side options only. You may wish to focus on only a few options. If you choose to address the evaluation criteria, you will probably want to use several future options as examples of how these criteria would be used.

Fact Finding and Analysis

- Review previous consumer panel integrated resource planning recommendations.
- Review Puget Power's previous two Integrated Resource Plans - 1987 and 1989.
- Review other utilities' integrated resource planning reports.
- Review the demand and supply reports prepared during the 1987 and 1989 integrated resource planning processes.
- Research other literature in the chosen area of interest.
- Arrange for speakers from organizations which can address the area of interest, including speakers from Puget Power. Assess the success of various options where they have been tried elsewhere.
- Develop a list of future demand and supply resource options available to Puget Power.

Develop Recommendations

- List the recommended options along with the reasons you think these options should be considered.
- Provide the criteria and weighting you think Puget Power should use in evaluating options.

Seek Community Comment

- Publicize, circulate, and discuss the proposed recommendations with other groups and individuals in the community to obtain feedback.

Finalize Recommendations

- Revise as appropriate and prepare final recommendations.

BACKGROUND/READING MATERIAL

Other Utilities' Integrated Resource Plans

- Seattle City Light
- PacifiCorp (Portland, Oregon)
- New England Electric Service (Westboro, Massachusetts)
- Central Maine Power (Augusta, Maine)
- Pacific Gas & Electric (San Francisco, California)

OTHER BACKGROUND/READING MATERIAL

- Oak Ridge National Laboratory (ORNL): Uncertainty in Long-Term Resource Planning for Electric Utilities and Benefits and Costs of Small, Short-Lead-Time Power Plants

  Demand-Side Programs in an Era of Load-Growth Uncertainty

  Key Issues In Electric Utility Integrated Resource Planning: Findings from a Nationwide Study

- Bonneville Power Administration – 1990 Resource Program
- Northwest Power Planning Council – Draft 1991 Northwest Conservation and Electric Power Plan
- Electric Power Research Institute – Technical Assessment Guide
- Pacific Northwest Utilities Conference Committee – Utility Perspectives on a Regional Plan
- Northwest Conservation Act Coalition – Map to a Regional Energy Future: A Model Action Plan for the Pacific Northwest
- Washington Utilities and Transportation Commission – Integrated Resource Planning WAC 480-100-251 Order (dated February 27, 1987).

Fact-Finding Sources

The following is a list of sources made available for the Consumer Panel fact-finding exercises. In addition to this list, several Puget Power planning departments were also accessible during the fact-finding phase of recommendation development.

Electric Power Research Institute (EPRI)
EPRI was organized by the nation's utility industry to manage and coordinate research activities. Founded in 1972, EPRI represents approximately 700 of the nation's public and investor-owned electric utilities. Research areas include advanced power systems, energy and environmental analysis and nuclear power.

Pacific N.W. Utilities Conference Committee (PNUCC)
PNUCC represents the three major customer groups of Bonneville: public utilities, investor-owned utilities and direct service industries. PNUCC provides a forum where its diverse membership can share information and views and work toward consensus in coordinated resource planning. PNUCC publishes an annual regional electric load forecast and is governed by a 15-member board elected from its membership.

Northwest Power Planning Council (NWPPC)
The Pacific Northwest Electric Power and Conservation Planning Council is an interstate compact among Idaho, Montana, Oregon and Washington, authorized by the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501). It is funded out of electricity revenues collected by the Bonneville Power Administration, a federal agency that markets power produced in the Pacific Northwest. The Pacific Northwest Electric Power and Conservation Planning Council is commonly referred to as the Northwest Power Planning Council.

Bonneville Power Administration (BPA)
The sole federal power marketing agency in the Northwest and the region's major wholesaler of electricity. Created by Congress in 1937, Bonneville services the states of Washington, Oregon, Idaho, Montana west of the continental divide and small adjacent portions of California, Montana, Nevada, Utah and Wyoming. Bonneville owns and operates the nation's largest network of long-distance, high-voltage transmission lines. Though part of the U. S. Department of Energy, Bonneville is not funded by tax revenues; the agency recovers the cost of operations and maintenance mainly through its electricity rates.

Federal Energy Regulatory Commission (FERC)
Regulates the interstate aspects of the electric power and natural gas industries. Issues and enforces licenses for construction and operation of non-federal hydroelectric projects and advises federal agencies on the merits of proposed federal multi-purpose water development projects.

Northwest Conservation Act Coalition (NCAC)
The NCAC is a region-wide alliance of environmental, consumer and other public interest groups and utilities. It monitors the implementation of the Northwest Power Act and publishes a biweekly trade journal, The Northwest Conservation Act Report.

Natural Resources Defense Council (NRDC)
The NRDC is a national non-profit environmental organization with more than 130,000 members and contributors. Its staff of attorneys and scientists works closely with the NCAC in following the implementation of the Northwest Power Act, and, in particular, its conservation provisions.

Washington Utilities and Transportation Commission (WUTC)
This is the utility regulatory agency in Washington state for investor-owned electric and gas utilities.

Washington State Energy Office (WSEO)
The Energy Office is Washington's principal energy planning agency.

Washington Energy Facility Site Evaluation Council
This agency has resource siting authority in Washington.

State Attorney General's Office-Public Counsel Division This office represents the public's interest for Washington state.

Direct Service Industries, Inc. (DSI)
Established in 1982, DSI is a non-profit corporation representing the industries that purchase electric power directly from Bonneville. The organization addresses electric power issues and represents members' interests with Bonneville and other regional groups. The members are Alumax, Inc.; Aluminum Company of America (ALCOA); Columbia Aluminum Corporation; Columbia Falls Aluminum Company; Georgia-Pacific Corporation; Kaiser Aluminum and Chemical Corporation; Northwest Aluminum Company; Oregon Metallurgical Corporation; Pennwalt Corporation; Reynolds Metals Company; and Vanalco, Inc.

Industrial Customers of Northwest Utilities (ICNU)
ICNU is a non-profit organization formed in 1981. ICNU represents 25 industrial companies with facilities throughout the Northwest. ICNU members purchase power from the region's public agencies and investor-owned utilities, rather than directly from BPA. ICNU focuses on policy matters and works actively with the Northwest Power Planning council, BPA and the region's utilities. Areas of interest include conservation, cogeneration, forecasting and reliability.

EXHIBIT B

TECHNICAL ADVISORY COMMITTEE MEETING SCHEDULE

This exhibit lists all of the Technical Advisory Committee (TAC) meetings with a general description of each meeting's agenda. The companies, organizations, agencies, citizen activists and other interested groups that participated in the TAC meetings are referenced in Exhibit C to this appendix.

June 14, 1990:
This kick-off meeting focused on the tentative integrated resource planning schedule, planning methodology and the identification of key issues. General support was expressed for scenario planning.

August 8, 1990:
This meeting presented information on the methodology, data inputs and models used by the company to develop sales/load forecasts.

October 8, 1990:
This meeting placed emphasis on the company's forecast of firm energy and capacity from existing generation and conservation resources plotted against load under medium forecast conditions. Other topics of discussion included the Notice of Inquiry incentive regulation, resource selection and an update on the sales forecast.

November 27, 1990:
This meeting focused on demand-side management issues. The development of demand-side incentives was discussed, along with conservation supply curves, rate design, load management and fuel switching.

January 22, 1991:
The supply alternatives meeting focused on the various resources available for power generation.

March 12, 1991:
This meeting featured a presentation that focused on transmission access and the impacts of continued growth. This meeting also included a status report on the 1991 demand-side performance targets.

April 23, 1991:
This supply alternatives meeting was a follow-up and clarification meeting for the January 22, 1991 meeting.

July 9, 1991:
This meeting reviewed the April 1991 rate order, with discussions on decoupling, earnings band and annual rate adjustment. The impact of the Clean Air Act was another area of focus; the meeting concluded with a presentation of the draft scenario analyses.

October 29,1991:
This meeting discussed the 1992-93 Integrated Resource Plan and distribution schedule. Other topics of discussion included company-developed resources, capacity needs and Canadian Entitlement.

EXHIBIT C

TECHNICAL ADVISORY COMMITTEE
TECHNICAL COLLABORATIVE GROUP
POLICY COLLABORATIVE GROUP
RATE DESIGN COLLABORATIVE GROUP PARTICIPANTS

The following companies, organizations, agencies, citizen activist groups and other interested parties participated in the activities of the Technical Advisory Committee, Technical Collaborative Group, Policy Collaborative Group and/or the Rate Design Collaborative Group . The participants provided Puget Power with valuable insights on various energy related issues.

The Boeing Company
Seattle, WA
Involvement: TAC, TCG, PCG, RDCG

Bonneville Power Administration
Portland, OR
Involvement: TAC

Building Owners and Managers Association
Bellevue, WA
Involvement: TCG, RDCG

Evergreen Legal Services
Seattle, WA
Involvement: RDCG

Industrial Customers of N.W. Utilities
Portland, OR
Involvement: TAC, TCG

Natural Resources Defense Council
San Francisco, CA
Involvement: TAC

Northwest Cogeneration and Industrial Coalition
Seattle, WA
Involvement: PCG, RDCG

Northwest Conservation Act Coalition
Seattle, WA
Involvement: TAC, TCG, PCG, RDCG

Northwest Power Planning Council
Portland, OR
Involvement: TAC, TCG, PCG, RDCG

Oak Ridge National Laboratory
Oak Ridge, TN
Involvement: TAC

The Opportunity Council (representing Wash. State Association of Community Action Agencies)
Bellingham, WA
Involvement: TCG, RDCG

Pacific Power
Portland, OR
Involvement: TAC

Rate Design Task Force
Puget Power Customers (primarily residential)
Involvement: RDCG

State Attorney General's Office
Public Counsel Division
Seattle, WA
Involvement: TAC, TCG, PCG, RDCG

Washington Industrial Committee
for Fair Utility Rates
Portland, OR
Involvement: PCG, RDCG

Washington State Energy Office
Olympia, WA
Involvement: TAC, TCG, PCG, RDCG

Washington State Senate Energy and Utilities Committee
Olympia, WA
Involvement: TAC, RDCG

Washington Utilities and Trans. Commission
Olympia, WA
Involvement: TAC, TCG, PCG, RDCG

Washington Water Power
Spokane, WA
Involvement: TAC

LEGEND:
TAC - Technical Advisory Committee
TCG - Technical Collaborative Group
PCG - Policy Collaborative Group
RDCG - Rate Design Collaborative Group

Detailed Scenario Planning Description

Puget Power continues to use scenario planning in the 1992-1993 Integrated Resource Plan. This appendix provides an in-depth description of the scenario planning process. This process is central to understanding and dealing with the inherent uncertainties of the utility business. The scenario planning methodology involves combining information about known events, trends and uncertainties to develop internally consistent descriptions of plausible alternative futures. These futures are "plausible" in that they are the result of logical sequences of possible events.

The appendix begins with a discussion of the scenario planning approach. Details are then provided concerning economics and demographics, 1990 Census data, trends in electricity sales, and the sales & load forecasts. After the sales and load forecasts, this appendix describes the scenarios and their potential affects on meeting the company's resource needs. The discussion then specifies financial assumptions used in the planning process. Next, the resource options identification process is explained, followed by the scenario analyses. The appendix concludes with the 1992-1993 resource strategy.

Scenario Planning Approach

Scenario planning provides a framework for identifying a range of uncertainties likely to confront Puget Power. The scenario analyses focus on key cause and effect relationships and the required decisions they imply, rather than predicting a multitude of future variables.

Once these causal relationships have been examined, analyses of "what if" questions can be performed to increase awareness and understanding of possible alternative futures. Although the future cannot be concretely predicted, the company can plan for and pursue actions that appear appropriate under a number of different scenarios.

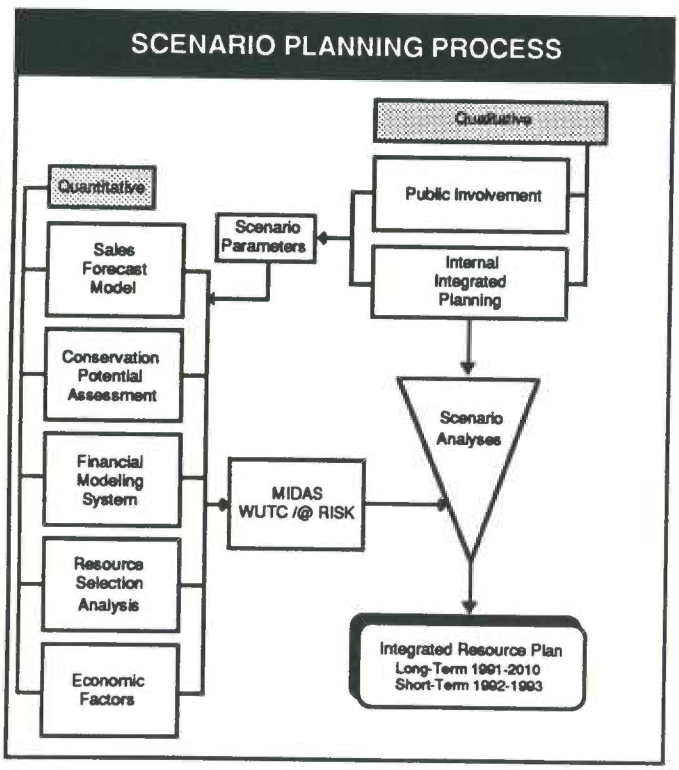
This Integrated Resource Plan focused on six alternative scenarios:

- High - Faster economic growth, greater environmental awareness and significant gas to electric conversions.
- Medium High - Faster economic growth with moderate fuel switching to natural gas.
- Medium - Moderate economic growth with moderate fuel switching to natural gas (this scenario is used as the baseline for planning purposes).
- Medium Low - Slower economic growth with moderate fuel switching to natural gas.
- Low - Slower economic growth with accelerated fuel switching to natural gas.
- Sudden Loss of Resources - Moderate economic growth with a sudden loss of existing resources.

The scenario planning process progressed from scenario development through scenario analyses and the selection of future resource portfolios. As in prior plans, the sales forecasts were a major component in the development of each scenario. The forecast parameters included economic conditions, demographic information, inflation, load growth and resource conditions. The perspectives of the Technical Advisory Committee and Consumer Panels were also incorporated into scenario development and analyses.

Quantitative information, such as conservation potential assessment and the resource selection procedure were used at various points throughout the scenario planning process. Once the supporting assumptions were fully developed, analyses were conducted to determine an appropriate resource mix for each scenario. These resource mixes were chosen for their responsiveness to a variety of changing elements including environmental constraints, economic shifts, customer growth and fuel price fluctuations. Additionally, these resources were selected to minimize the adverse effects on the company's revenue requirements, customer rates and the company's overall financial stability. Environmental and public acceptability also played a key role in the selection of the final resource portfolios. The overall scenario planning process is outlined in Figure H-1.

Figure H-1



Updated Integrated Resource Plan

Puget Power's least-cost Integrated Resource Plan was updated for this planning cycle by analyzing:

- Uncertainties considered throughout the planning process
- Progress since the 1989 Plan
- Outcomes of the scenario planning analyses
- Puget Power's planning experience
- Collaborative efforts representing the viewpoints of various groups and interested parties

The Plan includes both short and long-term activities for the company to pursue with the focus on providing customers with low-cost, reliable energy that has low environmental effects.

Economic and Demographic Trends

Puget Power faces a market experiencing rapid growth and changing energy use patterns. The growth in customers and electricity use is dependent upon economic and demographic trends. In this type of market, the sales and load forecast must account for population and employment growth, as well as factors causing changes in energy use patterns. After a review of demographic trends, this section explores the outlook on economic and customer growth nationally and in the area Puget Power serves.

Demographic Trends

Demographic trends play a key role in the scenario development process. These trends affect a variety of activities such as forecasting electricity loads, planning conservation programs, and workforce recruitment. In all scenarios, continued aging of the population and increased diversity of the workforce are expected.

Because of the importance of demographic trends, the company has begun a detailed analysis of 1990 Census data. Thus far, the analysis has provided information on population growth, changes in household size, ethnic diversity, living conditions of children and the elderly, and home ownership. The analysis will also provide information on education, income, and language spoken in the home. The final analysis of the 1990 Census data is expected to be completed in Spring 1992.

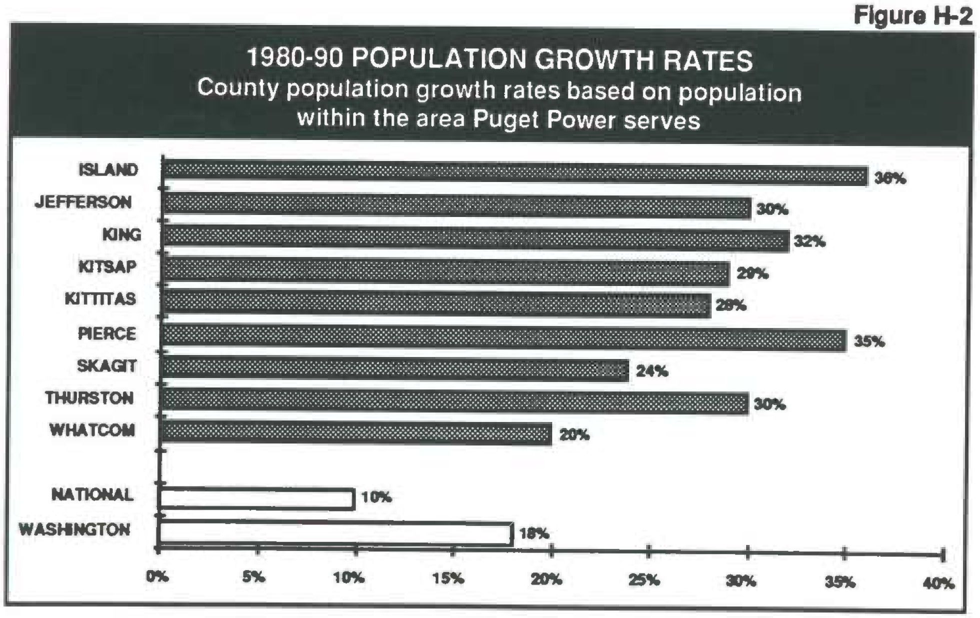
Key demographic trends already revealed by the 1990 Census include concentrated statewide population growth in the Puget Sound area, increased ethnic diversity, aging of the population, and changing household structure.

Population Growth Paces State

Population growth rates in the Puget Sound area exceeded statewide and national population growth rates during the 1980's. Service area population grew 31% during the 1980's, well above the statewide 18% growth rate (and the national growth rate of 10%). As shown in Figure H-2, the population growth rate for each county in the service area exceeded the statewide growth rate. About 55% of statewide population growth during the 1980's occurred in the area Puget Power serves.

While in-migration and population growth are expected to slow during the coming years, statewide population growth is expected to remain concentrated in the Puget Sound area. Current population forecasts from the Office of Financial Management expect 76% of statewide population growth during the 1990's to be in the Puget Sound region.

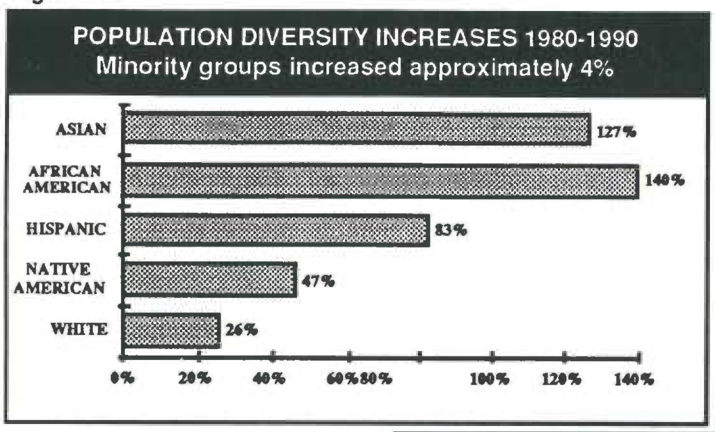
Figure H-2



Ethnic Diversity Increases

The service area population became increasingly diverse during the 1980's. As shown in Figure H-3 the Asian, African American, Hispanic, and Native American (including Eskimo and Aleut) populations in the area Puget Power serves experienced rapid growth. As a result, over 20% of population growth came from minority groups during the 1980's. The proportion of population accounted for by minority groups increased from less than 7% in 1980 to over 10% in 1990. Continued in-migration will will be a significant contributor to an increasingly diverse population.

Figure H-3

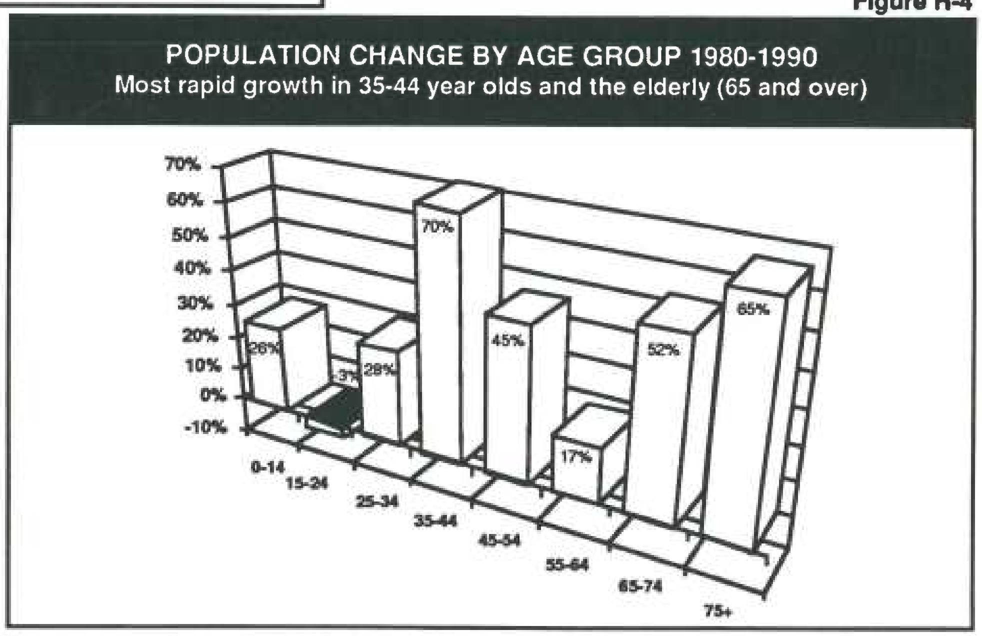


Population Grows Older

Service area population grew older during the 1980's, with the median age rising from 29.5 years in 1980 to 32.8 years in 1990. As shown in Figure H-4, the most rapidly growing groups were 35-44 year olds and the elderly (65 and over). Rapid growth in the 35-44 year old group reflects the post World War II baby boom and in-migration induced by the strong local economy. Rapid growth of the elderly population may be traced to declining mortality and in-migration of retirees. In 1990, almost 165,000 elderly persons (about 10% of total population) lived in the area Puget Power serves.

Goods and services produced in the economy will shift in response to the aging population. In particular, resources devoted to health services will continue to grow rapidly. Aging of the population will reduce persons per household and increase the percentage of customers living in multi-family housing.

Figure H-4



Household Composition Changes

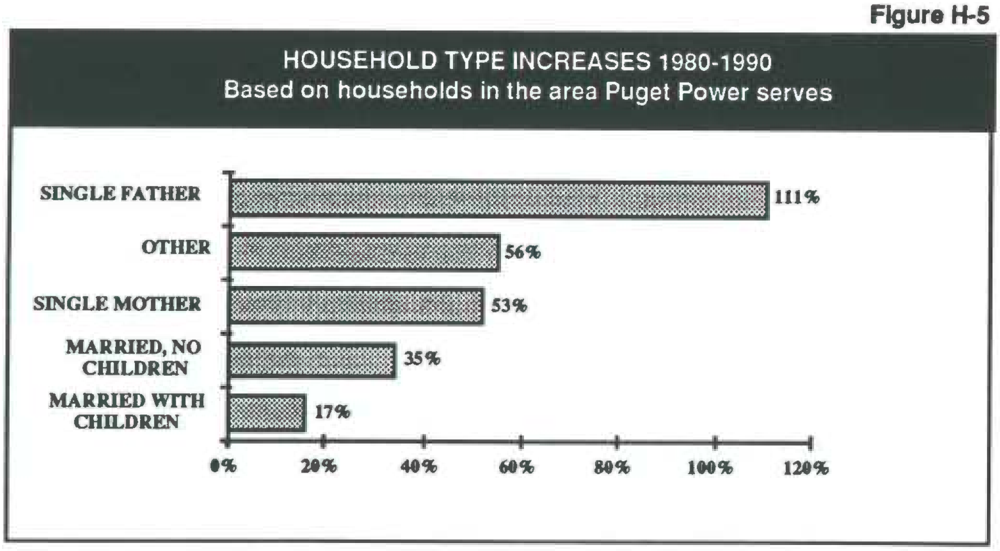
The 1990 Census revealed that only 29% of the households in the area Puget Power serves consist of married couples with children. Another 30% consist of married couples without children. About 8% of households were headed by a single parent.

Figure H-5 shows the growth rates during the 1980's for different household types. The most rapidly growing household types were single parents and other (which includes single adults, single persons, and unrelated persons living together). According to the 1990 Census, about 8% of households were headed by single parents. Of the 440,000 children in our service area, approximately 75,000 lived in single parent households. As the demographic characteristics of our customers change, Puget Power will need to respond to changing customer needs.

International Trade

It is assumed that international trade will continue to stimulate growth in the Puget Sound economy. Proximity to rapidly growing Pacific Rim markets and the U.S.-Canada free trade agreement have enabled Washington to rank first nationally in the percentage of gross state product exported. Washington State also generates twice the national average of per capita income from international trade. Retail purchases by Canadian shoppers continue to increase and have been boosted this year by the new Canadian goods and services tax.

Figure H-5



High Technology Industries

The Puget Sound economy will also benefit from growth in high technology industries. Even when the Boeing Company is excluded, high technology industries employ over 85,000 people in the state of Washington. The Microsoft Company, whose Redmond headquarters are located in the area Puget Power serves, is the largest maker of applications programs and operating systems for personal computers in the nation. Despite the slowing of the regional economy this year, employment growth in high technology industries has remained strong.

In-Migration

The strength of the local economy has attracted people from other regions of the country. During the past five years, Washington population has increased by over 410,000, over 50% of which has been accounted for by in-migration. This has caused rapid growth in the number of customers. During the past 10 years about 200,000 customers have been added, of which over 170,000 were residential. In 1990, customer additions reached their highest level since 1979, with nearly 28,000 customers added. Over 25,000 of these customer additions were residential, the equivalent of over 60,000 people.

With in-migration moderating during the next five years, less rapid population growth is expected. Washington State population is anticipated to increase a little more than 380,000 during this time period. Slightly over half of this population increase will occur within the area Puget Power serves.

As a result, the company expects to add 90,000 residential customers during the next five years, which represents an annual average of 18,000 residential customer additions. This is comparable to the average level of customer additions over the last decade.

Economic Variability and Social Values

While the scenarios developed for this Integrated Resource Plan cover a wide range of economic growth rates, they all contain a number of common assumptions about the future economy. Growing international economic interdependence will combine with the Puget Sound area's Pacific Rim location to create new opportunities for economic growth from international trade. However, this also implies continued global competition and a degree of vulnerability and instability. This vulnerability and instability introduces uncertainty in future electric loads which is treated in this Plan through the consideration of scenarios with significantly different rates of economic growth. Uncertainty about future load growth underscores the importance of flexibility in resource planning, so that resource acquisitions may be altered to meet unanticipated changes.

The economy will continue to move from producer dominance to consumer orientation. This implies that economic growth will be concentrated in the production of services. As a result, the commercial sector is the primary source of load growth in all scenarios.

Increased consumer orientation has been accompanied by growing environmentalism. Growing environmentalism implies increased emphasis on conservation programs and potential opposition to generation projects that are perceived to have negative environmental effects.

Trends in Electricity Sales

Electricity sales and customer additions have reflected the rapid economic growth in the Puget Sound area. Electricity sales continue to grow more rapidly in the area Puget Power serves than in other parts of the Pacific Northwest. Key trends in electricity sales include: 1) continued declining use per customer; and 2) continued shift in the sector mix of electricity sales from residential to commercial.

In the residential sector, over 170,000 customers have been added during the past 10 years, resulting in an annual average customer growth rate of over 3%. Despite this rapid growth in residential customers, residential electricity sales have grown at an annual average rate of only 1.4% (on a weather adjusted basis) during the same time period. A key factor slowing the rate of residential sales growth has been the declining use per customer.

Declines in Residential Use Per Customer

Use per residential customer declined rapidly until 1985, including a drop of almost 3000 kWh per customer between 1979 and 1985. Since 1987 use per customer has been declining again, falling by over 600 kWh between 1987 and 1990. A decline in annual use per customer of 100 kWh reduces residential system load by over 8 aMW.

A variety of factors affect the residential use per customer. Key factors reducing use per customer include conservation, price induced changes in customer behavior, changes in building codes and appliance efficiency standards, technological improvements, increased use of natural gas for space and water heating in single family residences, and a higher percentage of customers living in multi-family units.

Without conservation measures installed through customer programs since the late 1970's, use per customer in 1991 would have been more than 1400 kWh per year higher. Also, if Puget Power achieves its conservation targets included in this Plan, use per customer will be further reduced (see Appendix D for more details on conservation).

The share of residential customers living in multi-family housing increased from 14% in 1980 to 21% in 1990. With population growth increasing land prices, and growth management legislation encouraging higher densities, the share of customers living in multi-family housing is expected to continually increase.

Fuel choice by residential customers has also changed in recent years. In new single family homes, the electric space heat penetration rate has fallen from over 60% in 1984 to about 30% in 1991. Electric water heat penetrations in new single family homes have followed a very similar pattern. In the replacement equipment market, electric penetration rates in single family housing for space and water heat equipment have fallen, reflecting the increase in electric to gas conversions.

Changes In Electricity Sales Mix

The decline in use per residential customer, resulting in an average annual growth for residential sales of 1.4% over the past 10 years, affects Puget Power's sales mix. Over the same 10 year period, commercial sales grew at an annual average rate of 5.0% and industrial sales grew at a 3.7% rate. As a result, the share of system sales accounted for by the residential sector has declined from 55% in 1980 to 48% in 1990 while the share of system sales accounted for the by commercial sector has increased from 26% to 32% over the same period.

Over the next 20 years the share of system sales accounted for by the commercial sector is expected to continue increasing, although not as rapidly as during the past 10 years.

Sales And Load Forecasts

The sales forecasting process divides sales into five sectors - residential, commercial, industrial, street lighting and resale. Forecasts of residential and commercial annual energy sales are produced with end-use models. In these end-use models, electricity sales depend on the stock, efficiency and utilization of electric appliances. Energy use patterns are responsive to demographic, economic and technological changes.

Forecasts of annual sales in the remaining three sectors are produced with somewhat simpler models. The industrial forecasting model treats industrial sales as a function of industrial employment and fuel prices. Formal models do not exist for the street lighting and resale sectors; when combined, these sectors account for less than 1% of system sales and have forecasts based on examination of past sales trends.

Monthly sales forecasts are produced from the annual sales forecast. For each sector, historical data is used to determine the monthly share of annual sales. These shares of monthly sales are applied to the annual sales forecast to obtain a monthly sales forecast for each sector and the system. Load forecasts are also based on the annual sales forecast. The forecast of annual system sales is adjusted for losses and allocated across months to produce forecasts of annual and monthly average load.

Residential Sector Forecasting Process

Recent trends indicate that the forecasting procedure must not only accurately predict customer growth, but must also account for changes in fuel choice and other factors affecting electricity use patterns. Sales forecasts are produced with an end-use model developed by Oak Ridge National Laboratory called the Residential Reference House Energy Demand Model. Some minor changes in the model have been made since it was obtained from Bonneville Power Administration (BPA) in 1986. This model provides detailed analysis of energy use in the three different housing types and eight end-uses shown in Table H-1.

Table H-1

RESIDENTIAL END-USE MODEL ANALYSIS

Housing Types	End-Uses
Single Family	Space Heat
Multi-Family	Air Conditioning
Manufactured Housing	Water Heat
	Cooking
	Drying
	Refrigeration
	Freezing
	Other

A particularly valuable feature of this model is the treatment of fuel choice for space and water heat in new construction. In newly constructed homes, the model allows for simultaneous choice of building thermal performance, space heating equipment fuel and efficiency, and water heating equipment fuel and efficiency. Twelve different space heating systems (such as electric central furnace) and four different water heating systems are considered.

The model is currently calibrated to historical data from the 1982-90 period. Model sales are calibrated to within 1% of weather-adjusted sales for each year during this period. By having an eight year calibration period, historical data may be used to calibrate model parameters to accurately fit changing electricity using patterns. For example, data from fuel price changes and electric penetration rates have been used to calibrate the affect of fuel price changes on fuel choices.

Two particularly important sources of information for calibrating the model have been residential surveys and metered end-use load data. Data from residential surveys conducted in 1982, 1983, 1986 and 1989 has been used extensively in calibrating the model. Metered end-use load data from the End-Use Load and Consumer Assessment Program was recently obtained from BPA and used to refine input values.

Development of Residential Key Inputs

End-use models provide considerable flexibility for analyzing the components of residential electricity use. However, producing accurate forecasts requires the careful development of a wide range of inputs. Values based on the area Puget Power serves have been developed for many of the inputs. Key forecast inputs which must be updated for each forecast include the number of customers, fuel prices and conservation. Results from the sales forecasting model are affected more by the customer forecast than any other input.

The customer forecast begins with a forecast of service area population. Key sources of information used to produce this forecast included the Washington State Office of Financial Management, Puget Sound Council of Governments, Data Resources Inc., Seattle City Light, 1990 Census data, and Metered end-use data. Although the residential sales forecast is produced at the company level, separate population forecasts were prepared for each county in the service area. In the King, Pierce, Kittitas and Jefferson counties, it is necessary to estimate the percentage of population served by Puget Power. Forecasts of persons per household and the housing type mix of new construction are used to convert the population forecast into a forecast of customers by housing type.

Fuel prices also play a key role in the residential sales forecast. Changes in the price of electricity affect how intensively customers utilize electric appliances. Changes in the price of electricity relative to other fuels affect fuel choice in new construction and for replacement equipment.

Sources of information used to develop fuel price forecasts include avoided cost rate studies, the Energy Information Administration (EIA), Gas Research Institute, Data Resources Inc., and the National Economic Research Associates. The company's current forecast has prices for all fuels increasing slightly faster than inflation during the next 20 years. Electricity is expected to remain more expensive than natural gas, although the gap is expected to gradually narrow after 1995 as the rate of gas price escalation increases.

The residential sales forecast accounts for savings from only nonprogrammatic conservation (savings from programmatic conservation are treated as a resource in the integrated resource planning process). Nonprogrammatic conservation includes actions that customers take without the direct influence of Puget Power. Nonprogrammatic conservation is accounted for within the end-use model via changes in energy use per appliance.

Two examples of nonprogrammatic conservation specifically accounted for by the end-use model are the Federal Appliance Efficiency Standards and the 1991 Washington Building Code.

Federal Appliance Efficiency Standards require reductions in the electricity used by new refrigerators and freezers. Information from the Demand-Side Alternatives appendix of the 1989 Integrated Resource Plan was used to estimate the affects of these standards. The 1991 Washington Building Code requires all new single family and multi-family construction after mid-1991 to achieve Model Conservation Standard (MCS) efficiency levels. MCS homes were assumed to use about 30% less energy for space heating than a 1986 code home. After 1) estimating the size of new homes; and 2) estimating the percentage of current construction exceeding code requirements, target energy use intensities (EUIs) were chosen for space heating in new construction before and after the code change.

Commercial Sector Forecasting Process

Sales forecasts for the commercial sector are produced using an end-use model obtained from the Northwest Power Planning Council. This model examines commercial energy use across 11 building types and 8 end-uses (some minor changes in building type definitions have been made since this model was acquired from the Northwest Power Planning Council in 1986). Table H-2 lists the building types and end-uses examined in the commercial sales forecasts.

This model assumes that the stock, efficiency and utilization of electric equipment determines electricity sales. Input values of the model are calibrated over the 1982-90 period so that the product of floorspace, electric saturation rates (the percentage of floorspace served by electric equipment), and electricity use per square foot floorspace comes within 1% of historical weather-adjusted sales.

Key sources of information used to calibrate the model during this period include the following:

- Pacific Northwest Nonresidential Survey
- Commercial metered end-use data
- Commercial surveys
- Historical billing data from years 1982-1990
- Data Resources, Inc. (DRI) national economic forecast

Table H-2

COMMERCIAL END-USE MODEL ANALYSIS

Building Types	End-Uses
Office	Space Heating
Restaurant	Air Conditioning
Retail	Ventilation
Grocery	Water Heating
Warehouse	Cooking
Elementary/Secondary	Refrigeration
College	Lighting
Health	Other
Hotel/Motel	
Military	
Miscellaneous	

About 20% of commercial sales are customers who do not fall into any of the 11 building types. These customers include water and sewage utilities, whose electricity use is not clearly related to floorspace. Recognizing these customers in the commercial end-use model would be inappropriate, as the model assumes that floorspace drives sales. A forecast of non-building sales is added to the commercial end-use model results to obtain the total commercial sector forecast.

Development of Commercial Key Inputs

Like the residential end-use model, the commercial end-use model requires input on a large number of variables. Values based on the area Puget Power serves have been developed for many of the inputs. Key inputs which are updated for each forecast include floorspace, fuel prices and conservation.

Floorspace: Since floorspace represents the key driver variable in the commercial end-use model, considerable effort has been devoted to developing an accurate forecast of floorspace. This projection is based on a forecast of commercial employment. Data used to develop the commercial employment forecast included the Washington State Employment Security Department, Washington State Office of Financial Management, Data Resources Inc., Puget Sound Council of Governments and Seattle City Light.

Employment Forecast: The employment forecast is developed for each county in the area Puget Power serves. The forecast is developed at a two digit Standard Industrial Classification (SIC) code level and then aggregated to obtain a forecast of employment by building type.

The employment forecast by building type is multiplied by floorspace per employee (developed for each building type from historical series on floorspace and employment) to obtain a forecast of total floorspace by building type. The amount of floorspace built each year is then equated to the change in total floorspace from the previous year plus the amount of existing floorspace retired.

Fuel Prices: Fuel prices have both short and long-run effects in the commercial end-use model. In the short-run, they affect the utilization of existing equipment. In the long-run, they affect fuel choices and the efficiency of new equipment.

Sources of information used to develop fuel price forecasts include avoided cost studies, the Energy Information Administration (EIA), Data Resources Inc., and the National Economic Research Associates. In general, the outlook for commercial fuel prices is similar to that in the residential sector. Real fuel prices are expected to grow at a 1 to 3% annual average rate over the forecast period. As gas prices begin escalating more rapidly after 1995, the gap between electric and gas prices is expected to narrow but not disappear.

Conservation: As in the residential sector, nonprogrammatic conservation is treated within the end-use model while programmatic conservation is treated as a resource. Energy use per square foot for most end-uses does not change significantly, indicating that any efficiency improvements from nonprogrammatic conservation are offset by changes in equipment utilization.

Industrial Sector Forecasting Process

Unlike the models used to forecast residential and commercial sales, the industrial forecasting model does not use an end-use approach. The industrial forecasting model divides this sector into the seven industry categories listed in Table H-3.

Table H-3

INDUSTRIAL FORECAST CATEGORIES
❖ Petroleum Refining ❖ Transportation Equipment ❖ Paper & Allied Products ❖ Food & Kindred Products ❖ Lumber & Wood Products ❖ Chemical ❖ Other

This model was developed after an extensive examination of industrial forecasting models from other utilities, government agencies and Electric Power Research Institute.

The industrial forecast begins with the development of an industrial employment forecast for each industry category. Employment is multiplied by energy use per employee in each industry category to obtain an initial forecast of industrial sales. The forecast is then adjusted for expected changes in industrial fuel prices by combining estimates of industrial fuel price elasticities with a fuel price forecast.

Development of Industrial Key Inputs

Key inputs into the industrial forecasting model include industrial employment, fuel prices and discreet loads.

Industrial Employment: Data on industrial employment was developed following the same procedure as the commercial employment data, with county level employment forecasts being developed for each two digit SIC code and then aggregated into the seven industrial categories listed in Table H-3.

Fuel Prices: Fuel price forecasts were developed after reviewing the same sources as used for the residential and commercial sectors. As in the other sectors, industrial electric prices are expected to remain above natural gas prices throughout the forecast period, with the gap narrowing after 1995 as natural gas escalation rates increase.

Discreet Loads: Since industrial sales are more concentrated than commercial or residential sales, an effort was made to determine the impact of planned industrial facility expansions on electricity sales. Personnel from each company division were contacted to determine the discreet sales additions caused by planned expansions of industrial facilities. The forecast was then examined to insure that it included sufficient sales growth to cover these expected discreet additions to industrial sales.

Scenario Load Forecasts

To account for the economic and growth uncertainty discussed in this appendix, separate load forecasts were prepared for five of the six scenarios. These forecasts (and scenarios) are denoted as High, Medium High, Medium, Medium Low and Low. Each scenario uses a different set of logically consistent assumptions about the factors which drive load growth. The sixth scenario used the Medium load forecast with the added complexity of sudden loss of resources.

The Medium scenario incorporates the company's baseline assumptions about economic growth, fuel prices, and resource availability. The Medium High and Medium Low scenarios examine the impact of different rates of economic growth. These two scenarios use the same fuel price assumptions as the Medium scenario.

The High scenario uses the same economic assumptions as the Medium High scenario, but increases the fuel price assumptions. Similarly, the Low scenario uses the same economic assumptions as the Medium Low scenario, but lowers the fuel price assumptions. As noted earlier, the Sudden Loss of Resources scenario uses the same load forecast as the Medium scenario, but assumes that some existing resources are suddenly lost. Table H-4 displays the assumptions used in the scenario load forecasts.

Table H-4

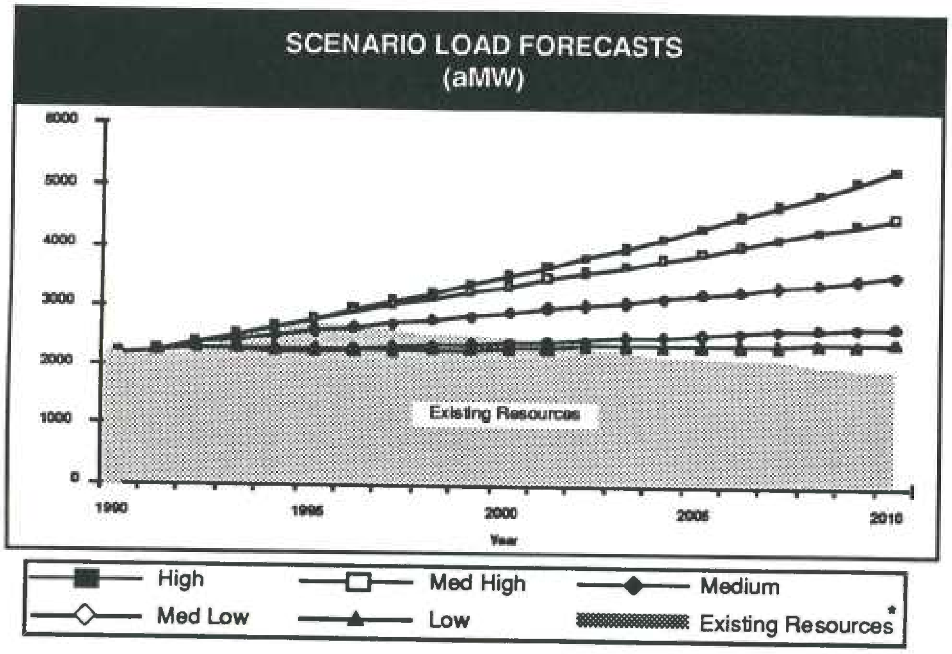
SCENARIO LOAD FORECAST ASSUMPTIONS

	High	Medium High	Medium	Medium Low	Low
Employment Growth (1991-2010 AARG)	3.5%	3.5%	2.6%	0.4%	0.4%
Per Capita Income (1991-2010 AARG)	2.0%	2.0%	1.5%	0.5%	0.5%
New Residential Penetration Rate (2010)					
SF SH	45.0%	15.0%	15.0%	15.0%	10.0%
MF SH	98.0%	91.0%	91.0%	91.0%	54.0%
Residential Use Per Customer (kWh in 2010)	12,200	11,170	11,070	11,230	10,700
Electricity Prices	1.6%	1.0%	1.0%	1.0%	.4%
Gas Prices	4.2%	2.3%	2.3%	2.3%	.2%

Each scenario load forecast was compared to existing resources to determine future resource needs. Figure H-6 shows the load forecasts for each scenario with a listing provided in Table H-5. The average annual growth rate for the planning horizon ranged from 0.4% in the Low scenario to 4.5% in the High scenario.

These two extreme scenarios provided a range or "band" of load forecasts ranging from a low of 2404 aMW to a high of 5301 aMW in the year 2010. This created a boundary where the probability would be minimal that actual load would fall outside the band. Additionally, Figure H-7 shows the annual average number of customers for the various scenarios.

Figure H-6



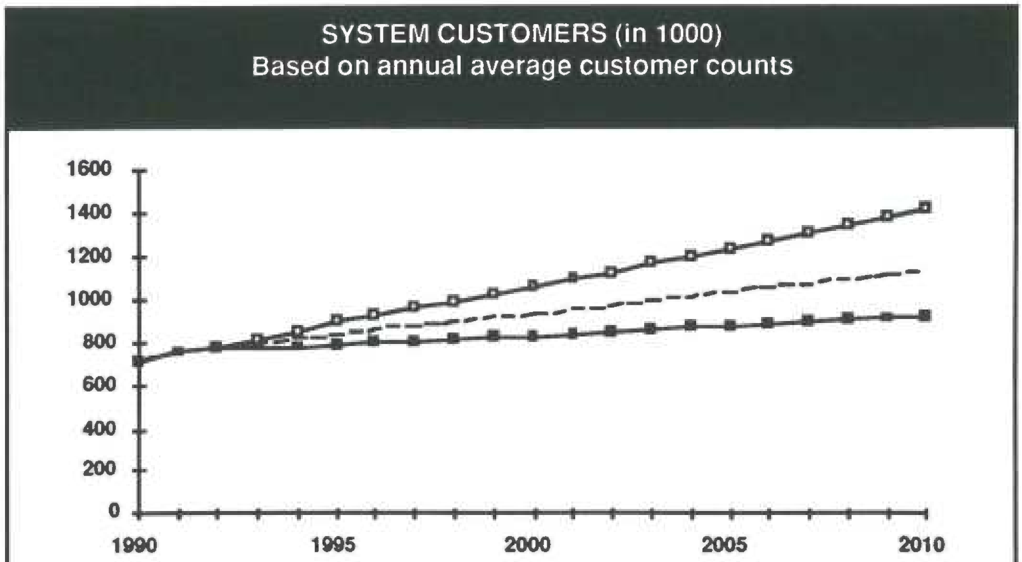
* Existing resources are those resources currently in use or resources that are being developed under contract

Table H-5

SCENARIO LOADS (aMW)

Year	High	Medium High	Medium	Medium Low	Low	Existing Resources*
1991	2243	2243	2243	2243	2243	2110
1992	2359	2348	2335	2289	2285	2182
1993	2493	2478	2415	2296	2289	2409
1994	2633	2618	2493	2259	2251	2637
1995	2794	2771	2576	2265	2249	2661
1996	2958	2919	2649	2284	2259	2620
1997	3085	3024	2714	2309	2274	2558
1998	3220	3129	2778	2336	2288	2522
1999	3367	3241	2844	2366	2302	2497
2000	3523	3358	2911	2396	2315	2445
2001	3665	3465	2972	2425	2327	2353
2002	3811	3567	3031	2452	2335	2280
2003	3970	3676	3091	2481	2343	2221
2004	4142	3788	3154	2511	2347	2156
2005	4315	3899	3216	2541	2353	2116
2006	4497	4015	3281	2571	2363	2097
2007	4685	4131	3345	2600	2372	2092
2008	4883	4252	3412	2632	2383	2020
2009	5088	4375	3480	2663	2394	1950
2010	5301	4498	3546	2692	2404	1950

Figure H-7



	1990	1995	2000	2010	1990-2010 Average Additions
High	732.3	895.7	1065.0	1424.3	35.3
Medium High	732.3	895.7	1065.0	1424.3	35.3
Medium	732.3	852.5	951.7	1159.2	21.3
Medium Low	732.3	790.3	835.3	928.4	10.0
Low	732.3	790.3	835.3	928.4	10.0

Scenario Descriptions

Medium Scenario

The Medium scenario baseline assumptions include employment in the area Puget Power serves at a 2.6% annual average rate during the 1991-2010 period, faster than in the Pacific Northwest or the nation. Services, trade and high-technology are the key sources of employment growth.

Resource based industries such as lumber and wood products, paper and food processing are not significant sources of growth. Aerospace and related industries provide a stable base of manufacturing employment but are not sources of rapid growth as during recent years.

Population within the area of Puget Power service grows at an annual average rate of about 2% during the forecast period.

In-migration slows from recent levels but remains a major component of population growth. About half of statewide population growth occurs within the area Puget Power serves. Multi-family construction continues to account for an increasing share of customer additions. Together with demographic trends, the increased share of multi-family housing causes persons per household to continue declining.

Electricity prices are expected to remain higher than natural gas prices in this scenario, although the difference narrows over time. With natural gas prices remaining lower than electric prices, fuel choices in new construction and conversions cause the electric saturation rate for single family space heating to decline from the current 40% to less than 30% by 2010. Similarly, the electric saturation rate for single family water heating declines from the current 70% to less than 45% in 2010. However, space and water heating in multi-family housing remains almost entirely electric and no significant change in electric market share occurs in the commercial sector.

Medium High Scenario

This scenario varies the economic growth assumptions used in the Medium scenario. In particular, the assumptions about employment, population/demographics, and income are changed. Real electricity and fossil fuel prices are identical to the Medium scenario.

In the Medium High scenario, the area Puget Power serves achieves a record high level of growth relative to the nation. Employment grows at an annual average rate of 3.5% during the planning period. Aerospace employment gradually increases over this period, providing an important source of growth, both directly and through multiplier effects (each additional aerospace job is assumed to support about three additional non-aerospace jobs). Expanded employment opportunities attract higher levels of in-migration than in the Medium scenario. Higher levels of business investment result in more rapid productivity growth, contributing to more rapid growth in per capita income.

The annual average rate of growth for real per capita income increases to 2.0%. These higher levels of income increase the demand for new appliances which uses electricity as well as the usage of existing appliances.

Compared to the Medium scenario, labor force participation rates are higher causing employment per person to increase. Higher population levels increase the share of customers living in multi-family housing, and higher incomes increase the rate of household formation. As a result, persons per household also declines more rapidly.

Medium Low Scenario

The Medium Low scenario is another variation of baseline assumptions in this scenario, the regional economy goes into a deep recession in the early 1990's. Led by a 30% decline in aerospace employment, total employment in the area of service declines by almost 10% between 1992 and 1995. Over the entire 1991-2010 planning horizon, the annual average rate of employment growth declines to 0.4%. With the national economy growing more rapidly than the local economy, out-migration reduces customer growth. Customer additions in this scenario are lower than during any period of the last 20 years.

Load growth is also slowed by the reduction in per capita income growth. With manufacturing employment declining over the forecast period, employment growth is restricted to lower wage service and trade occupations. Per capita incomes grows at an annual average rate of only 0.5% over the forecast period. Slower population growth reduces the need for higher population densities and lower incomes reduce the rate of household formation. As a result, persons per household experiences little change during the forecast period.

High Scenario

The High scenario uses the same economic growth assumptions as the Medium High, but alters the fuel price assumptions. All fuel prices rise more rapidly in this scenario due to higher national and worldwide demand for energy sources. The increase in fossil fuel prices relative to the Medium High scenario is greater than the increase in electricity prices, resulting in a lower price of electricity relative to natural gas.

This price crossover (gas to electricity) occurs after the year 2000, resulting in a greater share of electric space and water heat in new residential construction. The electric penetration rate for space heat in new single family construction rises to 45% in this scenario by 2010 compared to the forecasted decline to 15% in the Medium High. Load growth is also increased by conversion of space and water heating equipment in existing homes from natural gas to electricity. Increased use of electricity for space and water heating causes use per customer to rise over 1000 kWh above the level in the Medium High projection.

In the commercial sector, loads also increase because of higher electric saturation rates for space and water heating. In the industrial sector, restrictions on the use of residual oil (imposed because of environmental problems stemming from greater worldwide energy use) increase electric load.

Electric cars are assumed to be a commercial reality by the year 2000. By the year 2010, approximately 250,000 electric cars are assumed in the area Puget Power serves adding approximately 200 aMW of load.

Low Scenario

The Low scenario uses the same economic growth assumptions as the Medium Low projection, but alters the fuel price assumptions. Because of slower worldwide economic growth and greater discovery of new fossil fuel supplies, all fuel prices rise more slowly in this scenario. The decrease in fossil fuel prices relative to the Medium Low is greater than the decrease in electricity prices, resulting in a higher price of electricity relative to natural gas.

Because electricity prices are higher in this scenario relative to natural gas prices, the electric market share for space and water heating declines. By 2010, less than 10% of new single family construction is using electricity for space and water heating. Conversion activity in existing, single family homes also reduces electric load growth. Additionally, nearly half of new multi-family construction is using natural gas for space and water heating by 2010. Because of the reduced electric market share for space and water heating, use per customer is over 500 kWh less than in the Medium Low projection. In the commercial sector, loads are reduced due to lower electric saturation rates for space and water heating. Similarly, industrial load growth is reduced by greater use of natural gas and residual oil for energy.

Medium Scenario with Sudden Loss of Resources

This future considers the sudden loss of resources in combination with the economic assumptions of the Medium scenario. Utilities have always faced the possibility that a catastrophic event or equipment failure could cause the loss of a generating facility for potentially long time periods, resulting in a long-term energy deficit.

However, more recently, the possibility of a resource loss due to environmental, regulatory or political constraints on generating projects has increased utility awareness of the risk of possible resource losses. For example, in the Northwest, a recent event such as the potential effect of salmon recovery plans on hydroelectric generation has become a very important issues that could substantially alter the region's load and resource situation.

In the integrated resource planning process, the loss will be assumed to create a firm deficit on Puget Power's system and to occur without adequate warning to allow for the development of new resources.

Potential Scenario Affects

Each of the six scenarios considered in this plan is comprised of a different series of logically consistent events. Different scenarios consider different rates of customer growth, fuel price changes, and resource acquisition. The different events within each scenario have different affects on the company in meeting its resource needs.

Medium High Scenario

The acceleration of load growth in the Medium High scenario (relative to the Medium scenario) would have wide ranging impacts on the company. Meeting load would require accelerating conservation programs in both existing and new construction. While increased construction activity would increase conservation potential, it would also be necessary to acquire more (and hence higher cost) conservation from existing homes and buildings.

In addition, more generating resources would need to be acquired, as conservation alone would not be able to meet the accelerated rate of load growth. Due to rapid economic growth throughout the region, fewer opportunities to meet load growth with purchased power would exist. More rapid customer additions would increase expenditures for expanding and improving the distribution system. Additional measures would be required to assure that peak loads are met during extreme cold weather periods.

High Scenario

Since the High scenario further accelerates the rate of load growth, it further magnifies the Medium High scenario affects on the company. Since the High scenario also incorporates higher fuel prices, it raises the cost of acquiring fossil fuel based generating resources. The use of electric cars in the High scenario could also significantly alter daily load shapes, and could imply the need for changes in rate structure to minimize the affect of electric cars on peak load.

Medium Low Scenario

In contrast, events in the Medium Low scenario result in much slower load growth than in the Medium projection. Conservation potential would be reduced due to the decline in new construction. Recessionary conditions would reduce customer willingness to make capital investments for energy savings. Expenditures on the distribution system and generating resources would be reduced. Opportunities to meet load growth with purchased power would increase due to slower growth rates throughout the region.

Low Scenario

By further reducing the rate of load growth due to fuel price changes, the Low scenario builds upon the Medium Low scenario affects. Conservation potential would be further reduced by the loss of market share to natural gas. Since loss of market share would occur primarily for space and water heating, system load shapes would change and system load factors would rise. Lower fossil fuel prices would reduce the cost of acquiring fossil fuel based resources, but little new generation would be required.

Medium Scenario with Sudden Loss of Resources

Puget Power's reaction to a sudden resource loss would vary depending upon the amount of power lost, the duration of the power loss, and Puget Power's load and resource situation at the time. If the amount of power lost was relatively small (e.g., the 100 kW Smith Creek Hydroelectric Project), the same response would probably not be required as if the loss were on a larger scale (e.g., all 700 MW produced by the Colstrip units). If Puget Power were in a surplus situation, then a resource loss may not create a large need. The duration of the power loss would also constrain reaction alternatives. The scenario evaluation discussion describes the alternatives Puget Power would take if this future were to unfold.

Financial Assumptions

Financial forecasts also play a key role in resource planning. These assessments provide a financial base for the scenario analyses. The following discussion describes the financial assumptions incorporated into the scenario planning process and analyses.

Tables H-6 and H-7 show the levelized fixed charge rates for conservation and generating resources, respectively. Depreciation, capital costs, and tax costs make up the majority of the levelized fixed charge rate. Other costs incorporated into the levelized fixed charge rate include rates for state utility and municipal taxes, other revenue sensitive items, property tax and insurance. These cost are referenced in Table H-8.

Table H-9 contains the target capital structure used in the scenario analyses. Table H-10 presents the cost of capital assumptions for each scenario, which are based on Puget Power's current capital structure developed in conjunction with the various Data Resources Incorporated (DRI) forecasts.

Table H-6

LEVELIZED FIXED CHARGE RATES USED IN SCENARIO ANALYSES FOR CONSERVATION INVESTMENTS

Benefit Life	Low	Medium Low	Medium	Medium High	High
5 Yr.	27.89%	27.89%	26.94%	26.19%	26.19%
10 Yr.	17.58%	17.58%	16.98%	16.24%	16.24%
12 Yr.	15.97%	15.97%	15.42%	14.67%	14.67%
15 Yr.	14.45%	14.45%	13.95%	13.17%	13.17%
20 Yr.	13.08%	13.08%	12.63%	11.80%	11.80%
25 Yr.	12.40%	12.40%	11.96%	11.10%	11.10%
30 Yr.	12.03%	12.03%	11.60%	10.71%	10.71%
35 Yr.	11.82%	11.82%	11.40%	10.48%	10.48%
40 Yr.	11.70%	11.70%	11.28%	10.34%	10.34%
45 Yr.	11.63%	11.63%	11.22%	10.26%	10.26%
50 Yr.	11.59%	11.59%	11.18%	10.22%	10.22%
55 Yr.	11.57%	11.57%	11.16%	10.19%	10.19%
60 Yr.	11.56%	11.56%	11.14%	10.17%	10.17%
65 Yr.	11.55%	11.55%	11.14%	10.16%	10.16%

Table H-7

LEVELIZED FIXED CHARGE RATES USED IN SCENARIO ANALYSES FOR GENERATING RESOURCE INVESTMENTS

15 Year Tax Life (Combustion Turbine, IGCC)

Benefit Life	Low	Medium Low	Medium	Medium High	High
20 Yr.	16.07%	16.07%	14.51%	13.56%	13.56%
30 Yr.	14.73%	14.73%	13.16%	12.11%	12.11%

20 Year Tax Life (Hydro, Wind, Geothermal, Solar, Fuel Cell Coal)

Benefit Life	Low	Medium Low	Medium	Medium High	High
20 Yr.	16.70%	16.70%	14.94%	13.88%	13.88%
30 Yr.	15.28%	15.28%	13.53%	12.43%	12.43%
40 Yr.	14.88%	14.88%	13.18%	12.11%	12.11%
50 Yr.	14.49%	14.49%	12.83%	11.63%	11.63%

Table H-8

OTHER COST INCLUDED IN THE LEVELIZED FIXED CHARGE RATE

Depreciation of Generating Plant

- Book depreciation is straight line.
- Tax depreciation is 150% declining balance switching to straight line (at the point which straight line exceeds the declining balance rate).

Conservation Amortization

- Book amortization over 10 years.
- For tax purposes, conservation investment is fully expensed in the year incurred.
- The tax benefit is flowed through to customers.

Revenue Sensitive Items

State Utility Tax	3.85% *
WUTC Filing Fee	0.17%
Municipal Tax	2.22% **
Uncollectable	0.55%
	6.79%

Property Tax effective rate 1.15% of gross plant.

Insurance effective rate 0.16% of gross plant.

Property tax and insurance are not included in the fixed cost of conservation investments.

* *Statutory rate of 3.873% times 1-uncollectable rate*

** *Estimated rate of 2.23% times 1-uncollectable rate*

One factor not directly reflected in the cost of capital is the effect of purchased power contracts being increasingly viewed as debt equivalents by rating agencies. This could potentially result in a down-grading of the company's credit rating and could adversely affect the cost and availability of capital to the company because of the perceived increase in risk.

The general tax assumptions are shown in Table H-11. Tax rate fluctuations are directly influenced by economic conditions. In the Medium High and High scenarios, tax rates are presumed lower due to higher employment rates and less funding required for social programs. Conversely, in the Medium Low and Low scenarios, tax rates are higher due to lower employment rates and additional funding required for social programs.

Tables H-12 through H-16 lists the financing assumptions for the various scenarios. A basis spread is added to adjust the DRI forecast to Puget Power's cost rates. A 10 year average (1991 through 2000) is used to estimate the future marginal cost rates.

The Medium and Sudden Loss scenarios use the DRI Current Trend August 1991 forecast. The High and Medium High scenarios use the DRI Optimlong August 1991 forecast. The Low and Medium Low scenarios use the DRI Pessimlong August 1991 forecast.

The long-term debt (LTD) rate is calculated by adding 87 basis points to the 10 year average of DRI's 10 year Treasury bond forecast.

The short-term debt (STD) rate is calculated by adding 25 basis points to the 10 year average of DRI's 3 month commercial paper rate.

The preferred stock (PFD) cost is calculated by adding 75 basis points to the 10 year average of DRI's forecast of 30 year Treasury bond rates.

The cost of common equity (Common) is the allowed rate from U-89-2688-T during 1991 through 1993, 12.8%.
For 1994 through 2000 the equity rate is estimated as 450 basis points above the 30-year Treasury Bond.

Table H-9

TARGET CAPITAL STRUCTURE USED IN SCENARIO ANALYSES

	Capital Structure
Long-term Debt	46.4%
Short-term Debt	4.4%
Preferred Stock	7.7%
Common Equity	41.5%
TOTAL	100.0%

Table H-10

COST OF CAPITAL ASSUMPTIONS USED IN SCENARIO ANALYSES

Cost of Capital is a function of the scenario economic conditions

Capital	Low	Medium Low	Medium	Medium High	High
Long-term Debt	9.96%	9.96%	9.05%	8.04%	8.04%
Short-term Debt	8.41%	8.41%	7.49%	6.59%	6.59%
Preferred Stock	9.74%	9.74%	8.89%	7.92%	7.92%
Common Equity	13.30%	13.30%	12.52%	11.64%	11.64%
WACC	11.26%	11.26%	10.41%	9.46%	9.46%
Conservation					
Common	15.30%	15.30%	14.52%	13.64%	13.64%
WACC	12.09%	12.09%	11.24%	10.29%	10.29%

Table H-11

FEDERAL CORPORATE INCOME TAX RATE ASSUMPTIONS USED IN SCENARIO ANALYSES

Year	Low	Medium Low	Medium	Medium High	High
1991	40%	40%	34%	34%	34%
1992	40%	40%	34%	34%	34%
1993	42%	42%	34%	34%	34%
1994	42%	42%	34%	34%	34%
1995	42%	42%	34%	34%	34%
1996	42%	42%	34%	34%	34%
1997	44%	44%	34%	33%	33%
1998	44%	44%	34%	33%	33%
1999	44%	44%	34%	33%	33%
2000	44%	44%	34%	33%	33%
2001	46%	46%	34%	29%	29%
2002	46%	46%	34%	29%	29%
2003	46%	46%	34%	29%	29%
2004	46%	46%	34%	29%	29%
2005	48%	48%	34%	28%	28%
2006	48%	48%	34%	28%	28%
2007	48%	48%	34%	28%	28%
2008	48%	48%	34%	28%	28%
2009	50%	50%	34%	28%	28%
2010	50%	50%	34%	28%	28%

Table H-12

FINANCIAL ASSUMPTIONS FOR HIGH SCENARIO *										
Year	10-Yr. Treasury Bond	20-Yr. Treasury Bond	30-Yr. Treasury Bond	3 Month Commercial Paper	3 Month Treasury Bill	GNP Price Deflator	Coal Escalation	Gas Escalation	New Resource Escalation	Equipment Escalation
1991	8.18%	7.67%	8.35%	6.15%	5.70%	3.80%	0.80%	0.37%	9.54%	-2.20%
1992	8.76%	8.63%	8.87%	6.98%	6.66%	2.50%	5.49%	3.52%	-4.19%	-2.39%
1993	8.82%	8.77%	8.94%	7.16%	6.80%	2.80%	3.40%	5.51%	4.71%	0.10%
1994	8.34%	8.42%	8.45%	7.09%	6.45%	3.10%	3.30%	13.01%	8.04%	0.39%
1995	7.70%	7.70%	7.80%	6.36%	5.73%	3.10%	3.10%	12.75%	6.55%	-0.30%
1996	7.33%	7.34%	7.40%	5.91%	5.37%	2.80%	3.40%	11.60%	7.54%	-0.48%
1997	6.93%	6.93%	6.98%	5.51%	4.96%	2.60%	3.59%	10.94%	10.91%	0.02%
1998	6.50%	6.51%	6.53%	5.12%	4.54%	2.50%	3.39%	6.70%	4.45%	0.32%
1999	6.39%	6.38%	6.43%	5.03%	4.41%	2.50%	3.69%	7.21%	5.61%	0.92%
2000	6.34%	6.33%	6.38%	5.02%	4.36%	2.80%	3.79%	7.32%	5.94%	1.41%
2001	6.21%	6.27%	6.24%	5.00%	4.30%	2.90%	4.48%	7.23%	5.01%	1.61%
2002	6.12%	6.21%	6.13%	4.99%	4.24%	2.90%	4.28%	7.06%	5.73%	2.01%
2003	6.08%	6.16%	6.08%	4.98%	4.19%	2.90%	4.38%	7.08%	6.14%	2.01%
2004	6.06%	6.13%	6.06%	4.95%	4.16%	2.90%	4.68%	6.56%	6.29%	1.61%
2005	6.05%	6.13%	6.05%	4.95%	4.16%	2.90%	4.58%	6.43%	6.40%	1.61%
2006	6.02%	6.10%	6.02%	4.93%	4.13%	3.00%	4.38%	6.59%	5.71%	1.91%
2007	6.03%	6.09%	6.03%	4.93%	4.12%	3.10%	4.98%	6.73%	4.98%	2.11%
2008	6.04%	6.08%	6.04%	4.92%	4.11%	3.10%	4.78%	6.45%	4.07%	2.11%
2009	6.09%	6.08%	6.09%	4.91%	4.11%	3.10%	5.17%	6.19%	6.12%	2.11%
2010	6.14%	6.07%	6.15%	4.90%	4.10%	3.10%	5.17%	6.10%	5.28%	2.11%

Table H-12 (continued)

	S/T DEBT	BONDS	PREFERRED	COMMON	PCB FLOAT	ADJ RATE PREFERRED	AUCTION PREFERRED
Year	STD 3-Mo CP plus 25 points	LTD 10-Yr T plus 87 points	PFD 30-Yr T plus 75 points	Equity Actual or 30-yr T + 450 points	PCB FLT 3-Mo T-Bill + 229 points	Adj Rate Preferred 20-Yr T + 100 points	Auction Pref (3-Mo CP + 7 points) times 0.85
1991	6.40%	9.05%	9.10%	12.85%	3.41%	6.67%	5.17%
1992	7.23%	9.63%	9.62%	13.37%	4.37%	7.63%	5.87%
1993	7.41%	9.69%	9.69%	13.44%	4.51%	7.77%	6.03%
1994	7.34%	9.21%	9.20%	12.95%	4.16%	7.42%	5.97%
1995	6.61%	8.57%	8.55%	12.30%	3.44%	6.70%	5.35%
1996	6.16%	8.20%	8.15%	11.90%	3.08%	6.34%	4.96%
1997	5.76%	7.80%	7.73%	11.48%	2.67%	5.93%	4.62%
1998	5.37%	7.37%	7.28%	11.03%	2.25%	5.51%	4.29%
1999	5.28%	7.26%	7.18%	10.93%	2.12%	5.38%	4.22%
2000	5.27%	7.21%	7.13%	10.88%	2.07%	5.33%	4.21%
2001	5.25%	7.08%	6.99%	10.74%	2.01%	5.27%	4.19%
2002	5.24%	6.99%	6.88%	10.63%	1.95%	5.21%	4.18%
2003	5.23%	6.95%	6.83%	10.58%	1.90%	5.16%	4.17%
2004	5.20%	6.93%	6.81%	10.56%	1.87%	5.13%	4.15%
2005	5.20%	6.92%	6.80%	10.55%	1.87%	5.13%	4.15%
2006	5.18%	6.89%	6.77%	10.52%	1.84%	5.10%	4.13%
2007	5.18%	6.90%	6.78%	10.53%	1.83%	5.09%	4.13%
2008	5.17%	6.91%	6.79%	10.54%	1.82%	5.08%	4.12%
2009	5.16%	6.96%	6.84%	10.59%	1.82%	5.08%	4.11%
2010	5.15%	7.01%	6.90%	10.65%	1.81%	5.07%	4.11%

* *Data developed from the DRI Summer 1991 long-range projections. The High and Medium High scenarios use the Optimlong forecast.*

Table H-13

FINANCIAL ASSUMPTIONS FOR MEDIUM HIGH SCENARIO *

Year	10-Yr. Treasury Bond	20-Yr. Treasury Bond	30-Yr. Treasury Bond	3 Month Commercial Paper	3 Month Treasury Bill	GNP Price Deflator	Coal Escalation	Gas Escalation	New Resource Escalation	Equipment Escalation
1991	8.18%	7.67%	8.35%	6.15%	5.70%	3.80%	0.80%	0.46%	9.54%	-2.20%
1992	8.76%	8.63%	8.87%	6.98%	6.66%	2.50%	5.49%	2.50%	-4.19%	-2.39%
1993	8.82%	8.77%	8.94%	7.16%	6.80%	2.80%	3.40%	4.51%	4.71%	0.10%
1994	8.34%	8.42%	8.45%	7.09%	6.45%	3.10%	3.30%	5.80%	8.04%	0.39%
1995	7.70%	7.70%	7.80%	6.36%	5.73%	3.10%	3.10%	6.05%	6.55%	-0.30%
1996	7.33%	7.34%	7.40%	5.91%	5.37%	2.80%	3.40%	5.03%	7.54%	-0.48%
1997	6.93%	6.93%	6.98%	5.51%	4.96%	2.60%	3.59%	5.09%	10.91%	0.02%
1998	6.50%	6.51%	6.53%	5.12%	4.54%	2.50%	3.39%	5.84%	4.45%	0.32%
1999	6.39%	6.38%	6.43%	5.03%	4.41%	2.50%	3.69%	6.32%	5.61%	0.92%
2000	6.34%	6.33%	6.38%	5.02%	4.36%	2.80%	3.79%	6.49%	5.94%	1.41%
2001	6.21%	6.27%	6.24%	5.00%	4.30%	2.90%	4.48%	6.47%	5.01%	1.61%
2002	6.12%	6.21%	6.13%	4.99%	4.24%	2.90%	4.28%	6.35%	5.73%	2.01%
2003	6.08%	6.16%	6.08%	4.98%	4.19%	2.90%	4.38%	6.23%	6.14%	2.01%
2004	6.06%	6.13%	6.06%	4.95%	4.16%	2.90%	4.68%	5.64%	6.29%	1.61%
2005	6.05%	6.13%	6.05%	4.95%	4.16%	2.90%	4.58%	5.81%	6.40%	1.61%
2006	6.02%	6.10%	6.02%	4.93%	4.13%	3.00%	4.38%	5.83%	5.71%	1.91%
2007	6.03%	6.09%	6.03%	4.93%	4.12%	3.10%	4.98%	5.85%	4.98%	2.11%
2008	6.04%	6.08%	6.04%	4.92%	4.11%	3.10%	4.78%	5.78%	4.07%	2.11%
2009	6.09%	6.08%	6.09%	4.91%	4.11%	3.10%	5.17%	5.50%	6.12%	2.11%
2010	6.14%	6.07%	6.15%	4.90%	4.10%	3.10%	5.17%	5.23%	5.28%	2.11%

Table H-13 (continued)

	S/T DEBT	BONDS	PREFERRED	COMMON	PCB FLOAT	ADJ RATE PREFERRED	AUCTION PREFERRED
Year	STD 3-Mo CP plus 25 points	LTD 10-Yr T plus 87 points	PFD 30-Yr T plus 75 points	Equity Actual or 30-yr T + 450 points	PCB FLT 3-Mo T-Bill + 229 points	Adj Rate Preferred 20-Yr T + 100 points	Auction Pref (3-Mo CP + 7 points) times 0.85
1991	6.40%	9.05%	9.10%	12.85%	3.41%	6.67%	5.17%
1992	7.23%	9.63%	9.62%	13.37%	4.37%	7.63%	5.87%
1993	7.41%	9.69%	9.69%	13.44%	4.51%	7.77%	6.03%
1994	7.34%	9.21%	9.20%	12.95%	4.16%	7.42%	5.97%
1995	6.61%	8.57%	8.55%	12.30%	3.44%	6.70%	5.35%
1996	6.16%	8.20%	8.15%	11.90%	3.08%	6.34%	4.96%
1997	5.76%	7.80%	7.73%	11.48%	2.67%	5.93%	4.62%
1998	5.37%	7.37%	7.28%	11.03%	2.25%	5.51%	4.29%
1999	5.28%	7.26%	7.18%	10.93%	2.12%	5.38%	4.22%
2000	5.27%	7.21%	7.13%	10.88%	2.07%	5.33%	4.21%
2001	5.25%	7.08%	6.99%	10.74%	2.01%	5.27%	4.19%
2002	5.24%	6.99%	6.88%	10.63%	1.95%	5.21%	4.18%
2003	5.23%	6.95%	6.83%	10.58%	1.90%	5.16%	4.17%
2004	5.20%	6.93%	6.81%	10.56%	1.87%	5.13%	4.15%
2005	5.20%	6.92%	6.80%	10.55%	1.87%	5.13%	4.15%
2006	5.18%	6.89%	6.77%	10.52%	1.84%	5.10%	4.13%
2007	5.18%	6.90%	6.78%	10.53%	1.83%	5.09%	4.13%
2008	5.17%	6.91%	6.79%	10.54%	1.82%	5.08%	4.12%
2009	5.16%	6.96%	6.84%	10.59%	1.82%	5.08%	4.11%
2010	5.15%	7.01%	6.90%	10.65%	1.81%	5.07%	4.11%

* *Data developed from the DRI Summer 1991 long-range projections. The High and Medium High scenarios use the Optimlong forecast.*

Table H-14

FINANCIAL ASSUMPTIONS FOR MEDUIM SCENARIO AND MEDIUM WITH SUDDEN LOSS OF RESOURCE SCENARIO*

Year	10-Yr. Treasury Bond	20-Yr. Treasury Bond	30-Yr. Treasury Bond	3 Month Commercial Paper	3 Month Treasury Bill	GNP Price Deflator	Coal Escalation	Gas Escalation	New Resource Escalation	Equipment Escalation
1991	8.18%	7.67%	8.35%	6.15%	5.70%	3.80%	0.80%	0.46%	9.54%	-2.20%
1992	8.49%	8.36%	8.60%	6.71%	6.39%	2.80%	5.80%	2.80%	3.55%	-2.10%
1993	8.16%	8.11%	8.28%	6.50%	6.14%	2.70%	3.30%	4.41%	8.41%	0.00%
1994	8.18%	8.26%	8.29%	6.93%	6.29%	2.90%	3.10%	5.59%	6.03%	0.20%
1995	7.83%	7.83%	7.93%	6.49%	5.86%	3.00%	3.00%	5.95%	8.94%	-0.40%
1996	7.87%	7.88%	7.94%	6.45%	5.91%	3.40%	4.00%	5.64%	7.96%	0.10%
1997	7.88%	7.88%	7.93%	6.46%	5.91%	3.50%	4.50%	6.01%	10.60%	0.90%
1998	7.84%	7.85%	7.87%	6.46%	5.88%	3.50%	4.40%	6.87%	5.83%	1.30%
1999	7.82%	7.81%	7.86%	6.46%	5.84%	3.60%	4.80%	7.46%	6.30%	2.00%
2000	7.78%	7.77%	7.82%	6.46%	5.80%	3.90%	4.90%	7.63%	5.74%	2.50%
2001	7.67%	7.73%	7.70%	6.46%	5.76%	4.00%	5.60%	7.61%	6.30%	2.70%
2002	7.59%	7.68%	7.60%	6.46%	5.71%	4.10%	5.50%	7.59%	6.59%	3.20%
2003	7.56%	7.64%	7.56%	6.46%	5.67%	4.10%	5.60%	7.47%	5.87%	3.20%
2004	7.56%	7.63%	7.56%	6.45%	5.66%	4.10%	5.90%	6.87%	8.03%	2.80%
2005	7.55%	7.63%	7.55%	6.45%	5.66%	4.10%	5.80%	7.04%	6.89%	2.80%
2006	7.54%	7.62%	7.54%	6.45%	5.65%	4.20%	5.60%	7.06%	8.34%	3.10%
2007	7.55%	7.61%	7.55%	6.45%	5.64%	4.20%	6.10%	6.98%	5.25%	3.20%
2008	7.57%	7.61%	7.57%	6.45%	5.64%	4.30%	6.00%	7.01%	4.66%	3.30%
2009	7.63%	7.62%	7.63%	6.45%	5.65%	4.40%	6.50%	6.83%	7.52%	3.40%
2010	7.69%	7.62%	7.70%	6.45%	5.65%	4.40%	6.50%	6.56%	5.71%	3.40%

Table H-14 (continued)

Year	S/T DEBT STD 3-Mo CP plus 25 points	BONDS LTD 10-Yr T plus 87 points	PREFERRED PFD 30-Yr T plus 75 points	COMMON Equity Actual or 30-yr T + 450 points	PCB FLOAT PCB FLT 3-Mo T-Bill + 229 points	ADJ RATE PREFERRED Adj Rate Preferred 20-Yr T + 100 points	AUCTION PREFERRED Auction Pref (3-Mo CP + 7 points) times 0.85
1991	6.40%	9.05%	9.10%	12.80%	3.41%	6.67%	5.17%
1992	6.96%	9.36%	9.35%	12.80%	4.10%	7.36%	5.64%
1993	6.75%	9.03%	9.03%	12.80%	3.85%	7.11%	5.47%
1994	7.18%	9.05%	9.04%	12.79%	4.00%	7.26%	5.83%
1995	6.74%	8.70%	8.68%	12.43%	3.57%	6.83%	5.46%
1996	6.70%	8.74%	8.69%	12.44%	3.62%	6.88%	5.42%
1997	6.71%	8.75%	8.68%	12.43%	3.62%	6.88%	5.43%
1998	6.71%	8.71%	8.62%	12.37%	3.59%	6.85%	5.43%
1999	6.71%	8.69%	8.61%	12.36%	3.55%	6.81%	5.43%
2000	6.71%	8.65%	8.57%	12.32%	3.51%	6.77%	5.43%
2001	6.71%	8.54%	8.45%	12.20%	3.47%	6.73%	5.43%
2002	6.71%	8.46%	8.35%	12.10%	3.42%	6.68%	5.43%
2003	6.71%	8.43%	8.31%	12.06%	3.38%	6.64%	5.43%
2004	6.70%	8.43%	8.31%	12.06%	3.37%	6.63%	5.42%
2005	6.70%	8.42%	8.30%	12.05%	3.37%	6.63%	5.42%
2006	6.70%	8.41%	8.29%	12.04%	3.36%	6.62%	5.42%
2007	6.70%	8.42%	8.30%	12.05%	3.35%	6.61%	5.42%
2008	6.70%	8.44%	8.32%	12.07%	3.35%	6.61%	5.42%
2009	6.70%	8.50%	8.38%	12.13%	3.36%	6.62%	5.42%
2010	6.70%	8.56%	8.45%	12.20%	3.36%	6.62%	5.42%

* *Data developed from the DRI Summer 1991 long-range projections. The Medium and Medium with Sudden Loss of Resources Scenarios utilize the Treadlong forecast.*

Table H-15

FINANCIAL ASSUMPTIONS FOR MEDIUM LOW SCENARIO *										
Year	10-Yr. Treasury Bond	20-Yr. Treasury Bond	30-Yr. Treasury Bond	3 Month Commercial Paper	3 Month Treasury Bill	GNP Price Deflator	Coal Escalation	Gas Escalation	New Resource Escalation	Equipment Escalation
1991	8.18%	7.67%	8.35%	6.15%	5.70%	3.80%	0.80%	0.46%	9.54%	-2.20%
1992	7.70%	7.57%	7.81%	5.92%	5.60%	2.60%	5.59%	2.60%	14.52%	-2.29%
1993	8.03%	7.98%	8.15%	6.37%	6.01%	2.00%	2.60%	3.70%	7.61%	-0.68%
1994	8.07%	8.15%	8.18%	6.82%	6.18%	2.20%	2.40%	4.87%	8.64%	-0.48%
1995	8.28%	8.28%	8.38%	6.94%	6.31%	2.90%	2.90%	5.85%	6.75%	-0.50%
1996	9.01%	9.02%	9.08%	7.59%	7.05%	4.70%	5.31%	6.97%	9.71%	1.36%
1997	9.72%	9.72%	9.77%	8.30%	7.75%	5.30%	6.32%	7.85%	10.29%	2.65%
1998	9.95%	9.96%	9.98%	8.57%	7.99%	5.50%	6.42%	8.94%	6.72%	3.26%
1999	9.94%	9.93%	9.98%	8.58%	7.96%	5.70%	6.92%	9.64%	5.42%	4.07%
2000	9.92%	9.91%	9.96%	8.60%	7.94%	6.10%	7.12%	9.91%	6.63%	4.67%
2001	9.81%	9.87%	9.84%	8.60%	7.90%	6.30%	7.94%	9.99%	7.31%	4.97%
2002	9.75%	9.84%	9.76%	8.62%	7.87%	6.30%	7.73%	9.86%	5.22%	5.38%
2003	9.73%	9.81%	9.73%	8.63%	7.84%	6.30%	7.83%	9.74%	5.65%	5.38%
2004	9.72%	9.79%	9.72%	8.61%	7.82%	6.40%	8.24%	9.23%	7.69%	5.07%
2005	9.72%	9.80%	9.72%	8.62%	7.83%	6.30%	8.04%	9.30%	7.51%	4.97%
2006	9.71%	9.79%	9.71%	8.62%	7.82%	6.30%	7.73%	9.22%	7.77%	5.18%
2007	9.73%	9.79%	9.73%	8.63%	7.82%	6.30%	8.24%	9.14%	9.20%	5.28%
2008	9.76%	9.80%	9.76%	8.64%	7.83%	6.40%	8.13%	9.16%	10.62%	5.38%
2009	9.82%	9.81%	9.82%	8.64%	7.84%	6.50%	8.64%	8.98%	6.06%	5.48%
2010	9.89%	9.82%	9.90%	8.65%	7.85%	6.50%	8.64%	8.70%	5.06%	5.48%

Table H-15 (continued)

	S/T DEBT	BONDS	PREFERRED	COMMON	PCB FLOAT	ADJ RATE PREFERRED	AUCTION PREFERRED
Year	STD 3-Mo CP plus 25 points	LTD 10-Yr T plus 87 points	PFD 30-Yr T plus 75 points	Equity Actual or 30-yr T + 450 points	PCB FLT 3-Mo T-Bill + 229 points	Adj Rate Preferred 20-Yr T + 100 points	Auction Pref (3-Mo CP + 7 points) times 0.85
1991	6.40%	9.05%	9.10%	12.85%	3.41%	6.67%	5.17%
1992	6.17%	8.57%	8.56%	12.31%	3.31%	6.57%	4.97%
1993	6.62%	8.90%	8.90%	12.65%	3.72%	6.98%	5.36%
1994	7.07%	8.94%	8.93%	12.68%	3.89%	7.15%	5.74%
1995	7.19%	9.15%	9.13%	12.88%	4.02%	7.28%	5.84%
1996	7.84%	9.88%	9.83%	13.58%	4.76%	8.02%	6.39%
1997	8.55%	10.59%	10.52%	14.27%	5.46%	8.72%	7.00%
1998	8.82%	10.82%	10.73%	14.48%	5.70%	8.96%	7.23%
1999	8.83%	10.81%	10.73%	14.48%	5.67%	8.93%	7.23%
2000	8.85%	10.79%	10.71%	14.46%	5.65%	8.91%	7.25%
2001	8.85%	10.68%	10.59%	14.34%	5.61%	8.87%	7.25%
2002	8.87%	10.62%	10.51%	14.26%	5.58%	8.84%	7.27%
2003	8.88%	10.60%	10.48%	14.23%	5.55%	8.81%	7.28%
2004	8.86%	10.59%	10.47%	14.22%	5.53%	8.79%	7.26%
2005	8.87%	10.59%	10.47%	14.22%	5.54%	8.80%	7.27%
2006	8.87%	10.58%	10.46%	14.21%	5.53%	8.79%	7.27%
2007	8.88%	10.60%	10.48%	14.23%	5.53%	8.79%	7.28%
2008	8.89%	10.63%	10.51%	14.26%	5.54%	8.80%	7.28%
2009	8.89%	10.69%	10.57%	14.32%	5.55%	8.81%	7.28%
2010	8.90%	10.76%	10.65%	14.40%	5.56%	8.82%	7.29%

* *Data developed from the DRI Summer 1991 long-range projections. The Medium Low and Low Scenarios use the Pessimlong forecast.*

Table H-16

FINANCIAL ASSUMPTIONS FOR LOW SCENARIO *										
Year	10-Yr. Treasury Bond	20-Yr. Treasury Bond	30-Yr. Treasury Bond	3 Month Commercial Paper	3 Month Treasury Bill	GNP Price Deflator	Coal Escalation	Gas Escalation	New Resource Escalation	Equipment Escalation
1991	8.18%	7.67%	8.35%	6.15%	5.70%	3.80%	0.80%	0.46%	9.54%	-2.20%
1992	7.70%	7.57%	7.81%	5.92%	5.60%	2.60%	5.59%	1.58%	14.52%	-2.29%
1993	8.03%	7.98%	8.15%	6.37%	6.01%	2.00%	2.60%	2.68%	7.61%	-0.68%
1994	8.07%	8.15%	8.18%	6.82%	6.18%	2.20%	2.40%	-0.53%	8.64%	-0.48%
1995	8.28%	8.28%	8.38%	6.94%	6.31%	2.90%	2.90%	0.08%	6.75%	-0.50%
1996	9.01%	9.02%	9.08%	7.59%	7.05%	4.70%	5.31%	1.01%	9.71%	1.36%
1997	9.72%	9.72%	9.77%	8.30%	7.75%	5.30%	6.32%	1.07%	10.29%	2.65%
1998	9.95%	9.96%	9.98%	8.57%	7.99%	5.50%	6.42%	7.91%	6.72%	3.26%
1999	9.94%	9.93%	9.98%	8.58%	7.96%	5.70%	6.92%	8.06%	5.42%	4.07%
2000	9.92%	9.91%	9.96%	8.60%	7.94%	6.10%	7.12%	8.41%	6.63%	4.67%
2001	9.81%	9.87%	9.84%	8.60%	7.90%	6.30%	7.94%	8.57%	7.31%	4.97%
2002	9.75%	9.84%	9.76%	8.62%	7.87%	6.30%	7.73%	8.52%	5.22%	5.38%
2003	9.73%	9.81%	9.73%	8.63%	7.84%	6.30%	7.83%	8.11%	5.65%	5.38%
2004	9.72%	9.79%	9.72%	8.61%	7.82%	6.40%	8.24%	7.83%	7.69%	5.07%
2005	9.72%	9.80%	9.72%	8.62%	7.83%	6.30%	8.04%	7.71%	7.51%	4.97%
2006	9.71%	9.79%	9.71%	8.62%	7.82%	6.30%	7.73%	7.69%	7.77%	5.18%
2007	9.73%	9.79%	9.73%	8.63%	7.82%	6.30%	8.24%	7.67%	9.20%	5.28%
2008	9.76%	9.80%	9.76%	8.64%	7.83%	6.40%	8.13%	7.42%	10.62%	5.38%
2009	9.82%	9.81%	9.82%	8.64%	7.84%	6.50%	8.64%	7.17%	6.06%	5.48%
2010	9.89%	9.82%	9.90%	8.65%	7.85%	6.50%	8.64%	7.17%	5.06%	5.48%

Table H-16 (continued)

	S/T DEBT	BONDS	PREFERRED	COMMON	PCB FLOAT	ADJ RATE PREFERRED	AUCTION PREFERRED
Year	STD 3-Mo CP plus 25 points	LTD 10-Yr T plus 87 points	PFD 30-Yr T plus 75 points	Equity Actual or 30-yr T + 450 points	PCB FLT 3-Mo T-Bill + 229 points	Adj Rate Preferred 20-Yr T + 100 points	Auction Pref (3-Mo CP + 7 points) times 0.85
1991	6.40%	9.05%	9.10%	12.85%	3.41%	6.67%	5.17%
1992	6.17%	8.57%	8.56%	12.31%	3.31%	6.57%	4.97%
1993	6.62%	8.90%	8.90%	12.65%	3.72%	6.98%	5.36%
1994	7.07%	8.94%	8.93%	12.68%	3.89%	7.15%	5.74%
1995	7.19%	9.15%	9.13%	12.88%	4.02%	7.28%	5.84%
1996	7.84%	9.88%	9.83%	13.58%	4.76%	8.02%	6.39%
1997	8.55%	10.59%	10.52%	14.27%	5.46%	8.72%	7.00%
1998	8.82%	10.82%	10.73%	14.48%	5.70%	8.96%	7.23%
1999	8.83%	10.81%	10.73%	14.48%	5.67%	8.93%	7.23%
2000	8.85%	10.79%	10.71%	14.46%	5.65%	8.91%	7.25%
2001	8.85%	10.68%	10.59%	14.34%	5.61%	8.87%	7.25%
2002	8.87%	10.62%	10.51%	14.26%	5.58%	8.84%	7.27%
2003	8.88%	10.60%	10.48%	14.23%	5.55%	8.81%	7.28%
2004	8.86%	10.59%	10.47%	14.22%	5.53%	8.79%	7.26%
2005	8.87%	10.59%	10.47%	14.22%	5.54%	8.80%	7.27%
2006	8.87%	10.58%	10.46%	14.21%	5.53%	8.79%	7.27%
2007	8.88%	10.60%	10.48%	14.23%	5.53%	8.79%	7.28%
2008	8.89%	10.63%	10.51%	14.26%	5.54%	8.80%	7.28%
2009	8.89%	10.69%	10.57%	14.32%	5.55%	8.81%	7.28%
2010	8.90%	10.76%	10.65%	14.40%	5.56%	8.82%	7.29%

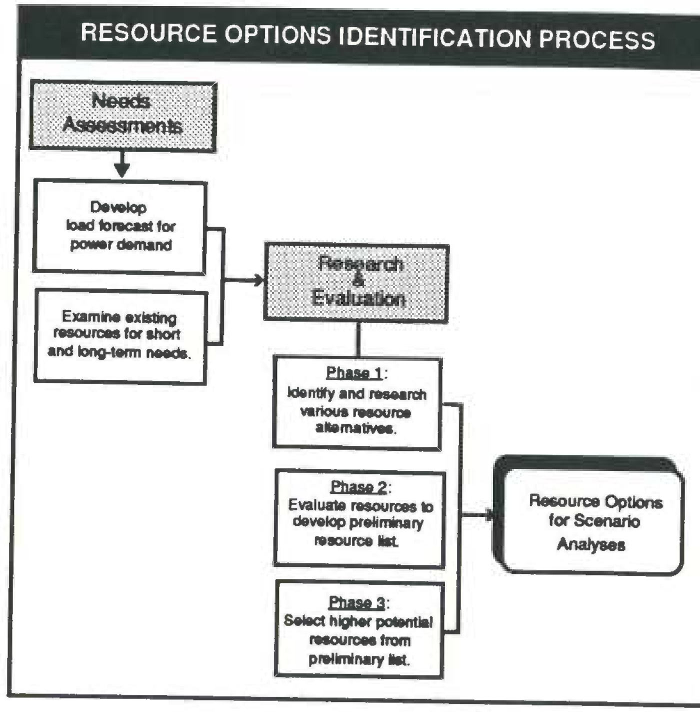
* *Data developed from the DRI Summer 1991 long-range projections. The Medium Low and Low Scenarios use the Pessimlong forecast.*

Resource Options For Scenario Analyses

The company's planning guidelines were used to direct the resource options identification process. This process is outlined in Figure H-8 Specifically, conservation and renewable resources were given preference. Additionally, high efficiency cogeneration was given preference over other thermal processes. Conservation will be included in all scenarios as a preferred resource alternative. Consideration of supply-side resources takes into account general environmental effects, generic permitting, licensing and design issues, estimated costs, and other general planning goals. This appendix also provides a brief discussion of the higher potential resource candidates. For more details on resources see the following appendices:

- Appendix C - Existing Resources
- Appendix D - Conservation Potential
- Appendix E - Supply-Side Alternatives

Figure H-8



Approach To Resource Candidate Selection

Each scenario load forecast shows continued growth and the need for additional resources. The following process describes Puget Power's approach to meeting those future needs.

Phase 1 - Identification and Research of Various Resource Alternatives

The company combined its own internal knowledge, research, and operating experience with that obtained from the Electric Power Research Institute (EPRI), the 1991 Regional Plan, various trade publications, the Technical Advisory Committee and Consumer Panels.

Additional information was obtained through the company's competitive bidding process. This activity provided information on resources being developed, availability characteristics, level of development, efficiencies and general cost-effectiveness. These various efforts, in conjunction with the company's planning guidelines, helped produce the demand-side and supply-side resource options listed in Table H-17.

Phase 2 - Preliminary List of Resource Candidates

The screening criteria for establishing the preliminary list of resource candidates included development potential in the Pacific Northwest and general consistency with Puget Power's resource planning guidelines. Other key characteristics included cost, environmental compatibility, development maturity, shorter lead times, and capacity factors.

TableH-17

DEMAND-SIDE AND SUPPLY-SIDE RESOURCE OPTIONS		
DEMAND-SIDE RESOURCES	**RENEWABLE RESOURCES**	**THERMAL RESOURCES**
Conservation	**Biomass**	**Natural Gas**
Residential	**Geothermal**	Cogeneration
Existing Single Family Space Heat	Basin and Range Sites	Combustion Turbine Combined-Cycle
Existing Multi-Family Space Heat	Cascades Sites	Combustion Turbine Simple-Cycle
Refrigerators & Freezers	**Hydro**	Fuel Cell
Lighting	**Municipal Solid Waste**	
Hot Water Heater	**Ocean**	**Coal**
Hot Water Heat Pump	Marine Biomass	Atmospheric Fluidized Bed Combustion
Heat Recovery	Ocean Current	Integrated Gasification Combined-Cycle
New Single Family Space Heat	Ocean Thermal	Pressurized Fluidized Bed Combustion
New Multi-Family Space Heat	Salinity Gradient	Pulverized Coal/SO_2 Scrubbers
New Mobile Home Space Heat	Wave Power	
Clothes Dryer	Tidal Power	**OTHER RESOURCES**
	Solar	
Commercial	Parabolic Trough	**Nuclear**
Existing	Parabolic Trough w/CCCT	Advanced Light Water Reactor
New	Parabolic Trough w/Gas Backup	
Remodel	Photovoltaic	
	Wind	
Industrial		
Per case basis		

Conservation: This resource is used in all scenarios. Costs and programs for the various scenarios are referenced in Appendix D which lists the estimated conservation potential in average megawatts, at incremental mills/kWh. The data used to develop the estimated conservation potential were derived by incorporating the methodology used in the 1991 Regional Plan.

Supply-Side: The preliminary resource candidates were ranked by levelized resource cost estimates (excluding wheeling charges). Appendix E displays this list of supply-side resources.

The data used to develop the levelized cost for supply-side alternatives were based on EPRI's Technical Assessment Guide and the 1991 Regional Plan. Where applicable, the resource information was calibrated to incorporate Puget Power's operating experience and knowledge. This cost ranking provided a baseline for screening resources.

Uncertainties associated with each cost forecast were also considered. For example, fuel costs for a pulverized coal project are viewed as relatively stable over time, while natural gas prices are viewed as much more volatile. The affects of fuel prices on electricity demand and resource supply were incorporated into the scenario forecasts.

Phase 3 - Resource Candidates for Scenario Analyses

Since conservation is considered a preferred resource in all scenarios, no further evaluation was required. However, the preliminary list of supply-side resources was further evaluated using qualitative measures (i.e., environmental effects, reliability), as well as advice and consultation received from the Technical Advisory Committee, and recommendations from Consumer Panels.

This resulted in a group of higher potential supply-side resource candidates for use in the scenario analyses. Preference is given to renewable resources. Additionally, high efficiency cogeneration is preferred over other thermal processes. The candidates reflect a resource mix similar to that identified in the previous plan and in the 1991 Regional Plan. Key differences from the Regional Plan are that Puget Power excludes nuclear power as a candidate and includes coal with SO_2 scrubbers.

While the company agrees nuclear power has the potential to play an important role in the region's power supply future, there are a number of issues to resolve in order for this resource to be acceptable to the public. Currently, there is limited public support for nuclear power, therefore, it has not been considered as a viable resource for this planning cycle. Additionally, Puget Power includes fully scrubbed coal facilities in the list of clean-coal technologies because of its ability to significantly reduce SO_2 emissions.

Higher Potential Resource Candidates

Higher potential resource candidates, discussed below, were selected based on specific scenario assumptions. These assumptions, identified in the sales forecast section of this appendix, included changes in load growth, economics, or greater environmental awareness.

Demand-side Resource Candidates

Conservation

Conservation is a resource defined as the more efficient use of electricity. This means using less energy to achieve the same benefits from heating, lighting, and refrigeration, etc. Conservation is pursued through all customer sectors (residential, commercial, industrial) and through all end-uses. It primarily involves the replacement of inefficient technologies with more efficient technologies. This also ensures energy efficient building construction and equipment selection at the time of new construction or remodeling. Every Puget Power customer can participate in conservation, thereby reducing electrical bills as well as the company's long-term resource requirement.

Renewable Resource Candidates

Hydroelectric

Hydroelectric power is a renewable energy resource that involves the production of electricity from generators driven by hydraulic turbines. The Pacific Northwest streams and rivers have the ability to provide abundant opportunities for small hydroelectric generation. This includes numerous potential sites located above natural barriers to anadromous fish (i.e., salmon). Hydropower continues to be an attractive, proven, long-term energy resource with low environmental effects and low costs. Development and operation are essentially free from toxic emissions and solid waste problems with the majority of project expenditures related to capital costs. Therefore, after the initial investment, uncertainties surrounding future energy costs are virtually eliminated, offering significant protection against rising fuel prices.

There are some present and potential constraints on the existing large-scale hydroelectric system which can affect operating flexibility. These include such non-power constraints as irrigation, recreational demands, and responses to the Endangered Species Act. Additionally, operating constraints could result if much of the non-firm energy were "firmed" or if hydro power was depended upon as a backup system for major wind development in the region. The challenge for utilities in the Pacific Northwest is to continually balance these limitations while maintaining the flexibility of hydroelectric generation.

Geothermal (binary)

The geothermal resource comes from underground reservoirs of hot water-steam mixtures which can be tapped for energy production. The binary plants can provide the most efficient use of geothermal resources in terms of net power per unit of fluid mass. Binary plant designs also tend to have lower costs and shorter implementation periods.

Geothermal development requires large areas of land and generally occurs near natural and wilderness areas. Timing and location of development can mitigate potential conflicts, and technology is available to control toxic emissions.

Wind Turbine

A wind turbine is a renewable resource that utilizes the energy in a moving air stream to drive a turbine-generator that produces electricity. The capital-related costs of a wind farm have declined since the mid-1980's. Wind is also becoming more attractive due to increased turbine generator reliability. A third generation of wind machines is currently under development and promises even greater reliability, efficiency and cost-effectiveness.

Wind power is appealing due to its low variable costs and zero air emissions. However, wind power lacks load shaping capability. Therefore, additional resources (e.g., hydropower) may be necessary as backup facilities to provide firm peaking requirements and to shape wind energy production to daily load variations. Wind power is usually available in remote locations which may lead to transmission access uncertainties and concerns.

Thermal Resource Candidates

High Efficiency Cogeneration

Cogeneration is the use of one primary fuel source for simultaneous generation of both thermal and electrical energy. While gas-fired cogeneration has been considered an attractive resource alternative for this planning cycle, other fuel types may be considered during acquisition.

Issues related to this technology include the integration of cogenerated electricity into the utility system, and the amount of electricity generated relative to the thermal requirements of the host facility. Working with the Policy Collaborative Group, Puget Power has increased the standard for cogeneration by expressing a preference for High Efficiency Cogeneration. These facilities require high efficiency turbines and boilers, and a minimum of 20% of their total energy output must be thermal.

Coal Plant - Integrated Gasification Combined Cycle (IGCC)

The 1989 resource plan noted the IGCC demonstration projects had proven that this clean coal technology could soon reach commercial status. While still maturing, IGCC plants are becoming more attractive when compared to other clean coal technologies (i.e., fluidized bed). They offer reduced lead times, are more cost-effective, produce less and more easily handled solid waste. Additionally, coal gasification provides a hedge against rising natural gas prices. However, IGCC is an emerging technology with promise that still lacks extensive operating experience.

Coal Plant -With SO_2 Scrubbers

The coal-fired facilities assumed as resource options for this planning cycle also include fully scrubbed plants. Scrubbers reduce particulates and SO_2 emissions to regulated levels. However, additional environmental controls may be necessary for the future. Nonetheless, coal-fired power plants have proven reliability and use an abundant and inexpensive fuel source. This plan assumes the use of western coal which tends to be naturally lower in sulfur.

Scenario analyses

Scenario analyses is a necessary task in the development of a plan that is flexible and responsive in a variety of plausible futures. In addition to the procedures discussed throughout this appendix (i.e., forecasting economic conditions, electricity sales, financial assumptions, conservation potential, and resource alternatives), two other models were used to analyzed the developed scenarios.

Puget Power continues to use the MIDAS model developed by the Electric Power Research Institute. This model simulates the utility environment and evaluates the interactions among demand, supply, financial, and rate planning for each scenario.

Using the data produced from the various sources of information, the MIDAS simulation module performed load analysis, capacity planning, production costing, financial projections and rate calculations. Quantitative measures of merit included:

- Revenue requirements
- Various coverage ratios
- Rate impact

In addition to the MIDAS model analyses, the Washington Utilities and Transportation Commission's (WUTC) model was used in conjunction with the @RISK application to forecast and analyze incremental future resource cost estimates over the 20-year planning horizon. The model simulated economic variables, load growth and resource conditions to form probability distributions of incremental resource costs.

Data sources included:

- Historical capital structure
- Data Resources Inc. (DRI) national economic forecast
- Resource Selection Analysis
- Puget Power annual reports

Scenario Evaluation and Results

The resource mix for the various scenarios are presented in Table H-18. The analyses resulted resources portfolios that were responsive to a variety of changes including environmental constraints, economic shifts, customer growth, and fuel price fluctuations.

Table H-18

SUMMARY TABULATION OF SCENARIO ENERGY DEFICIT AND FUTURE RESOURCE ADDITIONS

SCENARIO	TOTAL ENERGY DEFICIT (aMW)	FUTURE RESOURCE ADDITIONS	
Medium	1596	Conservation	296
		Renewables	90
		High efficiency cogeneration	1000
		Clean Coal	210
Medium High	2548	Conservation	351
		Renewables	90
		High efficiency cogeneration	1000
		Clean Coal	1107
Medium Low	742	Conservation	223
		Renewables	90
		High efficiency cogeneration	429
High	3351	Conservation	374
		Renewables	584
		High efficiency cogeneration	1000
		Clean Coal	1393
Low	454	Conservation	202
		High efficiency cogeneration	252

Medium Scenario with Sudden Loss of Resources

Immediate Response Alternatives: Puget Power's immediate, short-term load requirements would need to be met through the use of existing resources, including purchases. Puget Power's likely course of action would be to attempt to secure secondary power purchases or short-term firm purchases from other utilities, both regional and extra-regional. To the extent that these purchases were sufficient, available and reasonably priced, Puget Power may not need to pursue any further actions. However, if other utilities were also effected by the resource loss, purchases may not be available or market prices may be quite high.

Along with investigating the market for secondary purchases, Puget Power would simultaneously evaluate the cost and availability of natural gas and fuel oil for its peaking combustion turbines.

These resources, not normally operated for energy, could supply up to 700 MW of capacity. The costs of operating the combustion turbines would be compared to the costs of purchases before an alternative were selected.

On the demand-side, immediate actions could include interrupting service to Puget Power's schedule 46 customers. The company could also appeal to its customers for voluntary conservation or load curtailment if the situation required further load decreases. A final immediate action, also on the demand side, would be to curtail electric service to customers. This final action would only be taken after all other alternatives had been implemented without successful elimination of the deficit.

As directed by state law, Puget Power would curtail service to customers in the following order: 1) industrial customers; 2) commercial customers; and 3) residential customers. Puget Power would make every effort to apply any necessary curtailments equally across each customer group. The magnitude of the loss would heavily influence how far down the list Puget Power would need to proceed.

Share the Shortage Agreement: Power may be available under procedures which would be established by the proposed regional "Share the Shortage" Agreement. The Northwest regional utilities including BPA, the generating public utilities and investor-owned utilities, have been working together to develop this agreement which would specify procedures for utility responses to energy deficits. The proposed Share the Shortage Agreement is intended to assist utilities experiencing unanticipated energy deficits. However, the Agreement is not intended to provide either immediate emergency help for sudden losses or to be relied upon for long-term supply.

In the long-term, each utility is still expected to plan to meet its load and not to rely upon the agreement as a substitute for acquiring adequate resources. Therefore, the Share the Shortage Agreement can only be viewed as a mid-term, temporary option in the case of a sudden resource loss.

Long-Term Response Alternatives: Puget Power's long-term alternatives to a sudden resource loss would typically include the following: operating an accelerated conservation or load management program, building a company-owned generating resource, purchasing power from another utility, and contracting with a third party for new generation or conservation resources.

However, the exact response would be heavily influenced by the specific characteristics of the resource loss condition. Situational analysis would be conducted and Puget Power would request short lead time resource acquisition proposals from its personnel with expertise in securing such resources. The severity of the resource loss would determine how much time could be devoted to developing proposals and investigating alternatives. Puget Power would then evaluate the selected alternatives and pursue the most appropriate options.

Summary Results

Based on scenario analyses results, the range of potential resource acquisition activity can be reasonably estimated. This range is shown in Table H-19. Overall, there appears to be sufficient quantities of these resources to meet forecasted loads through the end of this decade. In the longer term, resource acquisition activity will be contingent on several factors, including the availability of natural gas supply contracts, environmental regulations, and technological developments. Table H-20 displays the present value of revenue requirements under each scenario.

Table H-19

RANGES OF POTENTIAL RESOURCE ACQUISITION ACTIVITY 1991-2010

Resource Types	Possible Acquisitions Energy (aMW)
Conservation	202 - 374
Renewables	90 - 584
High Efficiency Cogeneration	252 - 1000
Clean Coal	210 - 1393
Total	754 - 3351

Table H-20

PRESENT VALUE OF REVENUE REQUIREMENTS

Scenario	Millions of Dollars (nominal)	Discount Rate (percent)
Low	$13,683.19	11.26%
Medium Low	$14,338.84	11.26%
Medium	$16,850.62	10.41%
Medium High	$19,754.02	9.46%
High	$22,423.25	9.46%

Distribution of Incremental Future Resource Cost Estimates

This section discusses the aspects of incremental future resource costs, also referred to as avoided costs. These costs are estimates of a utility's resource expenses for meeting future load growth. Each scenario established an avoided cost forecast based on its resource mix over the planning horizon. The distribution of Puget Power's incremental future resource costs was independently verified by the WUTC model.

The WUTC model evaluated the resource alternatives chosen to meet future load demands. For each of the five quantifiable scenarios, @RISK forecasted and analyzed incremental future resource cost estimates over the 20-year planning horizon.

The WUTC model based these avoided cost estimates on assumptions related to the uncertainty of key input variables representing economic conditions. These specific input variables are listed in Table H-21. The WUTC analysis treats the input variables, all expressed in nominal terms, as having the same minimum and maximum limits across all scenarios.

However, the scenario planning process recognizes that there is an interdependence among many of the variables in all the scenarios.

The WUTC analysis was then facilitated by @RISK which produced distributions and calculations of statistical uncertainty for the incremental resource cost estimates. @ RISK generated the probability distributions by simulating future economic conditions affecting load growth and resources across many iterations. In a given iteration, @RISK randomly selected a value for each of the above variables within its pre-defined range, and then calculated the incremental future resource cost.

The values drawn by @RISK for the input variables were distributed according to a uniform distribution with limits set as the minimum and maximum values listed in Table H-21. Once @RISK had run a large number of iterations, a distribution of likely future resource costs emerged. Additionally, the cost of capital and fuel price escalation rates are assumed to follow trends in the overall inflation rate. One factor not reflected in the cost of capital for the WUTC model is the potential effect of purchased power on the company's crediting rating.

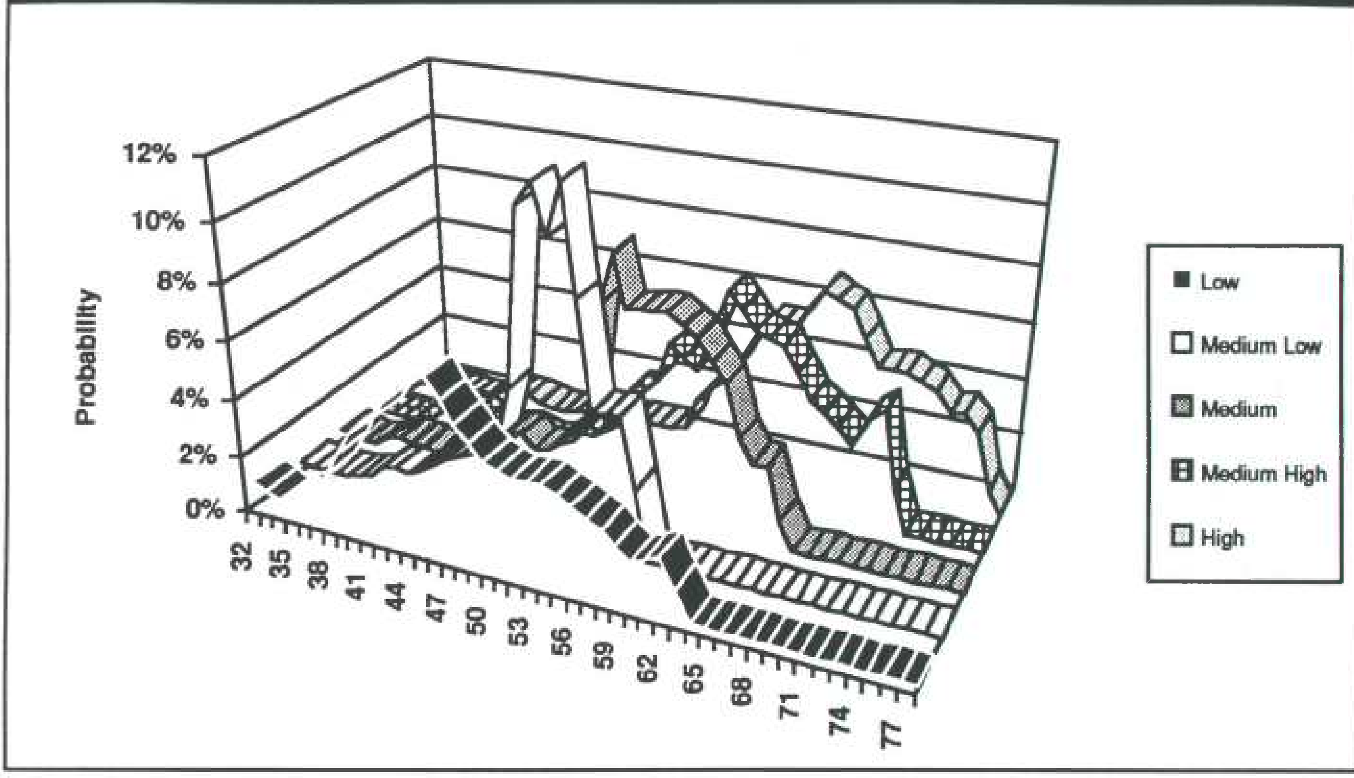
Table H-21

KEY INPUT VARIABLE RANGES

	Minimum	Maximum	Expected Value
General Inflation Rate	2.20%	6.70%	4.50%
Annual Load Growth	.40%	4.50%	2.40%
Gas Escalation Rate	2.92%	7.71%	5.32%
Coal Escalation Rate	2.30%	8.10%	5.20%
Cost of Debt	7.40%	10.42%	8.91%
Cost of Common Stock	11.39%	13.65%	12.52%

Figure H-9

DISTRIBUTION OF 20-YR LEVELIZED INCREMENTAL FUTURE RESOURCE COST ESTIMATES



Distribution Curves

For each scenario (with the exception of the Sudden Loss of Resources Scenario), the WUTC model was run for 500 iterations, an amount sufficient to ensure repeatable results. Each scenario used a different set of resource mix characteristics and produced correspondingly different distributions. These distributions are shown in Figure H-9.

The cost distributions reflect more expensive resources obtained under the Medium High and High scenarios compared to the Medium Low and Low scenarios. The most likely future is illustrated in the Medium scenario which has an incremental future resource cost distribution of 55 mills per kilowatt-hour.

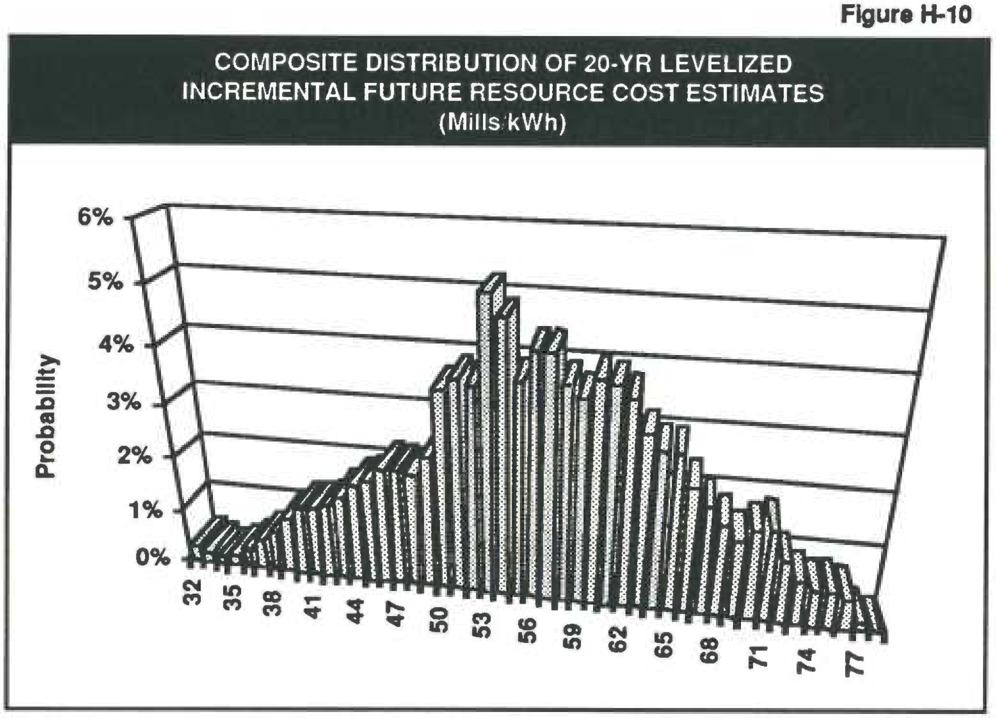
Composite Distribution

The five distributions represented in Figure H-9 were integrated to produce an equally weighted composite distribution of 20-year levelized incremental future resource cost estimates. This composite distribution, as shown in Figure H-10, has a median value of about 55 mills per kilowatt- hour. This distribution has a minimum value of about 32 mills per kilowatt-hour and a maximum value of 77 mills per kilowatt-hour. Compared to the composite distribution produced in the previous plan, the distribution in Figure H-10 is less skewed towards higher avoided cost levels. This may occur because of the increased emphasis given to environmental considerations in the scenario analyses for this planning cycle.

The median value of the composite distribution indicate an expected melded resource cost. The 1991 competitive bidding process commenced prior to final scenario analyses, and therefore used an avoided cost based on the results of the first resource solicitation and early estimates of the Medium scenario. A comparison of the competitive bidding avoided cost to the median value of the composite distribution indicates that the avoided costs are consistent at about 55 mills per kilowatt-hour.

The scenario analyses supported the use of conservation, renewable resources and cogeneration for this planning cycle. While there are uncertainties surrounding some aspects of these resource alternatives, indications are that they have the ability to perform cost-effectively in a variety of economic conditions. The company's short and long-term action items, identified in the following section, set the stage for the next integrated resource planning cycle.

Figure H-10



COMPOSITE DISTRIBUTION OF 20-YR LEVELIZED INCREMENTAL FUTURE RESOURCE COST ESTIMATES (Mills/kWh)

Resource Strategy and 1992-1993 Action Plan

This section describes Puget Power's least-cost Integrated Resource Plan as updated for this planning cycle. The Plan is based on the qualitative and quantitative analyses, perspectives and uncertainties outlined in the previous chapters. This Plan continues to focus on providing customers low-cost, reliable energy service with low environmental effects. Additionally, this Plan provides Puget Power the flexibility to address future changes and uncertainties in energy alternatives, resource technologies, regulation, and the economy, as well as customer needs and expectations.

The overall Plan, for both short and long-term activities, are discussed under four independent but integrated headings:

- Resource Characteristic Preferences
- Resource Alternatives
- Resource Acquisitions
- Action Plan for 1992-1993

Resource Characteristics

Preferred characteristics, as shown in Table H-22, will help guide the selection of future resources. This includes resources that are cost-effective, reliable, environmentally and publicly acceptable, and smaller facilities of 70 MW or less to match the company's resource needs and mitigate the risks of resource loss and project cancellations. Ultimately, the resources acquired will depend on how uncertainties presented in throughout this document are resolved in the future.

TableH-22

RESOURCE CHARACTERISTIC PREFERENCES	
❖ Cost-effective	❖ Environmental and public acceptance
❖ Short lead times	❖ Reliability
❖ Small facilities (<70 MW)	❖ Potential capacity opportunities
❖ System compatibility	❖ Diversity in resources, fuels, and acquisitions

Resource Alternatives

The resource alternatives identified for this Plan are listed in Table H-23 (the order does not indicate ranked priority). Preference is given to cost-effective conservation and renewable resources. High efficiency cogeneration resources are given preference over other thermal processes. Sufficient quantities of these resources appear to be available to meet a major part of the resource needs through the end of this decade. In addition, it is hoped that efforts now will spur development so that these resources will be more readily available to meet future growth.

This Plan also increases the focus on emerging clean coal technologies (i.e., IGCC). Despite uncertainties, Puget Power continues to support the use of clean coal due to its low cost and proven reliability. The company includes coal plants with SO_2 scrubbers in its definition of clean coal technologies.

TableH-23

RESOURCE ALTERNATIVES
❖ Cost-effective conservation
❖ Renewable resources (hydro, wind, geothermal)
❖ Increased generation from existing facilities
❖ Combustion turbines and load management for peaking.
❖ High efficiency cogeneration (with gas as the primary fuel source)
❖ Clean Coal (including SO_2 scrubbers)

Resource Acquisitions

Most of the resource alternatives described above could be developed by Puget Power. However, for some emerging new resources, there may be other companies better equipped to explore and develop these technologies. Due to a number of uncertainties associated with the development of resources, flexibility is designed into the company's acquisition approach.

Less emphasis will be placed on acquisition of traditional utility purchases and conservation transfers due to fewer available opportunities. Also, the company will evaluate the feasibility of pursuing additional seasonal exchanges given current capacity challenges.

Also, the company will participate in region-wide efforts to shorten lead times associated with siting, licensing, and design of generation facilities. Additional consideration will be given to lost opportunity resources (lost if not developed or acquired within a certain time period). As part of resource acquisition, transmission access and system enhancements will be pursued to deliver cost-effective, reliable energy service to customers. Puget Power addresses the above mentioned needs in the 1992-1993 Action Plan presented in Chapter 7 of the main report.