UE-910151

PUGET POWER

April 9, 1992

Mr. Paul Curl
Washington Utilities and Transportation Commission
1300 S. Evergreen Park Drive S.W.
Olympia, Washington 98504

SUBJECT: Integrated Resource Plan

Dear Paul:

Puget Power has completed its third cycle of least-cost integrated resource planning. Twelve copies of the plan entitled, Integrated Resource Plan 1992-93, and the appendices are attached.

Public involvement was expanded over the past two years to include a wider range of perspectives on various resource planning issues. Represented throughout this document are the viewpoints of customer groups, environmental organizations and governmental agencies. We believe these efforts have helped Puget Power develop a comprehensive resource strategy that will provide customers, reliable, low-cost energy service with low environmental effects.

Puget Power looks forward to presenting its Integrated Resource Plan to the Commission on May 26, 1992 in Bellevue at 1:30 p.m. (location to be confirmed). Please call if you have any questions or need additional copies of the plan. My number is (206) 462-3734.

Sincerely,

Corey

Corey A. Knutsen
Vice President
Corporate Planning

CAK:smc

Attachments

INTEGRATED RESOURCE PLAN

1992-1993

Planning and Innovating Together for Excellence

PUGET POWER

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Introduction

The purpose of resource planning at Puget Power is to develop long-term strategies, with shorter term action plans, that provide customers with reliable, low-cost energy service. This is achieved by evaluating environmentally acceptable demand and supply-side resources that will cost-effectively meet energy needs over a wide range of possible futures.

This is Puget Power's third published resource plan which includes perspectives obtained through public involvement, qualitative and quantitative analyses. It describes the company's approach to securing new resources by incorporating economic, environmental and social issues, and uncertainties. While the planning horizon is for 20 years, the plan is updated every two years in order to respond to the increasing complexities and uncertainties associated with resource planning.

Planning Integration

In 1987 and 1989, the company produced "least-cost" plans under the title of "Demand and Resource Evaluation: Securing Future Opportunities." For this planning cycle, the report is entitled, "Integrated Resource Plan: Planning and Innovating Together for Excellence." This title is an expression of the evolving role of integrated resource planning at Puget Power which has several dimensions. Of central importance is the acquisition of cost-effective conservation and generation resources which have low environmental effects and regulatory support. In the previous plan, some risks associated with the acquisition of these resources were identified that needed to be addressed by changes in regulation. Some changes were made, but other risks remain which are described in this report.

Another dimension of integrated planning, which is reflected in the report title, is the role of interdepartmental planning and collaborative efforts. Represented throughout this Plan are the viewpoints of customer groups, environmental organizations, and governmental agencies integrated with Puget Power's knowledge and experience.

Integrated resource planning is also a vital component of the company's "Corporate Plan for the '90s". Elements of planning integration are included in Puget Power's mission, values, and goals.

Additionally, this Plan is designed to meet the goals of least-cost planning defined in the Washington Utilities and Transportation Commission's least-cost planning rule (WAC 480-100-251). It is also consistent with the regional 1991 Northwest Conservation and Electric Power Plan.

Organization of this Plan

This Integrated Resource Plan is organized chronologically in chapter format. The first two chapters provide a background for the planning process. Chapter 1 gives perspectives on key events and Chapter 2 is a status report of the previous plan's action items. Looking to the future, Chapter 3 presents economic and demographic trends and the load forecasts followed by Chapter 4 which highlights various planning issues. Chapter 5 describes how resources were selected for planning purposes, and Chapter 6 brings all the planning activities together in the description of the scenario analyses. This Plan concludes in Chapter 7 with details on Puget Power's resource strategy and action plan.

CHAPTER 1

Planning Perspectives

Many changes have occurred since Puget Power's last resource plan, dated December 1989. Comparisons with previous cycles are highlighted in this chapter to provide a perspective on the events that have helped shape the current Plan. This chapter also includes a discussion on trends related to resource planning and changes in costs to customers. These trends, coupled with a description of the planning process, provide a perspective on Puget Power's long-term resource planning efforts. This chapter concludes with an overview of the planning guidelines used in the preparation of this report.

Key changes guiding this Plan were:

- **Shifts in Utility Regulation:** State regulatory change, recently implemented on a three-year experimental basis through the establishment of the Periodic Rate Adjustment Mechanism (PRAM), provides support for more aggressive integrated resource planning that benefits both customers and the company.

- **Expanded Public Involvement:** Various planning efforts were enhanced through increased collaborative efforts with customer groups, governmental agencies, and environmental organizations.

- **Environmental Considerations:** New issues were merged into the planning process for resource alternatives and the scenario analyses.

- **Resource Needs and Acquisitions:**
  - Load forecasts indicate continued growth
  - Regional surplus continues to diminish
  - Resource diversity strategy influences planning considerations
  - Conservation receives increased emphasis and a 10% price credit in the scenario analyses
  - Renewable resources receive increased emphasis and a 10% price credit in the scenario analyses
  - High efficiency cogeneration is given preferential consideration over other thermal processes

- **Transmission and Distribution Challenges:** The system planning process was enhanced through increased public involvement, system efficiencies and new planning approaches.

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 through the dampening effects of vigorous conservation on sales.

Regulatory Experiment Addresses Cost Recovery

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. As a result, in April 1991, the Commission approved the PRAM on a three-year experimental basis. The Commission order allows for more timely recovery of changing power costs and new conservation expenditures.

Support for Increased 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.

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.

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
- Assist the company in meeting its obligation to serve customers
- Enhance the ability to remain competitive
- Supports 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.

Expanded Public Involvement

Public involvement, as an ongoing component of the company's planning efforts, was expanded during the development of this Plan. This increased focus to address specific planning issues is referred to in this document as the collaborative process. Viewpoints from parties representing customer groups, environmental organizations, and governmental agencies were merged to form approaches on various planning issues. Coupled with this was the continued involvement by Consumer Panels. Appendix G and its accompanying exhibits identify in more detail the following collaborative efforts:

Policy Collaborative Group

This group was very involved in the debate and rate proceeding leading up to the regulatory changes the Commission adopted in the PRAM order. The Policy Collaborative developed the incentive proposal adopted by the Commission and, as part of that, assisted in development of Puget Power's definition for high efficiency cogeneration.

Technical Collaborative Group

This technical level group focused on demand-side management issues. Primary work included development of annual performance targets for conservation programs, a measurement and evaluation plan, and conservation potential estimates, also referred to as conservation supply curves.

Rate Design Collaborative Group

This group was formed fourth quarter 1991 to focus on rate design issues. Results from this group effort will be incorporated into the April 1992 filing on rate design as directed by the Commission in the April 1991 PRAM order.

Customer Rate Design Task Force

This task force, comprised primarily of residential customers, focused on rate design issues and worked with the Rate Design Collaborative Group. Participants included former Consumer Panel members. Results from this group effort will be incorporated into the company's April 1992 filing.

Consumer Panels

As in previous years, the company's Plan was developed with comments from Consumer Panels, comprised of Puget Power customers. A total of 76 recommendations were received in June 1991 following a six month fact-finding process by eight different Consumer Panels. Recommendations on options to meet growing customer demands were in the areas of conservation, generation resources, alternative generation resources, rates, communications, policy and planning, load shifting and rebates. A summary of the recommendations is provided in Appendix G, Exhibit A, which also includes the least-cost integrated resource plan mission statement, pertinent issues, suggested work plan, and fact-finding sources provided to the panels.

Additionally, Consumer Panel members from years 1987 through 1991 were asked to provide comments on the proposed incentives mechanism for demand and supply-side resources.

Technical Advisory Committee

As with the last two plans, this committee provided guidance and advice on a variety of planning and technical issues in the development of this Integrated Resource Plan. Appendix G, Exhibit B, provides a brief description of the nine committee meetings.

Transmission and Distribution Citizen Advisory Committees

This recent effort seeks involvement of customers in the planning process for specific project proposals. The level of customer involvement will depend on the specific project, but could include public comments on such items as site selection criteria and alternatives as a precursor to the permitting process.

Environmental Considerations

In meeting customer needs for electricity, the company selects resources in a manner that is sensitive to environmental effects. For example, the company's current competitive bid for new resources gives a 10% price credit to conservation and renewable resources in the evaluation process to give preference to resources with lower environmental effects. This was approved by the Commission on an experimental basis. Also, preference is given to high efficiency cogeneration over other thermal processes.

There remains considerable controversy over the proper costing of environmental effects not included in the direct cost of electricity, referred to as environmental externalities. Puget Power customers have been asked to examine environmental externalities as one of the 1992 Consumer Panel topics.

Additional environmental issues which represent significant uncertainty in the future power supply for the region include:

- Implications of the Federal Clean Air Act Amendments (1990)
- Public concern over electromagnetic fields (EMF)
- Effects on the regional hydroelectric system from the current and proposed listings of salmon runs as endangered or threatened species under the Federal Endangered Species Act.

Resource Needs to Meet Growing Load

The Pacific Northwest is one of the fastest growing regions of the nation. Within Washington State, economic growth is expected to remain concentrated in the Puget Sound region. Within the Puget Sound region, the company serves most of the rapidly growing areas.

This is not a new situation for Puget Power. Over the past two decades, the company's planning process has continually sought to respond to customer growth while faced with resource uncertainties. In the early 1970's, it became apparent that hydroelectricity, once inexpensive and abundant, would be insufficient for future resource needs. Mounting environmental considerations, increasing non-power demands, and load growth were reducing large-scale hydroelectric generating potential in the Pacific Northwest.

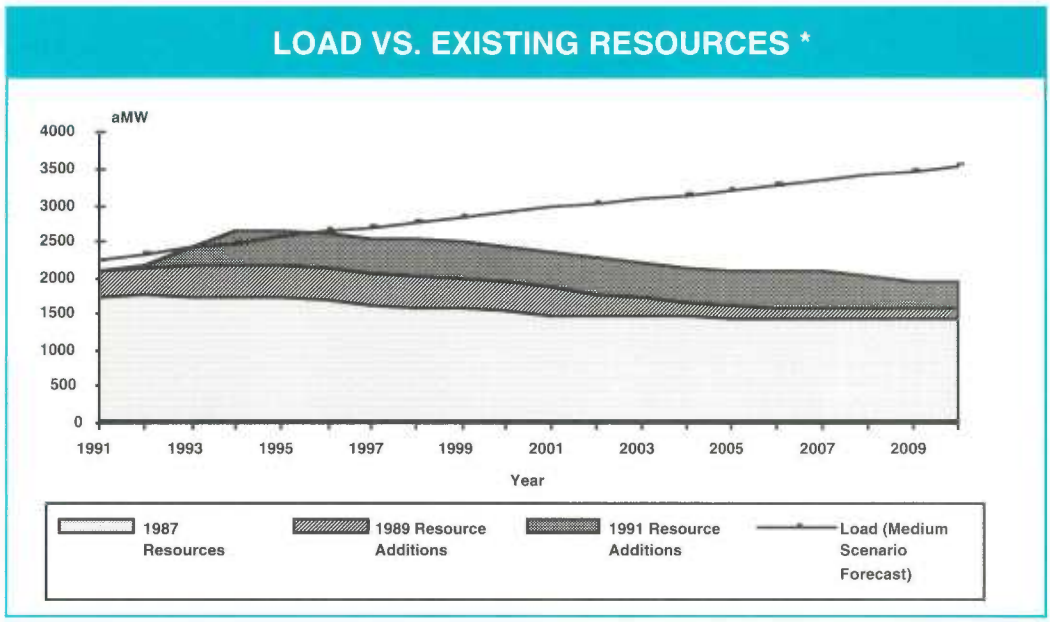
With few acceptable large-scale hydro sites available to serve the growing load, Puget Power turned to conservation and low-cost fossil fuels (i.e., coal and gas). Efforts to develop cost-effective small hydro projects met obstacles in the permitting and licensing process at both the state and federal levels. However, the company continued to explore ways to preserve this attractive option. Attempts were also made to construct nuclear plants, however, they were subsequently cancelled.

Hydro Remains An Attractive Resource

Today, Puget Power remains a hydro-based company. Hydroelectricity, especially small hydro, is still attractive, and the company will pursue development to the extent that it is balanced with other constraints and considerations. Over the years, resource alternatives have changed, bringing with them new uncertainties and planning challenges. In response, the company has pursued a flexible resource strategy designed to preserve future options that provide low-cost energy to customers.

Demand For Electricity Increases

Figure 1-1



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

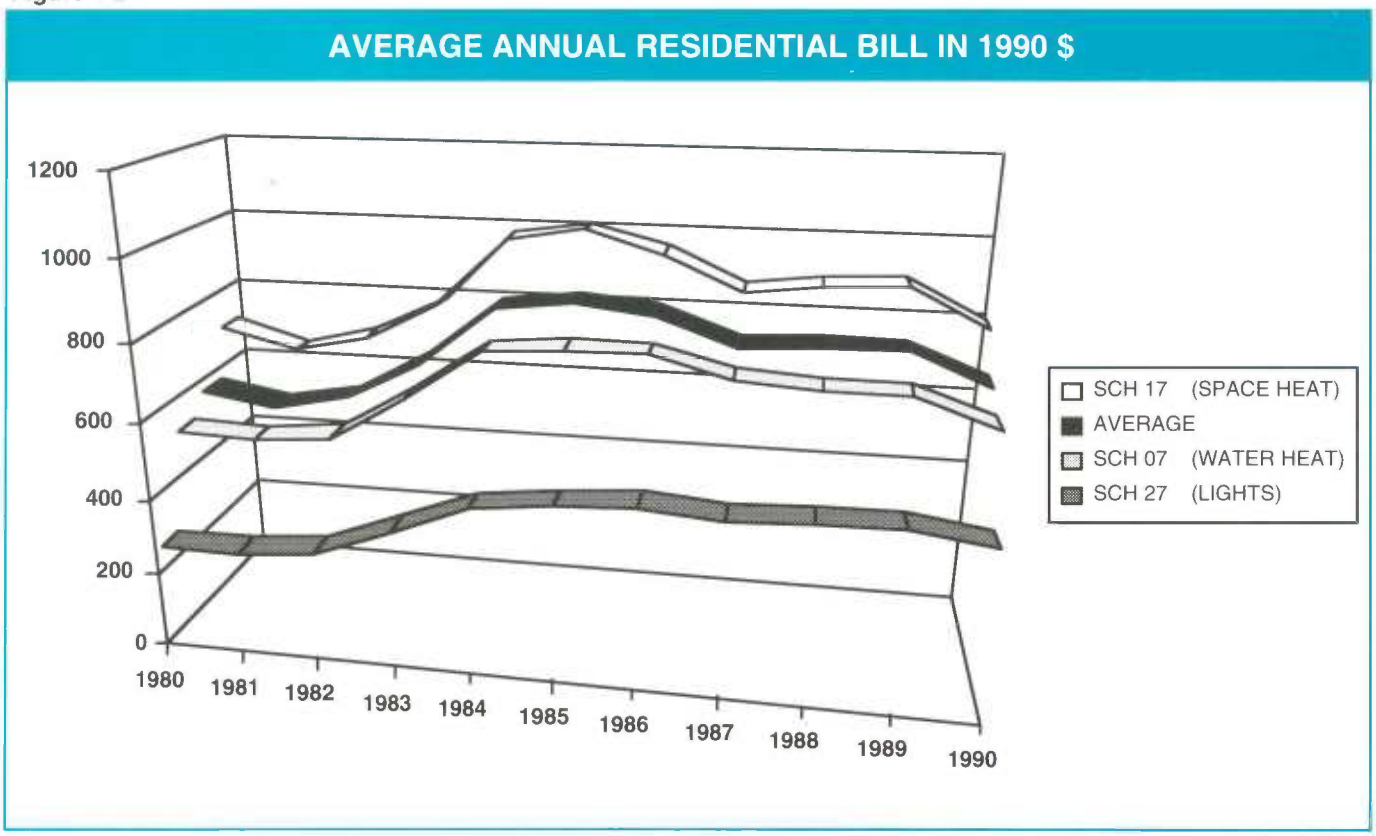
The load forecast continues to show growth and the need for long-term resources, as shown in Figure 1-1. However, the resource deficit at the end of this planning cycle has been reduced by about 172 aMW since the last plan. This represents a decline in resource needs of about 10% when comparing the maximum deficits (under medium load forecast) between the two planning cycles. Contributing factors include conservation measures, reduced use per customer, and acquisition of additional power purchase contracts. The result is a slight, short-term surplus that is forecasted to occur between operating years 1993-94 and 1995-96. In the long-term, the forecast indicates a need for an additional 1600 aMW (in the Medium scenario) by the year 2010. This is the result of load growth coupled with decreases in existing contractual resources.

Customer Bills Decrease

Ultimately, all of Puget Power's planning efforts and business decisions affect the customer in some way. Figure 1-2 shows that the average inflation adjusted annual residential customer bill, based on actual use per customer, began declining in 1986. The average inflation adjusted residential bill declined by about 19% between 1985 and 1990 (although not shown, weather-adjusted numbers had a similar decline). This resulted from a combination of declining use per customer and reductions in inflation adjusted electricity rates. Inflation adjusted electricity rates have declined by 10% since 1985 due to factors such as company costs rising slower than the rate of inflation and rate reductions through the Bonneville Power Administration's (BPA) residential exchange programs (effective in 1990).

Resource needs continue but forecasted deficit declined 10% due to conservation measures, reduced use per customer and new power sales contracts.

Figure 1-2



Factors contributing to the decline in use per residential customer include company conservation programs, fuel switching, price induced changes in customer behavior, a growing share of customers living in multi-family units, improvements in appliance efficiency, new state building codes, and conservation measures undertaken by customers.

Planning efforts, business decisions and customer choices contributed to 19% decline in the average inflation-adjusted residential bill between 1985 and 1990.

This Plan calls for pursuing cost-effective conservation through programs that capture conservation potential in the areas Puget Power serves. However, assessments of that potential indicate conservation cannot meet all of Puget Power's future resource needs. Of the estimated 1600 aMW of resources needed by the year 2010 in the Medium scenario, cost-effective conservation is expected to provide about 300 aMW. Additional resources will be needed that are cost-effective, have public acceptance and low environmental effects.

Resource Diversity Helps Mitigate Risks

Key elements of the resource diversity strategy are described in this section. Resource diversity refers to balancing risks associated with resource types, fuels, and resource acquisition methods. This diversity increases the company's flexibility to pursue resource opportunities that help ensure reliable service to customers. Further, the company's financial risk and credit worthiness is materially influenced by its resource portfolio.

Resource Type Diversity: This refers to avoiding dependence on any one type of resource added to the system. It includes both demand and supply-side resources. Resource type diversity helps minimize exposure to risks associated with such issues as cost, reliability of supply, environmental and public acceptance, and regulatory changes.

Fuel Diversity: This refers to reducing exposure to risks associated with fuel price, availability, and use restrictions. Fuel diversity provides flexibility for responding to potential limitations imposed on any one fuel. For example, the repealed 1978 Fuel Use Act, designed to increase national energy self-sufficiency, limited use of gas and oil. Future limitations might result from restrictions on CO_2 emissions or other as yet unspecified effects from resource development.

Acquisition Diversity: This refers to balancing overall financial, operating and other risks associated with resource acquisition methods. For example, contracts to purchase power from others are increasingly being viewed as equivalent to debt obligations by rating agencies. This could potentially result in the down-grading of the company's credit rating and could adversely affect the cost and availability of capital to the company because of this perceived increase in risk. A more balanced approach, adding some company-owned new resources to the resource portfolio, would be viewed more favorably by the agencies.

Table 1-1

INTEGRATED RESOURCE PLANNING GUIDELINES

RESOURCE DIVERSITY CONSIDERATIONS	OPERATIONAL CONSIDERATIONS
✔ Resource type diversity (avoidance of being overly dependent on any one type of resource added to the system)	✔ Customer service needs and expectations
✔ Fuel diversity (avoidance of current and future risks associated with fuel price, availability, and use restrictions)	✔ Environmental and public acceptance
✔ Acquisition diversity ("balancing" of overall financial, operating and other risks associated with resource acquisitions)	✔ Lost-opportunity resources
✔ Regulatory support for resource planning and acquisition	✔ Resource operating experience
	✔ Resource availability
	✔ Reliability
	✔ Cost-effectiveness and energy efficiency
	✔ Resource size
	✔ Asset life
	✔ Resource lead-time
	✔ Geographic location
	✔ Siting and permitting issues

Puget Power's resource planning approach incorporates resource diversity considerations to ensure a balanced resource mix that provides reliable energy service to customers. Planning guidelines, identified in Table 1-1, address diversity needs as well as other operational considerations. The order of this listing does not indicate a priority.

Resource Acquisitions Shift Focus

This Plan increases the emphasis on conservation and renewable energy resources (e.g., hydro, wind, solar and geothermal) because of their low environmental effects. A 10% price credit is given to these resources throughout all scenarios. Additionally, preference is given to high efficiency cogeneration over other thermal processes. Bid evaluations within Puget Power's current competitive bidding process are structured around this priority. This is also the same resource priority as in the Northwest Power Planning Council's 1991 Regional Plan, and it reflects the vast majority of views obtained through the company's public involvement efforts. Conservation and renewable resources also support the company's resource diversity strategy.

Cost-Effective Conservation Targeted

This Plan calls for pursuing cost-effective conservation resources that would more than double the amount achieved in the past decade. The 300 aMW target for the 20-year planning horizon helps meet the 1600 aMW deficit forecasted in the Medium scenario. The energy savings from 300 aMW of conservation would provide enough energy to serve the resource needs of about 200,000 residential customers.

The 1991 target of 16 aMW was surpassed with more than 17 aMW achieved; double Puget Power's conservation achievements the previous year. The 1992 target, established with the Technical Collaborative Group, challenges the company to achieve 24 aMW. In addition to company conservation programs, the Washington State building codes and federal appliance standards help improve the efficiency of electricity use in the area Puget Power serves.

Traditional Utility Purchase Opportunities Diminish

Both previous plans recommended utility purchases as a supply source and Puget Power successfully negotiated several cost-effective, long-term contracts. However, as the regional surplus of the 1980's diminishes, so does the opportunity for long-term utility purchases. 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.

Additionally, as called for in the previous plan, Puget Power pursued conservation transfers and signed a power purchase contract between Puget Power and Snohomish County PUD, Lewis County PUD, Mason County PUD, and BPA. 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.

Non-Utility Purchases Are Tested

Non-utility contracts signed for future projects during this planning cycle are expected to produce more than 400 aMW. These include resources selected through the company's competitive bidding process as well as other negotiations. This market appears to have significant potential, but the final test will be whether the projects come on-line and produce the power over their contract terms.

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.

An additional concern is the trend towards the use of natural gas in non-utility projects. While gas is currently an attractive fuel source, issues surrounding the dominance of gas use include potential price fluctuations, environmental considerations and reliability of supply. Puget Power will monitor this trend as part of its resource diversity strategy.

Company-Developed Resources Offer Flexibility

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.

Puget Power is also pursuing additional generation from existing hydro facilities. In November 1991, the company filed with the Federal Energy Regulatory Commission (FERC) a final relicense application for the Snoqualmie Falls Project. This includes a proposal to increase the project output by 31 MW for a total of 73 MW. The current license expires December 31, 1993. Puget Power is considering increasing the capacity at two other existing hydroelectric projects. Timing for these improvements is uncertain because all require FERC approval.

Transmission and Distribution Challenges

Finding ways to keep pace with anticipated growth and providing adequate reliability pose increasing challenges in the company's transmission and distribution system planning efforts. Concerns about aesthetics, growth management, potential health issues and environmental effects have contributed to construction delays in efforts to expand and rebuild the existing system.

Puget Power has responded by including more public involvement in project planning through Citizen Advisory Committees. Additionally, the company is exploring options for load control, system efficiencies, and customer demand-side management.

Another collaborative effort involves the company working with other regional utilities to address the increasing potential for voltage instability in the Puget Sound Basin. Both near-term and long-range solutions to this problem are being developed.

As noted in the previous plan, transmission availability is critical for maintaining flexibility in acquiring low-cost resources outside the service area, and for making the most efficient use of existing and future resources. A major factor in the recent 300 aMW seasonal exchange contract with Pacific Gas & Electric was negotiation with BPA for a transmission arrangement.

Concluding Comments

In general, this planning cycle has not been business as usual. Past experience suggests that new challenges and complexities will occur with each potential source of energy. The use of scenario planning, guided by comprehensive resource planning guidelines (as displayed in Table 1-1), is a way for Puget Power to address plausible future changes and uncertainties. The end result is that integrated resource planning continues to be a valuable tool for seeking ways to understand business uncertainties, and for securing future opportunities that provide customers low-cost energy service with low environmental effects.

Major Accomplishments

This chapter reviews the major accomplishments and successes achieved by Puget Power since publication of the December 1989 Integrated Resource Plan. Included is a description of progress on action items designed to ensure reliable, cost-effective energy service to customers. Puget Power's forecasted future resource requirements are lower compared to previous planning cycles, and near-term energy needs appear to be met. Even so, the company will face a long-term energy deficit and will need to acquire additional firm resources to meet future load.

Puget Power's 1990-1991 resource planning action items were presented in the previous plan under six interrelated categories as displayed in Table 2-1. The major accomplishments are outlined in Table 2-1 and described on the following pages. Appendix A provides a complete listing of all action items and a detailed review of the corresponding accomplishments.

Table 2-1

1990-1991
SUMMARY OF MAJOR ACCOMPLISHMENTS

Conservation

- ✔ Achieved targets
- ✔ Added new measures to company efforts
- ✔ Contracted for 10 aMW through competitive bid
- ✔ Developed relationships in retail marketplace
- ✔ Supported code and standard establishment
- ✔ Developed supply curves
- ✔ Involved in regional efforts
- ✔ Developed a measurement and evaluation plan

Supply-Side Alternatives

- ✔ Implemented pilot competitive bid
- ✔ Contracted for 163 aMW through competitive bid
- ✔ Contracted for 263 aMW of other non-utility resources
- ✔ Contracted for a seasonal power exchange and for conservation transfers
- ✔ Decided to pursue termination of the Creston site

Transmission and Distribution

- ✔ Continued efforts on improve transmission availability and system strength and efficiency
- ✔ Piloted new energy-efficient distribution transformers
- ✔ Explored use of demand-side measures to reduce construction needs
- ✔ Developed voltage dependent load models

Regional Involvement

- ✔ Participated in regional power and economic planning
- ✔ Explored contractual opportunities to ensure long-term supply from Mid-Columbia generating plants where contracts are nearing expiration
- ✔ Participated in discussions to renew/extend contractual arrangements for hydro power under the Columbia River Treaty
- ✔ Participated through PNUCC in responding to current and pending NMFS actions on salmon species

Leading Indicators and Monitoring

- ✔ Improved procedures relating customer growth to economic conditions
- ✔ Tracked the competitive bidding process
- ✔ Monitored natural gas prices
- ✔ Monitored supply resources and technological progress related to end-uses

Planning and Evaluations

- ✔ Evaluated the competitive bidding process
- ✔ Explored the use of rate design to support conservation and power supply objectives
- ✔ Expanded public involvement activities

Conservation

Puget Power has continued to actively implement conservation programs and set aggressive conservation targets. The company achieved the 1990 conservation target of 8 aMW and surpassed the 1991 target of 16 aMW by achieving more than 17 aMW of conservation. This significantly exceeds the 7-10 aMW annual targets established in the previous resource plan.

New measures that have been added to company programs include higher efficiency water heaters, high efficiency shower-heads and faucet aerators, energy efficient refrigerators, compact fluorescent lights and energy efficient motors. In addition to the above accomplishments, the first competitive bid for new resources 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.

Puget Power has been active in the retail marketplace. Relationships were developed with trade allies, suppliers and manufacturers to improve existing delivery methods, and to increase the ability of all parties to obtain cost-effective conservation. In addition, Puget Power actively supported the establishment of energy efficiency codes and standards, including the Washington State Energy Code.

In 1991, Puget Power developed new conservation supply curves based upon the Northwest Power Planning Council's work and using data specific to the customers and areas served by Puget Power. The Technical Collaborative Group reviewed and commented on the development of the supply curves. Puget Power was also involved in commenting on efforts to develop regional conservation programs and conservation potential estimates for the region.

A measurement and evaluation plan was developed with the Technical Collaborative Group and various consultants. These evaluations will be used to assess the value of conservation as an energy resource, provide feedback to improve programs, and furnish information for least-cost integrated resource planning efforts.

Supply-Side Alternatives

Supply-side action items incorporate utility and non-utility activities including competitive bidding. Since the previous planning cycle, Puget Power has contracted for future resources totalling more than 400 aMW (see Table 2-2). The company implemented a pilot competitive bid for demand and supply-side resources in 1989. Bids were received for 1279 aMW and contracts were signed for 180 aMW.

The generation contracts signed through competitive bidding were a gas-fired cogeneration facility in Whatcom County to be developed by Encogen, and a geothermal facility in northern California proposed by Trans-Pacific Geothermal. A third contract, a municipal solid waste facility in Pierce County, was cancelled by the county. Additional non-utility contracts following the competitive bid process were signed for 263 aMW. These were the March Point Phase II and Tenaska gas cogeneration projects. Contracts were also signed for a seasonal power exchange, and a conservation transfer with area utilities and BPA. No new power purchases from utilities were signed since the last planning cycle. Finally, issues related to the preservation of the Creston site were evaluated. The decision was made to pursue termination of this proposed coal-fired project if the region is not interested in assuming the site.

Table 2-2

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**		

* This project was cancelled after contracts were signed.

Transmission and Distribution

Puget Power continued efforts to improve transmission availability and system strength and efficiency. Puget Power is seeking additional transmission capability both within the region and between regions of the western U.S. and Canada. Efforts included a joint technical study with BPA on an interconnection with British Columbia Hydro and Power Authority. The company pursued participation in the Third AC Intertie. New energy-efficient distribution transformers were successfully piloted resulting in a second purchase of 200 25 KVA amorphous core distribution transformers. Studies indicate no-load energy losses are only 35% of the losses for comparable conventional silicon steel core transformers. The company explored the use of demand-side measures as one option to reduce construction in high load growth areas. At the recommendation of a Puget Power study group, an area-specific process is being developed that will address load growth projections, distribution of customer classes, system design, demand and supply-side options and marginal capacity costs. Puget Sound area utilities and BPA have developed voltage dependent load models for each distribution substation in the region and have agreed to install Under Voltage Load Shedding relays to mitigate potential voltage stability problems.

Regional Involvement

Accomplishments included continued participation in regional power and economic planning through the Pacific Northwest Utilities Conference Committee (PNUCC), the Northwest Regional Power Planning Council, the Intercompany Pool, the Northwest Power Pool and BPA. Puget Power made efforts to ensure long-term supply from Mid-Columbia generating plants (e.g. Wanapum and Priest Rapids) by exploring opportunities for new contracts and extensions of existing contracts. Additionally, discussions were held regarding agreements under the Columbia River Treaty that are expiring: the Pacific Northwest Coordination Agreement and the agreement for purchase of the Canadian Entitlement power. Puget Power and other regional utilities continued to work 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 and Monitoring

The company monitored a number of diverse issues in the business environment during the 1990-1991 planning cycle. Procedures for relating customer growth to economic conditions have been improved. In the pilot competitive bidding process, submissions totalled more than 1200 aMW. Demand and supply-side contracts (all below avoided cost) were signed for 163 aMW to come on line by 1993. This indicates that there is strong interest to develop non-utility resources. Natural gas prices were monitored and have continued to be at their lowest point in many years.

Planning and Evaluations

An evaluation of the pilot competitive bidding process was conducted internally and by an external consultant, Charles Rivers and Associates. As a result, the bidding process was refined for the second solicitation which is currently underway. Public involvement was increased on planning issues. A Rate Design Collaborative Group and a Customer Rate Design Task Force were established to explore rate design alternatives that support conservation and power supply objectives. The company continued planning involvement with the Consumer Panels and Technical Advisory Committee, and continued participation in the Electric Power Research Institute.

Concluding Comments

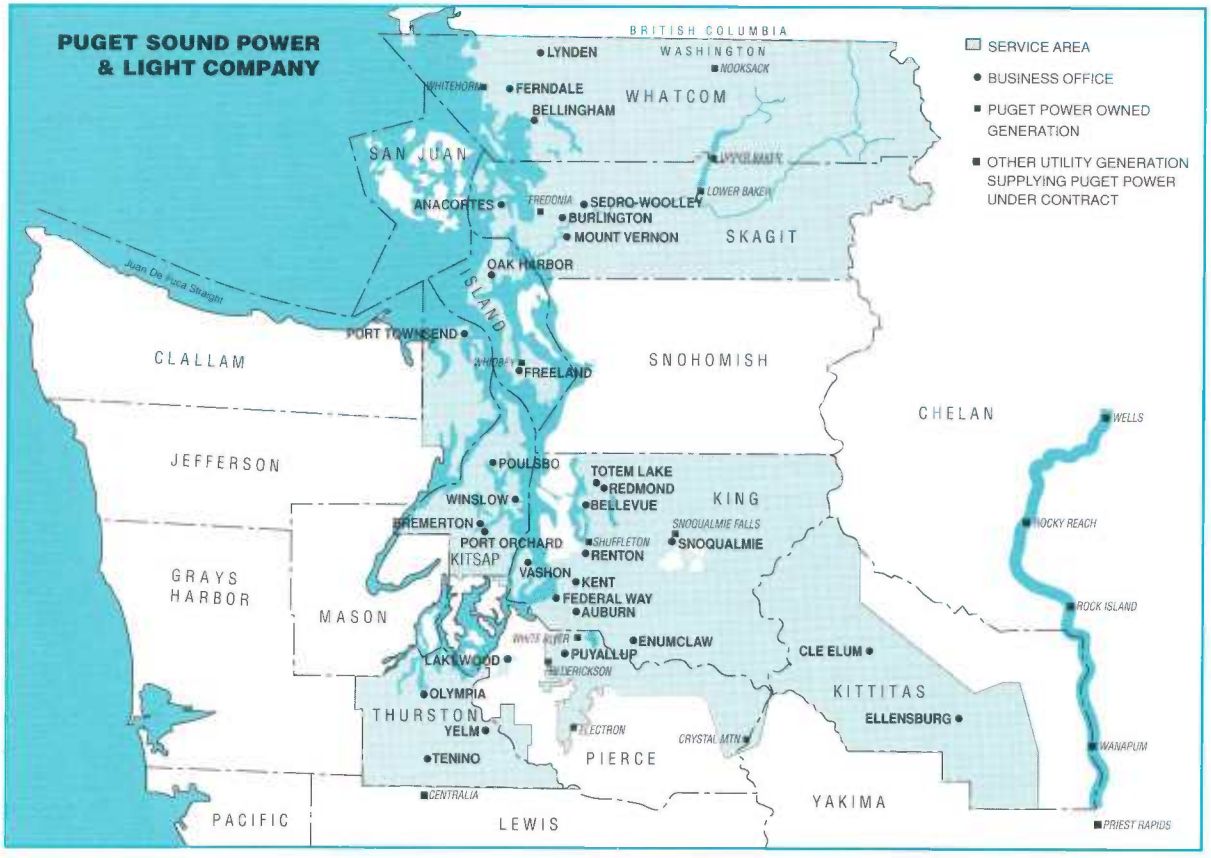
The company's progress on these 1990-1991 action items influences the remainder of this Plan. These achievements serve as a reference point from which future efforts, including planning issues and scenario analyses, are considered. They also guide the development of the 1992-1993 action items for this Plan which are listed in Chapter 7.

Load Forecasts

This chapter discusses how the load forecasts were developed for use in this Integrated Resource Plan. It begins with a brief description of the area Puget Power serves which is shown in Figure 3-1. Future loads across all plausible futures are dependent upon demographic trends and economic growth. Therefore, a discussion is included on key demographic trends developed from the 1990 Census, customer additions, and trends in electricity sales.

The economic outlook for the Puget Sound region is then discussed because economic growth is a key driver (and source of uncertainty) in future load. Next, the sales forecasting process is summarized. The Medium load forecast is used as the baseline for planning purposes throughout this Plan. However, additional projections were created for the various alternative futures, referred to as scenarios. Assumptions used to create each scenario load forecast are then reviewed. This chapter concludes with a discussion of the scenario load forecasts (see Appendix H for more detail).

Figure 3-1



Customer Diversity in Service Area

Puget Power serves more than 1.7 million people within a 4,500 square mile area of service. Customers within this area are now served by twelve operating divisions, shown in Figure 3-1, located within nine counties in Washington State. In 1989, Puget Power reorganized the customer service divisions to respond to a growing customer base, changing customer needs, and new system requirements. These changes are designed to increase operational efficiency and allow the company to better understand and respond to customer needs.

The area Puget Power serves is economically and geographically diverse and includes much of the largest metropolitan area in the Pacific Northwest. Major industries include transportation equipment, software production, services and natural resources industries such as forest products, fisheries, agriculture and petroleum refining. Foreign trade resulting from the region's proximity to Pacific Rim locations has become a growing source of employment and business opportunities.

Demographic Trends Affect Planning Process

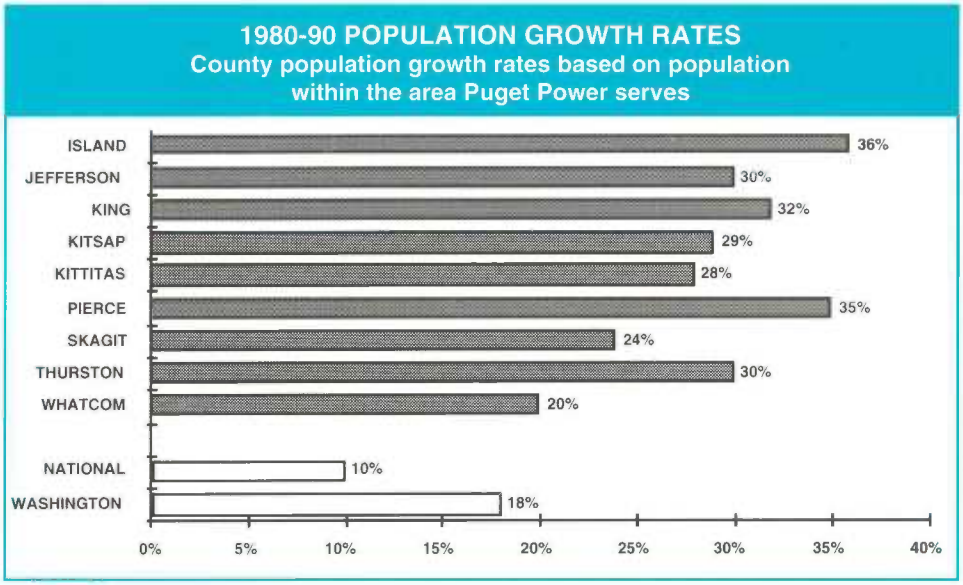
Demographic trends play a key role in the planning process (see Appendix H for details). These trends affect a variety of activities such as scenario development, electricity load forecasting, conservation programs, and workforce recruitment.

Because of the importance of demographic trends, the company has begun a detailed analysis of 1990 Census data to be completed Spring 1992. From preliminary analysis of the 1990 Census data, two major trends are expected in all plausible futures and directly affecting load growth: population growth and continued aging of the population. Additional trends from this preliminary analysis include increased ethnic diversity and changing household structure away from traditional household types. As a result of continued in-migration, population will continue to become increasingly diverse.

Population Growth Out Paces State And Nation

Population growth rates in the Puget Sound area exceeded statewide and national population growth rates during the 1980s. Population in the area Puget Power serves grew 31% during the 1980s, well above the statewide 18% growth rate and 10% national growth rate. As shown in Figure 3-2, the population growth rate for each county in the area Puget Power serves exceeded the statewide rate of growth.

Figure 3-2

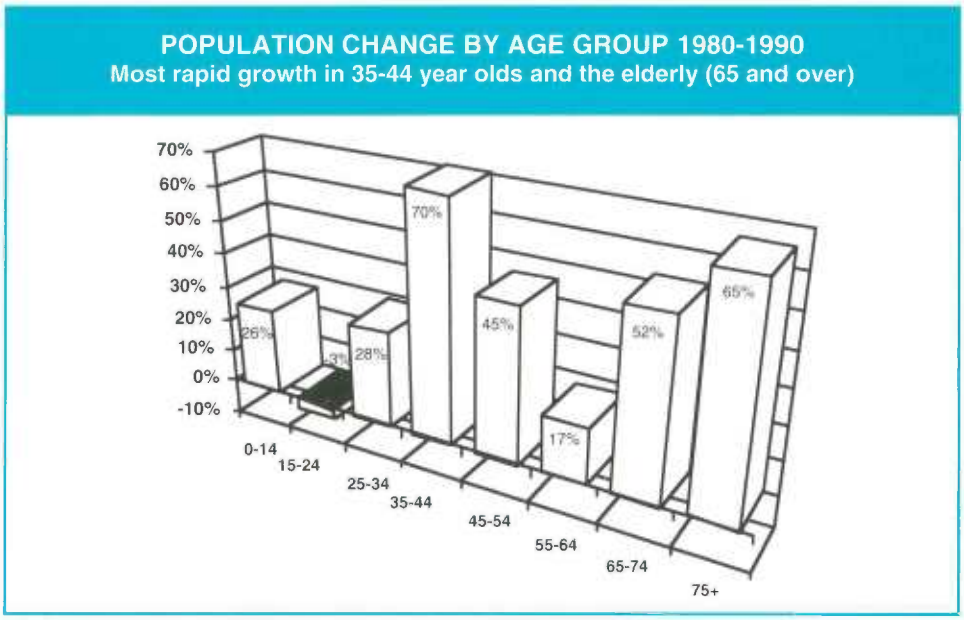


While in-migration and population growth are expected to slow during the coming years, statewide population growth is expected to remain concentrated in the Puget Sound area.

Population Grows Older

The population in the area Puget Power serves grew older during the 1980s, with the median age rising from 29.5 years in 1980 to 32.8 years in 1990. As shown on the following page in Figure 3-3, 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.

Figure 3-3



Rapid growth of the elderly population may be traced to declining mortality and in-migration of retirees.

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. As the demographic characteristics of customers change, Puget Power will need to respond to changing customer needs.

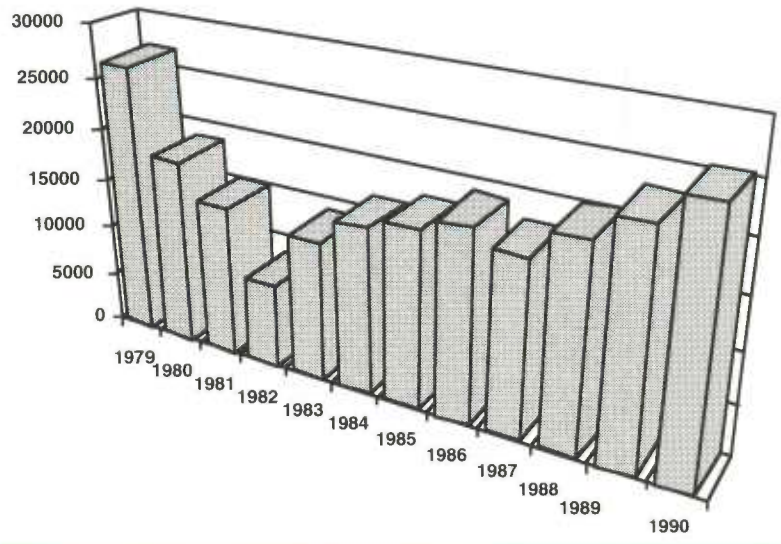
Trends in Customer Additions and Electricity Sales

Electricity sales and customer additions reflect the rapid economic growth in the Puget Sound area. Sales continue to grow more rapidly in the area Puget Power serves than in other parts of the Pacific Northwest.

During the 1980's, the residential sector added over 167,000 customers, resulting in an annual average customer growth rate of over 3%. In 1990, as shown in Figure 3-4, over 25,000 residential customers were added, the highest number of annual residential customer additions since 1979.

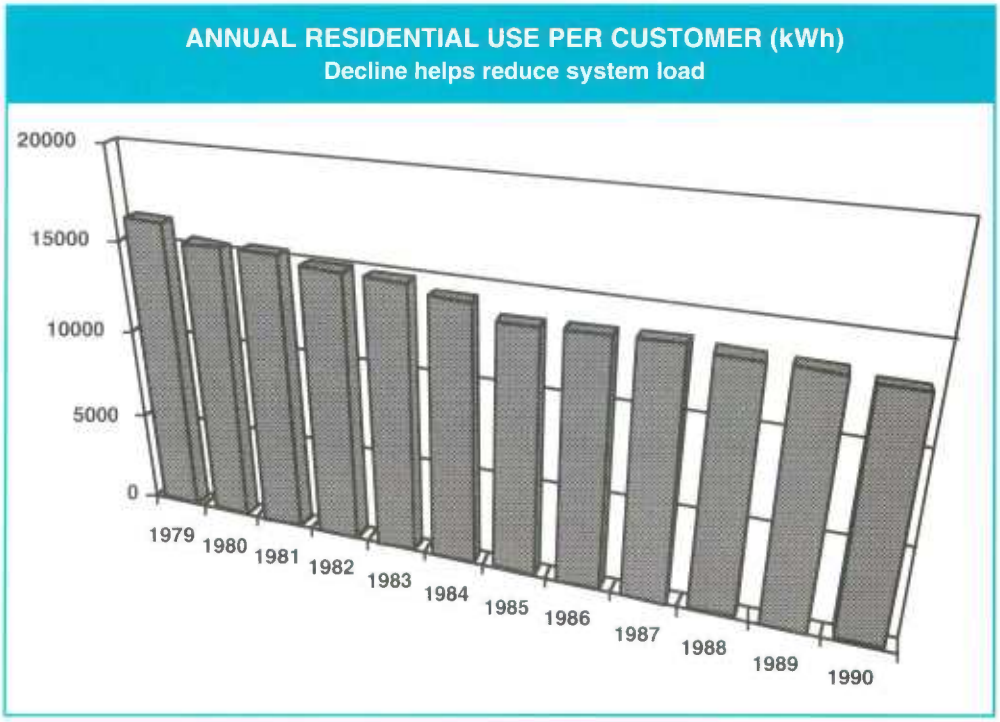
Figure 3-4

ANNUAL RESIDENTIAL CUSTOMER ADDITIONS AVERAGED 3% FROM 1979-1990



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 past ten years. A key factor slowing the rate of residential sales growth has been the declining use per customer.

Figure 3-5



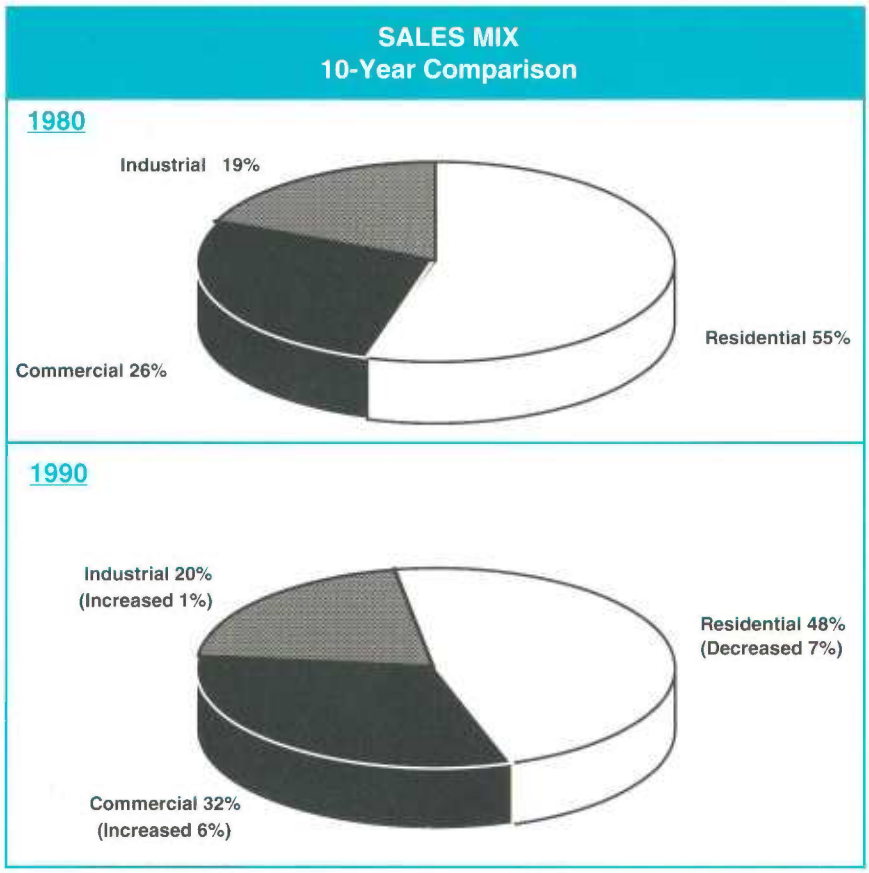
As shown in Figure 3-5, annual residential use per customer declined rapidly until 1985, including a drop of almost 3000 kWh per customer between 1979 and 1985. Since 1987, use per customer has been declining again, falling by over 600 kWh between 1987 and 1990. A decline in annual use per customer of 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 would have been on the average over 1400 kWh per year higher in 1991.

Additionally, if Puget Power achieves its conservation targets included in this Plan, use per customer will be further reduced (see Chapter 4 for more detail on conservation). The decline in use per residential customer, resulting in an average annual growth for residential sales of 1.4% over the past ten years, impacts Puget Power's sales mix. Over the same ten-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.

Figure 3-6 and 3-7

The share of system sales accounted for by the commercial sector has increased from 26% to 32% over the same period. These changes in sales mix are shown in Figure 3-6 and 3-7. Over the next twenty years, the share of system sales accounted for by the commercial sector is expected to continue increasing, although not as rapidly as during the last decade.



Economic Outlook

Future load growth is closely tied to local and national economies, and the economies of trading partners. Regional economic growth increases employment and the demand for electricity by commercial and industrial customers. In addition, regional economic growth increases the number of residential customers by attracting more in-migration. National and international economic patterns affect the demand for products exported from Washington.

Economy To Move From Recession

The national economy is expected to move from the recession of 1990-91 into a period of moderate economic growth during the next two years. Real gross national product is estimated to grow at an annual average rate between 2.5% and 3% during the next two years, and at a similar rate over the next decade. Washington State's economy has grown more rapidly in recent years than that of the Pacific Northwest, which has been one of the fastest growing regions of the nation. Within Washington State, economic growth has been concentrated in the Puget Sound area.

It is assumed that economic activity will continue to expand more rapidly in the Puget Sound area than in the state or nation. Factors enabling the Puget Sound area economy to out-perform the national economy include a stable base of manufacturing employment, expanding international trade, and rapidly growing high-tech employment.

Employment To Grow In Diverse Local Economy

Following dramatic increases in the late 1980's, manufacturing employment in Washington has stabilized and will continue as a stable base of employment in the coming years. Despite recent layoffs resulting from short-term financial problems in the airline industry, the Boeing Company's long-term outlook remains strong. The backlog of orders at the Boeing Company resulted in the expansion of manufacturing facilities in areas such as Pierce county. Proximity to rapidly growing Pacific Rim markets and the U.S.-Canada free trade agreement will continue to stimulate growth in the Puget Sound economy. 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 operating systems and applications programs in the nation.

Half Of State Population Growth In Service Area

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, which was shown earlier in Figure 3-4.

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.

While the economic outlook for the region is positive, there are a number of economic uncertainties which must be incorporated into the resource planning process. These uncertainties include the future performance of the commercial airline industry, the impact of upcoming defense cuts, the ability of high-technology industries to continue rapid growth, and the impact of timber supply restrictions. By considering load forecasts based on different assumptions regarding economic growth, this Plan accounts for these sources of economic uncertainty.

Sales and Load Forecasts

The 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. The industrial forecasting model treats industrial sales growth as a function of changes in industrial employment and fuel prices. Formal models do not exist for the street lighting and resale sectors. These two sectors account for less than 1% of system sales and have forecasts based on past sales trends.

Monthly sales forecasts are produced from the annual sales forecasts. 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 total system.

Load forecasts are based on the annual system sales forecast. The forecast of annual system sales is adjusted for losses and allocated across months to produce forecasts of annual and monthly average system load.

Table 3-1

RESIDENTIAL END-USE MODEL ANALYSIS

Housing Types
- Single Family
- Multi-family
- Manufactured Housing

End-Uses
- Space Heat
- Air Conditioning
- Water Heat
- Cooking
- Drying
- Refrigeration
- Freezing
- Other

Residential Sector Forecasting Process

Recent trends indicate that the forecasting procedure must not only accurately predict customer growth, but also account for changes in fuel choice and other factors affecting electricity use patterns. The residential sales forecast is produced with an end-use model obtained in 1986 from the Bonneville Power Administration. This model provides detailed analysis of energy use in the three different housing types and eight end-uses shown in Table 3-1.

A valuable feature of this model is that it allows for multiple fuel choices for space and water heat in new construction. The model is currently calibrated to historical data from the 1982-90 period. By having an eight-year calibration period, historical data may be used to calibrate model parameters to more accurately reflect changing electricity use patterns. Two important sources of information for calibrating the model have been residential surveys and metered end-use load data. Further discussion of input development for the residential end-use model is provided in Appendix H.

Table 3-2

COMMERCIAL END-USE MODEL ANALYSIS

Building Types
- Office
- Restaurant
- Retail
- Grocery
- Warehouse
- Elementary/Secondary
- College
- Health
- Hotel/Motel
- Military
- Miscellaneous

End-Use
- Space Heating
- Air Conditioning
- Ventilation
- Water Heating
- Cooking
- Refrigeration
- Lighting
- Other

Commercial Sector Forecasting Process

The commercial sales forecast is 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 3-2 lists the building types and end-uses analyzed in the commercial sales forecast.

The model assumes that the stock, efficiency, and utilization of electric equipment determines electricity sales. Input values for the model are calibrated with historical data from the 1982-90 period. Additional important sources of information used to calibrate the model include the Pacific Northwest nonresidential survey, commercial metered end-use data, and commercial surveys. A forecast of commercial sales to customers who do not fall into any of the 11 building types is added to the commercial end-use model results to complete the commercial sector forecast. Further discussion of input development for the commercial end-use model is discussed in Appendix H.

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 the industrial sector into the seven industry categories shown in Table 3-3. This model was developed after an extensive examination of industrial forecasting models from other utilities, government agencies and the Electric Power Research Institute.

Table 3-3

INDUSTRIAL FORECAST CATAGORIES

- Petroleum Refining
- Transportation Equipment
- Paper & Allied Products
- Food & Kindred Products
- Lumber & Wood Products
- Chemical
- Other

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. Further discussion of input development for the industrial sales forecasting model is discussed in Appendix H.

Scenario Load Forecasts

Due to the uncertainty regarding future load growth, separate load forecasts were created for five of the six scenarios. These forecasts (and scenarios) are denoted as High, Medium High, Medium, Medium Low, and Low. Each load forecast uses a different set of logically consistent assumptions about the factors which drive load growth. A sixth scenario was created by combining the Medium load forecast with the added complexity of a 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. As shown in Table 3-4, these forecasts vary baseline assumptions on employment, income, and customer growth. However, they use the same fuel price assumptions as the Medium scenario.

Table 3-4

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)					
Single Family Space Heat	45.0%	15.0%	15.0%	15.0%	10.0%
Multi-Family Space Heat	98.0%	91.0%	91.0%	91.0%	54.0%
Electricity Prices (1991-2010 AARG*)	1.6%	1.0%	1.0%	1.0%	.4%
Gas Prices (1991-2010 AARG*)	4.2%	2.3%	2.3%	2.3%	.2%
Customer Additions (1991-2010 Annual Avg.)	35,300	35,300	21,300	10,000	10,000
Residential Use Per Customer (kWh in 2010)	12,200	11,170	11,070	11,230	10,700

*AARG = Average Annual Rate of Growth

Table 3-5

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

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

The impact of changes in fuel prices was examined in the High and Low scenarios. As shown in Table 3-4, the High scenario uses the same economic assumptions as the Medium High scenario, but uses higher fuel prices. The Low scenario uses the same economic assumptions as the Medium Low scenario, but lowers the fuel price assumptions.

Each scenario load forecast was compared to existing resources to determine future resource needs. Table 3-5 shows the load forecast for each scenario and existing resources. 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 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.

Concluding Comments

Load forecasts are an essential part of integrated resource planning. They allow for the comparison of future demand and existing supply to determine future resource needs. In the next chapter, planning issues are addressed prior to the identification of potential resource alternatives in Chapter 5.

Planning Issues

This chapter discusses a number of the issues that influence the company's resource planning efforts. Puget Power operates in a complex and dynamic business environment. This environment generates a number of diverse issues that the company must continually consider and evaluate.

These issues influence the planning process by focusing opportunities, establishing areas for collaborative efforts, and introducing limitations, constraints and uncertainties. As noted in Table 4-1, planning issues ultimately affect one or more areas of Puget Power's Integrated Resource Plan. They affect selection of resource candidates for the scenario analyses, development of the parameters for the scenarios, and/or development of the action items.

Table 4-1

ISSUES INFLUENCING THE PLANNING PROCESS

Planning Issue	Resource Candidate Preferences	Scenario Development	Action Items
Conservation Opportunities:			
Potential Estimates	✔	✔	✔
Conservation Targets		✔	✔
Sources of Conservation	✔	✔	✔
Supply-Side Planning Changes:			
Mid-Columbia River Purchase Agreements			✔
PNCA and CSPE/Canadian Entitlement			✔
Share-the-Shortage Agreement	✔	✔	✔
Non-Utility Contracts	✔		✔
Capacity and Peaking	✔		✔
Hydroelectric Projects	✔	✔	✔
Small Resources	✔	✔	✔
Natural Gas Prices and Availability	✔	✔	✔
Transmission/Distribution:			
BPA/Puget Power NW Trans. Project			✔
Puget Sound Voltage Stability			✔
Third AC Intertie			✔
Electromagnetic Fields			✔
Environmental Considerations:			
Clean Air Act	✔	✔	✔
Global Climate Policy	✔	✔	✔
Endangered Species Act		✔	✔
Puget Sound GMA		✔	✔
Environmental Externalities	✔	✔	✔
Electric Vehicles		✔	✔

Puget Power must continually balance the opportunities and benefits created by these issues against the uncertainties they present. The planning issues are divided into four categories:

- Conservation opportunities
- Supply-side planning changes
- Transmission and distribution
- Environmental considerations

Appendix B provides more detail on the issues and Puget Power's responses summarized in this chapter.

Conservation Opportunities

Substantial amounts of conservation have already been obtained through a combination of company programs, independent efforts by customers, price-induced actions, and improvements in building codes and appliance efficiency standards. Company conservation programs have been offering funding to customers since 1978. These programs have reduced current load by more than 112 aMW. This is equivalent to the amount of the total energy needed annually to serve the cities of Bellevue, Issaquah, and the Totem Lake area of Kirkland.

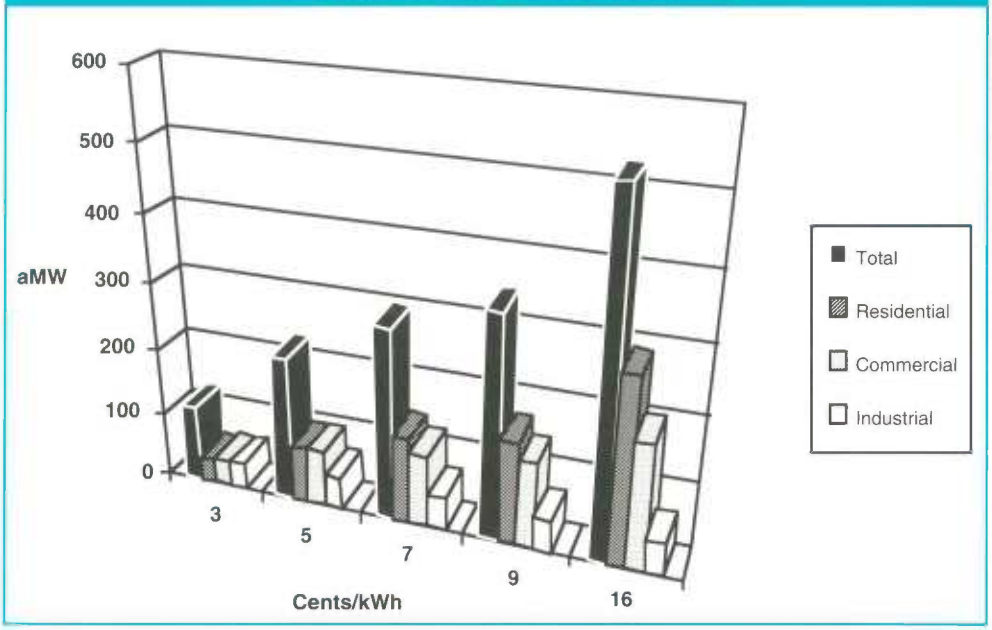
Conservation Potential Estimates

New estimates of conservation potential were developed by incorporating the methodology used by the Northwest Power Planning Council in its 1991 Northwest Conservation and Electric Power Plan, and data specific to the areas served by Puget Power. These conservation potential assessments, referred to as conservation supply curves, were formulated for 14 combinations of customer sectors and end-uses. Figure 4-1 represents the aggregate conservation supply curve under the Medium scenario (See Chapter 6 for scenario descriptions).

Conservation potential is estimated in average megawatts at various cost levels (expressed in levelized cents/kWh). As in the Northwest Power Planning Council's methodology, costs shown are the total capital and installation costs of obtaining conservation measures. Actual company expenditures may be less due to customer contributions to these costs. This supply curve shows that the majority of the industrial conservation potential is available at the 3 cent/kWh cost level. However, the residential and commercial sectors dominate the conservation potential above the 3 cent/kWh level.

Figure 4-1

TOTAL CONSERVATION POTENTIAL BY THE YEAR 2010 FOR THE MEDIUM SCENARIO



Company conservation supply curves do not include conservation stemming from changes in fuel prices and market or regulatory forces. These are accounted for in end-use forecasting models. Supply curves are estimates at a given point in time and will improve in accuracy as data and methodologies progress. The adoption of the Northwest Power Planning Council's methodology accounts for much of the difference between these estimates and those developed in the previous planning cycle. Current conservation potential estimates are 30% to 60% higher than 1989 estimates.

Conservation Targets

Puget Power, working with the Technical Collaborative Group, established aggressive new cost-effective conservation targets. The ambitious 1991 target of 16 aMW of conservation was exceeded with more than 17 aMW achieved through 1991 programs. This target was double the level of the company's achievement in the previous year and well beyond the 7-10 aMW per year objectives established in the 1989 Integrated Resource Plan. A challenging target of 24 aMW of cost-effective conservation has been established for 1992. Targets in later years may decline because opportunities for cost-effective conservation are expected to decrease. This Plan calls for pursuing an aggregate of 300 aMW of cost-effective conservation resources between 1991 and 2010. By comparison, Puget Power has achieved 112 aMW of conservation between 1978 and 1991.

Sources of Conservation

Company conservation programs in all customer sectors are the primary means to achieve challenging conservation goals. Continual improvements in measurement and evaluation help determine the value, effectiveness, and efficiency of conservation programs. Consistent with recommendations from the Technical Collaborative Group, the company determined that programs designed to encourage customer fuel switching are not appropriate at this time, but Puget Power will continue to monitor this issue. See the Action Items listed in Chapter 7 for more detail on future conservation programs. Additionally, competitive bidding has been identified as a potential source of new conservation resources. An important test will be whether Puget Power receives the 10 aMW of conservation contracted through the bidding process for delivery by the end of 1993.

Supply-Side Planning Changes

Continued restrictions on the region's hydro base, a tightening of the power market, and the diminishing regional surplus are among the supply-side issues contributing to uncertainties surrounding Puget Power's long-term resources. No traditional long-term utility power contracts were signed during this planning cycle, indicating that the window of opportunity, for now, has passed for attractive, cost-effective utility purchases like the ones Puget Power obtained in previous years. While the company will remain active in the power market, Puget Power's options include non-utility contracts and projects developed by the company or by a group of utilities. This shift introduces both opportunities and new uncertainties into the resource picture. A variety of resources and acquisition approaches will be pursued, including company-developed facilities, to maintain a balanced resource portfolio. The key issues are described here as part of the planning process for both the scenario analyses and the 1992-93 Action Plan.

Contracts-Utility

Puget Power is engaged in various utility contract negotiations involving the hydroelectric system, and a proposed regional agreement that is designed to deal with the possibility of a prolonged and significant loss of resources. The regional hydroelectric system continues to experience non-power constraints (e.g., recreational uses, flood control, irrigation, and water for fish), and growing regional loads. Additionally, preliminary discussions are underway to renew power agreements with Canada and others for Mid-Columbia River hydro projects (from which Puget Power acquires a majority of its hydro power). These contracts also provide Puget Power with its lowest priced resources and much of its operating flexibility. The combination of these contracts and company-owned hydroelectric facilities provides the ability to follow short-term fluctuations in system load. Additionally, a recovery plan has been developed for salmon species including those listed as endangered or proposed as threatened. This plan, along with future plans under the Endangered Species Act, will affect hydro operations. This issue is discussed in more detail later in this chapter.

Mid-Columbia River Purchase Agreements

Puget Power has five purchase agreements for projects on the Columbia River that begin expiring from 2005 through 2018. Preliminary discussions have begun to renegotiate or extend the existing agreements.

The Columbia River Treaty between Canada and the United States was designed to maximize the power benefits of hydroelectric facilities developed on the Columbia River. Two agreements resulting from that Treaty are also nearing expiration:

- **Pacific Northwest Coordination Agreement (PNCA):** Efforts are underway to renew the agreement which expires in 2003. This agreement provides for coordinated planning and operation of all major Northwest hydroelectric projects to maximize firm energy production.

- **Columbia Storage Power Exchange/Canadian Entitlement:** Puget Power and other utilities have expressed interest in renewing purchase of the Canadian Entitlement power. This power represents increased power generation in the U.S. resulting from water releases in Canada pursuant to the Treaty. The Columbia Storage Power Exchange was created to facilitate purchase of this power by various utilities in the Pacific Northwest. Power from the Columbia Power Storage Exchange will phase out over the period 1998-2003. Canada's interest in renewing deliveries is uncertain at this time.

Share the Shortage Agreement

Northwest utilities are working together on an agreement that would serve as the basis for coordinating utility responses in the event of a prolonged energy deficit within the region.

Contracts - Non-Utility

Almost all new supply-side energy resources being added over the next few years are non-utility projects, which, if completed, would provide more than 400 aMW. A portion of the new non-utility resources come from the company's first competitive bidding process, issued in 1989. Generation contracts from this pilot solicitation process currently total 153 aMW (excluding the 10 aMW contracted for conservation, and the cancelled 17aMW municipal solid waste project).

Currently underway is a second competitive bid request for 100-200 aMW to come on-line in the 1995-98 time period. In this solicitation, a 10% credit is given to conservation and renewable resources in the evaluation process to give preference to resources with lower environmental effects. Also, preference is given to high efficiency cogeneration over other thermal processes. The company hopes that its efforts now will spur development of these resources so that they will be more readily available beyond this decade.

A key concern is the ability of the developers to deliver the expected resources over the contracted term and at the contracted price. Additionally, a majority of these resources are gas-fired. While natural gas currently appears to be an attractive resource for meeting future customer needs, dependence on such purchases may lead to an imbalance in the company's resource portfolio. As noted in Chapter 1, financial considerations are also a key factor, such as preserving the company's credit ratings.

Puget Power will continue to monitor non-utility projects closely. There have been small non-utility projects on the company's system since the early 1980's. The first large, non-utility project came on-line in the fall of 1991. The 80 MW Phase I March Point Cogeneration Company project is a gas-fired cogeneration facility located at the Texaco Refinery in Anacortes, Washington.

Capacity and Peaking Issues

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.

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. 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.

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. For the future, 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 Attractive for Near-Term Needs

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 cancellations 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 Usage Increases

Many new electric utility and non-utility generation projects are using natural gas as a fuel. 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. 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.

Puget Power's resource diversity strategy strives to reduce fuel risks by avoiding over dependence on any one type of new resource. 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.

Transmission and Distribution Challenges

At a time when Puget Power's transmission and distribution systems require enhancements to serve the growing load reliably, public and environmental pressures are making it increasingly difficult to build new or rebuild existing transmission lines, distribution lines, and substations. Concerns about aesthetics, growth management, potential health issues and environmental considerations, such as the effects on forest and wetland areas, have contributed to construction delays.

Additionally, transmission availability, and the associated costs, continue to challenge efforts to make the most efficient use of existing resources and to reach low-cost resources outside Puget Power's transmission system network. Puget Power will increase its efforts to work with customer groups, special interest groups, and governmental agencies to address these important issues. For example, a Citizen Advisory Committee was recently formed to provide comment on a project proposed for a growing residential area. An overview of the major planning issues and progress in addressing them are described on the next two pages. While the transmission issues are not addressed in the scenario analyses, they continue to be emphasized in the Action Plan (see Chapter 7).

Joint Transmission Project To Provide Canadian Access

BPA and Puget Power have proposed a joint transmission project in Whatcom and Skagit Counties which improves local and regional reliability, and provides access to Canadian power. Currently under environmental review, the project Plan of Service proposes upgrades of existing facilities and new construction. Completion of the BPA/Puget Power Northwest Transmission Project is scheduled for mid-1996.

Puget Sound Voltage Stability Problems

Voltage instability, as in other parts of the country, is becoming an increasing problem for the Puget Sound Basin. Various studies indicate that under extremely heavy winter load conditions, and with the loss of a cross-Cascade 500kV transmission line, Puget Sound area customer loads would likely be interrupted. As a result, affected utilities developed the Puget Sound Area Electric Reliability Plan, a cooperative capacity contingency action plan. Among the strategies identified to address this potential problem are conservation and load management programs, and installation of voltage support equipment.

New AC Line to Provide Seasonal Load Diversity

There is substantial support from regional utilities and environmental groups for the construction of an additional 500kV AC line for the Pacific AC Intertie, coordinated by BPA. The required facilities are divided into two projects, the Third AC Intertie and the California/Oregon Transmission Project. This new line can provide for further utilization of the seasonal load diversity between the Pacific Northwest and the Pacific Southwest. Construction is expected to be completed in November 1993. BPA is conducting an Environmental Impact Statement. During this process, it will be determined whether non-federal participation will be allowed for the Third AC Intertie project. BPA will develop an allocation methodology to address current over-subscription. Puget Power has requested a 400 MW share if non-federal ownership is offered.

Electromagnetic Fields (EMF) Controversy

Much controversy and publicity surround the potential health effects of extremely low frequency electromagnetic fields (EMF) from transmission and distribution facilities. Even though most experts believe studies have not proven that there is a cause and effect relationship between EMF and adverse health effects, there is still public concern. That concern has contributed to delayed permitting of transmission and distribution facilities. Puget Power is supporting additional research through its membership in the Electric Power Research Institute.

Also, in 1987 the company established a task force to monitor ongoing research, to develop employee and customer education programs, and to provide free measurement services and information to those concerned about EMF. Puget Power believes that it has an obligation to provide customers with access to credible sources of information on EMF.

Environmental Considerations

Puget Power is committed to pursuing resources with low environmental effects. This pursuit is balanced with other considerations such as regulatory support, public acceptance, and the company's resource diversity strategy. During this planning cycle, evolving environmental issues challenged assumptions about existing resources and the development of future alternatives. Key environmental concerns which may affect resource planning are highlighted in this section.

Clean Air Act Amendments Prompt Compliance Planning

The Federal Clean Air Act Amendments (1990) include extensive new regulations designed to significantly reduce major pollutants nationwide. Key provisions posing challenges to electric utilities are the acid rain regulations designed to reduce sulfur dioxide emissions. Implementation plans are still being finalized by the Environmental Protection Agency.

Puget Power has an ownership interest in coal-fired plants at Colstrip and Centralia. The Colstrip units, "scrubbed" for air pollution control, can attain or surpass the sulfur dioxide limits set by the Amendments for the year 2000. The Centralia plant will not meet those standards. 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. Additional regulations may occur 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 being debated. Discussions include international agreements on CO_2 limits, an allowance trading system, and a potential 'carbon tax' on fuels.

Global Climate Controversy Continues

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.

Internationally, a panel to study climate change resulting from greenhouse gases was established in 1988 under the guidance of the United Nations environmental program. In November 1991, a global energy charter was agreed to by a coalition of representatives from the United Nations. The charter promotes 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.

Actions Under Endangered Species Act May Reduce Regional Resource Options

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 which combines a certain amount of springtime flow enhancement with other measures including habitat and hatchery enhancement and harvest reduction. Puget Power and other regional utilities participated in the development of this plan, and are beginning 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. 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.

Environmental Externalities Treatment

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 societal costs and benefits, or whether this is a legislative function. 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.

Approaches to Address Externalities

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. Also, preference is given to high efficiency cogeneration over other thermal processes.

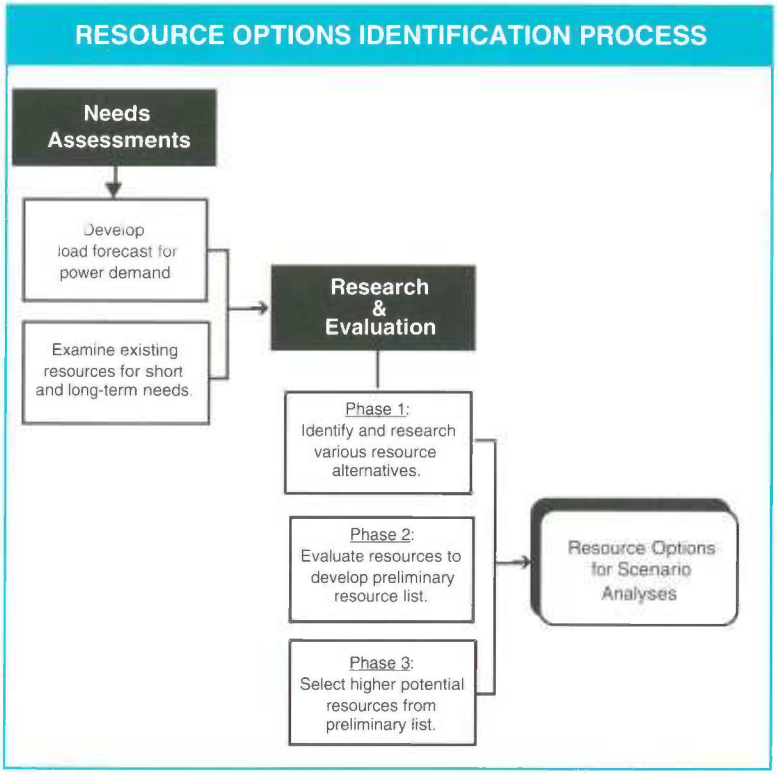
Additionally, the issue of environmental externalities is being pursued at the state level. Governor Gardner, in Executive Order 90-06 signed in November 1990, appointed the Washington State Energy Office to lead a study and make recommendations on the environmental costs of energy development. Puget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

Electric Vehicles Viability Strengthens

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.

Figure 5-1



Resource Options For Scenario Analyses

This chapter focuses on how resources were chosen for inclusion in the scenario analyses. The process followed is outlined in Figure 5-1.

The company's planning guidelines, described in Chapter 1, were used to guide this process. 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 guidelines. This chapter concludes with 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

Approach To Resource Candidate Selection

As noted in Chapters 1 and 3, load forecasts show continued growth and the need for additional resources. For the Medium scenario, the long-term energy deficit totals approximately 1600 aMW by the year 2010. The following resource options identification 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 5-1.

Table 5-1

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		

Table 5-2

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

	Mills/kWh				
Program	3 mills	5 mills	7 mills	9 mills	16 mills
Residential					
Exist Single Family Space Heat	6.0	6.6	7.0	7.7	36.5
Exist Multi-Family Space Heat	9.5	15.2	16.3	16.3	18.3
Refrigerators & Freezers	0.8	0.8	4.6	7.0	19.6
Lighting	0.0	9.5	9.5	9.5	9.5
Hot Water Heater	10.3	35.2	68.1	70.0	111.8
Hot Water Heat Pump Heat Recovery	0.0	0.0	0.0	16.3	16.3
New Single Family Space Heat	0.0	2.0	4.7	7.3	15.4
New Multi-Family Space Heat	0.0	0.0	3.0	3.0	11.5
New Mobile Home Space Heat	8.0	14.2	20.1	20.2	29.6
Clothes Dryer	1.8	1.8	1.8	1.8	8.5
Commercial					
Existing	6.7	14.6	23.6	35.2	42.1
New	25.3	48.3	58.8	69.1	81.8
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

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.

Conservation: This resource is used in all scenarios. Costs and programs are shown in Table 5-2 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 (see Chapter 4 and Appendix D for more detailed information).

Supply-Side: Resource candidates, listed in Table 5-3 on the next page, were ranked by levelized resource cost estimates (excluding wheeling charges). 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 evaluated in the different scenarios.

Table 5-3

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 = (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.*

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 identified in Table 5-3, 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 list reflects 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, introduced in Chapter 3, included changes in load growth, economics, or greater environmental awareness. The scenarios are described and discussed further in the next chapter.

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

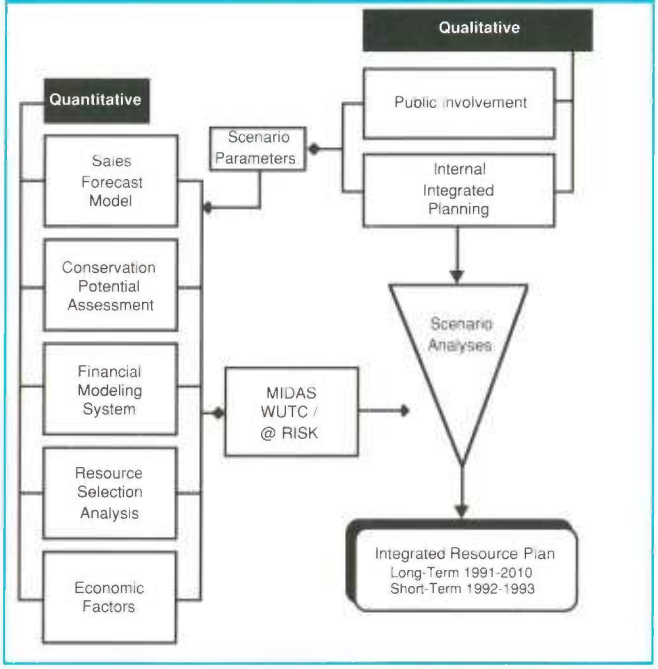
The coal-fired facilities assumed as resource options for this planning cycle also include fully scrubbed plants. Scrubbers reduce particulates and SO_2 emissions to regulated levels. However, additional environmental controls may be necessary for the future. Nonetheless, coal-fired power plants have 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.

Concluding Comments

The resource options identification process assessed a wide range of alternatives. This does not preclude other resources from being pursued as they become available in the future. However, for planning purposes, these higher potential resource candidates are used for further evaluation in the next chapter.

Figure 6-1

SCENARIO PLANNING PROCESS



Scenario Analyses

This chapter discusses the role of scenario planning, the sources of information used during analyses and the scenario evaluation results. This chapter then concludes with the distribution of incremental future resource cost estimates. The overall scenario planning process is shown in Figure 6-1 and detailed in Appendix H.

The purpose of scenario analyses is to determine what actions the company would take if a particular future were to unfold. Scenario analyses continues to be a good method to deal with uncertainties by systematically anticipating and assessing a range of plausible futures in which an appropriate plan could be implemented.

Scenario Planning

The scenario planning process created several different views of the future using analytical and qualitative information. Six scenarios evolved using forecast parameters such as inflation, economy, load growth, fuel prices and cost of capital. Also included were the perspectives of the Technical Advisory Committee and Consumer Panels. The resources used in the scenario analyses were chosen from the resource candidates identified in Chapter 5. A brief description of the scenarios are shown in Table 6-1.

Table 6-1

BASIC SCENARIO PARAMETERS

High: Faster economic growth with greater environmental awareness and gas to electric conversions.

Medium High: Faster economic growth.

Medium: Moderate economic growth (This scenario is used as the baseline by Puget Power for planning purposes).

Medium Low: Slower economic growth.

Low: Slower economic growth with accelerated fuel switching to natural gas.

Sudden Loss of Resources: Moderate economic growth with sudden loss of resources.

Scenario Analyses

The purpose of scenario analyses is to incorporate factors related to planning uncertainties that reduce associated levels of risk. This was accomplished by merging qualitative analysis (resource planning guidelines, judgment, and experience) with quantitative information. The data sources used during the analyses included economic variables, load growth, conservation potential and resource data. The sources of information that assisted the scenario analyses are referenced in the following paragraphs.

Sales Forecast Process

Separate sales forecasts were developed for the residential, commercial and industrial sectors. The residential forecast was produced using the Residential Reference House of Energy model. This was developed by Oak Ridge National Laboratory. Data sources included:

- Residential surveys
- 1990 Census data
- Metered end-use sales data
- Historical data from years 1982-1990
- Data Resources, Inc. (DRI) national economic forecast

The commercial forecast was produced using the Northwest Power Planning Council's end-use model. This model examines commercial energy use across several building types and end-uses. Data sources included:

- 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

The industrial sales forecast was produced using Puget Power's Industrial Sales Forecast model. This model evaluated the relationship of key economic variables.

Data sources included:

- Historical billing data from years 1982 - 1990
- Industrial employment data
- Fuel prices
- Data Resources, Inc. (DRI) national economic forecast

Conservation Potential Assessment Process

Puget Power adopted as closely as possible the methodology and data used by the Northwest Power Planning Council. This information, coupled with data specific to the areas Puget Power serves, resulted in the estimated conservation potential through the year 2010. The Technical Collaborative Group reviewed and commented on the development of these estimates. The results represent Puget Power's "share" of the region's conservation potential. Data sources included:

- Puget Power sales forecasts
- Puget Power customer surveys
- Puget Power conservation programs
- Northwest Power Planning Council cost and savings assumptions

Financial Assessment Process

Financial forecasts play a key role in long-range resource planning. These assessments provided a financial base for the MIDAS model (see discussion below). The financial model consists of several integrated corporate modules which include construction, plant, revenue, expense, finance and consolidation. Data sources included:

- Tariffs
- Power cost studies
- Capital and Operating/Maintenance budgets
- Data Resources, Inc. (DRI) national economic forecast

Resource Selection Process

This procedure evaluated the resource candidates for use in scenario analyses as identified in Chapter 5. Factors considered were escalated fuel prices, operation and maintenance expenditures, capital costs, and resource planning issues. This resulted in a cost-effective resource portfolio for the various scenarios.

Qualitative and quantitative measures of merit included:

- Levelized cost
- Availability
- Reliability
- New technologies
- Resource diversity risk

Multi-Objective Integrated Decision Analysis System (MIDAS)

The company continues to use the MIDAS model developed by the Electric Power Research Institute. This model simulated the utility environment and evaluated the interactions amongst forecasted demand, supply, various financial parameters, and rate planning for each scenario. The MIDAS model incorporated data the informational sources referenced above. These data were processed through the MIDAS simulation module to perform load analysis, capacity planning, production costing, financial projections and rate calculations. Quantitative measures of merit included:

- Revenue requirements
- Various coverage ratios
- Rate impact

WUTC Model / @Risk

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 Process
- Puget Power annual reports

Scenario Evaluation and Results

The scenario evaluation process took into consideration the planning uncertainties and planning guidelines discussed throughout this report. These considerations provided assistance in selecting future resource alternatives for the various scenarios. For instance, as noted in Chapters 1 and 4, smaller resources are preferred in the near-term to match the company's resource needs and to mitigate the risks of project cancellations or loss of resources.

Key economic assumptions are referenced in each scenario description presented on the following pages. Financial assumptions, including levelized fixed charge rates, targeted capital structure, and cost of capital, are referenced in Appendix H. One factor not directly reflected in the scenario analyses is the effect of purchased power contracts being increasingly viewed as debt equivalents by rating agencies. As noted in Chapter 1, 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.

Scenario Comparison

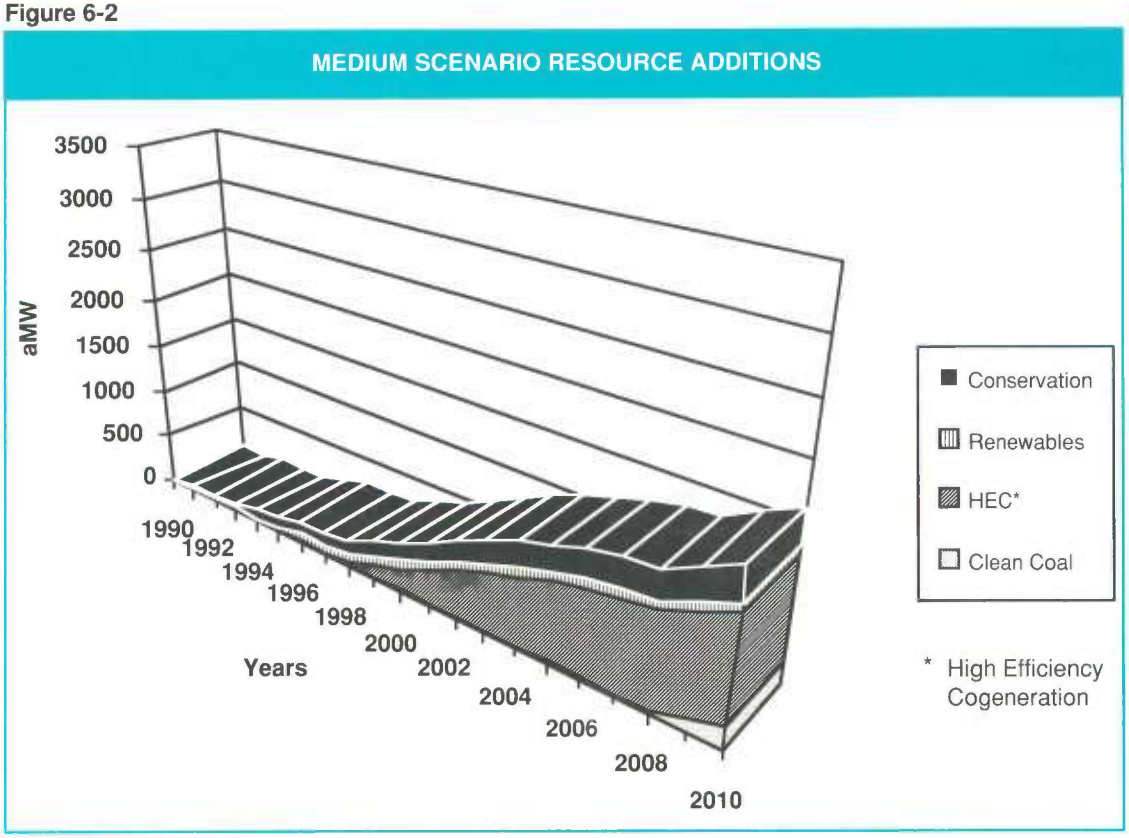
In general, the Medium scenario incorporates the company's baseline assumptions about economic growth, fuel prices, and resource availability. The Medium High and Medium Low scenarios examine the impact of different rates of economic growth. These two scenarios use the same fuel price assumptions as 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. The Sudden Loss of Resources scenario uses the same load forecast as the Medium scenario, but assumes that some existing resources are suddenly lost.

The results of the six scenarios are described in the following resource portfolio charts (Figures 6-2 through 6-6) and evaluation summary tables (Tables 6-2 through 6-7). One difference in the evaluation presentation relates to the Medium with Sudden Loss of Resource scenario. This scenario describes Puget Power's actions if faced with a catastrophic event or equipment failure that caused a large resource loss for an extended time period. As noted earlier, it assumes the economic conditions of the Medium scenario, and focuses on emergency response planning. Therefore, a resource portfolio has not been produced; instead, immediate and long-term action measures have been identified in Table 6-7.

Medium Scenario

Figure 6-2



The Medium scenario serves as a foundation for the various scenarios. Baseline assumptions include employment and population growing faster in the area Puget Power serves than in the Pacific Northwest or the nation. Services, trade and high-technology are the key sources of employment growth. Population within the area Puget Power serves continues to grow during the forecast period. However, in-migration slows from recent levels but remains a major component of population growth.

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, fuel choices in new construction and conversions cause a decline in the electric saturation rates for single family space and water heating. 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.

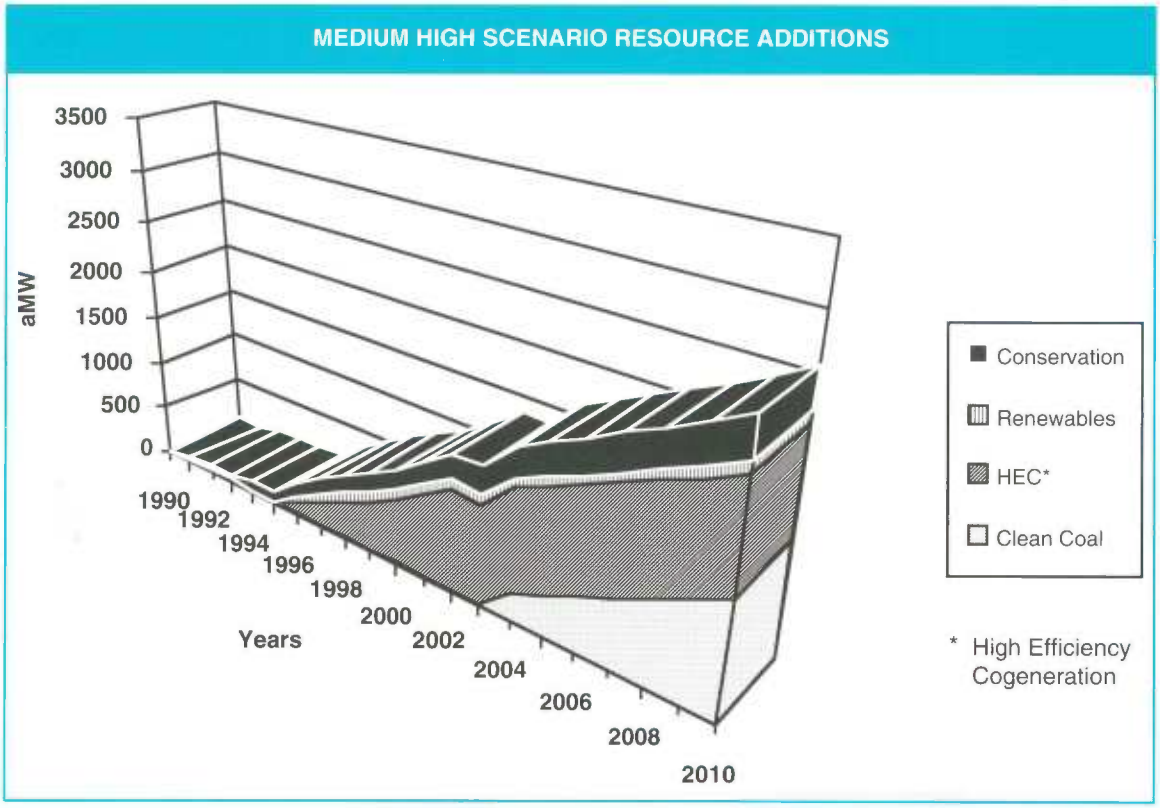
Table 6-2

MEDIUM SCENARIO EVALUATION SUMMARY

Resource Candidates	On-Line Dates	aMW	Annual Average Growth Rates / Additions		Comments / Influences
Conservation	1991-2010	296	Employment:	2.6%	• Moderate economic growth
Renewables	1994-1996	90	Customers:	21,300 additions	• Moderate load growth
High efficiency cogeneration	1998-2010	1000	Real Fuel Prices:	Elec. = 1.0% Gas = 2.3%	• Moderate in-migration • Good conservation potential
Clean Coal	2009-2010	210	Load:	2.4%	• Moderate fuel switching (to gas)

Medium High Scenario

Figure 6-3



This scenario assumes faster economic growth over medium baseline assumptions, and fuel prices remain unchanged.

Record high levels of growth relative to the nation are achieved and aerospace employment gradually increases over this period. Expanded employment opportunities attract higher levels of in-migration and increased business investments contribute to more rapid growth in per capita income. These higher levels of income increase new appliance demand and existing appliance usage.

Accelerated load growth boosts construction activity, increasing conservation potential. Additional generating resources are needed, however, purchased power opportunities are less due to rapid regional economic growth.

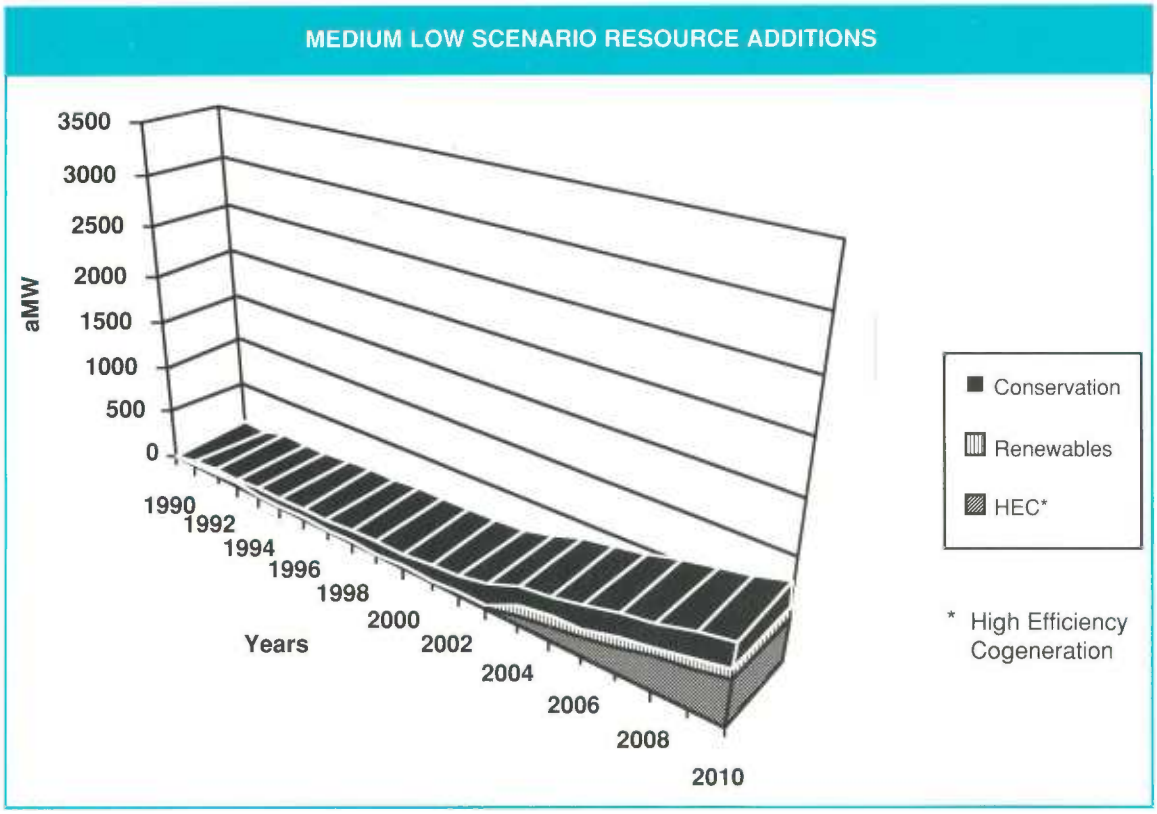
Table 6-3

MEDIUM HIGH SCENARIO EVALUATION SUMMARY

Resource Candidates	On-Line Dates	aMW	Annual Average Growth Rates / Additions		Comments / Influences
Conservation	1991-2010	351	Employment:	2.6%	• Faster economic growth
Renewables	1996-1998	90	Customers:	35,300 additions	• Increased load growth
High efficiency cogeneration	1996-2002	1000	Real Fuel Prices:	Elec. = 1.0% Gas = 2.3%	• Increased in-migration • Increased conservation potential
Clean Coal	2004-2010	1107	Load:	3.6%	• Moderate fuel switching (to gas)

Medium Low Scenario

Figure 6-4



This scenario assumes slower economic growth relative to medium baseline assumptions, and fuel prices remain unchanged. In this scenario, the regional economy goes into a deep recession in the early 1990s, led by a significant total employment decline in the area Puget Power serves. The national economy grows more rapidly than the local economy, and out-migration reduces customer growth.

Load growth is also slowed by reduction in the growth of per capita income. Slower population growth reduces the need for higher population densities and lower incomes reduce the rate of household formation. The conservation potential is reduced due to the decline in new construction and reduced customer willingness to make capital investments for energy savings. Opportunities to meet load growth with purchased power could increase due to slower growth rates throughout the region.

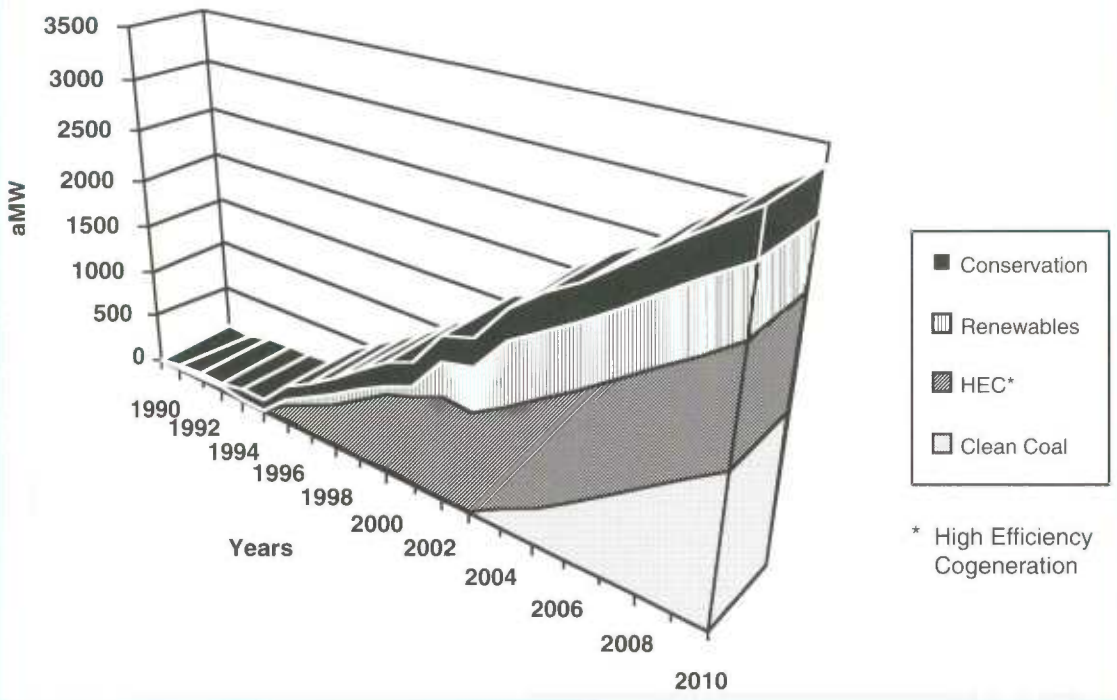
Table 6-4

MEDIUM LOW SCENARIO EVALUATION SUMMARY

Resource Candidates	On-Line Dates	aMW	Annual Average Growth Rates / Additions		Comments / Influences
Conservation	1991-2010	223	Employment:	0.4%	• Severe recession followed by slower economic growth
Renewables	2002-2004	90	Customers:	10,000 additions	• Slow load growth
High efficiency cogeneration	2004-2010	429	Real Fuel Prices:	Elec. = 1.0% Gas = 2.3%	• Moderate out-migration
Clean Coal			Load:	1.0%	• Decreased conservation potential • Moderate fuel switching (to gas)

Figure 6-5

HIGH SCENARIO RESOURCE ADDITIONS



High Scenario

The High scenario uses the same faster economic assumptions as the Medium High scenario. However, this scenario accelerates the rate of load growth, and incorporates higher fuel prices.

All fuel prices rise more rapidly in this scenario due to higher national and worldwide demand for energy sources. The rise in fossil fuel prices may preclude the use of conventional coal. However, integrated gasification combined cycle remains a cost-effective alternative. Natural gas prices also rise faster than electricity with a price crossover after the year 2000. This results in an increased electric market share in all customer sectors, heightening the conservation potential.

Electric cars are also 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. The use of electric cars could significantly alter daily load shapes, and could imply rate structure changes to minimize the impact of electric cars on peak load.

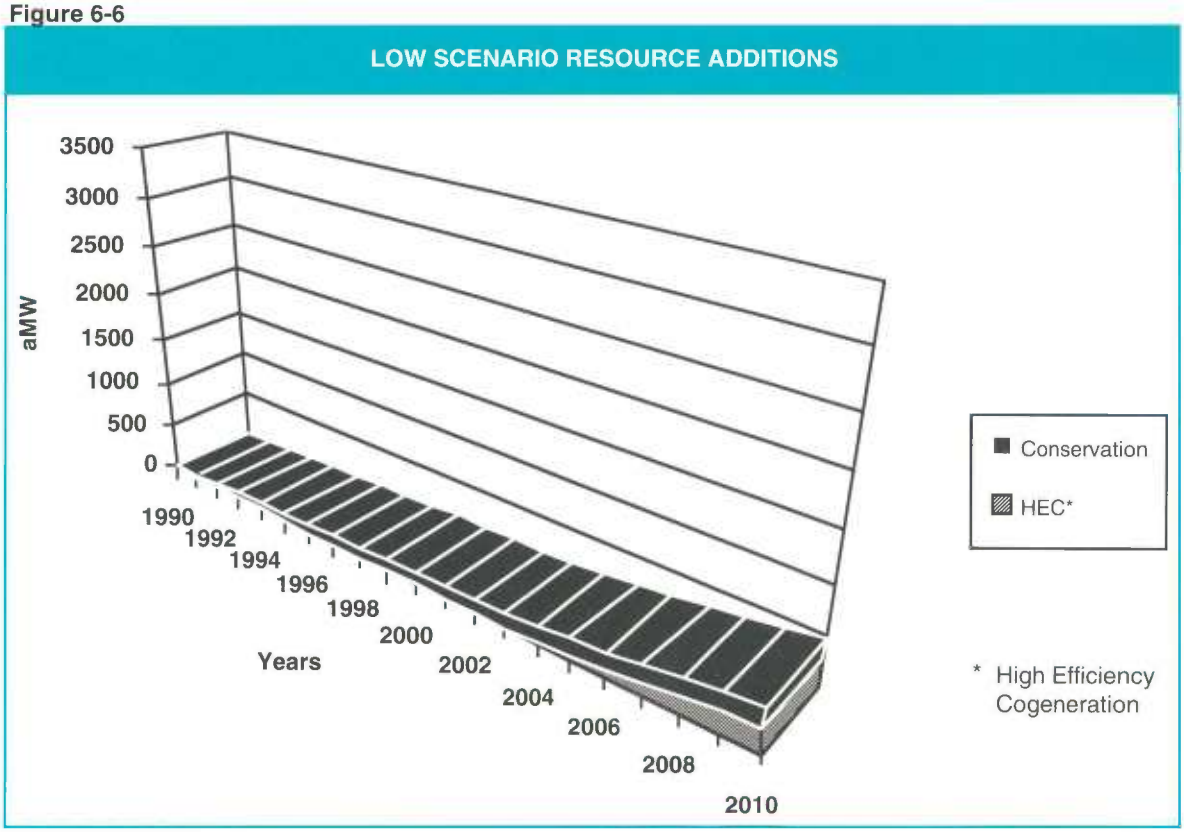
Table 6-5

HIGH SCENARIO EVALUATION SUMMARY

Resource Candidates	On-Line Dates	aMW	Annual Average Growth Rates/Additions		Comments / Influences
Conservation	1991-2010	374	Employment:	3.5%	•Faster economic growth
Renewables	1996-2004	584	Customers:	35,300 additions	•Increased conservation potential
High efficiency			Real Fuel Prices:	Elec. = 1.6%	•Increased environmental awareness
cogeneration	1996-2002	1000		Gas = 4.2%	•Higher fuel prices
Clean Coal	2004-2010	1393	Load:	4.5%	•Significant gas to electric conversions
					•Electric cars become a commercial reality by year 2000
					•Increased load growth

Low Scenario

Figure 6-6



The Low scenario uses the same economic growth conditions as the Medium Low projection, but lowers fuel price assumptions and load growth.

Contributing factors include slower worldwide economic growth and greater discovery of new fossil fuel supplies. Fossil fuel prices decrease more rapidly than electricity prices, resulting in a much lower price of natural gas. The electric market share in all customer sectors significantly declines, reducing conservation potential. This loss of market share occurs primarily for space and water heating, thereby changing system load shapes. Resources selected for this scenario are cost-effective conservation and high efficiency cogeneration. While renewable resources have extremely low operating cost, they were not selected because the capital costs for development are higher in this scenario.

Table 6-6

LOW SCENARIO EVALUATION SUMMARY

Resource Candidates	On-Line Dates	aMW	Annual Average Growth Rates / Additions		Comments / Influences
Conservation	1991-2010	202	Employment:	0.4%	• Severe recession followed by slower economic growth
Renewables			Customers:	10,000 additions	• Minimal load growth
High efficiency cogeneration	2004-2010	252	Real Fuel Prices:	Elec. = 0.4% Gas = 0.2%	• Moderate out-migration
Clean Coal			Load:	0.4%	• Decreased conservation potential • Accelerated fuel switching (to gas)

Medium With Sudden Loss of Resources

This future considers the sudden loss of resources in combination with the economic assumptions of the Medium scenario. Utilities continually face the possibility of a catastrophic event or equipment failure causing long-term loss of a generating facility. More recently, there are possibilities of a long-term resource loss due to environmental, regulatory or political constraints on generating projects. For planning purposes, the loss is assumed to create a firm energy deficit on Puget Power's system which occurs without adequate warning to allow for the development of new resources.

The course of action for a sudden resource loss would vary depending upon the amount and duration of power loss, and Puget Power's load and resource situation. Table 6-7 describes the company's immediate and long-term responses that would be taken if this future were to unfold.

Table 6-7

MEDIUM WITH SUDDEN LOSS OF RESOURCES SCENARIO EVALUATION SUMMARY

Immediate Response	Long-term Response	Comments / Influences
✔ Purchase additional secondary or short-term firm energy. ✔ Operate peaking resources for energy. ✔ Curtail service to interruptible customers. ✔ Request voluntary curtailment from customers. ✔ Curtail service to customers according to priority established by state.	✔ Request short lead time resource acquisition proposals. ✔ Operate an accelerated conservation or load management program. ✔ Build company-developed generating resource (including increased generation from existing resources). ✔ Purchase power from another utility. ✔ Contract with a third party for new generation or conservation resources.	✔ Type of loss (e.g., equipment failure, environmental, regulatory or political constraints. ✔ Duration of loss ✔ Results of resource acquisition request ✔ Some of these responses are also included in the proposed Share the Shortage agreement.

Summary of Results

Based on scenario analyses results, the range of potential resource acquisition activity can be reasonably estimated. This range is shown in Table 6-8. 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 6-9 displays the present value of revenue requirements under each scenario. Appendix H provides a detailed discussion of the scenario planning approach, load forecasts, and data assumptions (e.g., financial). Appendix H also provides a summary table of customer demand, existing resources, energy deficit, resource additions, and revenue requirements.

Table 6-8

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

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 least-cost planning model.

Table 6-9

PRESENT VALUE OF REVENUE REQUIREMENTS (For the Years 1991-2010)

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%

WUTC Model/@Risk

The WUTC model evaluated the resource alternatives chosen to meet future load demands. For each of the five quantifiable scenarios, the model, augmented by a software application called @RISK, was used to forecast and analyze incremental future resource cost estimates over the 20-year planning horizon.

Key Input Variables

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 6-10.

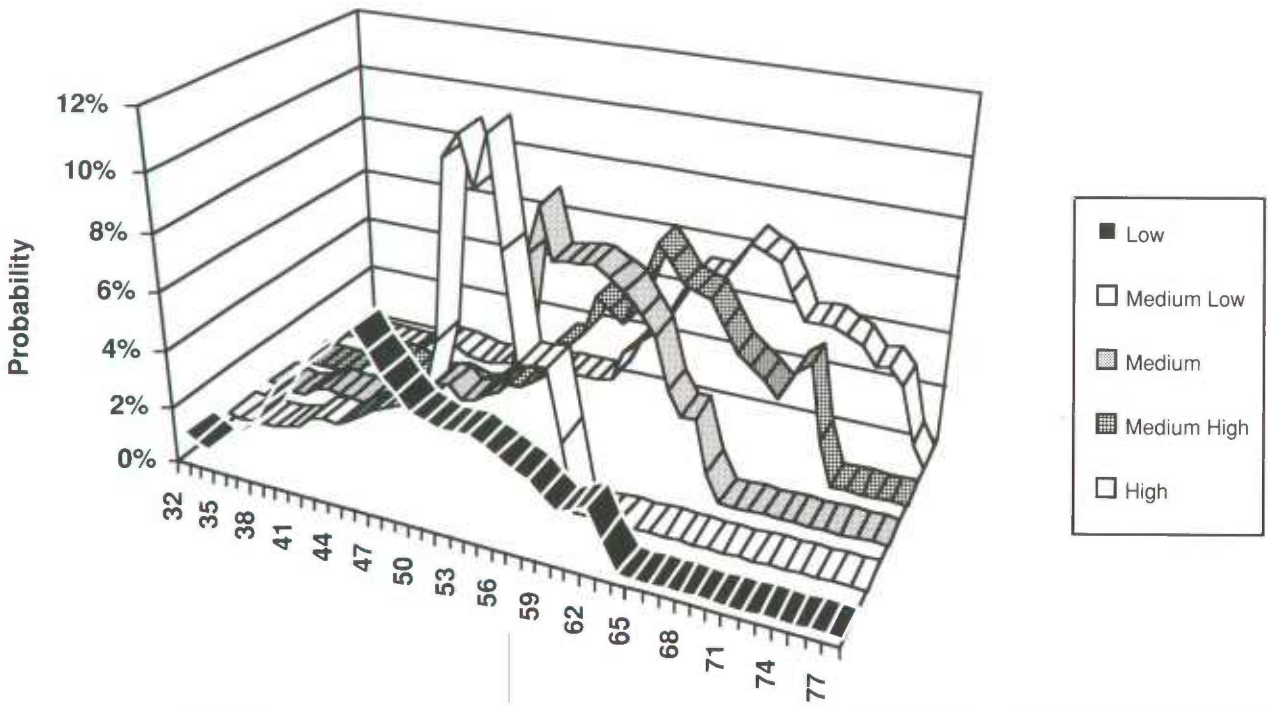
Table 6-10

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%
Cost of Preferred Stock	7.20%	10.58%	8.89%

Figure 6-7

DISTRIBUTION OF 20-YR LEVELIZED INCREMENTAL FUTURE RESOURCE COST ESTIMATES (Mills/kWh)



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 6-10. 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.

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. The scenarios used different sets of resource mix characteristics, as displayed in Figures 6-2 through 6-6, and produced correspondingly different distributions. These distributions are shown in Figure 6-7. 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 a median incremental future resource cost of 55 Mills per kilowatt-hour. Median values for each scenario distribution are displayed in Table 6-11.

Composite Distribution

The five distributions represented in Figure 6-7 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 6-8, 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 6-8 is less skewed towards higher incremental resource cost levels.

Figure 6-8

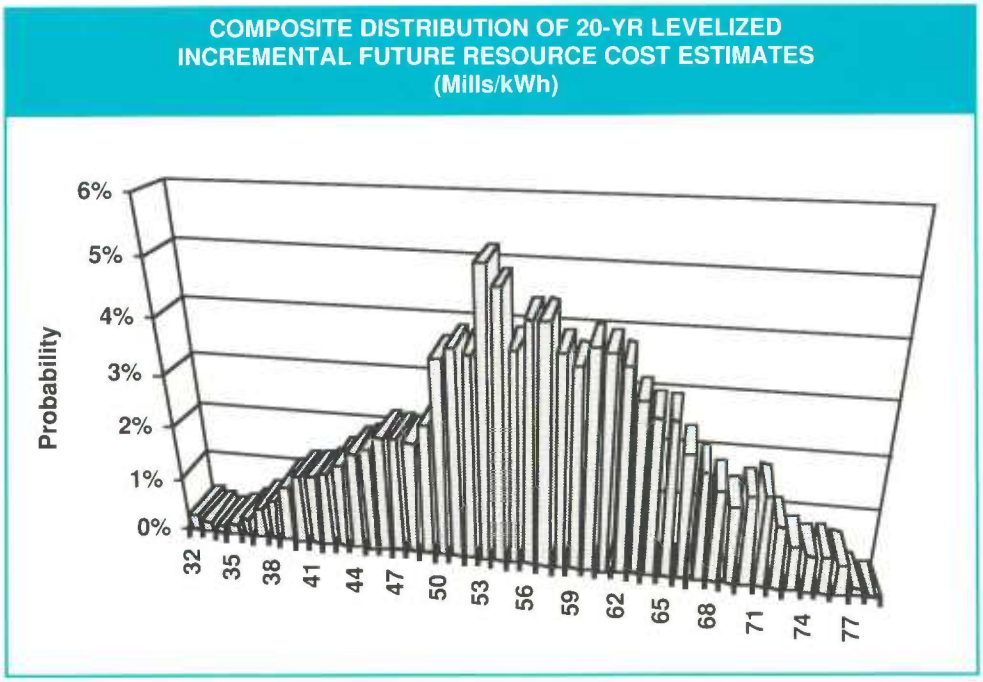


Table 6-11

MEDIAN VALUES OF FUTURE RESOURCE COST DISTRIBUTIONS
Mills/kWh

Scenario	Median Value
Low	46
Medium Low	51
Medium	55
Medium High	60
High	65

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 suggest an expected melded resource cost of about 55 mills per kilowatt-hour. This is consistent with the resource costs used in the 1991 competitive bidding process and the medium scenario.

Concluding Comments

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 under a variety of economic conditions. The company's short and long-term action items, identified in Chapter 7, set the stage for the next integrated resource planning cycle.

Resource Strategy & 1992-1993 Action Plan

This chapter 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 7-1, will help guide the selection of future resources. This includes resources that are cost-effective, reliable, and environmentally and publicly acceptable. Also, small facilities (less than 70 MW) are preferred because this size more closely matches the company's resource needs and helps to mitigate the risks of resource loss or project cancellations. Ultimately, the resources acquired will depend on how uncertainties presented throughout this document are resolved in the future.

Table 7-1

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

Table 7-2

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)

The resource alternatives identified for this Plan are listed in Table 7-2 (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.

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.

Action Plan Summary 1992-1993 Integrated Resource Plan

Puget Power's Integrated Resource Plan concludes with the Action Items summarized on this page and detailed on the following pages. The Action Items are not listed in order of preference. Progress on the Action Items will be monitored over the two-year planning cycle, and reported in the next plan. While the Action Items are categorized under distinct headings, there is overlap in all the categories, underscoring the value of integrated resource planning. This Action Plan supports the resource strategy discussed earlier in this chapter.

Table 7-3

CONSERVATION PROGRAMS	SUPPLY ALTERNATIVES	TRANSMISSION & DISTRIBUTION
Continue to pursue cost-effective conservation opportunities. Pursue "lost opportunity" conservation. Increase the emphasis on commercial/ industrial programs. Increase customer participation. Improve conservation infrastructure. Review competitive bidding. Continue to develop programs to test and build the capability to acquire new conservation resources. Implement the evaluation plan for conservation programs. Develop information to analyze the capacity value of conservation programs and the feasibility of load management programs. Examine fuel switching.	Pursue acquisition of long-term renewable resources. Pursue acquisition of high efficiency cogeneration resources. Conduct study and plan for peak demand and supply-side resources to cover extreme cold weather possibilities. Monitor progress on existing non-utility generation contracts. Review competitive bidding. Evaluate and implement, as necessary, potential modifications to the Shuffleton facility. Terminate Creston if the region does not want to maintain this site as a resource option. Assess compliance for the 1990 Federal Clean Air Act Amendments.	Monitor and comment on transmission access legislation. Continue to pursue transmission access and strengthen the existing transmission system. Explore the feasibility of using targeted conservation programs to reduce transmission and distribution system requirements in high load growth areas. Conduct further studies to seek system efficiency improvements. Continue coordination of transmission and distribution system planning and resource planning.
REGIONAL & PUBLIC INVOLVEMENT	**PLANNING & EVALUATIONS**	**REGULATORY SUPPORT**
	(includes Leading Economic Indicators)	
Continue public involvement to address various planning issues. Participate in Growth Management Act activities. Pursue studies on environmental externalities and monitor approaches taken by other states. Participate in regional studies and analyses as appropriate (i.e., endangered species activities). Participate in the development of the regional Share the Shortage arrangements. Participate in contract negotiations (i.e., Pacific N.W. Coordination Agreement). Continue studies of potential voltage instability in the Puget Sound Basin. Continue BPA-NR studies. Participate in region-wide efforts to shorten lead times for siting, licensing and design of generation facilities.	Assess quarterly economic growth and determine load growth demands. Assess competitive bidding results. Monitor natural gas supply, purchases, and prices. Monitor technological advancements. Analyze feasibility of pursuing further exchange agreements. Monitor emerging renewable and other resource developments. Continue development and use of new analytical tools and planning approaches. Continue support of EPRI and encourage research on issues of special interest to the Pacific Northwest. Continue to monitor and support electric vehicle research and development.	Continue to pursue regulation that supports least-cost integrated resource planning. Analyze and pursue rate design mechanisms that support integrated resource planning goals and activities. Seek regulation and legislation that provides for recovery of the conservation investment where an end-use is switched to a new energy supplier.

Detailed Action Plan
1992-1993 Integrated Resource Plan

Conservation Programs

This category identifies activities to achieve aggressive conservation targets.

Continue to pursue cost-effective conservation opportunities.

Pursue "lost opportunity" conservation:

- Support the implementation of the new Washington State Energy Code in the residential sector, including builder incentive payments. Provide incentives for cost-effective conservation measures that exceed the new code.
- Provide incentives at the factory level to have manufactured homes built to regional Manufactured Housing Acquisition Program efficiency standards.
- Operate programs that ensure efficient appliances and lighting are installed at the time of equipment replacement.

Increase the emphasis on commercial / industrial programs:

- Provide and promote incentives for cost-effective measures used in commercial and industrial new construction that exceed the energy code or current construction practices.
- Increase participation in commercial and industrial retrofit programs in recognition of significant conservation potential available from these sectors.
- Develop additional services that encourage ongoing preventive maintenance and operations training to ensure persistence of energy savings.

Increase customer participation:

- Continue the Conservation Communications Plan to increase customer awareness of programs and to motivate behavioral changes.
- Enhance program delivery using results from research program evaluations and targeted marketing.

Improve the conservation infrastructure:

- Continue to expand trade ally networks.
- Work with neighboring utilities to streamline and coordinate their programs and develop consistency in performance specifications.
- Develop and support training for personnel needed to expand programs, both in terms of utility staff and outside trade allies.

Review competitive bidding.

- Work to acquire resources on round one contracts.
- Evaluate proposals and, as appropriate, award a second round of competitively bid conservation contracts.

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

- Continue to develop residential lighting conservation by expanding delivery methods and incorporating technological improvements.
- Evaluate the performance results of exhaust, air heat pump water heaters in residential applications, and continue to develop the infrastructure for this appliance.

Aggressively implement the evaluation plan for conservation programs and activities.

- Assess the value of conservation as a resource.
- Provide feedback to improve programs and develop new programs.
- Provide input for future conservation targets and integrated resource planning efforts.

Develop information to analyze the capacity value of conservation programs and the feasibility of load management programs.

- Determine capacity reductions from specific programs as part of the conservation evaluation plan.

Examine fuel switching:

- Continue to analyze the appropriate role of fuel switching as a demand-side management strategy, working together with the WUTC and other interested parties.

Supply Alternatives

This category identifies activities to meet forecasted energy and capacity needs.

Pursue acquisition of long-term renewable resources.

- Pursue higher potential small hydro, wind, and geothermal resources.
- Encourage renewable resources in the competitive bidding process for new resources.
- Pursue relicensing of Puget Power-owned hydro facilities.

Pursue small generation facilities of less than 70 MW.

Pursue acquisition of high efficiency cogeneration resources.

Plan peak demand and supply-side resources to cover extreme cold weather possibilities.

- Conduct analysis to further study appropriate planning criteria.
- Use short-term firm purchases and simple-cycle combustion turbines in near term.
- Evaluate all potential demand and supply-side long-term peak resources, including the capacity value of conservation programs.

Monitor progress on existing non-utility generation contracts.

Review competitive bidding.

Evaluate and implement, as necessary, potential modifications to the Shuffleton facility.

Terminate the Creston site if the region does not want to maintain this site as a resource option.

Assess compliance options for the 1990 Federal Clean Air Act Amendments.

Transmission & Distribution

This category identifies activities to assure adequate transmission capability, including access, interties, and strengthening of Puget Power's existing system.

Monitor and comment on transmission access legislation.

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

Explore the feasibility of using targeted conservation programs to reduce Transmission & Distribution system requirements in high load growth areas.

Conduct further studies to seek system efficiency improvements.

Continue coordination of transmission and distribution system planning and resource planning.

Regional and Public Involvement

This category identifies activities that Puget Power will pursue through collaborative efforts.

Continue public involvement and collaborative efforts to address various planning issues including:

- Conservation
- Supply alternatives
- Transmission & Distribution
- Integrated resource planning

Participate in Growth Management Act activities.

- Monitor progress on 1990 Washington state Growth Management Act.
- Coordinate planning efforts with local governments in the areas Puget Power serves.

Pursue studies on environmental externalities and monitor approaches taken by other states.

Participate in regional studies and analyses as appropriate, including:

- Endangered species activities
- Regional power and economic planning
- Direct Services Industries top quartile service related to firm and non-firm requirements

Participate in the development of the regional Share the Shortage arrangements.

- Utility agreements
- State plan

Participate in contract negotiations, including:

- Pacific Northwest Coordination Agreement
- Canadian Entitlement
- Mid-Columbia River

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

Continue studies to seek better definition and price stability of BPA-NR rate.

Participate in region-wide efforts to shorten lead times for siting, licensing, and design of generating facilities.

Planning and Evaluations

This category identifies activities related to monitoring leading economic indicators, technological developments (R&D) and evaluation of the integrated resource planning process.

Assess quarterly economic growth and determine load growth demands:

- ❖ Issue reports that interpret economic development relative to future energy resource needs.

Assess competitive bidding results:

- ❖ Assess capacity, costs, and on-line dates.

Monitor regional natural gas supply, prices, and purchases.

Monitor technological advancements:

- ❖ Conservation
- ❖ Supply Alternatives
- ❖ Transmission & Distribution

Analyze feasibility of pursuing further exchange agreements.

Monitor emerging renewable and other resource developments.

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

Continue support of EPRI and encourage research on issues of special interest to the Pacific Northwest including:

- ❖ Advanced fossil systems (i.e., coal gasification, fluidized bed)
- ❖ Conservation and energy efficiencies
- ❖ Electromagnetic fields
- ❖ Renewable energy (i.e., biomass, solar, wind)
- ❖ Transmission systems
- ❖ Underground distribution cable

Continue to monitor and support electric vehicle research and development.

Regulatory Support

This category identifies activities that address the company's continuing regulatory needs.

Continue to pursue regulation that supports least-cost integrated resource planning.

Analyze and pursue rate design mechanisms that support integrated resource planning goals and activities.

Seek regulation and legislation that provides for recovery of the conservation investment in cases where an end-use is switched to a new energy supplier.

FIGURES

TABLES

GLOSSARY

Average Megawatt (aMW): A measure of the average rate of energy delivered. One aMW equals 8,760,000 kWh per year.

Avoided Costs: The costs a utility would otherwise incur to generate or purchase power if not acquired from another source.

Bonneville Power Administration (BPA): The U.S. Department of Energy's power marketing agency for the Pacific Northwest.

Capacity: The maximum load a generator, turbine, power plant, transmission circuit, or power system can supply under specified conditions for a given period of time without exceeding approved limits of temperature and stress. Synonymous with Capability.

Demand: The instantaneous rate at which electric energy is delivered to or used by a system. Synonymous with Load.

Electric and Magnetic Fields (EMF): Invisible lines of force surrounding an electric conductor. Electric fields are created by the voltage on the wire; magnetic fields are produced by the electric current.

Electric Power Research Institute (EPRI): A nonprofit corporation funded by member utilities to plan and manage research and development on behalf of the electric utility industry.

End-Use: A type of electricity use by customers (e.g., space and water heating, cooking, etc.).

Environmental Externalities: Environmental effects, including environmental benefits, that are not directly reflected in the cost of electricity.

Existing Resources: Those resources that are currently in use, or being developed under contract but not yet in operation.

Federal Energy Regulatory Commission (FERC): A division of the U.S. Department of Energy responsible for regulating power generation and setting rates and charges for the transportation and sales of gas and electricity across state boundaries. FERC also licenses hydroelectric power plants.

Fixed Costs: Costs that do not vary in relation to change in plant output.

Fossil Fuels: Coal, oil, natural gas and other fuels deriving from fossilized geologic deposits.

Integrated Resource Planning (IRP): A process by which utilities assess the cost of, and choose among, various resource options. This planning activity develops long-term strategies with shorter-term action plans, to provide customers with reliable, low cost energy service.

Kilowatt (kW): A measure of electrical power equal to 1,000 watts.

Kilowatt-hour (kWh): A common unit of electric energy consumption. Power (measured in kilowatts) multiplied by the time of operation (measured in hours) equals kilowatt-hours. Ten 100-watt light bulbs burning for one hour use 1 kWh. Using the same formula, a 2-kW (2000 watt) air conditioner operating for one half hour uses 1 kWh.

Levelized cost: A fixed annualized payment, the present value of which equals the present value of costs over the life of an asset.

Load Forecast: The predicted demand for electric power for planning purposes.

Megawatt: A measure of electrical power equal to 1,000,000 watts.

Megawatt-hour (MWh): A measure of electric energy equal to one megawatt of power supplied from an electric circuit for one hour.

Mill/kWh: One mill equals one-tenth of a cent. Frequently used as a monetary measure when referring to the cost of producing or conserving electricity.

Nominal: Rates or costs that include forecasted inflation.

Non-Firm or Secondary Energy: Electric energy having limited or no assured availability.

Non-Utility Generation: Generation by producers other than electric utilities.

Northwest Power Planning Council: A multi-state chartered council who establishes policy on Northwest electrical energy, fish and wildlife issues. Members include representatives from Idaho, Oregon, Montana and Washington.

Pacific Northwest Coordination Agreement (PNCA): An agreement signed in 1964 by the federal government and Northwest utilities to agree to operate generating projects as a single entity to make optimum use of the water and storage resources in the region.

Peak: The greatest amount of demand occurring during a specified period of time.

Periodic Rate Adjustment Mechanism (PRAM): An annual rate adjustment mechanism for prompt recovery of purchased power costs and conservation investments. The mechanism is presently in effect on an experimental basis.

Planning Horizon: A long-term study period (e.g., 20 years) for planning purposes. The current Integrated Resource Plan planning horizon includes years 1991 through 2010.

Real: Costs or rates expressed in base year dollars (inflation excluded).

Service Obligation: A term used to describe the duties a utility is legally required to perform. Usually considered to include the duty to: 1) serve all customers; 2) provide adequate service; and 3) render safe, efficient, and nondiscriminatory service.

Tariff: A schedule filed by a utility with a regulatory agency describing transactions between the utility and customers in terms of type of service, conditions of service, rates charged, and means of payment.

Transmission Availability: Transmission capability both within the region and between regions of the western United States and Canada to make the most efficient use of existing and future resources and to reach low cost resources outside the service area.

Variable Costs: Cost that vary in direct proportion with plant output.

Washington Utilities and Transportation Commission (WUTC): The state agency that regulates Puget Power's rates, services, facilities, and practices.

Watt (W): A basic unit of electric power. One watt is equal to 0.00134 horsepower or 0.73756 foot-pounds per second.

Wheeling: The use of one utility system's transmission facilities to transmit power of and for another system.

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