VII. DEMAND-SIDE RESOURCES

This chapter discusses PSE's current electric and gas energy efficiency programs; the outcome of the 2004 electric efficiency resource acquisition Request for Proposal (RFP) process; and the results of the demand-side resource potentials analysis, which are a key input to the integrated resource analysis described in subsequent chapters.

A. Existing Energy Efficiency Resources

Overview

PSE has provided conservation services for its electricity customers since 1979. The conservation measures installed through PSE programs from 1985 - 2004 are currently saving a cumulative total of approximately 229 aMW (about 2,003,000 MWh) in 2004. These energy savings have been captured through energy efficiency programs designed to serve all customers – including residential, low-income, commercial and industrial. The Company has expended approximately $430 million in electricity conservation since 1985.

On the gas side, PSE has provided energy efficiency services since 1993, installing enough conservation measures through 2004 to be currently saving a cumulative total of 1,114,267 decatherms in 2004 – half of which has been achieved since 2002. These energy savings were captured through energy efficiency programs primarily serving residential and low-income customers through 1998. Beginning in 1999, PSE increased its focus on achieving gas energy savings from commercial and industrial customer facilities. Since 1993, the Company has expended close to $12 million in natural gas conservation.

PSE currently operates its energy efficiency programs in accordance with requirements established as part of the stipulated settlement of PSE's 2001 general rate case (WUTC Docket Nos. UE-11570 and UG011571).

In its August 2003 Least Cost Plan Update, PSE completed an extensive analysis of energy efficiency savings potential and its contribution to the Company's electric and gas resource portfolios. The results were used to develop PSE's energy efficiency program targets for 2004 and 2005. This assessment was the culmination of a collaborative effort between PSE and key external stakeholders represented in the Conservation Resource Advisory Group (CRAG) and the Least Cost Plan Advisory Group (LCPAG).

The outcome of this process was the development of a two-year target for energy savings of approximately 39 aMW of electric energy efficiency and 500,000 decatherms of natural gas energy efficiency by the end of 2005, to be achieved through a variety of program offerings to all customer classes. Such targets represent an increase over 2002-2003 targets, which in turn represented a significant ramp-up over previous levels. The Company also issued an RFP to acquire electric efficiency resources, consistent with the findings of the August 2003 Least Cost Plan Update. The status and results of PSE's conservation programs and RFP process are presented below.

Current Energy Efficiency Programs

PSE currently offers electric energy efficiency programs under tariffs effective from January 1, 2004 through December 31, 2005. Programs provide for energy savings from all customer sectors, including both electricity and natural gas. PSE funds the majority of its energy efficiency programs using electric "Rider" and gas "Tracker" funds, collected from all customers. A portion of electric program funding also occurs through arrangements with the Bonneville Power Administration (BPA) to provide Conservation and Renewable Discount (C&RD) credits. Based on best current estimates of costs and savings projections, these conservation programs provide a cost-effective resource.

The year 2004 marked the beginning of a new conservation tariff period spanning 2004 and 2005 that continues ongoing programs and initiates a number of new pilot programs. Exhibit VII-1 shows how PSE has done in 2004 compared to two-year budget and savings goals for electric energy efficiency programs (including BPA C&RD programs). Based on jobs in progress and program status, current projections are that PSE will achieve 100 percent of the two-year savings goals on or under budget by the end of 2005.

During 2004, PSE's electric energy efficiency programs saved a total of 19.8 aMW of electricity, putting the Company on track to achieve its two-year electric savings goal of 39,2 aMW by the end of 2005. Programs under the electric Rider achieved total savings of 138,288 MWh (15.79 aMW) at a cost of $20,869,462. In addition, under BPA's C&RD program, PSE saved an additional 34,927 MWh (3.99 aMW) in first-year savings at a cost of $4,126,802 (does not include cost of renewables). The 2004 savings achievement is 14 percent higher than the 2003 total of 17.3 aMW saved.

PSE's 2004 gas efficiency programs saved a total of 318,000 decatherms, putting the Company on track to achieve its two-year gas savings goal of 500,000 decatherms by the end of 2005. Natural gas energy efficiency savings were achieved at a cost of $3,781,810. The 2004 achievement is a 47 percent increase over the 2003 total of 217,500 decatherms saved.

Exhibit VII-1
Annual (Jan. 2004 – Dec. 2004) Energy Efficiency
Program Summary

Tariff + C&RD Programs	2004 ACTUALS	2 YEAR BDGT./GOAL	'04 vs. '04/05 % Total
Electric Program Costs	$24,996,264	$52,218,000	47.9%
MWh Savings	173,215	343,080	50.5%
Gas Program Costs*	$3,781,810	$9,106,000	41.5%
Decatherm Savings	318,982	501,348	63.6%

* Does not include Low Income Weatherization O&M funding of $300k per year.

Electric Energy Efficiency RFP

In February 2004, PSE issued an "all-comers" RFP for acquisition of electric energy efficiency resources, consistent with 2003 Least Cost Plan findings of a short-term need for electric energy resources (with energy efficiency included as a least-cost option), as well as with WAC 480-107 requirements. The Energy Efficiency RFP process was run in parallel with the RFPs for wind and all generation resources.

The Energy Efficiency RFP sought two types of proposals:

- *Resource Programs:* Programs to acquire energy savings via installation of high-efficiency equipment and technologies at customer premises, with a minimum project size of 5,000 MWh/year delivered within two years.
- *Pilot Projects:* Small-scale programs designed to introduce energy efficiency measures not yet widely adopted in PSE's service territory, and/or to demonstrate program delivery to market segments that have experienced low participation in energy efficiency programs.

The primary implementation period targeted by the RFP was 2006-2007, with earlier implementation as an option, if appropriate. The long lead time was driven by the fact that 2004

– 2005 targets, programs, and a regulatory penalty mechanism were established through consensus agreement with the CRAG prior to development of the RFP process. This was pursuant to conditions stipulated in the Conservation Agreement as part of PSE's 2001 General Rate Case (WUTC Docket Nos. UE-11570 and UG011571). Therefore, a proposal had to align very closely with PSE's current established mix of programs to be selected for implementation prior to 2006.

In April 2004, PSE received bids for 29 efficiency projects, totaling 30 aMW. These bids underwent an extensive, two-stage structured evaluation process, focusing on cost-effectiveness, technical merits, compatibility with existing PSE programs, and the risk of not delivering projects as proposed. PSE also sought to choose a variety of proposals such that all customer classes were included. The first stage of the evaluation process was completed in June 2004, resulting in the selection of a short list of 12 proposed projects. The second evaluation phase was completed in August 2004 to select finalists. The results of this evaluation process have been reviewed with the CRAG.

Five projects, totaling 7 aMW, were selected to receive Letters of Interest to pursue final contracts. Three of the finalists target the commercial/industrial sector (1 pilot and 2 resource programs), while the other two finalists address the residential sector (1 pilot and 1 resource program). The two residential projects are being considered for implementation starting in 2005, while the commercial/industrial projects are more likely to be implemented in 2006-2007. Contract negotiations are in progress and will be completed by mid-2005.

Given PSE's extensive experience in operating energy efficiency programs, the Company has determined that a "targeted" approach to acquiring energy efficiency resources from third-party providers would be more effective than the "all-comers" approach. The 2004 RFP process found few new technologies or innovative service delivery mechanisms, and no respondent could match PSE's current programs in terms of delivery efficiency and cost-effectiveness (some of which already utilize third-party providers). PSE (supported by bidder comments and questions during the RFP process) would prefer to focus future RFPs on specific customer segments, end uses, or technologies that would enhance or expand its current program mix. Such a targeted process would likely yield more competitive bids that best meet PSE's needs at potentially lower costs to its customers, and provide bidders with more structure and guidance.

PSE also found that the misalignment between the program implementation cycle, required by its 2001 General Rate Case stipulation, and the electric resource RFP process mandated by the WAC, created an extremely long lead time between issuance of the RFP and implementation of selected projects. As explained above, PSE had to set targets and commit to programs and budgets before the RFP process could be completed. Projects selected by the RFP process were thus pushed into the next "open" program implementation cycle by this timing conflict, putting them more than a year out. Public comments on the RFP indicated that such a long lead time greatly increases the risk and uncertainty faced by bidders about future costs and market conditions, which could be reflected in higher bid prices or their decision to bid at all. PSE would like to explore alternatives to reduce this timing conflict in future RFPs, which should encourage more cost-effective bid submittals.

B. Demand-Side Resources – Potential

Overview

Developing reliable estimates of the magnitude, timing, and price of alternative demand-side resources is a critical first step in a least-cost, integrated resource planning process. These estimates also help to guide and inform demand-side planning and inform conservation program development efforts.

As part of its 2003 least cost planning process, PSE commissioned a study to investigate the "technical" and "achievable" electric and gas conservation potentials in its service area for the 2004-2023, 20-year planning horizon. The results of that study were filed with the Washington Utilities and Transportation Commission (WUTC) in the August 2003 update to PSE's Least Cost Plan, originally filed in April 2003 under Docket UE-030594.

In an effort for the 2005 Least Cost Plan to more fully consider the potentials for demand-side resources within PSE's service territory, the Company engaged Quantec, LLC, an energy and environmental consultancy in Portland, Oregon, to conduct a comprehensive assessment of all achievable demand-side resources, including energy-efficiency, fuel conversion, and demand-response options. A detailed report on this demand-side potential assessment is included as Appendix B. The principal goal of this study was four-fold:

1. To update the results of the 2004-2023 conservation potentials study using more recent market data for the residential, commercial, and industrial sectors in the Company's service area; and to extend the analysis to the 2006-2025 planning period.
2. To investigate the potentials for additional demand-side resource options including electric-to-gas fuel conversion and demand response, taking into account the interactions among various resource options and resource acquisition scenarios.
3. To employ a simple, flexible, and transparent approach consistent with the methods used by the Northwest Power and Conservation Council, relying on the most recent market data.
4. To create discrete "bundles" of demand-side resource potentials comprised of groups of homogeneous measures, and to provide supply curves for each bundle that would allow the demand-side resource options to be evaluated against supply options on an equal basis in PSE's least cost, integrated resource planning process.

Estimates of long-term, demand-side resource potentials in this study were derived with standard practices and methods in the utility industry, using the most recent data. Studies such as this require compilation of large amounts of data from multiple sources on existing demand management strategies, technologies, and market dynamics that affect their adoption. They also rely on assumptions concerning the future, particularly changes in demand for energy, codes and standards, energy efficiency technologies, market conditions, and consumer behavior. It is, therefore, inevitable that the findings of this study will have to be revisited periodically to take into account the impacts of emerging technologies and the changing dynamics of the energy markets.

General Methodology

Concurrent assessment of demand-side resources poses significant analytic challenges. Due to their inherently unique characteristics and the types of load impacts that they generate, analyses of energy-efficiency, fuel conversion, and demand-response potentials require different methodologies and data. While these methodologies are capable of producing reliable estimates for each demand-side resource individually, they must also have the capability to accurately account for interactions among these resources, particularly capturing the effects of fuel conversion on energy efficiency potentials.

This study incorporated significant improvements over the 2004-2023 assessment with respect to both methodology and data quality. Due to the more complex nature of the assessment, largely arising from the interactions between energy efficiency and fuel conversion, a more advanced and more flexible methodology and modeling approach had to be adopted. The study also relied on substantially more accurate and more recent market data on market characteristics, conservation measure impacts, and costs, especially in the residential and commercial sectors.

The overall approach in this study distinguishes between two distinct, yet related, definitions of resource potential that are widely used in utility resource planning. The first is “technical potential,” and the second is “achievable potential.” Technical potential assumes that all demand-side resource opportunities may be captured regardless of their costs or market barriers. Achievable potential, on the other hand, represents that portion of technical potential that is likely to be available over the planning horizon given prevailing market barriers and administrative program costs that may limit the implementation of demand-side measures. For the purpose of this study, “achievable” energy efficiency and fuel conversion potentials are defined as that portion of technical savings potential remaining after factoring in market penetration rates, and which has a levelized per unit cost of less than $115 per MWh for electricity and less than $10.50 per decatherm for gas, inclusive of program administration and delivery costs.

Estimates of technical energy efficiency and fuel conversion potential for the residential and commercial sectors were derived using Quantec’s QuantSim model, an electric and gas end-use forecasting model. For each customer class, application of the model involves three steps: 1) producing separate, end-use specific forecasts of loads over the 20-year planning horizon, and calibrating the end-use forecasts to PSE’s 20-year aggregate customer class forecasts to ensure consistency between the two, 2) producing a second forecast for each end-use that incorporates the saturations and energy impacts of all feasible energy efficiency measures, and 3) calculating technical potentials by end-use, and measure as the difference between the two forecasts.

Due to the more complex nature of the industrial market, end-uses and equipment, on the one hand, and the lack of reliable information on measure-specific saturations, on the other hand, energy efficiency potentials in the industrial sector were analyzed using an alternative, “top-down" approach. Application of this method involved two steps. First, total firm industrial loads were disaggregated into standard classes, and major end-uses within each class based on PSE's latest sales data. Second, for each end-use, potential savings and per unit cost of the potential savings were estimated using available data from industrial energy efficiency programs in the Northwest and California, and market information on PSE's industrial customer accounts.

Given the technical challenges of and market barriers facing fuel conversion in the commercial and industrial sectors, opportunities for electric conservation from fuel conversion were assessed only for the residential sector. Four residential end-uses were considered, namely space heating, water heating, cooking, and clothes drying. In order to account for the effects of fuel conversion on electric and gas conservation opportunities, potentials for energy efficiency and fuel conversion in the residential sector were modeled simultaneously.

As explained later in this chapter, potentials for each demand-response resource acquisition strategy were estimated using a hybrid, top-down, bottom-up approach. It consisted of first disaggregating PSE's total load into customer sectors and end-uses, estimating load reduction potentials for each end-use, and then aggregating end-use impacts to sectors and system level.

The methodologies used to assess the potentials for energy efficiency, fuel conversion, and demand response are described more fully in Appendix B.

Data Sources

Implementation of the methodology described above required compilation of a large database of measure-specific technical, economic, and market data from a large number of primary and secondary sources. The main sources used in this study included, but were not limited to, the following

- ***Puget Sound Energy*:** Latest load forecasts, load shapes, economic assumptions, PSE's historical energy efficiency and demand-response program activities, PSE's 2004 residential appliance saturation survey (RASS) designed with a particular emphasis on obtaining market to support this study, and the Commercial Building Stock Assessment (CBSA) - a study of the Northwest's commercial building characteristics sponsored jointly by BPA, the Northwest Energy Efficiency Alliance, and PSE.

- ***Northwest Power Planning Council and the Regional Technical Forum*****:** Technical measure information, measure costs, measure savings, measure life.
- ***California Energy Commission Database for Energy Efficiency Resources (DEER)*****:** Measure costs and savings, measure applicability factors, and technical feasibility factors.
- ***Existing Studies:*** Previous conservation potentials studies and conservation program evaluation reports on energy efficiency programs in the Northwest and California.

Summary of the Results – Energy Efficiency

Technical energy efficiency potentials in the residential and commercial sectors were derived based on an analysis of 127 unique electric measures, and 62 unique gas measures. The Northwest Power and Conservation Council was the primary source for electric measures in the residential and commercial sectors. This list was augmented by additional measures from DEER. The list of gas measures in all sectors was compiled mainly from DEER.

Under consideration were six residential segments (existing single-family, existing multi-family, existing manufactured homes, new-construction single-family, new-construction multi-family, new-construction manufactured homes) and 20 commercial segments (10 building types within the existing and new structure segments). Since many energy efficiency measures are applied to multiple segments and building types, a total of 1,756 electric and 736 gas measure/segment/structure combinations were included in the analysis. All major end-uses in all 15 major industrial segments in PSE's service area, including wastewater treatment, were analyzed. The measure/segment/structure combinations were then grouped into "bundles" with similar cost and load shape characteristics, as described later in this chapter.

Based on the results of this study, cumulative 20-year technical conservation potentials in PSE's service area are estimated at 895.5 aMW megawatts of electricity and 38,223,912 decatherms of natural gas savings, of which 297 aMW (33 percent) and 10,788,029 decatherms (28 percent) are expected to be achievable. Achievable savings represent 9.3 percent of the electric load and 8.6 percent of projected gas use over the 2006-2025, 20-year planning period.

As shown in Exhibit VII-2, the commercial sector accounts for the largest share of achievable electricity savings (147.6 aMW), followed by the residential sector with an achievable savings potential of 133.4 aMW over 20 years. The industrial sector accounts for 15.9 aMW of electricity savings during the same period.

Exhibit VII-2
2006 - 2025 Electric Technical and Achievable Potential

Sector	2025 Total Load (a)	20-Year Cumulative Potential (a/% of Baseline)	
		Technical	Achievable
Residential	1,450	375.8	133.4
Commercial	1,578	503.7	147.6
Industrial	158	15.9	15.9
Total	3,186	895.4	296.9

Exhibit VII-3
2006 – 2025 Natural Gas Technical and Achievable Potential

Sector	2025 Total Gas Sales (Decatherms)	20-Year Cumulative Potential (Decatherms as % of Baseline)	
		Technical	Achievable
Residential	75,278,759	27,738,747	6,334,280
Commercial	42,637,285	10,170,241	3,864,537
Industrial	4,028,666	314,924	314,924
Total	121,944,710	38,223,912	10,513,741

The largest share of achievable natural gas potential is expected to occur in the residential sector, which accounts for nearly 60 percent of total achievable natural gas savings. The commercial and industrial sectors respectively account for 37 percent and 3 percent of the achievable gas conservation potential, as shown in Exhibit VII-3.

Distributions of achievable electricity savings in the residential and commercial sectors by end-use are shown in Exhibits VII-4 and VII-5. Savings in lighting (Exhibit VII-4), achieved mainly through installation of energy-efficient lighting technologies such as compact fluorescent light bulbs and fixtures, represents the largest electric conservation potential in the residential sector, accounting for 42 percent of the sector's achievable savings. The results also show that about 24 percent of achievable savings in the residential sector may be obtained through installation of measures to improve space-heating performance, such as insulation, weatherization and equipment replacement. The remaining savings can be achieved through the implementation of water heating measures, such as water heating equipment upgrades (20 percent), installation of Energy Star rated appliances (13 percent), and cooling measures (1 percent).

In the commercial sector (Exhibit VII-5), lighting retrofit represents the largest potential for electricity savings. Nearly 45 percent of potential electricity savings in the commercial sector is attributable to the application of energy-efficient lighting. Retrofit, upgrade and better operation and maintenance of HVAC equipment are also shown to be effective conservation measures, which account for over 38 percent of the total electricity savings potential in this sector. High-efficiency office and cooking equipment (plug loads) account for 14 percent of the savings potential, while water heating measures account for 3 percent of total commercial-sector electricity savings.

Exhibit VII-4
Distribution of Achievable Electric Conservation Potential by End-Use
Residential Sector

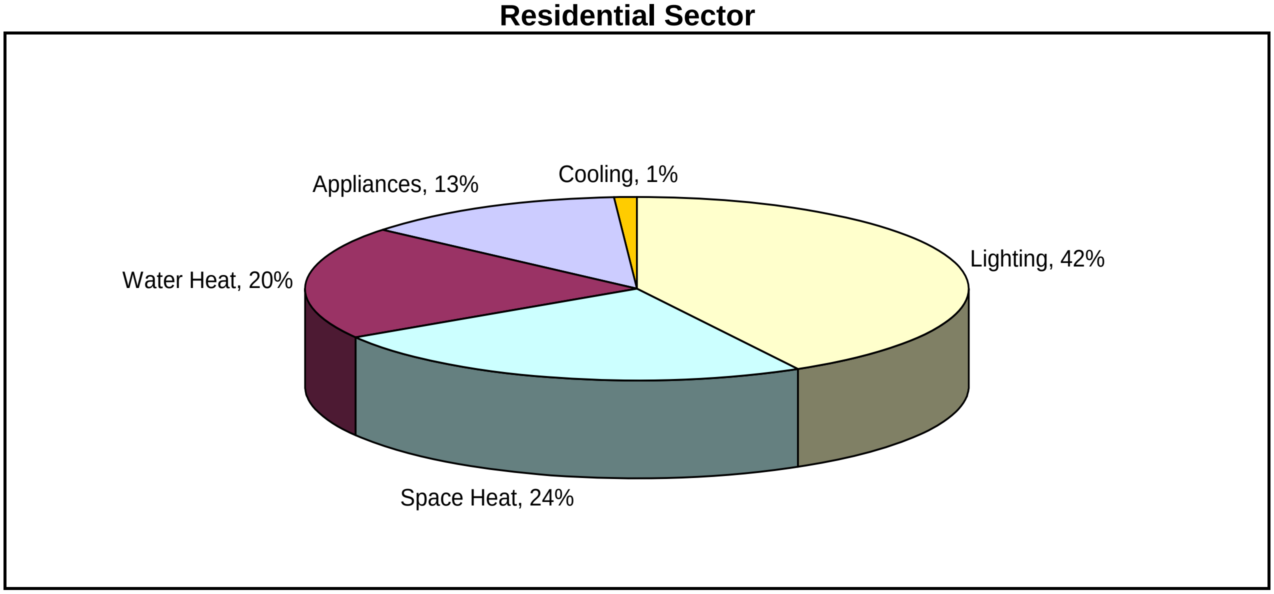
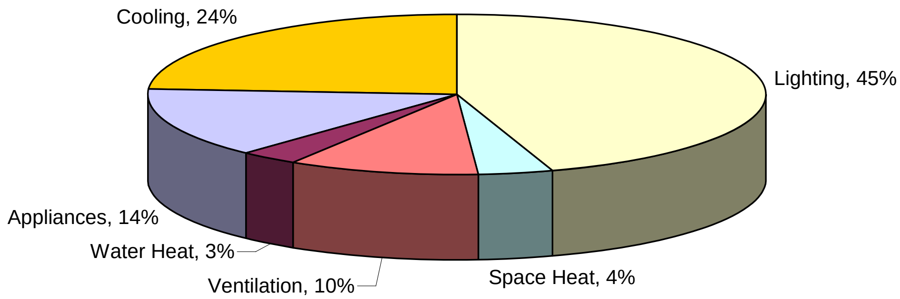


Exhibit VII-5
Distribution of Achievable Electric Conservation Potential by End-Use
Commercial Sector



As shown in Exhibit VII-6, expected savings in space heating is the largest component of the achievable natural gas conservation potential in the residential sector, accounting for nearly 69 percent of the gas savings potential. Upgrade of heating equipment with alternative, more energy-efficient equipment provides the main source for the potential savings. The results also show that installation of more efficient water heaters and application of measures that improve the performance of existing water heating equipment, such as insulation and, to a lesser degree, water-saving measures and home weatherization, together account for over 31 percent of the gas conservation potential in the residential sector.

As Exhibit VII-7 illustrates, space heating, water heating and appliance conservation measures provide the largest potentials for gas savings in the commercial sector. These measures respectively represent 52 percent (space heating), 37 percent (water heating), and 10 percent (appliances – primarily cooking) of the total achievable gas conservation potential in the commercial sector. Pool heating conservation measures account for a small share of the total gas savings potential in this sector.

Exhibit VII-6
Distribution of Achievable Natural Gas Conservation Potential by End-Use Residential Sector

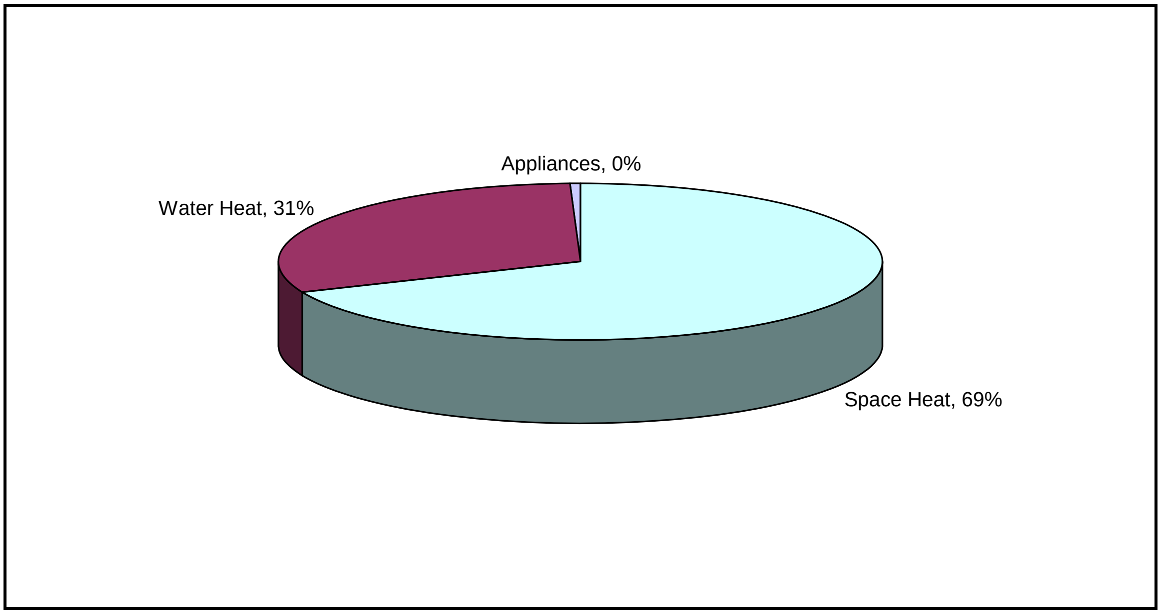
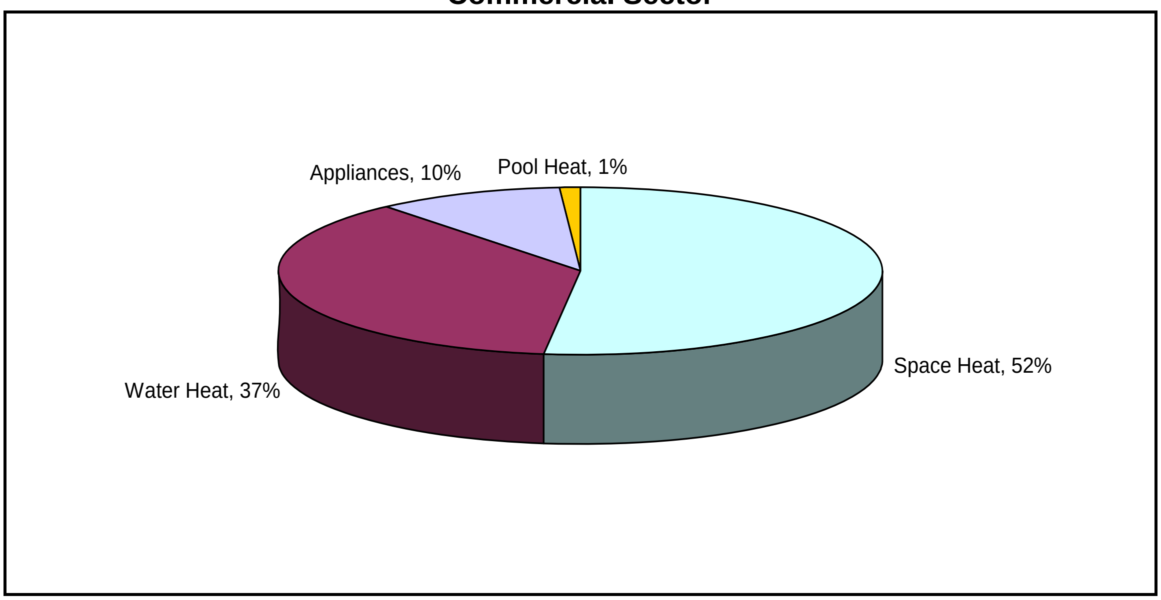


Exhibit VII-7
Distribution of Achievable Natural Gas Conservation Potential Commercial Sector



Achievable electric conservation potentials in the industrial sector are estimated at 15.9 aMW, which is equivalent to approximately 10 percent of the total industrial load. As shown in Exhibit

VII-8, nearly 70 percent of these savings are attributable to potential efficiency gains in facility improvements, primarily HVAC and lighting retrofits. Energy efficiency improvements in refrigeration and process cooling account for the remaining 30 percent of savings potential. As shown in Exhibit VII-9, boiler (86 percent) and HVAC (14 percent) upgrades account for all of the gas conservation potential in the industrial sector.

Exhibit VII-8
Distribution of Achievable Electric Conservation Potential
Industrial Sector

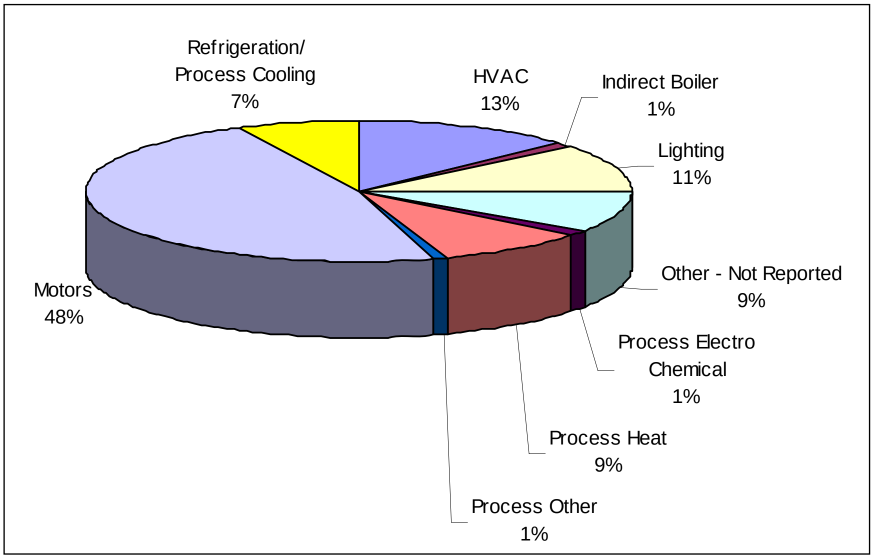
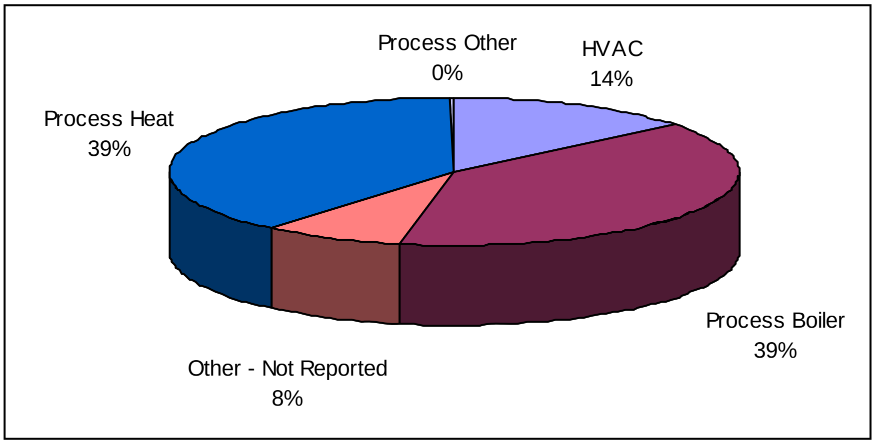


Exhibit VII-9
Distribution of Achievable Natural Gas Conservation Potential
Industrial Sector



Timing is an important element in developing strategies to acquire energy efficiency resources. Consistent with the definitions established by the Northwest Power and Conservation Council, PSE distinguishes between "lost opportunities" and "retrofits" in considering the potentials for conservation. "Lost opportunities," such as energy efficiency potentials in new construction and upgrades to equipment upon their natural replacement, tend to be timing-dependent and must be captured as they become available. "Retrofits," on the other hand, are assumed to remain available over time.

The results of this assessment, as shown in Exhibit VII-10, indicate that over two-thirds (68 percent) of achievable electric energy efficiency potentials in the residential sector are comprised of retrofit opportunities, while lost opportunities account for a greater portion of achievable electric energy efficiency potentials in the commercial sector (57 percent compared to 43 percent). With respect to natural gas achievable energy efficiency potentials, however, lost opportunities are larger in both the residential and commercial sectors (see Exhibit VII-11). All of the estimated electric and gas achievable energy efficiency potentials in the industrial sector are shown to result from retrofits.

Exhibit VII-10
Electric Energy Efficiency Potentials: Retrofit vs. Lost Opportunities

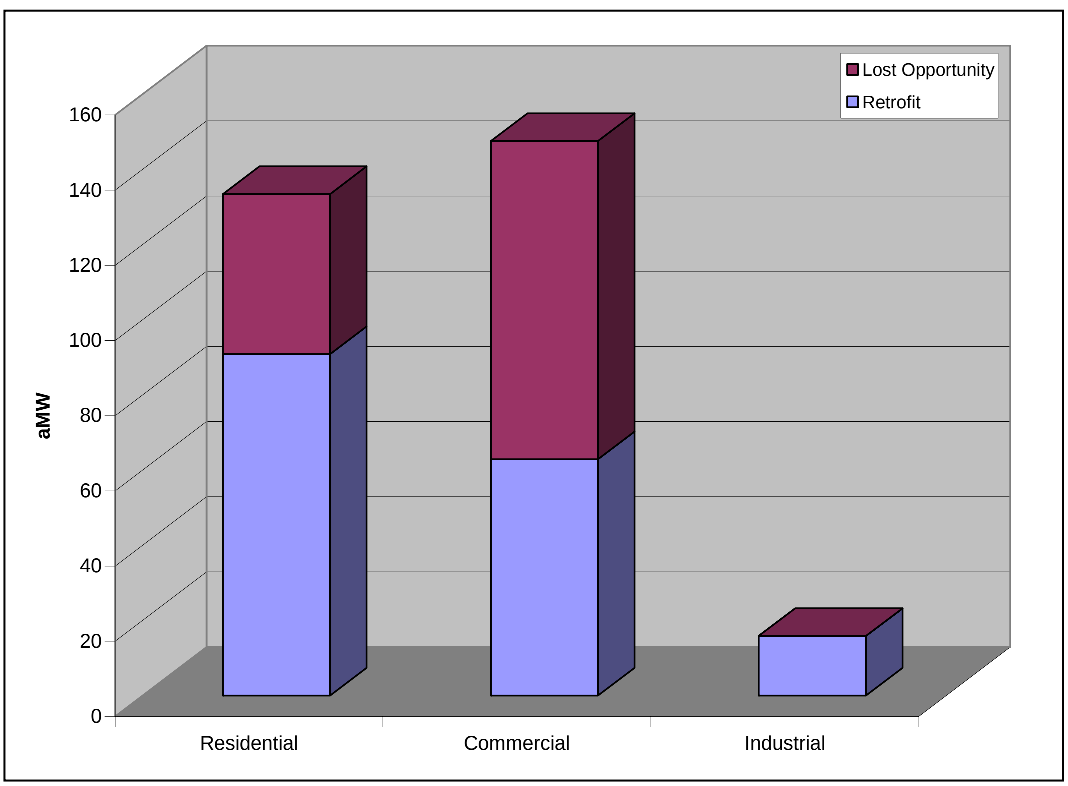
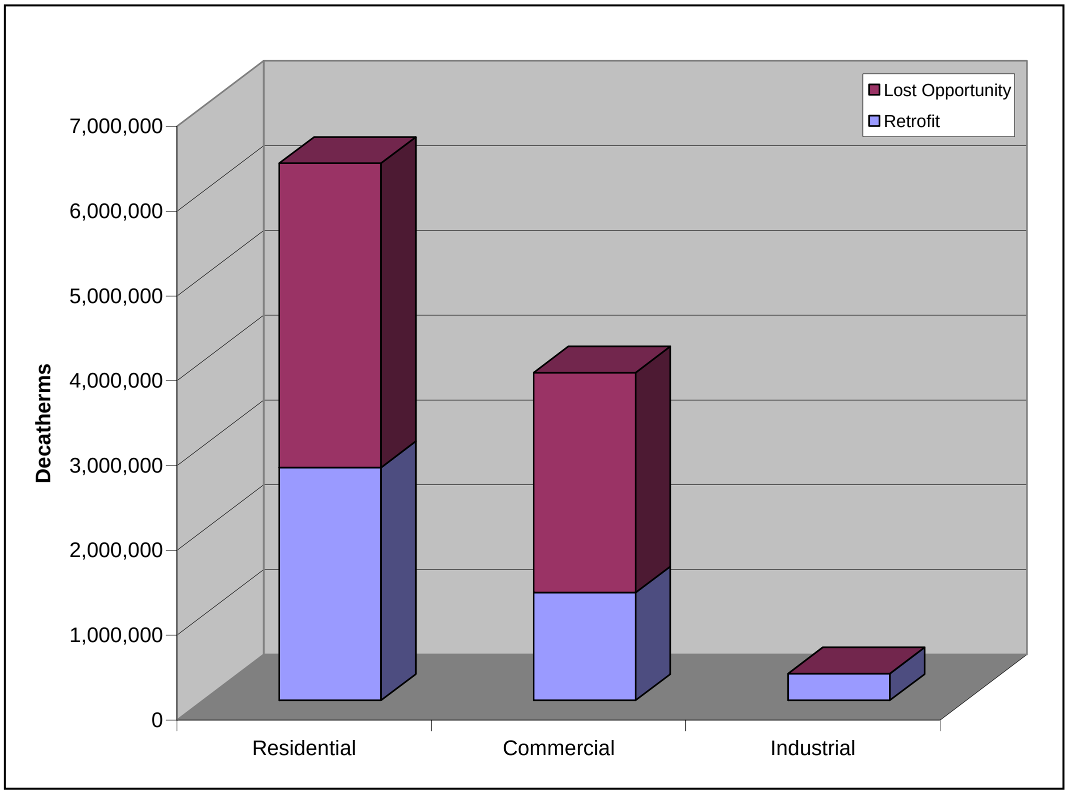


Exhibit VII-11
Gas Energy Efficiency Potentials: Retrofit vs. Lost Opportunities



Estimates of achievable electric conservation potentials from this study are slightly lower than those reported in the 2003 Least Cost Plan. A comparison of the results of the two studies shows a decline in electric conservation potentials in the residential and commercial sectors and a slight increase in the industrial sector. In aggregate, achievable electric conservation potential decreased by approximately 9.5 percent (from 328 aMW to 297 aMW). This difference is explained by several intervening factors including the effects of PSE's conservation activities in 2003 – 2004 (see Section A), refinements to measure data, changes in assumptions regarding saturation of energy efficient technologies, and, particularly, changes in load forecasts. Gas conservation potentials were nearly unchanged, declining modestly from 10.8 million decatherms in 2003 to 10.6 million decatherms in 2005.

Fuel Conversion Potentials

Fuel conversion potential was assessed in conjunction with energy efficiency potential, rather than on a stand-alone basis. Fuel conversion resources augment electric energy efficiency potentials in reducing total electric loads. At the same time, fuel conversion precludes realizing the full electric energy efficiency potentials of affected electric end-uses because the substitution of gas appliances for electric replaces some opportunities to install electric efficiency measures. Fuel conversion also results in increased consumption of natural gas, which, in turn, increases the potential opportunities for gas energy efficiency. Due to this interdependency, analyses of electric conservation and fuel conversion potentials must be performed simultaneously, explicitly taking into account interactions between the two resource options.

Potentials for fuel-conversion were made only for the population of residential customers in PSE's combined electric and gas service area, since fuel conversion is only being considered as an electric resource strategy in this Least Cost Plan. Four end-uses were examined: space heating, water heating, cooking, and clothes drying. For each end-use, conversion potentials were estimated under both "normal" and "early" equipment replacement scenarios. Under the "normal" replacement scenario, it is assumed that conversions would occur at a naturally-occurring pace upon failure of existing equipment. The early replacement scenario assumes a more aggressive approach, where conversions are made during the first ten years of the planning horizon regardless of age and condition of existing equipment. Additional fuel conversion potential, as an electric resource alternative, may be available from PSE electric customers in areas served by other gas utilities. However, lack of data on the ability to serve additional loads, coverage of existing gas distribution systems, and the line extension plans of other gas utilities precludes quantifying this additional potential.

Service availability and distribution system constraints are important considerations in assessing the achievable potentials for fuel conversion. As Exhibit VII-12 demonstrates, PSE provides gas service to 70 percent of residential customers in its electric service area. Of these customers, 62 percent are on gas mains, of which 76 percent are currently receiving gas services from PSE. Moreover, current loads indicate that 24 percent of customers who are served by PSE are on capacity-constrained gas mains, which may limit the ability to add new load in those areas, without significant new investment in distribution facilities. Although in the long term most of these constrained mains would likely be upgraded, the timing of planned upgrades may limit or delay conversions in some areas. New loads could also be added if the gas distribution system were extended into new areas. Based on this data, approximately 33 percent of all customers offer an opportunity for conversions without imposing additional main extension or hook-up costs, because they are already PSE gas customers that are simply converting additional end uses. Another 15 percent of PSE's customers could be converted from all-electric to gas (10 percent in areas where gas is already available and 5 percent through short main extensions), but would incur additional costs associated with new service connections.

Exhibit VII-12
Geographic Distribution of Residential Gas Customers by Utility Service Area, Service Availability, and System Characteristics

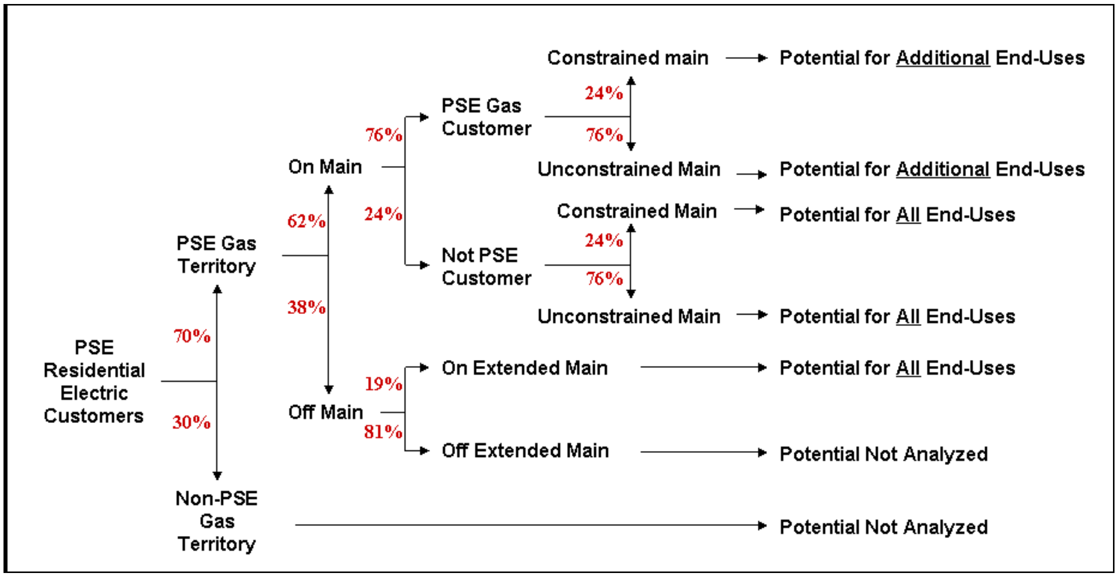


Exhibit VII-13 shows the technical and achievable electricity savings resulting from fuel conversion for the normal and early replacement scenarios. Under the normal replacement scenario, fuel conversion is estimated to provide 132.8 aMW in technical potential, and 62.5 aMW in achievable potential. In an accelerated conversion scenario that assumes early equipment replacement, technical and achievable potentials are expected to increase to 189.5 aMW and 101.5 aMW respectively.

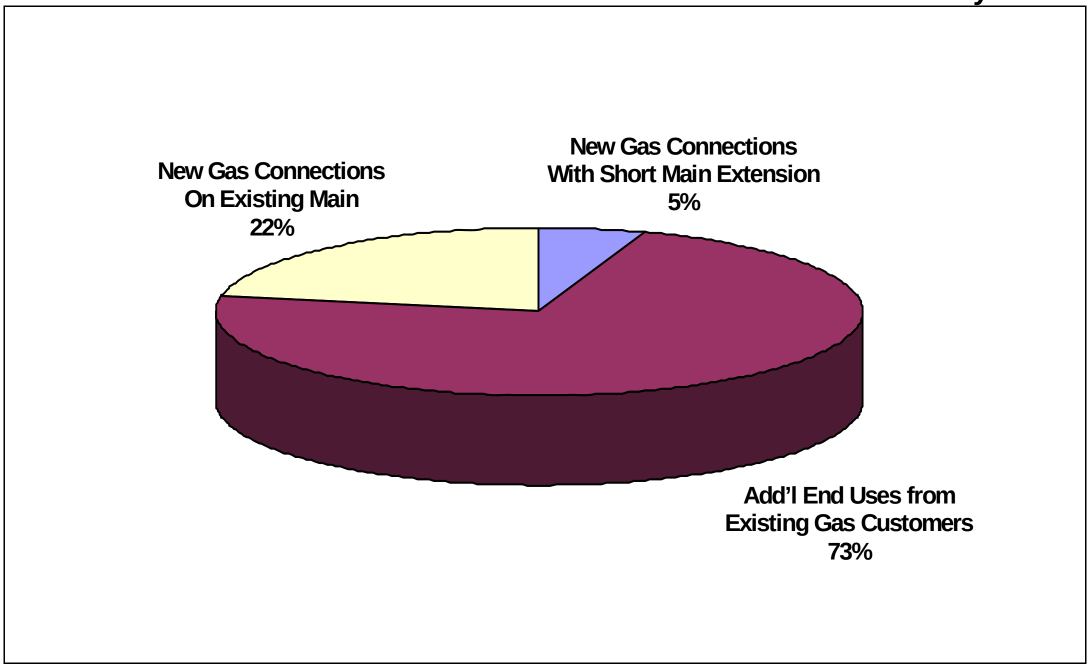
Fuel conversion will slightly diminish the potentials for electric energy efficiency. As can be seen in Exhibit VII-13, achievable electric conservation potentials will be reduced from 133.4 aMW to 127.9 under the normal replacement scenario, and 123.5 aMW under the early replacement scenario.

Exhibit VII-13
Effects of Fuel Conversion on Residential Electric Energy Efficiency Potentials

Electric Resource Potential - 2025	Without Fuel Conversion (aMW)	With Normal Replacement (aMW)	With Early Replacement (aMW)
Technical			
Fuel Conversion Potential (gross)		132.8	189.5
Energy Efficiency	375.8	338.5	321.2
Total Technical Potential	375.8	471.2	510.7
As % of Residential Load	25.9%	32.5%	35.2%
Achievable			
Fuel Conversion Potential (gross)		62.5	101.5
Energy Efficiency	133.4	127.9	123.5
Total Achievable Potential	133.4	190.4	224.9
As % of Residential Load	9.2%	13.1%	15.5%

As can be seen in Exhibit VII-14, under the normal conversion scenario, most (73 percent) fuel conversion potential comes from existing PSE gas customers that convert additional end-uses, while relatively small proportions of fuel conversion potential are attributable to hook-up of entirely new gas customers.

Exhibit VII-14
Distribution of Electric Conservation Potential from Fuel Conversion by Source



Increases in gas consumption due to fuel conversions were examined under both "standard" (current state and federal codes) and "high" equipment efficiency levels (the same as those used in energy efficiency potential). As shown in Exhibit VII-15, fuel conversion will result in lowering the technical and achievable gas energy efficiency potentials by nearly 7.8 million decatherms and 4.2 million decatherms under the standard efficiency scenario, and 7 million decatherms and 3.6 million decatherms under the high-efficiency equipment scenarios. The efficiency level of the gas equipment has no impact on the amount of electric load reduction from fuel conversion.

Exhibit VII-15
Effects of Fuel Conversion Potentials on Residential Gas Load

Gas Resource Potential – 2025	Technical (Decatherms)	Achievable (Decatherms)	Technical (Decatherms)	Achievable (Decatherms)
Efficiency Level of New Gas Appliances:	**Standard**	**Standard**	**High**	**High**
Increased Use Due to Fuel Conversion	7,763,444	4,169,422	6,987,099	3,752,480
Gas Use Increase as % of Residential Load	10.3%	5.5%	9.3%	5.0%

Although the amounts of conversion potential per customer tend to be large among customers who are not currently hooked up, capturing such opportunities would require significant additional investments in customer hookup and/or expansion of the existing distribution system. Based on PSE records, average hook-up cost (service line from in-street main to house plus meter) for new customers is currently estimated at over $2,000 per single-family home. The costs of gas line extensions/upgrades can vary widely, depending on the length of the line and the number of new gas customers connected, and therefore were not quantified. Thus, the total costs of hooking up new customers are somewhat underestimated.

Hook-up costs for new customers, combined with the additional gas fuel costs, have important ramifications in terms of overall fuel conversion resource costs. The effects of additional hook-up and fuel costs on overall fuel conversion costs were analyzed under the accelerated and normal conversion scenarios assuming standard and high-efficiency gas equipment. For the purpose of this analysis, hook-up costs were allocated to the three end-uses in proportion to their shares of total potential. Average fuel conversion resource costs for all end-uses can be expected to approximately double once additional fuel costs are taken into account. Inclusion of hook-up costs for new customers will nearly quadruple per MWh cost of fuel conversion resources (see Appendix B for more information).

Energy Efficiency and Fuel Conversion Resource Portfolios

While an accurate assessment of achievable demand-side potentials represented an important objective of this study, the paramount consideration was to construct portfolios of electric and natural gas conservation resource options, which could be compared with and evaluated against supply options on a balanced and consistent basis.

To facilitate the incorporation of the results of this study into PSE's least cost, integrated resource planning process, energy efficiency and fuel conversion potential estimates for each fuel type and customer sector were disaggregated into distinct cost-based "bundles" of conservation resource. Eight (8) electric and seven (7) gas cost-group "bundles" were created by grouping 1,756 electric and 736 gas conservation measure/segment/structure combinations with similar cost and load-shape characteristics. The energy savings from each of these bundles were then distributed across seven cost ranges. Electric and gas measures with costs above the thresholds of $115/MWh or $10.50/decatherm were not considered as economic or achievable. Fuel conversion potentials were incorporated into the same end-use bundles as energy efficiency to produce bundles that represent the net combination of energy efficiency and fuel conversion. The costs of the bundles with fuel conversion include PSE's costs to serve the additional natural gas demand (commodity costs and new service hookup costs), as well as the costs of the new gas end-use appliances.

The market segment/end-use bundles and cost range categories used for energy efficiency and fuel conversion resource analysis are listed in Exhibit VII-16 and VII-17, respectively. The segment/end-use bundles for natural gas resources are more simplified that what is shown in Exhibit VII-17, using only two end-uses: space heat (weather sensitive) and base load (non-weather sensitive). Most demand-side energy savings potential falls into the lower cost categories. The distribution of electric and natural gas energy efficiency resource potentials across each market segment/end-use bundle and the associated cost ranges are included in Appendix B.

Exhibit VII-16
Segment/End-Use Bundles for Energy Efficiency and Fuel Conversion Resources

Residential	Commercial	Industrial
Existing Construction- Appliances	Existing Construction- Appliances	Existing Construction- General
Existing Construction- HVAC	Existing Construction- HVAC	
Existing Construction- Lighting	Existing Construction- Lighting	
Existing Construction- Water Heat	Existing Construction- Water Heat	
New Construction- Appliances	New Construction- Appliances	
New Construction- HVAC	New Construction- HVAC	
New Construction- Lighting	New Construction- Lighting	
New Construction- Water Heat	New Construction- Water Heat	

Exhibit VII-17
Cost Groups for Energy Efficiency and Fuel Conversion Resources

Electricity Cost Category	Gas Cost Category
A: less than $45/MWh	A: less than $4.50/decatherm
B: $45 - $$55/MWh	B: $4.50 - $5.50/decatherm
C: $55 - $65/MWh	C: $5.50 - $6.50/decatherm
D: $65 - $75/MWh	D: $6.50 - $7.50/decatherm
E: $75 - $85/MWh	E: $7.50 - $8.50/decatherm
F: $85 - $95/MWh	F: $8.50 - $9.50/decatherm
G: $95 - $105/MWh	G: >$9.50/decatherm
H: >$105/MWh	

Electric Demand-Side Resource Acquisition Scenarios

In assessing long-run, demand-side resource potentials, timing of the resources over the planning period has significant ramifications for the integrated resource planning process. A large portion of energy efficiency and fuel conversion potential is made up of finite resources, particularly savings from retrofits and early replacement. Thus, the amount of demand-side resources already acquired affects current and future potentials. The timing for the acquisition of demand-side resources must also take into account practical administrative and logistical considerations, as well as potential market barriers (see Section C for further discussion).

In this analysis, two alternative scenarios for acquisition of achievable electric energy efficiency resources were considered: “Base Case” and “Accelerated.” The Base Case scenario assumes that energy efficiency potential occurs in equal annual proportions over the 20-year planning horizon, which equates to approximately 15 aMW per year. Under the Accelerated scenario, it is assumed that the timing of energy efficiency potential would be accelerated and all achievable retrofit or early replacement potentials would occur during the first 10 years of the plan. The Accelerated Case results, on average, in 24 aMW per year over the first 10 years and 5 aMW per year over the last 10 years.

Similarly, different scenarios for the timing of fuel conversion resource potential were developed. In the “Normal Replacement” scenario, fuel conversion potential occurs at the time of naturally-occurring appliance turnover, when the useful life of the electric appliance is complete, averaging about 3 aMW per year. This is analogous to the Base Case for energy efficiency. The “Early Replacement” scenario assumes all possible electric appliances are converted in the first 10 years, regardless of age or condition, which is analogous to the Accelerated Case for energy efficiency. The Early Replacement scenario for fuel conversion averages approximately 10 aMW of potential savings per year for the first 10 years and none afterward.

Consistent with PSE’s past experience with energy efficiency programs, the measure costs for demand-side resource potentials were adjusted upward by 10 percent to account for program development, delivery and administrative expenses under the Normal Replacement scenario. Average measure costs were increased by 30 percent under the Accelerated Case to take into account the need for more aggressive market planning, program promotion and product delivery mechanisms, as well as for normal program operation costs. In some cases, inclusion of program operation costs shifts some potential into higher cost categories. For some measures, costs were shifted beyond the achievable potential thresholds of $115/kWh and $10.50/decatherm, but were left as achievable potential in the highest cost bundles.

Demand-Response Resource Potentials

Demand-response (or demand-responsive) resources are comprised of flexible, price-responsive loads, which may be curtailed or interrupted during system emergencies or when wholesale market prices exceed the utility’s supply cost. Acquisition of demand-response resources may be based on either reliability considerations or economic/market objectives.

Objectives of demand response may be met through a broad range of price-based (e.g. time-varying rates and interruptible tariffs) or incentive-based (e.g. direct load control, demand buy-back, demand bidding, and dispatchable stand-by generation) strategies. In this assessment, five demand-response options were considered, similar to those examined in PSE's 2003 Least Cost Plan:

1) Direct Load Control: This strategy allows the utility to remotely interrupt or cycle electrical equipment and appliances such as water heaters, space heaters, and central air-conditioners. Direct load control programs are generally best suited for the residential and, to a lesser extent, small commercial sectors.

2) Time-of-Use Rates: This demand response option consists of two-part pricing structures designed to encourage customers to curtail consumption during peak, or shift it to off-peak hours. TOU tariffs are designed to reflect the utility's marginal cost of power supply.

3) Critical Peak Pricing: Critical peak or extreme-day pricing refers to incentive-based, demand-response strategies that aim to preempt system emergencies by encouraging customers to curtail their loads for a limited number of hours during the year. The amount of incentive is generally based on the utility's avoided cost of supply during extreme peak events.

4) Curtailment Contracts: These refer to contractual arrangements between the utility and its large customers who agree to curtail or interrupt their operations for a predetermined period when requested by the utility. The duration and frequency of such requests and levels of load reduction are also stipulated in the contract. Customers who agree to participate are typically compensated either through lower rates or fixed payments.

5) Demand Buyback: Under demand buyback arrangements, the utility offers payments to customers for reducing their demand when requested by the utility. The buyback amount generally depends on market prices published by the utility ahead of the curtailment event, and the level of reduction is verified against an agreed upon baseline usage level.

As in the case with energy efficiency and fuel conversion, demand response opportunities were assessed in terms of both "technical" and "achievable" potential.

- ***Technical Potential***: In the context of demand response, technical potential assumes that all applicable end-use loads in all customer sectors are wholly or partially available for curtailment, except for those customer segments (e.g. hospitals) and end-uses (e.g. restaurant cooking loads), which clearly do not lend themselves to interruption.

- ***Achievable Potential***: Achievable potential is a subset of technical potential and takes into account the customers' ability and willingness to participate in load reduction programs subject to their unique business priorities, operating requirements, and economic (price) considerations. Evaluation of achievable potential is a significant refinement of the Company's 2003 Least Cost Plan assessment of demand response, which focused on technical potential. In this assessment, estimates of achievable potentials were derived by adjusting technical potentials by two factors: expected rates of <u>program</u> participation, and expected rates of <u>event</u> participation. Assumed rates of program and event participation were estimated based on the recent experiences of PSE, other utilities in the Northwest, other national utilities, and Regional Transmission Organizations (RTOs) which have offered similar programs. Unlike energy efficiency and fuel conversion, no cost constraints were applied to achievable demand response potentials.

Demand response options are not equally applicable to or effective in all segments of the electricity consumer market, and their impacts tend to be end-use specific. Recognizing this, the study employed a "bottom-up" approach, which involved first breaking down PSE's system load by sector, market segment, and end-use; estimating demand response potentials at the end-use level; and then aggregating the end-use resource potentials estimates to sector and system levels. The approach was implemented in six steps as follows.

1) Define customer sectors and market segments. System load was disaggregated into four sectors: 1) residential, 2) commercial, 3) industrial, and 4) other. The commercial sector was further broken down into eleven segments.

2) Create sector and segment load profiles. Using PSE's annual hourly interval data, total sales were broken down by sector and segment.

3) Develop sector- and segment-specific typical peak day load profiles. "Typical" weekday profiles were developed for winter (January and February), and summer (July and August).

4) Screen customer segments and end-uses for eligibility. This step involved screening customers for applicability of specific demand-response strategies. For example, the hospital segment and certain commercial end-uses such as cooking loads in the restaurant segment were excluded.

5) Estimate end-use shares by sector and market segments. End-use shares were estimated by applying annual end-use load profiles obtained from the Northwest Power and Conservation Council.

6) Estimate technical potential. For each demand-response strategy, estimates of technical potentials were developed by applying the fraction of load for each end-use that might be curtailed based on available data from the California Energy Commission's recent assessments of load reduction opportunities in commercial and industrial buildings.

7) Estimate achievable technical potential. Finally, for each demand response strategy, achievable potential was estimated by taking into account program participation as the fraction of appropriate end-use loads, which may be curtailed or interrupted.

PSE's hourly system load and sales by customer class, and end-use load shapes available from the Northwest Power and Conservation Council, served as the primary sources of data for this assessment. Estimates of expected load impacts resulting from various demand response strategies were based on data available from the commercial and industrial Enhanced Automation Study sponsored by the California Energy Commission, and the experiences of PSE and other utilities in the Northwest with various demand-response programs.

Complete descriptions of the methodology and data sources used to assess demand response potentials are included in Appendix B.

The results of this assessment, as summarized in Exhibit VII-18, indicate that critical peak pricing and direct load control of residential space heating and water heating, with achievable potentials of 155 MW (4.6 percent of system peak) and 95 MW (2.8 percent of system peak) respectively, offer the largest opportunities for demand response interventions. Achievable peak reductions from time-of-use tariffs are estimated at 49 MW, representing 1.5 percent of system peak. Opportunities resulting from curtailment contracts and demand buy-back are expected to be relatively small, averaging between 0.5 percent and 0.8 percent of system peak. Although the potentials for different demand response strategies are not mutually exclusive, hence not additive, it is estimated that selected combinations of these strategies might achieve as much as 200 MW of total peak demand reduction. For example, if Direct Load Control were selected for residential customers, and Critical Peak Pricing for industrial and commercial customers, the total would be 175 MW. There would still be possible additional reductions from programs using Curtailment Contracts and/or Demand Buy-Back.

Exhibit VII-18
Demand-Response Potentials Summary - 2025

Sector	Direct Load Control	TOU	Critical Peak Pricing	Curtailment Contracts	Demand Buy-Back
Industrial					
Technical Potential (MW)	-	4.9	19.8	12.2	14.8
Achievable Potential (MW)	-	1.7	7.4	2.7	4.4
Commercial					
Technical Potential (MW)	-	14.8	164.5	66.4	75.5
Market Potential (MW)	-	*5.2*	*72.1*	*14.9*	*22.6*
Residential					
Technical Potential (MW)	381.3	121.5	202.5	-	-
Achievable Potential (MW)	*95.3*	*42.5*	*75.9*	-	-
Total*					
Technical Potential (MW)	381	141	387	79	90
% of System Peak	11.2%	4.1%	11.4%	2.3%	2.7%
Achievable Potential (MW)	95	49	155	18	27
% of System Peak	2.8%	1.5%	4.6%	0.5%	0.8%
Average Cost ($/kW)	$55.0	$44.1	$21.6	NA	NA
Average Cost ($/mWh)	NA	NA	NA	$154.7	$154.7

* Note that strategies are not mutually exclusive, hence potentials are not additive.

The demand-response strategies considered here also vary significantly with respect to their costs. Costs for direct load control, time-of-use tariffs and critical peak pricing were estimated on a kW basis. For direct load control and time-of-use tariffs, costs were estimated using the most recent data from PSE and other regional utilities with experience in similar programs, especially Portland General Electric Company. For both strategies, it was assumed that the total estimated achievable potentials would be captured in five years, and that participants would remain in the program for seven years, after which customers would have to be re-recruited in order to continue to get peak savings. This choice was based on the expectation that most customers tend to relocate after seven years or less.

The results of the analysis show that based on the available data, critical peak pricing, has the lowest average cost at $21.6 per kW. Time-of use-tariffs ($44.1/kW) and direct load control ($55/kW) have the next lowest costs.

Since participant incentives for curtailment contracts and demand-buy-back programs are generally based on reduction in energy, costs for these strategies were estimated on a dollar per MWh basis. Based on the results of the commercial and industrial sector load reduction programs offered by PSE and other regional utilities during the summer of 2001, the achievable potentials for these strategies appear to be relatively small, mainly due to low program and/or event participation. The data shows that of the 457 eligible customers, only 19 (4 percent), representing about 3 percent of the eligible load, participated in PSE's program.

Through its demand buy-back program in 2001, PSE was able to acquire a total of 21.1 MWh (approximately 2 MW) at an average cost of nearly $155 per MWh. Participation levels in such programs are to a large extent a function of incentive amounts; but they also depend on the customers' willingness and ability to commit to curtailment. An analysis of PSE's program activity during the spring and summer of 2001 indicates that load response to prices was indeed relatively in-elastic, with an estimated elasticity of 0.8 percent. This indicates that a 1 percent increase in incentives is likely to increase load reduction by 0.8 percent. The results of this analysis suggest that significantly larger prices must be paid if PSE is to capture all or most of the expected achievable potential for such demand response strategies.

Assessment of demand-response potential poses considerable analytic challenges and tends to be less precise than for energy efficiency. This is particularly the case in assessing achievable potentials for market-based strategies such as curtailment contracts and demand buy-back, due to the lack of sufficient market data on customer willingness to participate in such programs. In its assessment of demand-response strategies, PSE has relied on the best available methods and data. The results of this assessment, therefore, are to be regarded as indicative, rather than conclusive.

C. Demand-Side Planning and Implementation Issues

This section examines the uncertainties of quantifying demand-side resources, program implementation issues beyond the Least Cost Plan modeling process, and some considerations for accelerated resource acquisition scenarios. Additional implementation issues associated with demand-side resources are discussed in Chapter VIII.

Uncertainties for Quantifying Demand-Side Resource Potentials

The amount of demand-side potential identified for the Least Cost Plan relies on the best available information today about prices, efficiency, consumer behavior and preferences, and projects that information 20 years into the future. As with other resources, demand-side resource assessment depends heavily on energy load forecasts and projected growth rates, with all of the associated uncertainty.

Also analogous to supply-side resources, assessments of demand-side potential are limited by what is currently available in the marketplace in terms of cost-effective technologies for improving energy efficiency. The impacts of new technologies and new energy efficiency codes and standards are difficult to accurately predict. This uncertainty is mitigated through biennial updates of the Least Cost Plan, which provides the opportunity to incorporate advances in demand-side technologies and programs.

Somewhat unique to demand-side resources is the utility's dependence on large numbers of very small purchases, each tied to the individual consumer's day-to-day purchasing and behavioral decisions. The utility attempts to influence these decisions through its programs, but the consumer is the ultimate decision-maker regarding the purchase of demand-side resources. PSE's assessments of demand-side resources make the best possible estimates of customers' willingness to participate, based on previous utility program experience. But the actual experience of any new program is likely to vary from planning estimates. The uncertainty about program participation is greater for fuel conversion and demand response than for energy efficiency, which generally has a more extensive track record of actual program operation.

Implementation Considerations that Extend Beyond Resource Portfolio Modeling

Many specific details are required to implement successful demand-side programs. As discussed previously, actual implementation design, delivery, and market conditions will cause energy-efficiency program savings and costs to vary. Customer participation in a program is heavily influenced by the level of incentive paid by the utility vs. the cost to the customer. Program implementation depends on staff with the appropriate skills and tools to be able to provide customer service, sales, engineering, database use, marketing, evaluation, and management. A number of program support services need to be in place for collecting customer-specific information, monitoring/reporting performance metrics, and evaluation of cost-effectiveness. External infrastructure considerations must also be addressed, such as product availability to utility customers and an adequate network of contractors, retailers, and other trade allies to support a program.

As new measures or expanded programs are developed and added to the current program mix, internal and external resources and capabilities need to grow accordingly and progress through a "learning curve." Small pilot programs often precede full-scale programs to test the performance of demand-side technologies and customer acceptance of a particular market delivery mechanism.

In short, a utility cannot immediately launch into full-scale deployment of all the demand-side measures identified by its Least Cost Plan, nor should such results be expected. The estimates of fuel conversion resource potentials in this Least Cost Plan do not account for any "ramp-up" that would be required to reach the savings levels achievable from fully mature programs.

Accelerated Scenarios for Electric Demand-Side Resources

For the 2005 Least Cost Plan, PSE examined several demand-side resource acquisition scenarios focused on constant or "normal" rates of acquisition and accelerated or "early replacement" cases for energy efficiency and fuel conversion. While the difference between these scenarios is significant in terms of short-term energy-efficiency program activity, it is fairly minor in terms of the magnitude of the resource need PSE will experience in the next several years. The process of determining an optimal level of demand-side resource acquisition for the short term should consider the advantages of steady, consistent levels of annual energy-efficiency acquisition vs. a mode that would have the utility ramp-up market-place activity for a few years, and ramp-down in later periods. There are additional costs associated with the delivery of higher levels of efficiency in a shorter time frame, including acquiring the necessary resources, training personnel and trade allies, and more intensive promotional activities. Ramping up also depends on sufficient lead times to ensure the proper infrastructure development.