ASSESSMENT OF LONG-TERM ELECTRICITY AND NATURAL GAS CONSERVATION POTENTIAL IN PUGET SOUND ENERGY SERVICE AREA 2003-2024

Prepared for

Puget Sound Energy
Bellevue, Washington

Prepared by

KEMA-XENERGY Inc.
Oakland, California

and

Quantec, LLC

August 25, 2003

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

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

This report summarizes the results of an assessment of technical and achievable electricity and natural gas conservation potentials in Puget Sound Energy's (PSE's) service area for the 2004-2023 planning horizon. The assessment was performed for PSE as a collaborative effort between KEMA-XENERGY and Quantec, LLC. The principal goal of this study was three-fold:

1. Develop reasonable and reliable estimates of "technical" and "achievable" electricity and gas conservation potentials for the residential, commercial and industrial customers served by PSE.
2. Employ a simple, flexible, and transparent approach consistent with the methods used by the Northwest Power and Conservation Council, relying mainly on available data from secondary regional sources.
3. Create discrete "bundles" of conservation potential comprised of groups of homogeneous conservation measures and provide supply curves for each bundle that would allow energy conservation options to be directly evaluated and compared with supply options in PSE's integrated resource planning process.

Estimates of long-term conservation potentials provided in this report are based on standard practices and methods in the utility industry, using the best available data. Studies such as this require compilation of large amounts of data from multiple sources on existing technologies and prevailing market conditions. They also rely heavily on assumptions concerning the future. Changes in energy-efficiency technologies, market conditions, and consumer behavior are likely to affect these results. 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.

1.1 ORGANIZATION OF THIS REPORT

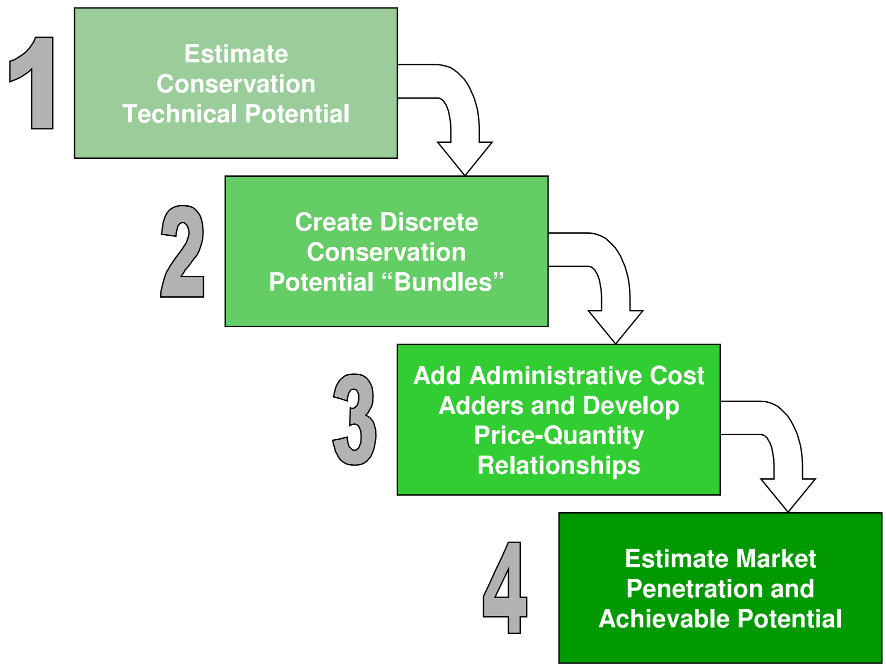
The methodological approach developed by the KEMA-XENERGY/Quantec team is described in Section 2. Section 3 describes and documents the data sources we relied upon from the Pacific Northwest and elsewhere. Conservation potential results are provided in Section 4, and conservation bundle aggregates and acquisition strategies are presented in Section 5. Detailed results and data inputs are provided in Appendices A through F.

2 METHODOLOGY

2.1 OVERVIEW

Our general approach, which is depicted in Figure 2-1, combined four primary activities:

Figure 2-1
Methodological Approach



1. ***Estimate conservation technical potential***. These estimates are comprised of a combined bottom-up/top-down analysis of electric and gas energy savings in PSE's service area. The bottom-up analysis, which was applied to the residential and commercial sectors, integrated measure-specific data (per-unit costs, absolute and relative savings, impacts by time period) with baseline building stock data (base-case fuel saturations, measure saturations, feasibility factors) and baseline energy-use data to produce estimates of levelized per-unit (kWh, therm) cost and total savings for each measure included in the analysis. This analysis was conducted using the DSM ASSYST model, described later in this section.

   The top-down analysis, which was applied to the industrial sector, disaggregates loads into industry types and end uses and applies data on overall percentage savings at the industry/end-use level, as well as costs and measure life, to produce levelized costs and total savings.

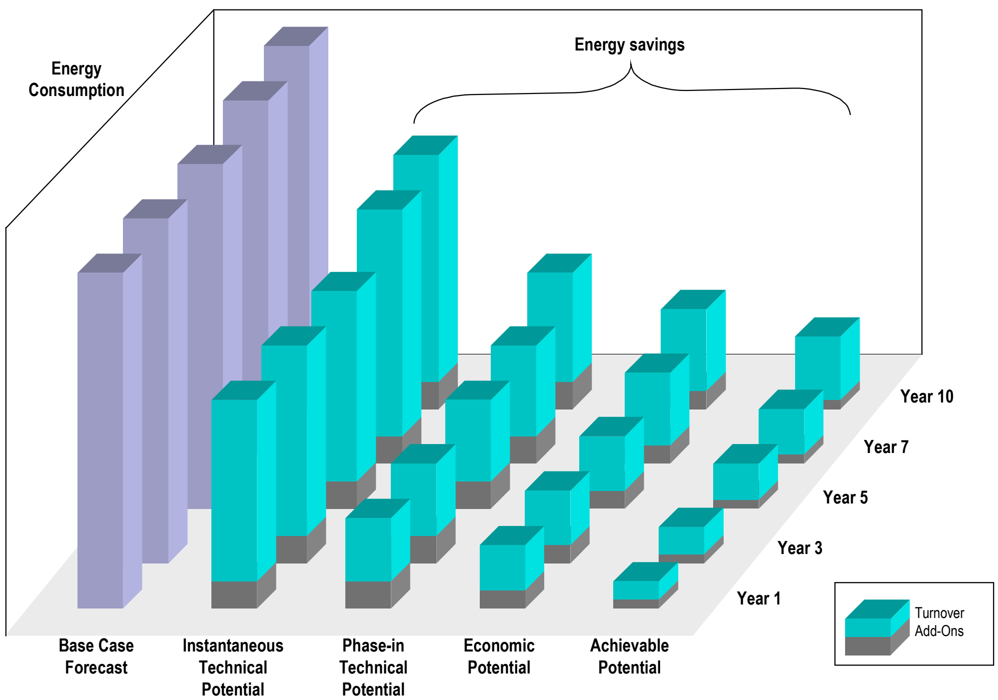
2. ***Create discrete conservation potential "bundles."*** The conservation technical potential is divided into subgroups—which we refer to as bundles—that are homogeneous in terms of sectors, markets segments, and end-use load shape.[1]

3. ***Add administrative cost adders and develop price-quantity relationships***. This step involved the addition of an administrative cost/program delivery adder to each measure within the bundles, and sorting and grouping each measure into price-quantity combinations. The resulting "supply curves" provide discrete blocks of conservation potential within each bundle.

4. ***Estimate market penetration and achievable potential***. The last step in this approach consisted of estimating market penetration factors from past, similar bundles or programs. These estimates were then applied to the price-quantity combinations to derive estimates of "achievable" potential for each resource bundle within PSE service area.

As shown in Figure 2-2, the technical and achievable potential estimates in this study refer to subsets of the possible definitions of conservation potential used in conservation resource assessment in the utility industry.

Figure 2-2
Alternative Types of Energy-Efficiency Potential



- ***Instantaneous technical potential***. The energy savings from a total, instantaneous conversion to the most energy-efficient technologies and measures. All equipment is

[1] The industrial sector has one bundle each for electric and gas savings.

converted immediately in this hypothetical case regardless of the age of the equipment.

- ***Phase-in technical potential***. The energy savings from conversion to the most energy-efficient technologies and measures when equipment is replaced at the end of its useful life, when new equipment is installed.
- ***Economic potential***. As a subset of technical potential, economic potential represents the energy savings from conversion to the most energy-efficient technologies and measures only when such measures are deemed to be cost-effective from a total resource-cost (TRC) perspective.
- ***Achievable potential***. The energy savings potential from conservation programs taking into account resource cost effectiveness and practical constraints such as market barriers and program development and administrative costs.
- ***Naturally occurring conservation***. Naturally occurring conservation, that is, conservation that occurs as a result of prevailing market forces such as energy prices, is an additional aspect of conservation potential that is typically taken into account. In this study, naturally occurring conservation is implicitly taken into account, since conservation effects were already incorporated in the load forecasts used in establishing the base-case forecasts.

It is important to recognize the differences in the two types of technical potential, instantaneous and phased-in. Instantaneous technical potential assumes immediate retrofit and replacement of equipment in existing buildings and full installation at the time of new construction. Phased-in technical potential assumes replacement only upon burnout of equipment in existing buildings and gradual implementation of retrofit actions. This distinction has important implications for planning and timing of how conservation resources are acquired over time, and is used in developing the alternative conservation acquisition cases described in Section 5.2. In the long run, such as the 20-year plan developed by PSE, the two estimates converge. Thus, the total cumulative 2023 technical potential estimates developed in this study can be viewed as either instantaneous or phased-in.

Economic potential is typically viewed as a subset of technical potential, which includes only those measures that pass a certain cost threshold or economic criterion based on the utility's avoided generation costs. However, the notion of economic potential relates to resource planning efforts where conservation resources are analyzed separately from supply side resources. PSE's integrated resource planning (IRP) effort eliminates the need to apply such a screen. The price-quantity combinations in the bundles provide the information needed to dynamically evaluate conservation resource economics within the IRP process.

Instead, we estimate achievable potential directly from the technical potential estimates. Achievable potential is defined as that portion of the potential that is likely to be available over the planning horizon under prevailing market barriers and administrative constraints that hamper delivery or implementation of energy-efficiency measures.

In estimating the achievable potential, a 15% conservation program administration and delivery cost adder was applied to each measure/bundle combination, resulting in minor shifts of the price-quantity relationships (supply curves) within the technical potential bundles. This adder is consistent with past PSE program experience. Second, likely penetration rates, derived from industry literature, previous planning efforts conducted by KEMA-XENERGY and Quantec, and PSE's previous programmatic experiences as recorded in the company's tracking system, were used to derive estimates of achievable potential. These estimates take into account the company's ability to ramp up programs and customers' willingness to adopt measures assuming incentives fully cover all incremental conservation measure costs. Finally, since very high cost measures were unlikely to be selected by the IRP model, we excluded all measures with a per-unit cost of conserved energy in excess of 11 cents per kWh for electricity, and 1 dollar per therm for gas.

2.2 MEASURES CONSIDERED

Technical conservation potentials in the residential and commercial sectors were derived based on an analysis of 125 unique electric measures and 60 unique gas measures. The measures included in this study were drawn from a variety of sources in the Pacific Northwest and nationally.

As a preliminary screening criterion, only measures that are commonly available and are based on well-understood technology were included in the analysis. Six residential segments (existing single-family, existing multi-family, existing manufactured homes, new single-family, new multi-family, new manufactured homes) and 20 commercial segments (10 building types within the existing and new structure segments) were considered.

Since many conservation measures may be applied to multiple segments and building types, a total of 1,630 electric and 610 gas measure/structure combinations were included in the analysis. The industrial savings potentials were estimated by analyzing energy-efficiency potentials for all major end-uses in all 15 major industrial segments in PSE's service area.

2.3 RESIDENTIAL AND COMMERCIAL SECTOR BOTTOM-UP APPROACH

DSM ASSYST, the model used for the residential and commercial analyses, is a proprietary Excel model developed by KEMA-XENERGY. It follows a standard bottom-up approach that is consistent with the methods used widely by energy utilities across the country, including the Northwest Power and Conservation Council.

Application of the DSM ASSYST model begins with compiling a comprehensive list of conservation measures applicable to the residential and commercial sectors and their associated end-uses, calculating the savings potential for each measure, and aggregating measure-specific savings to derive total savings potential. For each measure, the approach integrates measure-specific data (per-unit costs, savings, and measure life) with baseline building stock data (base-case fuel saturations, measure applicability factors, current measure saturations) and baseline energy-use data to produce estimates of levelized costs per unit of energy saved.

The basic instantaneous technical potential equation for each conservation measure is as follows:

Instantaneous technical potential =
*Units * base usage * adjustment factor * applicability factor **
*feasibility factor * non complete factor * savings factor*

Where,

- **Units** are the number of units in the market (e.g., households, square footage).
- **Base usage** is the pre-installation end-use usage per unit (e.g., use per household appliance, square foot).
- **Adjustment factor** represents a proportionate adjustment for standard replacement equipment relative to average stock equipment in existing buildings. This factor ensures that the reduction in consumption associated from replacing stock equipment with minimum federal or local standards is not misrepresented as conservation potential.
- **Applicability factor** is the fraction of the floor space or households that is applicable for conversion to the DSM technology for each market segment or building type. It generally corresponds to the saturation of the base case technology, which is equal to the share of households or floor space that have the end-use times the fuel share.
- **Not complete factor** is the fraction of the applicable floor space or households that has not yet been converted to the particular energy-efficiency technology.
- **Feasibility factor** is the fraction of the applicable floor space or households that is technically feasible for conversion to the energy efficiency technology from an engineering perspective. If multiple measures apply to the same base end-use (e.g., two types of heat pumps), the feasibility factor is used to allocate the potential to each measure such that the sum of the factors is less than or equal to 100%.
- **Savings factor** is the percentage savings of the technology relative to the base usage and takes into account interactions among measures such as lighting and HVAC.

The residential and commercial segments and end-uses analyzed for PSE are shown in Tables 2-1 and 2-2, respectively. DSM ASSYST treats the existing building stock and new construction as separate markets within each segment.

Table 2-1
Residential Dwelling Types and End Uses

Segments	Electric End Uses	Gas End Uses
Single Family	Central AC	Boiler
Multifamily	Clothes Washer	Clothes Washer
Manufactured	Cooking	Cooking
	Dishwasher	Dishwasher
	Freezer	Furnace
	Heat Pump	Water Heating
	Lighting	Other
	Plug Loads	
	Refrigeration	
	Room AC	
	Space Heat	
	Water Heat	
	Other	

Table 2-2
Commercial Building Types and End Uses

Segments	Electric End Uses	Gas End Uses
Office	Cooking	Cooking
Dry Goods Retail	Cooling	Space Heating
Restaurant	Space Heating	Water Heating
Grocery	Lighting	Other
Warehouse	Plug Load	
School	Process	
University	Refrigeration	
Hospital & Heath Care	Ventilation	
Hotel	Water Heat	
Miscellaneous	Other	

2.4 INDUSTRIAL SECTOR TOP-DOWN APPROACH

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, conservation potential in the industrial sector was analyzed using an alternative, top-down approach. The approach involved two steps. First, total firm industrial loads were disaggregated into standard SIC classes and major end uses within each class based on PSE's latest sales data. Table 2-3 shows the SICs and the electric and gas end uses considered in the analysis. Second, for each end use, we estimated potential savings and per-unit cost of the potential savings, relying on available data from a large number of industrial energy-efficiency programs in the Northwest and California and market information on PSE's customers available from industrial accounts representatives.

Table 2-3
Industrial Segments and End Uses

Segments	Electric End Uses	Gas End Uses
Food/kindred products	HVAC	HVAC
Lumber/wood products	Indirect boiler	Process boiler (upgrade/controls/ht recov)
Paper/allied products	Lighting	Process boiler O&M
Printing/publishing	Motors (excluding compressed air O&M)	Process heat
Chemical/allied products	Motors compressed air O&M	Process other
Petroleum related	Process Electro Chemical	Steam distribution systems
Rubber/plastics products	Process heat	Other
Stone/clay/glass/concrete products	Process other	
Primary metal industries	Refrigeration/process cooling	
Fabricated metal products	Other	
Machinery, except electrical		
Electric/electronic equipment		
Transportation equipment		
Instruments/related products		
Miscellaneous		

2.5 LOAD FORECAST CALIBRATION

An accurate assessment of conservation potential requires that base conditions closely approximate the historical sales and the load forecast. In this study calibration was achieved by (1) calibrating end-use estimates to PSE's sector-level weather-normalized, per-customer sales for the 2002 calendar year, and (2) by applying projections of customer counts through 2023. The industrial sector top-down estimates are automatically calibrated in the top-down approach.

2.5.1 Customer Forecast Calibration

The number of eligible residential and commercial customers for existing and new construction are based on the forecasted customer counts in PSE's April 30, 2003 Least Cost Plan. To the extent that the long-term customer forecast changes due to new population and employment estimates or from energy price changes, the estimates of conservation potential will also change.

The share of residential customers across the single-family, multi-family, and manufactured segments is derived by applying their respective shares from PSE's 1998 Residential Appliance Saturation Survey to the residential sector customer forecast totals. These shares are assumed to remain constant over the forecast horizon. Similarly, applying the appropriate shares for each commercial segment to the commercial customer forecast derives the number of commercial customers by building segment over the forecast horizon. The commercial building shares are derived from the 1994 and 2002 studies of the commercial building stock in PSE's service area.[2]

2.5.2 Energy Use Calibration

The next step in the calibration is to ensure that base energy sales are consistent with PSE load forecasts. For the residential and commercial bottom-up analyses, this is accomplished in one or two steps:

1. Residual energy is attributed to the miscellaneous end use. This value should be greater than or equal to zero, but should not exceed 10% of 2002 energy sales. For the residential electric sector, the miscellaneous allocation was less than one half of one percent, and for residential gas, the miscellaneous allocation was 9%. The commercial electric and gas results overstated sales because the number of customers exceeds buildings.[3] The commercial sector therefore required step 2.
2. When non-calibrated total usage is on the high side, the next step is to proportionately reduce the per-unit (i.e., customer or square foot) energy usage of each segment and end use until the total sector usage in the baseline equals actual 2002 consumption. Since all energy savings are defined in percentage terms, this process has no affect on savings estimates other to ensure that they are consistent with PSE's commercial sector loads.

2.6 BUNDLE AGGREGATION

Individual conservation measures are not distinct enough to be useful within PSE's IRP model. The aggregation of conservation measures has to be large enough that they can be directly compared to alternate, supply-side resource options. We refer to the aggregates as bundles. The bundles are relatively homogeneous in terms of end-use load shapes. All industrial measures are aggregated into a single bundle. Table 2-4 shows the bundle breakouts we used for the residential and commercial bottom-up analyses.

Table 2-4
Residential and Commercial Bundles

End Use	Market	
	Existing Construction	New Construction
HVAC	Electric, gas	Electric, gas
Lighting	Electric	Electric
Water Heating	Electric, gas	Electric, gas
Cooking	Gas	Gas
Appliances & Plug Loads	Electric, gas	Electric, gas

2 Commercial End-Use Survey, Customer Services Department, Puget Sound Energy, December 1994; and 2002 Commercial Building Stock Assessment, Northwest Energy Efficiency Alliance (forthcoming report).

3 This is because, while some commercial accounts aggregate loads from two or more buildings, more often there are multiple accounts within a building.

After dividing the measures into bundles, the next step was to sort and group the residential and commercial measures into price-quantity combinations. Each bundle consists of multiple price-quantity points, with the price component representing the levelized cost of the following:

- Incremental measure cost (material & installation)
- Program administration and implementation costs
- Quantifiable non-energy O&M costs or savings.

The resulting supply curve provides discrete blocks of conservation potential within the homogeneous bundles. These blocks represent price-quantity combinations within a bundle and can be thought of as discrete intervals along a bundle-specific supply curve. Tables 2-5 and 2-6 show the various blocks and the associated break points for electric and gas residential and commercial measures.[4]

Table 2-5
Electric Price-Quantity Combinations

Block (Price-Quantity Combination)	**Measure Levelized Cost Thresholds**
Cost Level A	≤ 3 cents/kWh
Cost Level B	3.0 to 4.5 cents/kWh
Cost Level C	4.5 to 6 cents/kWh
Cost Level D	6 to 8.5 cents/kWh
Cost Level E	8.5 to 11 cents/kWh
Cost Level F	> 11 cents/kWh

Table 2-6
Gas Price-Quantity Combinations

Block (Price-Quantity Combination)	**Measure Levelized Cost Thresholds**
Cost Level A	≤ 30 cents/therm
Cost Level B	30 to 45 cents/therm
Cost Level C	45 to 65 cents/therm
Cost Level D	65 cents to 1 dollar/therm
Cost Level E	> 1 dollar/therm

2.7 Market Penetration and Achievable Potential

A variety of factors affect market penetration of energy-efficiency measures, including inherent market barriers resulting from the customers' tendency to avoid the potential administrative and financial burdens, program marketing strategies, and delivery mechanisms. This is why even

4 All industrial electric and gas measures fall into the low cost category

some energy-efficiency programs with full incremental cost incentives can have such a wide range of penetration rates. The available information suggests that, although incentive levels do play a significant role in determining program success, other, non-financial factors may play an equal, if not more important, role.

Estimates of market penetration in this study were based on the expectation of what full incremental cost rebates, consistent with a 15% administrative cost adder, are likely achieve on average. The penetration rates for electric and gas potential across end-use bundles are reported in Tables 2-7 and 2-8, respectively. All of the rates range from 30% to 60%, with the great majority set equal to 50% of technical potential.

Table 2-7
Penetration Rates for Electric Bundles

Sector/Vintage	Appliances	HVAC	Lighting	Water Heat
Commercial				
Existing	50%	50%	50%	50%
New Construction	50%	50%	50%	50%
Residential				
Existing	60%	60%	30%	60%
New Construction	50%	50%	50%	50%
Industrial				
All	50%	50%	50%	50%

Table 2-8
Penetration Rates for Gas Bundles

Sector/Vintage	Appliances	HVAC	Lighting	Water Heat
Commercial				
Existing	50%	50%	50%	50%
New Construction	50%	50%	50%	50%
Residential				
Existing	-	60%	60%	60%
New Construction	-	50%	50%	50%
Industrial				
All	50%	50%	50%	50%

2.8 Other Methodological Issues

Appropriate treatment of fuel conversion, particularly with regard to space- and water-heating applications in the residential and commercial sectors, represents an additional consideration in the development of dual-fuel conservation potentials. This study did not explicitly take into account conservation potentials based on fuel conversion.

3 DATA SOURCES

Implementation of the methodology described above required compilation of a large database of measure-specific technical and market data from both primary and secondary sources. Given the accelerated schedule for completion of this study, we relied mainly on data available from secondary regional and national sources.

The main data sources were Puget Sound Energy (PSE), Pacific Northwest utilities and energy organizations, California utilities and energy organizations, and studies for other states conducted by KEMA-XENERGY, Quantec, and others. As shown in the sections below, in some cases we relied on multiple data sources. For example, we used residential load shapes provided by the Northwest Power and Conservation Council (NWPCC)and Tacoma Public Utilities (TPU).

The necessary data on current and forecast industrial loads by SIC categories were provided by PSE. The load data were then disaggregated by major end-uses using industrial energy use data from the Energy Information Administration (EIA) Office of Industrial Technologies. In deriving estimates of conservation measure costs (per-unit cost of conserved energy) and savings (relative savings by end-use), we also relied heavily on the experience and judgment of the engineering staff at KEMA-XENERGY and Quantec, PSE industrial energy-efficiency account representatives, and available information from recent evaluations of industrial-sector energy-efficiency programs at regional utilities.

3.1 PUGET SOUND ENERGY

Primary data from PSE included customer and load forecasts, previous conservation actions, residential appliance saturation studies (RASS), commercial building stock assessment, estimates of end-use loads, and previous conservation potential studies. Details are provided in Table 3-1.

Table 3-1
PSE Data Sources

PSE Data Source	Key Variables	Use in This Study
2003 Load Forecast	Energy and Peak Forecasts, Customer Counts, Employment and Population Forecasts	Conservation Potential Share of Forecast, Per Customer Use for Calibration, New Construction Forecast
Conservation Tracking Database	Conservation Measures Installed Between 1990 and 2003	Incomplete Factors
1999 Residential Energy Study (RASS)	Dwelling Characteristics, Equipment Saturations, and Fuel Shares	Dwelling Type Breakouts, Square Footage per Dwelling, Applicability Factors, Forecast Calibration
1994 Commercial End-Use Survey	Building Characteristics, Equipment Saturations, and Fuel Shares	Building Type Breakouts, Square Footage per Dwelling, Applicability Factors, Forecast Calibration
1995 Washington Natural Gas DSM Study	Residential Gas Usage	End Use Consumption (UEC) Estimates

3.2 Pacific Northwest Studies

Several Pacific Northwest organization provided data critical to this effort, including the NWPCC, the Regional Technical Forum (RTF), the Northwest Energy Efficiency Alliance, and TPU. The information included technical information on measure savings, costs and lives, hourly end-use load shapes, and commercial building and energy characteristics. Details are provided in Table 3-2.

Table 3-2
Pacific Northwest Data Sources

Pacific Northwest Data Source	Key Variables	Use in This Study
NWPCC 2004 Power Plan (in progress)	Measure Data, Conservation Potential Estimates	Measure Savings, Costs and Lives, and Cross-Check of PSE Potential Estimates
NWPPP Hourly Electric Load Model (HELM)	Hourly Load Shapes	Hourly End-Use Load Shapes for Residential, Commercial, and Industrial Sectors
RTF Web Site	Measure Data	Measure Savings, Costs and Lives
TPU Hourly Electric Load Model (HELM)	Hourly Load Shapes	Hourly End-Use Load Shapes for the Residential Sector
2002 NEEA 2004 Commercial buildings Stock Assessment (in progress)	Building Characteristics, Equipment Saturations, and Fuel Shares	Building Type Breakouts, Square Footage per Dwelling, Applicability Factors, Forecast Calibration
2002 Clean Electricity Options for the Pacific Northwest: An Assessment of Efficiency and Renewable Potentials through the Year 2020 (Tellus Institute report prepared for the NW Energy Coalition	Conservation Program Market Penetration Estimates	Conservation Bundle Market Penetration Estimates

3.3 STATE OF CALIFORNIA

Over the last few years the California has been very active in developing energy efficiency measure data. Studies have been jointly funded through the state's public goods charge, and managed by Pacific Gas and Electric Company, Southern California Edison, San Diego Gas and Electric Company, and Southern California Gas Company.

The utilities worked together through the California Measurement Advisory Council, which included representatives of the California Energy Commission and the California Public Utilities Commission. KEMA-XNERGY was the prime contractor on each of the studies referenced in Table 3-3.

Table 3-3
State of California Data Sources

California Data Source	Key Variables	Use in This Study
2003 California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study	Commercial Gas Measure Data, Conservation Potential Estimates	Commercial Gas Measure Savings, Costs and Lives; Applicability, Feasibility Factors
2002 California Statewide Commercial Sector Energy Efficiency Potential Study	Commercial Electric Measure Data, Conservation Potential Estimates	Commercial Electric Measure Savings, Costs and Lives; Applicability, Feasibility Factors
2002 California Statewide Industrial Sector Energy Efficiency Potential Study	Industrial Electric Measure Data, Conservation Potential Estimates	Industrial Electric and Gas Measure Savings, Costs and Lives
2002 California Statewide Residential Sector Energy Efficiency Potential Study	Residential Electric and Gas Measure Data, Conservation Potential Estimates	Residential Electric and Gas Measure Savings, Costs and Lives; Applicability, Feasibility Factors
2001 DEER (Database for Energy Efficiency Resources) Update Study	Residential and Commercial Measure Data	Measure Savings, Costs and Lives

3.4 OTHER DATA SOURCES

Other data sources, as listed in Table 3-4, consisted primarily of available information from past energy-efficiency market studies, conservation potential studies and evaluations of energy-efficiency programs performed by the consultants.

Table 3-4
Other Data Sources

Other Data Source	Key Variables	Use in This Study
U.S. Department of Energy, Office of Industrial Technologies	Energy Efficiency Technologies, Estimated Savings, Technology Saturations	Estimated Savings, Technology Saturations on Motors and Compressors
2002-03 Assessment of Energy and Capacity Savings Potential in Iowa (Global Energy Partners and Quantec)	Measure Data, Conservation Potential Estimates	Measure Savings, Costs and Lives, and Cross-Check of PSE Potential Estimates
1995 Multi-client Study, Market Penetration of DSM Programs: The Effects of Price and Non-price Program Features (Barakat and Chamberlin, Inc.)	Conservation Program Market Penetration Estimates	Conservation Bundle Market Penetration Estimates

4 CONSERVATION POTENTIAL RESULTS

4.1 TECHNICAL AND ACHIEVABLE CONSERVATION POTENTIAL SUMMARY

Based on the results of this study, cumulative 20-year technical conservation potentials in PSE's service area are estimated at 1,016 aMW megawatts of electricity and 45,708,939 decatherms of natural gas savings, of which 328.3 aMW (32%) and 10,788,029 decatherms (24%) are estimated to be achievable. Cumulative, long-run technical and achievable conservation potentials are shown in Tables 4-1 and 4-2, and Figures 4-1 and 4-2 for electricity and natural gas respectively.

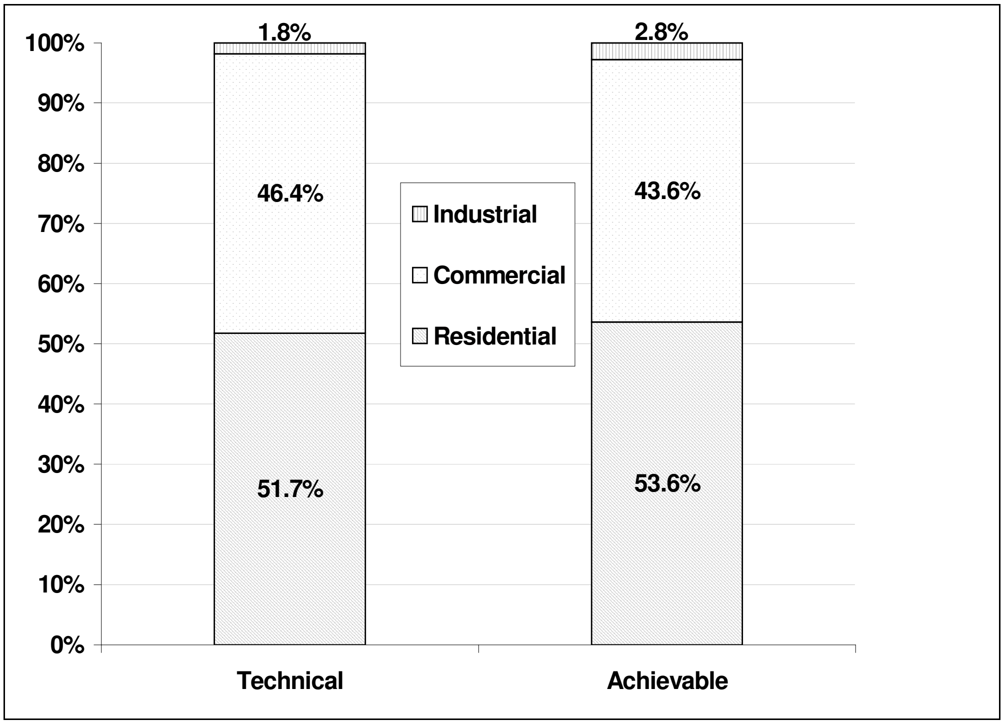
As shown in Table 4-1 and Figure 4-1, the residential sector accounts for the largest share of achievable electricity savings (176 aMW), followed by the commercial sector with an achievable savings potential of 143 aMW over 20 years. The industrial sector accounts for 9 aMW of electricity savings during the same period.

Table 4-1
Long-Run Electric Technical and Achievable Potential

Sector	Total 2023 Baseline Load[1] (aMW)	20-Year Cumulative Potential (aMW and % of Baseline)	
		Technical	Achievable
Residential	1,538	525.7	176.0
		34.2%	11.4%
Commercial	1,331	471.8	143.1
		35.4%	10.7%
Industrial	179	18.4	9.2
		10.3%	5.1%
Total	3,048	1,016.0	328.3
		33.3%	10.8%

[1]From PSE April 30, 2003 Least Cost Plan load forecast.

Figure 4-1
Distribution of Electric Technical and Achievable Potential by Sector



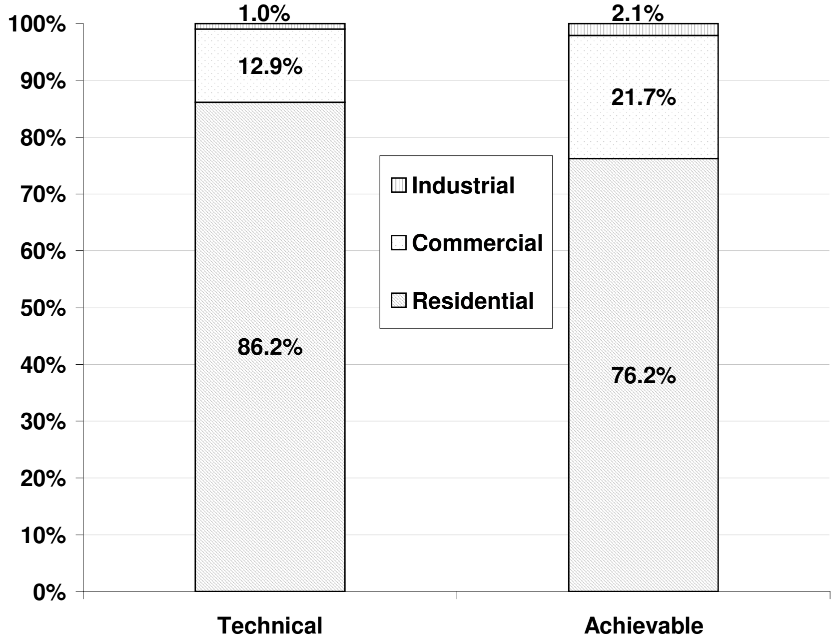
The largest share of achievable natural gas potential is in the residential sector, which accounts for nearly 76% of total achievable natural gas savings. The commercial and industrial sectors respectively account for 22% and 2% of the achievable potential.

Table 4-2
Long-Run Natural Gas Technical and Achievable Potential

Sector	Total 2023 Baseline Load[2] (Decatherms)	20-Year Cumulative Potential (Decatherms and % of Baseline)	
		Technical	Achievable
Residential	81,319,163	39,383,771	8,223,569
		48.4%	10.1%
Commercial	29,562,290	5,880,506	2,342,129
		35.4%	10.7%
Industrial	4,789,020	444,662	222,331
		9.3%	4.6%
Total	115,670,473	45,708,939	10,788,029
		39.5%	9.3%

[2]From PSE April 30, 2003 Least Cost Plan load forecast.

Figure 4-2
Distribution of Gas Technical and Achievable Potential by Sector



To add additional perspective on the scope and magnitude of the estimated achievable conservation potential on various sectors, the resulting impacts are presented on a per-customer basis relative to average consumption. As can be seen in Table 4-3, estimated conservation potentials are likely to have the largest impacts in the residential sector, reducing average electricity and gas use per residential customer by 11.4% and 10.1% respectively. The results also suggest that if all the achievable conservation potential is acquired, per-customer electricity and gas use in the commercial sector would be lowered by nearly 11% and 8%, respectively, in 2023.

Table 4-3
Per Customer Energy Usage in 2023

Fuel/Sector	Baseline Use Per Customer in 2023[3]	Use per Customer After Achievable Potential	% of Use per Customer Baseline
Electric (kWh)			
Residential	11,161	9,883	11.4%
Commercial	77,411	69,091	10.7%
Industrial	376,022	356,686	5.1%
Gas (Therms)			
Residential	819	736	10.1%
Commercial	4,956	4,563	7.9%
Industrial	15,911	15,172	4.6%

[3]From PSE April 30, 2003 Least Cost Plan load forecast.

Measure-specific results and data inputs for each sector are provided in Appendices A through F.

4.2 Residential Achievable Conservation Potential

4.2.1 Residential Electric Potential

The distribution of achievable electricity savings in the residential sector by end-use is shown in Figure 4-3. As can be seen, the upgrade and replacement of appliances with energy-efficient technologies provide the largest opportunity for acquisition of electric conservation resources. Savings in this end-use represent approximately 42% of all achievable electricity savings in the residential sector.

The results also show that about 32% of achievable electric savings in the residential sector may be obtained through the application of energy-efficient lighting technologies, primarily compact fluorescent light bulbs and fixtures. The remaining savings can be achieved through the implementation of water-heating measures (16%) and HVAC measures (10%). More detailed breakouts of the measure categories within each of the bundles are presented in Figures 4-4 through 4-7.

Figure 4-3
Distribution of Residential Sector Achievable Electric Conservation Potential by End-Use

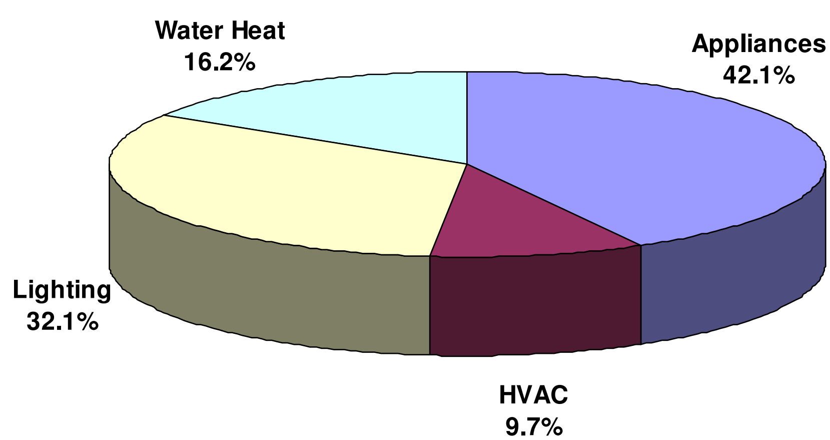


Figure 4-4
Distribution of Residential Electric HVAC Savings by Measure Category

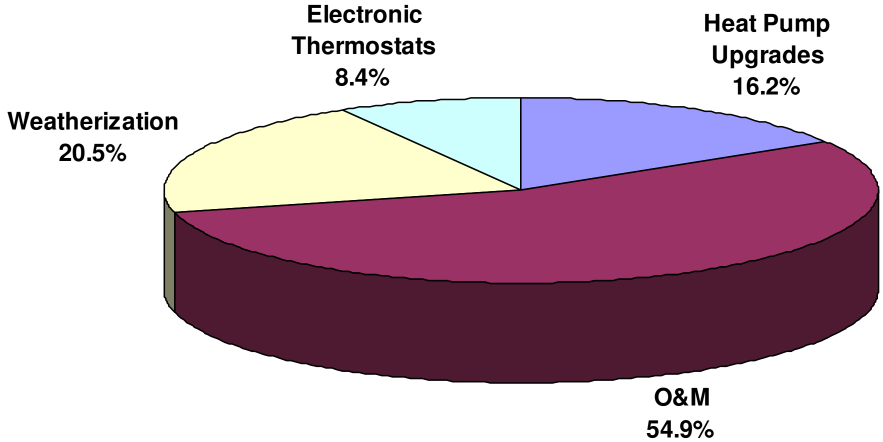


Figure 4-5
Distribution of Residential Electric Lighting Savings by Measure Category

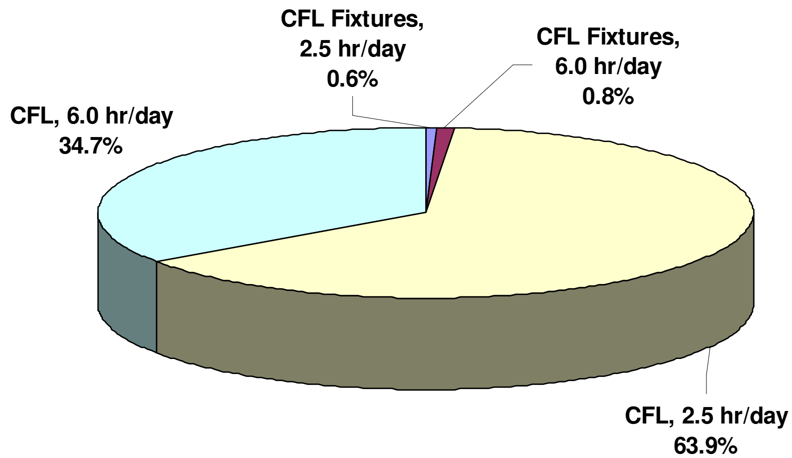


Figure 4-6
Distribution of Residential Electric Water Heating Savings by Measure Category

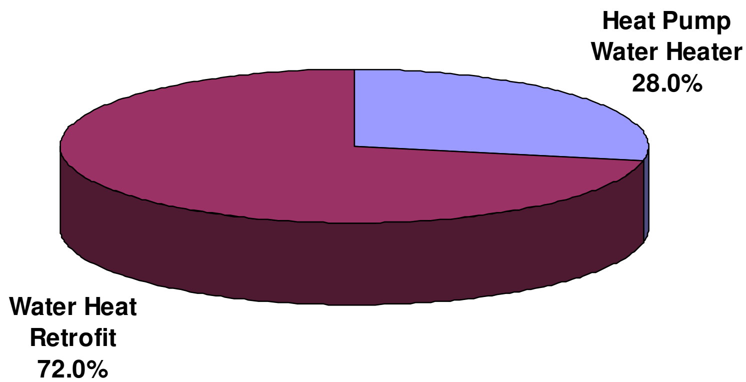
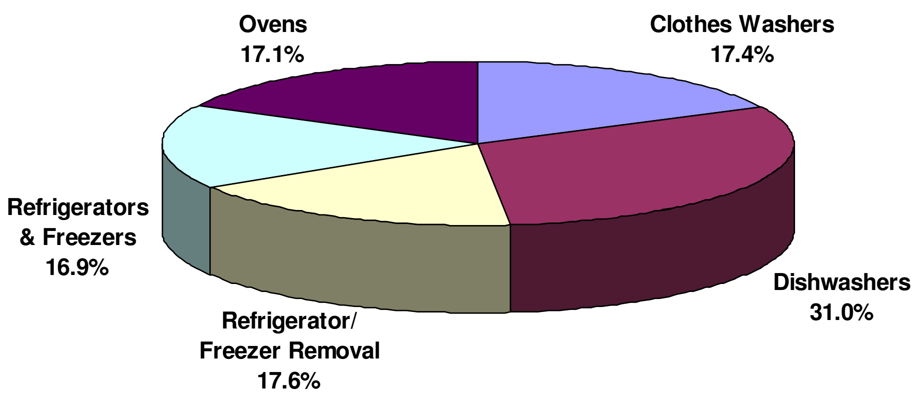


Figure 4-7
Distribution of Residential Electric Appliance Savings by Measure Category



4.2.2 Residential Gas Potential

As shown in Figure 4-8, expected savings in space heating is the largest component of the achievable natural gas conservation potential in the residential sector and accounts for nearly 67% of the gas savings potential. Upgrade of heating equipment with alternative, more energy-efficient equipment is the main source for the potential savings. The results also show that installation of more efficient water heaters and application of measures that improve performance of existing units account for nearly 30% of the gas conservation potential in the residential sector. Figures 4-9 and 4-10 show the share of savings for various measure categories for space heating and water heating.

Figure 4-8
Distribution of Residential Sector Achievable Natural Gas Conservation Potential by End-Use

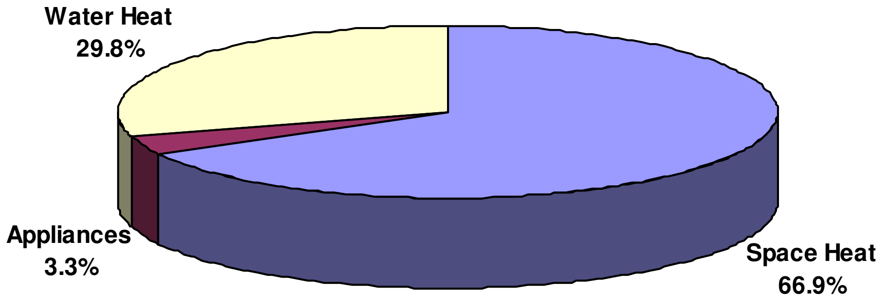


Figure 4-9
Distribution of Residential Gas Space Heat Savings by Measure Category

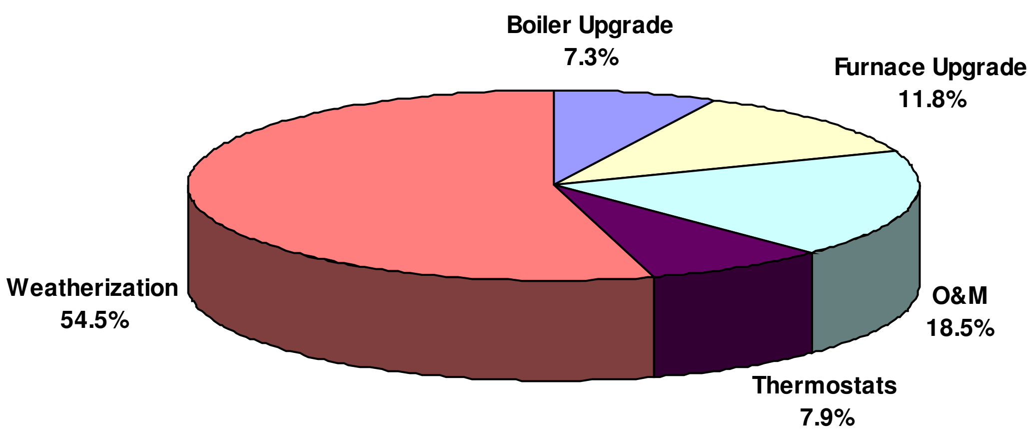
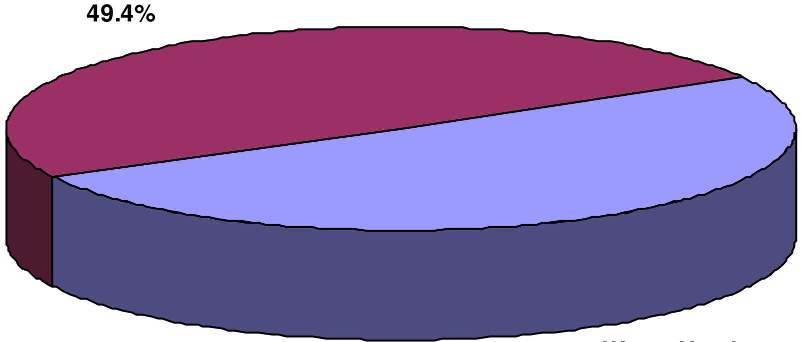


Figure 4-10
Distribution of Residential Gas Water Heat Savings by Measure Category



4.3 COMMERCIAL ACHIEVABLE CONSERVATION POTENTIAL

4.3.1 Commercial Electric Potential

As shown in Figure 4-11, nearly 74% of potential electricity savings in the commercial sector are 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 23% of the total electricity savings potential in this sector. Appliances (plug loads) and water heating measures together account for about 3% of total commercial-sector electricity savings. Figure 4-12 and 4-13 show the savings by measure category for HVAC and appliances.

Figure 4-11
Distribution of Achievable Commercial Sector Electric Conservation Potential by End-Use

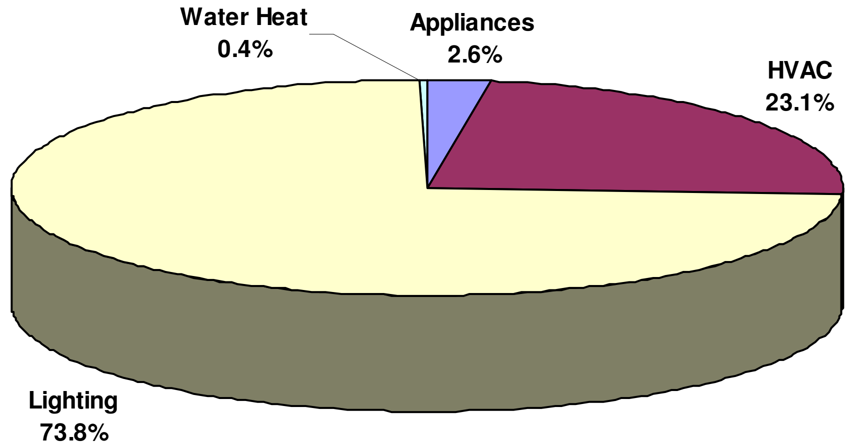


Figure 4-12
Distribution of Commercial Electric HVAC Savings by Measure Category

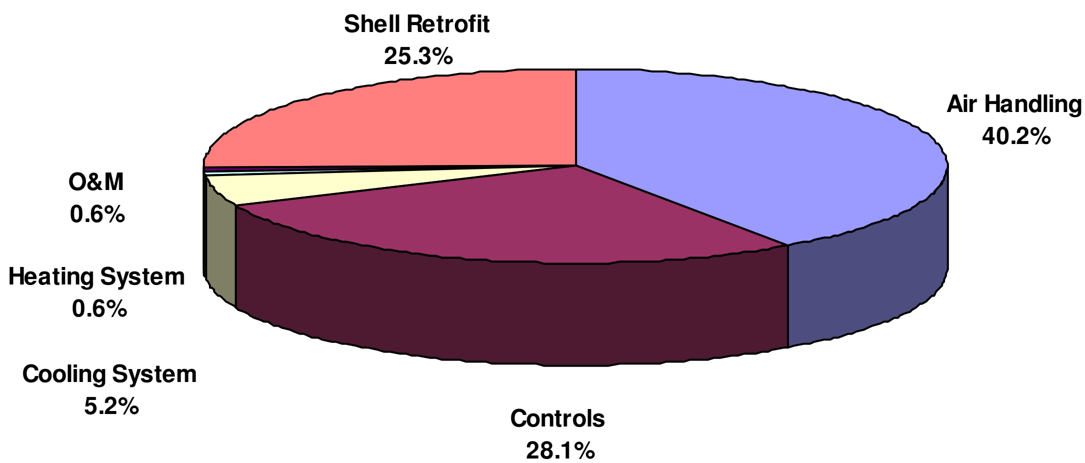
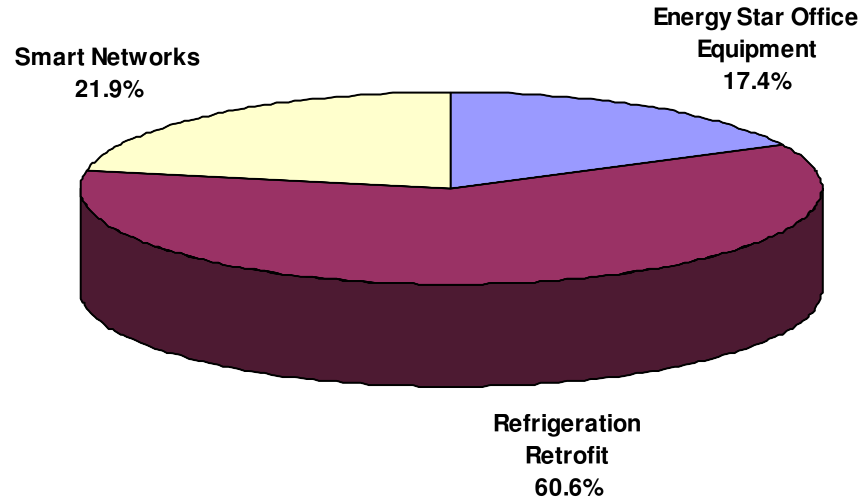


Figure 4-13
Distribution of Commercial Electric Appliance Savings by Measure Category



4.3.2 Commercial Gas Potential

As can be seen in Figure 4-14, space heating, water heating and cooking conservation measures provide the largest potentials for gas savings in the commercial sector. These measures respectively represent 40% (space heating), 34% (water heating), and 26% (cooking) of the total achievable gas conservation potential in the commercial sector. Upgrades to miscellaneous gas appliances account for a relatively small share of the total gas savings potential in this sector. Figures 4-15 and 4-16 show the distribution of savings by measure category for space heat and water heat, respectively.

Figure 4-14
Distribution of Commercial Sector Achievable Natural Gas Conservation Potential

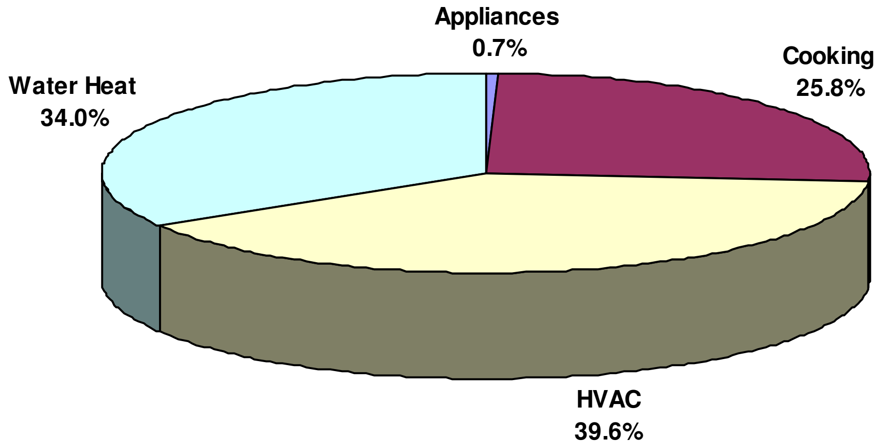


Figure 4-15
Distribution of Commercial Gas Space Heat Savings by Measure Category

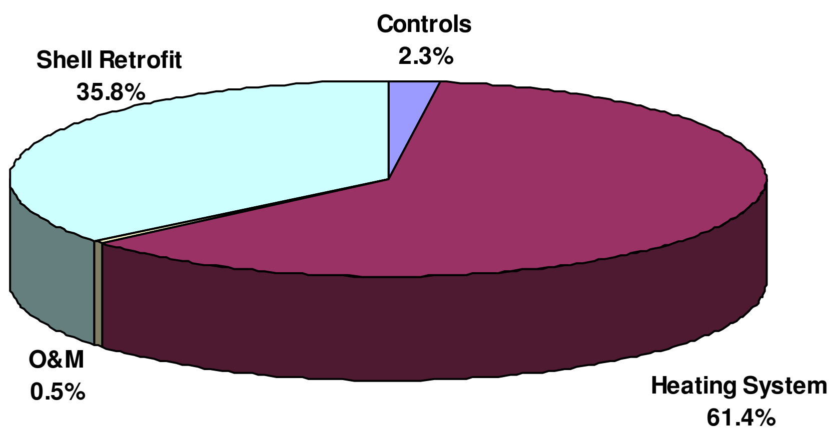
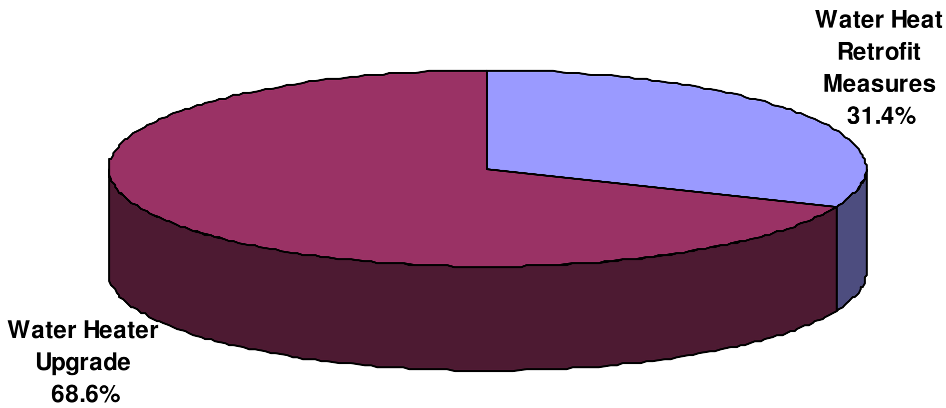


Figure 4-16
Distribution of Commercial Gas Water Heat Savings by Measure Category



4.4 Industrial Achievable Conservation Potential

Achievable electric and gas conservation potentials were estimated for all major end-uses and within 15 major industrial sectors in PSE's service territory. Long-term achievable savings potentials in the industrial sector savings are estimated at 9.2 aMW of electricity and 222,330 decatherms of gas.

The distribution of achievable electricity potential by major industrial end-uses is show in Figure 4-17. Motor upgrades present by far the largest source for electricity savings in all industrial segments, accounting for over 55% of potential electricity savings. The remaining 45% of the savings potentials is distributed in similar proportions across compressed air, refrigeration, HVAC, and lighting applications.

As can be seen in Figure 4-18, steam distribution system efficiency improvements account for the largest portion (46.2%) of gas conservation potential in the industrial sector. Process boiler upgrade, boiler controls, and heat recovery measures account for 23.4% of savings; and 15.4% of the gas savings is attributable to improvements in boiler operation and maintenance.

More detailed estimates of industrial achievable potential by end-use and sector are provided in Tables 4-4 through 4-7.

Figure 4-17
Distribution of Industrial Sector Achievable Electric Conservation Potential by End-Use

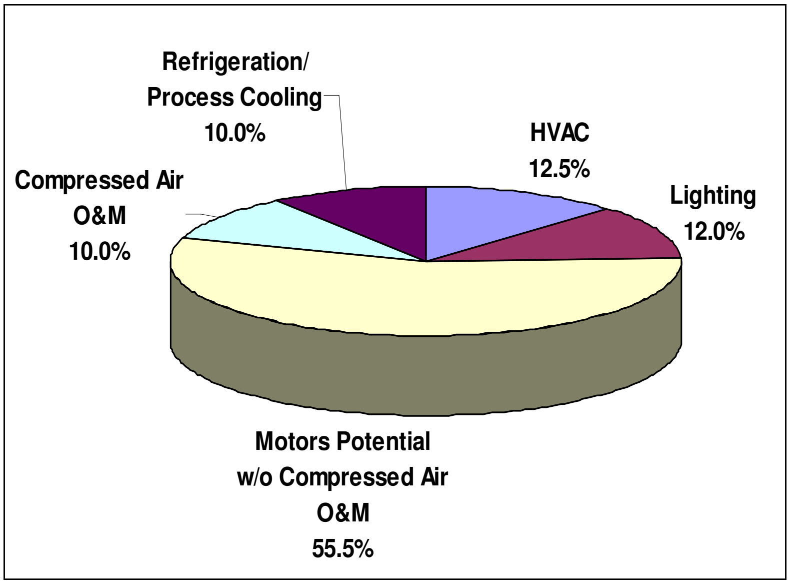


Figure 4-18
Distribution of Industrial Sector Achievable Gas Conservation Potential by End-Use

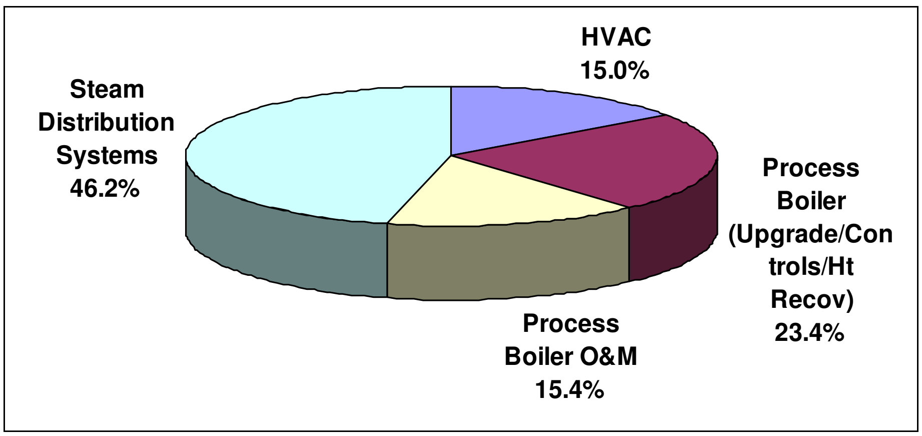


Table 4-4
Industrial Technical Electric Conservation Potential by End-Use

Electric	1999 Firm Consump-tion Total (MWh)	Measure Life (Years)	% Industrial Load	% End Use	First Year Savings (MWh)	First Year aMW	Measure Cost $/kWh Saved	Total Cost ($)	Simple Payback @ $0.05/kWh	Cum. Savings (MWh)	Cost of Conserved Energy ($/kWh)
Total Load	1,571,020	15.9	10.3%	N/A	161,575	18.4	$0.186	$30,123,781	3.7	2,565,203	$0.012
Uncoded	171,553	-	-	-	-		-	-	-	-	-
HVAC	179,248	15.0	1.3%	11.3%	20,165	2.3	$0.450	$9,074,414	9.0	302,480	$0.030
Indirect Boiler	15,182	-	-	-	-	-	-	-	-	-	-
Lighting	156,980	10.0	1.2%	12.4%	19,418	2.2	$0.250	$4,854,575	5.0	194,183	$0.025
Other - Not Reported	128,713	-	-	-	-	-	-	-	-	-	-
Process Electro Chemical	17,651	-	-	-	-	-	-	-	-	-	-
Process Heat	132,084	-	-	-	-	-	-	-	-	-	-
Process Other	9,354	-	-	-	-	-	-	-	-	-	-
Motors Technical Potential	654,866	17.3	6.7%	16.2%	105,801	12.1	$0.130	$13,766,273	2.6	1,825,688	$0.008
Motors Potential	N/A	20.0	5.7%	13.7%	89,671	10.2	$0.148	$13,282,369	3.0	1,793,428	$0.007
Compressed Air O&M	N/A	2.0	1.0%	2.5%	16,130	1.8	$0.030	$483,904	0.6	32,260	$0.015
Refrigeration/Process Cooling	105,388	15.0	1.0%	15.4%	16,190	1.8	$0.150	$2,428,519	3.0	242,852	$0.010

Table 4-5
Industrial Electric Technical Conservation Potential by Sector

Electric		1999 Firm Consump-tion Total (MWh)	2000 Employment (1000s)	Savings as % of Total Industrial Load	First Year Savings (MWh)	First Year aMW	Measure Cost ($/kWh Saved)	Total Cost ($)	Measure Life (Years)	Simple Payback @ $0.05/kWh	Cum. Savings (MWh)	Cost of Conserved Energy ($/kWh)
Total Load		1,571,020	193.6	10.3%	161,575	18.4	$0.186	$30,123,781	15.9	3.7	2,565,203	$0.012
Uncoded		171,553	9.1	-	-		-	-	-	-	-	-
20	Food/Kindred Products	218,111	19.5	3.2%	50,621	5.8	$0.165	$8,339,117	17.1	3.3	866,547	$0.165
24	Lumber/Wood Products	158,492	12.6	1.3%	21,006	2.4	$0.160	$3,353,261	18.3	3.2	384,773	$0.160
26	Paper/Allied Products	11,266	4.1	0.1%	2,015	0.2	$0.168	$338,944	18.8	3.4	37,861	$0.168
27	Printing/Publishing	60,628	16.9	0.2%	3,171	0.4	$0.279	$884,440	14.2	5.6	44,966	$0.279
28	Chemical/Allied Products	74,275	3.1	1.0%	15,261	1.7	$0.143	$2,186,051	16.8	2.9	256,020	$0.143
29	Petroleum Related	12,669	2.2	0.2%	2,958	0.3	$0.144	$427,140	18.2	2.9	53,906	$0.144
30	Rubber/Misc. Plastics Products	181,192	6.7	0.9%	14,361	1.6	$0.180	$2,584,388	15.2	3.6	218,687	$0.180
32	Stone/Clay/Glass/Concrete Prod.	43,199	6.0	0.3%	4,906	0.6	$0.140	$686,563	14.3	2.8	70,321	$0.140
33	Primary Metal Industries	10,407	1.9	0.1%	1,608	0.2	$0.153	$245,273	18.2	3.1	29,303	$0.153
34	Fabricated Metal Products	138,048	8.4	0.5%	8,516	1.0	$0.187	$1,588,856	11.7	3.7	99,638	$0.187
35	Machinery, except Electrical	117,877	13.2	0.8%	12,009	1.4	$0.230	$2,756,809	14.2	4.6	170,643	$0.230
36	Electric/Electronic Equip.	69,128	8.5	0.5%	7,233	0.8	$0.234	$1,691,069	13.8	4.7	100,124	$0.234
37	Transportation Equipment	127,224	66.7	0.6%	9,303	1.1	$0.257	$2,392,709	12.8	5.1	119,187	$0.257
38	Instruments/Related Products	85,294	8.1	0.4%	5,995	0.7	$0.293	$1,755,533	13.5	5.9	81,056	$0.293
39	Miscellaneous	91,657	6.7	0.2%	2,613	0.3	$0.342	$893,627	12.3	6.8	32,172	$0.342

Table 4-6
Industrial Technical Gas Conservation Potential by End-Use

Gas	1999 Consump-tion Total	Measure Life (Years)	% Industrial Load	% End Use	First Year Savings (therms)	Measure Cost ($/therm Saved)	Total Cost ($)	Simple Payback @ $0.67/therm	Cum. Savings (therms)	Cost of Conserved Energy ($/therms)
Total Sales	47,890,199		9.3%	-	4,446,617	-	$8,044,845	-	66,014,080	$0.12
Uncoded	5,316,313	-	-	-	-	-	-	-	-	-
Miscoded	1,904,499	-	-	-	-	-	-	-	-	-
HVAC	5,981,028	15	1.4%	11.2%	667,332	$5.48	$3,656,979	8.2	10,009,980	$0.37
Process Boiler	15,554,164		7.9%	24.3%	3,779,285	$1.16	$4,387,865	1.7	56,004,101	$0.08
Boiler	N/A	15	2.2%	6.7%	1,038,582	$1.52	$1,578,645	2.3	15,578,732	$0.10
Boiler O&M	N/A	5	1.4%	4.4%	685,176	$0.41	$280,922	0.6	3,425,879	$0.08
Steam Distribution Systems	N/A	18	4.3%	13.2%	2,055,527	$1.23	$2,528,298	1.8	36,999,490	$0.07
Other - Not Reported	3,209,210	-	-	-	-	-	-	-	-	-
Process Heat	15,738,121	-	-	-	-	-	-	-	-	-
Process Other	186,864	-	-	-	-	-	-	-	-	-

Table 4-7
Industrial Technical Gas Conservation Potential by Sector

Gas	1999 Consump-tion Total (therms)	2000 Employ-ment (1000s)	Savings as % of Total Industrial Load	First Year Savings (therms)	Measure Cost ($/therm Saved)	Total Cost ($)	Measure Life (Years)	Simple Payback @ $0.67/ therm	Cum. Savings (therms)	Cost of Conserved Energy ($/therm)
Total Load	47,890,199	193.6	9.3%	4,446,617	$1.809	$8,044,845	14.8	2.7	66,014,080	$0.12
Uncoded	5,316,313	9.1	-	-	-	-	-	-	-	
Miscoded	1,904,499	N/A	-	-	-	-	-	-	-	-
Food/Kindred Products	10,977,761	19.5	4.0%	1,925,469	$1.32	$2,550,596	14.8	2.0	28,546,178	$0.09
Lumber/Wood Products	2,629,749	12.6	0.7%	322,973	$1.50	$484,991	14.8	2.2	4,790,658	$0.10
Paper/Allied Products	181,156	4.1	0.1%	33,755	$1.24	$41,753	14.8	1.8	500,310	$0.08
Printing/Publishing	721,429	16.9	0.1%	61,403	$2.46	$150,957	14.9	3.7	913,264	$0.17
Chemical/Allied Products	1,758,317	3.1	0.5%	250,081	$1.25	$311,879	14.8	1.9	3,706,782	$0.08
Petroleum Related	515,874	2.2	0.1%	43,767	$1.19	$51,905	14.8	1.8	648,612	$0.08
Rubber/Misc. Plastics Products	351,480	6.7	0.1%	46,342	$1.98	$91,862	14.9	3.0	688,320	$0.13
Stone/Clay/Glass/Concrete Prod.	3,417,557	6.0	0.2%	77,229	$2.50	$193,232	14.9	3.7	1,148,783	$0.17
Primary Metal Industries	2,503,494	1.9	0.2%	102,490	$2.05	$210,376	14.9	3.1	1,522,602	$0.14
Fabricated Metal Products	6,032,092	8.4	0.9%	425,319	$2.62	$1,113,012	14.9	3.9	6,328,670	$0.18
Machinery, except Electrical	3,010,511	13.2	0.2%	110,061	$5.48	$603,136	15.0	8.2	1,650,918	$0.37
Electric/Electronic Equip.	879,715	8.5	0.2%	100,780	$2.07	$208,603	14.9	3.1	1,497,270	$0.14
Transportation Equipment	4,411,532	66.7	1.1%	541,361	$2.00	$1,084,332	14.9	3.0	8,041,401	$0.13
Instruments/Related Products	786,369	8.1	0.3%	131,062	$2.09	$273,305	14.9	3.1	1,947,256	$0.14
Miscellaneous	2,492,351	6.7	0.6%	274,525	$2.46	$674,907	14.9	3.7	4,083,057	$0.17

5 CONSERVATION RESOURCE BUNDLES

5.1 COST BUNDLES

To facilitate the incorporation of the results of this study into PSE's least-cost, integrated resource planning process, electricity and natural gas conservation potential estimates for each sector were disaggregated into distinct cost-based "bundles" of conservation resource. The grouping of measures into cost bundles begins with ranking of all measures by their respective cost per energy unit saved to create "measure supply curves" as shown in Figures 5-1 and 5-2, irrespective of sector or end-use. (The horizontal axis in each figure shows cumulative savings and the vertical axis shows the average cost per unit of energy saved.) The measures are then assigned to specific resource bundles based on sector and end use.

Five cost-based bundles (levels A-E) were created for electricity by grouping conservation measures with similar cost and load-shape characteristics. For gas, there are four cost categories (A-D). Originally, there were six categories for electric and five categories for gas, but the highest cost categories (electric measures with costs greater than $0.11/kWh, natural gas measures with costs greater than $1/therm) were deemed unlikely to ever be selected as cost-effective resources and were therefore dropped from the analysis prior to the estimation of achievable potential. Levelized-cost thresholds for these electric and gas cost groups are provided in Section 2, Tables 2-5 and 2-6.

Figure 5-1
Electric Achievable Potential Measure Supply Curve

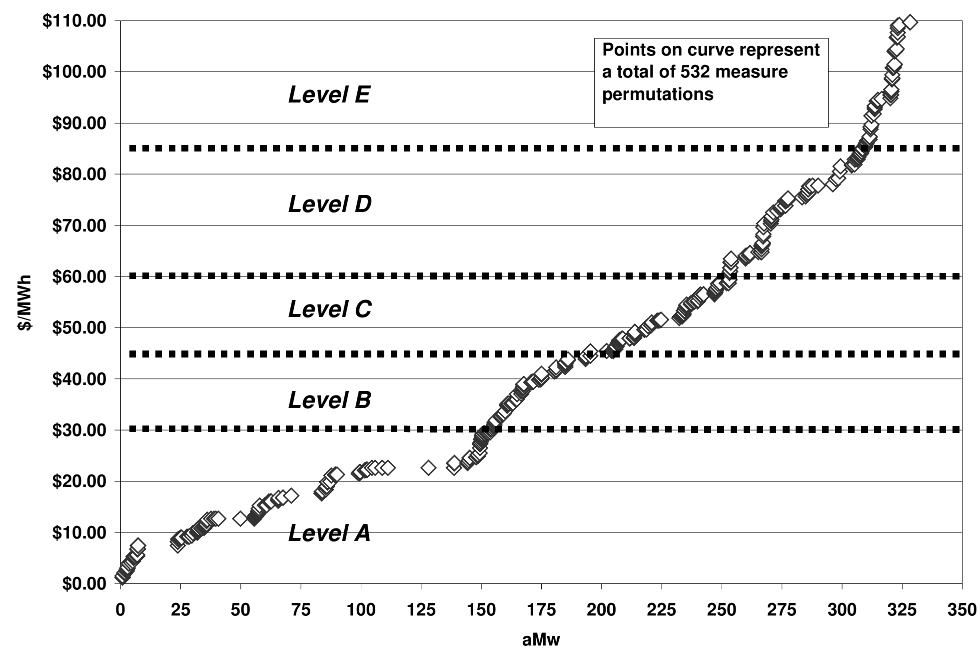
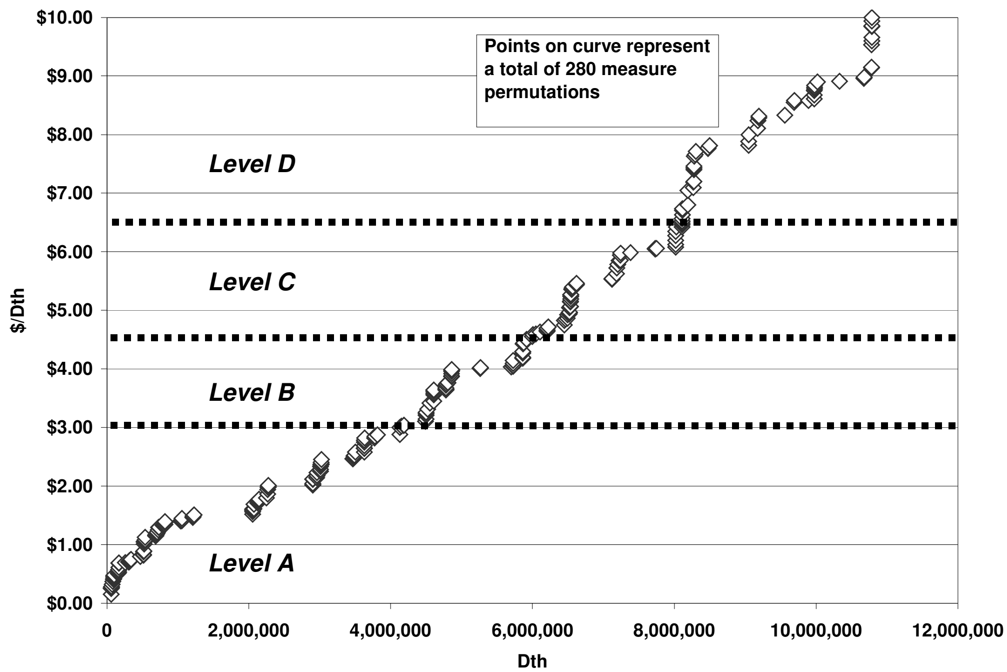


Figure 5-2
Gas Achievable Potential Measure Supply Curve



The composition of electric and natural gas resource portfolios and their associated costs ranges are shown in Tables 5-1 and 5-2. More detailed breakdown of the electricity and natural gas conservation resource bundles by market segment are presented in Tables 5-3 and 5-4.

As shown in Table 5-1, nearly 56% of achievable electricity savings in the residential sector, 33% of the achievable savings in the commercial sector, and all potential savings in the industrial sector fall in the low-cost category. With respect to natural gas, conservation potentials are more evenly distributed across the four cost categories, particularly in the residential sector (see Table 5-2). Again, a significant portion of potential conservation in the residential (32.6%) and commercial (52.4%) sectors and all potential savings in the industrial sector fall in the low-cost resource category.

Table 5-1
Technical and Achievable Electric Potential by Sector and Cost Groups

	Residential 20-Year Potential (aMW/Cost Group as % of Total)		Commercial 20-Year Potential (aMW/Cost Group as % of Total)		Industrial 20-Year Potential (aMW/Cost Group as % of Total)		Total 20-Year Potential (aMW/Cost Group as % of Total)	
	Technical	Achievable	Technical	Achievable	Technical	Achievable	Technical	Achievable
Cost Level A	225.4	97.8	105.4	46.6	18.4	9.2	349.3	153.7
(</= $0.03/kWh)	53.5%	55.6%	34.9%	32.6%	100.0%	100.0%	47.1%	46.8%
Cost Level B	33.9	2.0	89.1	39.6	-	-	123.1	41.6
($0.03 - 0.045/kWh)	8.1%	1.1%	29.5%	27.7%	0.0%	0.0%	16.6%	12.7%
Cost Level C	21.2	24.1	61.2	33.7	-	-	82.3	57.8
($0.045 - 0.06/kWh)	5.0%	13.7%	20.3%	23.6%	0.0%	0.0%	11.1%	17.6%
Cost Level D	70.9	40.0	25.3	15.4			96.3	55.4
($.06 - .085/kWh)	16.8%	22.8%	8.4%	10.7%	0.0%	0.0%	13.0%	16.9%
Cost Level E	69.7	12.0	20.7	7.8	-	-	90.4	19.8
($0.085 - 0.11/kWh)	16.5%	6.8%	6.9%	5.5%	0.0%	0.0%	12.2%	6.0%
Total Up to $0.11/kWh	421.1	176.0	301.7	143.1	18.4	9.2	741.3	328.3

Table 5-2
Technical and Achievable Natural Gas Potential by Sector and Cost Groups

	Residential 20-Year Potential (Decatherms/Cost Group as % of Total)		Commercial 20-Year Potential (Decatherms/Cost Group as % of Total)		Industrial 20-Year Potential (Decatherms/Cost Group as % of Total)		Total 20-Year Potential (Decatherms/Cost Group as % of Total	
	Technical	Achievable	Technical	Achievable	Technical	Achievable	Technical	Achievable
Cost Level A	5,116,161	2,681,181	2,627,962	1,227,305	444,662	222,331	8,188,785	4,130,817
(</=$0.3/therm)	33.2%	32.6%	54.8%	52.4%	100.0%	100.0%	39.6%	38.3%
Cost Level B	2,341,164	1,445,086	1,054,087	300,781	-	-	3,395,251	1,745,867
($0.3-.45/therm)	15.2%	17.6%	22.0%	12.8%	0.0%	0.0%	16.4%	16.2%
Cost Level C	2,181,009	1,503,636	866,307	729,379	-	-	3,047,316	2,233,015
($0.45-.65/therm)	14.1%	18.3%	18.1%	31.1%	0.0%	0.0%	14.7%	20.7%
Cost Level D	5,794,673	2,593,666	249,538	84,664	-	-	6,044,211	2,678,330
$0.65-1.00/therm)	37.5%	31.5%	5.2%	3.6%	0.0%	0.0%	29.2%	24.8%
Total Up to $1/ therm	15,433,008	8,223,569	4,797,894	2,342,129	444,662	222,331	20,675,564	10,788,029

Table 5-3
Achievable Electricity Conservation Potentials by Resource Bundle and Segment (Cumulative 2004-2023)

Bundle/Segment	Cost Level A *(<=$0.03/kWh)*	Cost Level B ($0.03-0.045/kWh)	Cost Level C ($0.045-0.06/kWh)	Cost Level D ($0.06-0.085/kWh)	Cost Level E ($0.085-0.11/kWh)	Total Achievable Potential
Res. Ex. Const. – Appliances	29.2	-	18.2	19.9	0.1	67.4
Res. Ex. Const. – HVAC	8.4	1.8	2.0	3.2	0.8	16.2
Res. Ex. Const. – Lighting	32.7	-	-	-	0.3	32.9
Res. Ex. Const. – Water Heat	4.7	-	-	12.5	0.5	17.7
Res. New Const. – Appliances	-	-	1.2	3.5	2.0	6.7
Res. New Const. – HVAC	-	-	0.2	0.6	-	0.8
Res. New Const. – Lighting	23.0	0.2	-	0.3	-	23.5
Res. New Const. – Wtr. Heat	-	-	2.5	-	8.4	10.8
Subtotal Residential	97.8	2.0	24.1	40.0	12.0	176.0
Com. Ex. Const. – HVAC	7.0	2.9	6.0	5.6	2.9	24.4
Com. Ex. Const.- Lighting	28.2	32.3	24.1	6.9	3.2	94.8
Com. Ex. Const. – Plug Loads	1.7	0.2	0.4	0.3	0.3	2.9
Com. Ex. Const. – Water Heat	0.2	0.1	0.1	0.1	0.0	0.4
Com. New Const. – HVAC	2.3	1.1	1.9	2.0	1.4	8.7
Com. New Const. – Lighting	6.7	2.9	1.1	0.3	0.0	10.9
Com. New Const. Plug Loads	0.5	0.1	0.1	0.1	0.0	0.8
Com. New Const. – Wtr. Heat	0.1	0.0	0.0	0.0	0.0	0.2
Subtotal Commercial	46.6	39.6	33.7	15.4	7.8	143.1
Ind. Existing Const. – General	9.2	-	-	-		9.2
Total All Sectors	153.7	41.6	57.8	55.4	19.8	328.3

Table 5-4
Achievable Gas Conservation Potentials by
Resource Bundle and Segment (Cumulative 2004-2023)

Bundle/Segment	Cost				Total Achievable Potential
	Level A (</=$0.3/ therm)	Level B ($0.3-0.45/therm)	Level C ($0.45-0.65/therm)	Level D ($0.65-1.00/therm)	
Res. Existing Construction -- Appliances	-	-	-	199,062	199,062
Res. Existing Construction – HVAC	2,292,015	485,777	17,933	1,319,257	4,114,982
Res. Existing Construction – Water Heat	389,166	402,822	753,004	227,488	1,772,480
Res. New Construction – Appliances	-	-	-	127,193	127,193
Res. New Construction – HVAC	-	-	-	550,215	550,215
Res. New Construction – Water Heat	-	556,487	732,699	170,452	1,459,638
Subtotal Residential	2,681,181	1,445,086	1,503,636	2,593,667	8,223,570
Com. Existing Const. – Appliances	10,310	-	-	3,187	13,497
Com. Existing Construction – Cooking	279,629	-	267,348	11,376	558,353
Com. Existing Construction – HVAC	417,348	228,400	121,530	28,069	795,347
Com. Existing Const. – Water Heat	379,030	22,996	230,898	16,025	648,949
Com. New Construction – Appliances	1,743	-	-	-	1,743
Com. New Construction – Cooking	462	24,138	21,162	426	46,188
Com. New Construction – HVAC	68,300	1,023	41,106	21,212	131,641
Com. New Construction – Water Heat	70,483	24,224	47,335	4,369	146,411
Subtotal Commercial	1,227,305	300,781	729,379	84,664	2,342,129
Industrial Existing Construction – General	222,331	-	-	-	222,331
Total All Sectors	4,130,817	1,745,867	2,233,015	2,678,331	10,788,030

5.2 ELECTRIC CONSERVATION RESOURCE ACQUISITION CASES

In assessing long-run conservation resource potentials, timing of how conservation resources are acquired over time has significant ramifications for the integrated resource planning process. Since a large portion of conservation potentials, especially savings from retrofit and replacement opportunities, may be considered a finite resource, the amount of conservation available at any given time depends on how much of the resource is acquired earlier. The timing for the acquisition of conservation resources must also take into account practical administrative and logistical considerations as well as potential market barriers.

In our analysis, we considered three alternative cases for acquisition of achievable electric conservation resources:

- ***Case 1: Constant Rate of Acquisition Case***. This case assumes that electric conservation resources would be acquired in equal annual proportions over the 20-year planning horizon, which for PSE equates to 16.4 aMW per year across all achievable potential cost categories.

- ***Case 2: Accelerated Lighting Case***. Under the accelerated lighting case, we assume that conservation resource acquisition for residential and commercial lighting retrofit measures would be accelerated through a two-year ramp-up, continue at 22.8 aMW per year during years three to ten, then gradually ramped down during years eleven and twelve to a level of 10 aMW per year for years thirteen through twenty. All savings associated with applicable measures would be acquired with aggressive marketing during the first twelve years of the plan. It is important to note that only the retrofit portion of the existing customer potential may be subject to accelerated acquisition. In Case 2, the residential administrative-cost adder is increased from 15% to 50%, and the commercial administrative-cost adder is increased from 15% to 30%.

- ***Case 3: Accelerated All Retrofit Case***. Under the accelerated all retrofit case, we assume that conservation resource acquisition for all residential and commercial electric retrofit measures – including lighting, HVAC, water heating, and appliances – would be accelerated via the same ramp-up / ramp-down strategy as Case 2, with the same administrative-cost adders. In Case 3, the acquisition of conservation potential ramps up to 25.5 aMW per year for years three to 10, then down to 7.1 aMW per year for years thirteen to twenty.

The results of these three cases are shown graphically in Figures 5-3 and 5-4. Figure 5-3 shows the cumulative savings each year over PSE's 20-year horizon, and Figure 5-4 shows the incremental savings each year.

Figure 5-3
Electric Conservation Resource Acquisition Cases, Cumulative aMW

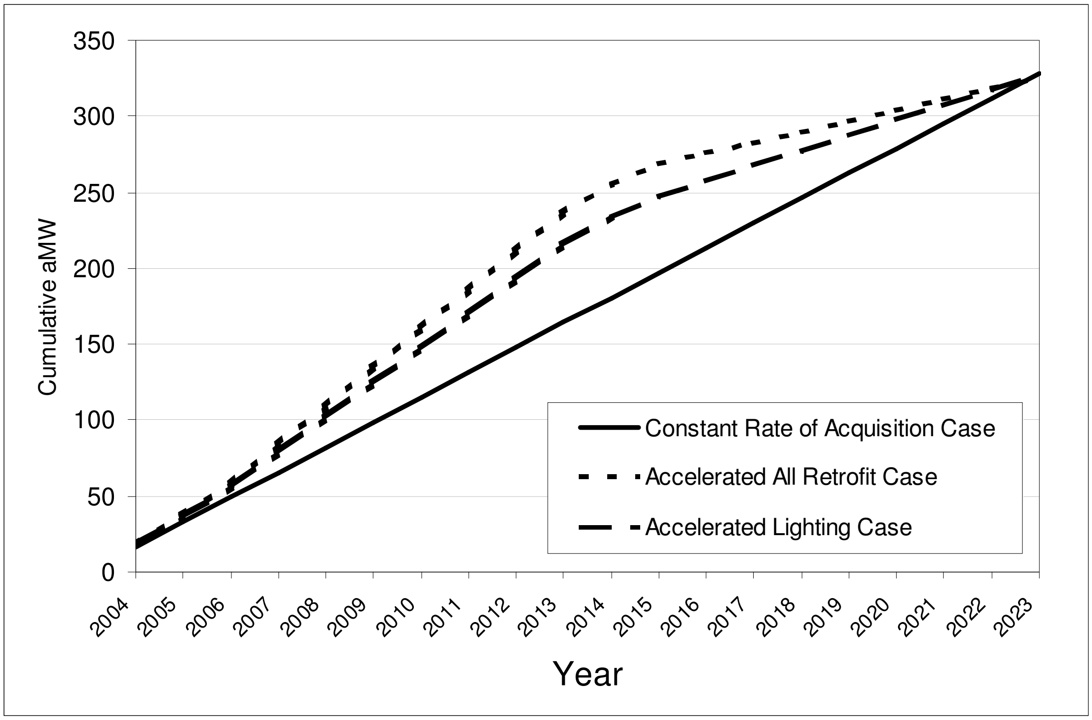


Figure 5-4
Electric Conservation Resource Acquisition Cases, Incremental aMW