Pacific Northwest Regional Assessment of the Potential Benefits of the Direct Use of Natural Gas as a Regional Resource Strategy

Prepared for the

Northwest Gas Association

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by

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Table of Contents

Executive Summary 1
Introduction 4
Scope 8
Approach and Parameters 10
Methodology 16
Results -- Unitary Savings Analysis 18
Results -- Projected Savings Analysis 22
Findings And Recommendations 30
Appendix A – Detailed Methodology and Assumptions 32
Appendix B – Utility Projected Savings 42
Appendix C – Individual Utility Data 43

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TABLE of TABLES and FIGURES

Table 1 Potential PNW Regional Annual Direct Use Benefits (2002, 2008, 2025) by Utility.....2
Table 2 Past PNW Regional Direct Use Studies.....6
Table 3 Analysis Approaches and Results.....11
Table 4 List of Data Elements Considered in the Analysis. 13
Table 5 Efficiencies of Gas and Electric Space Heaters and Water Heaters.....14
Table 6 Energy Use of Gas and Electric Dryers 14
Table 7 List of Resource Characteristics Considered in the Analysis.....15
Table 8 Appliance end-use electricity for homes in Puget Sound Energy service territory (kWh/yr) 32
Table 9 Sources for calculating marginal source of electricity generation.....33
Table 10 Efficiencies of electric space heaters and water heaters.....34
Table 11 Efficiencies of gas space heaters and water heaters 34
Table 12 Comparison of energy usage for an electric dryer and gas dryer 34
Table 13 Number of appliances for potential conversions in the Terasen service territory.....36
Table 14 Potential gas savings in the Intermountain Gas service territory ('000 therms/yr). 37
Table 15 Potential CO_2 emissions savings in the Avista service territory (tonnes/yr). 37
Table 16 Utility Potential Energy and Environmental Benefits (2002, 2008, 2025) 42

Figure 1 Service Area Map of PNW Participating Natural Gas Utilities. 8
Figure 2 Methodology –Unitary Savings Analysis 16
Figure 3 Methodology - Projected Savings Analysis 17
Figure 4 Avista Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas 18
Figure 5 Cascade Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas 19
Figure 6 Intermountain Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas 19
Figure 7 NW Natural Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas..20
Figure 8 Puget Sound Energy Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas.....20
Figure 9 Terasen Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas.....21
Figure 10 Overall Savings Results - PNW United States and British Columbia, Canada 22
Figure 11 Overall Savings Results - PNW United States Only.....23
Figure 12 Regional Distribution of Direct Savings by Appliance 24
Figure 13 Space Heating Savings Results - PNW United States and British Columbia, Canada .25
Figure 14 Space Heating Savings Results - PNW United States Only.....25
Figure 15 Water Heating Savings Results - PNW United States and British Columbia, Canada.26
Figure 16 Water Heating Savings Results – PNW United States Only 27
Figure 17 Clothes Dryer Savings Results – PNW United States and British Columbia, Canada .28
Figure 18 Clothes Dryer Savings Results – PNW United States Only.....28

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EXECUTIVE SUMMARY

Regional planners have been interested in the potential benefits of the direct use of natural gas to displace regional heating needs now met by electricity since the early 1980s. Over a dozen assessments of the potential energy benefits for the region have been undertaken. The major research question has always been, "If the region were to support a direct use conversion policy, would benefits, in terms of reduced overall energy use, accrue to the regional electric generation system?" Traditionally, the region's energy efficiency efforts have focused on efficiency improvements in existing fuel uses. As energy efficiency goals have become more ambitious, the need for reductions in green house gases (GHG) more apparent, and natural gas expected to be the marginal resource for regional electric generation, questions are once again being raised[1] about the environmental and energy benefits of promoting natural gas in certain end-uses.

Several utilities in the region (both investor owned and public power[2]) have begun analyzing the potential for direct use of natural gas to meet a larger portion of their customer's future needs. The focus of these efforts has been on the residential sector where cost-effective natural gas applications hold the promise of providing customers lower costs with reduced environmental impacts compared to using natural gas to generate electricity. Given the regional interest in the question, in March 2008, the Northwest Gas Association (NWGA) engaged Navigant Consulting, Inc. (NCI) to undertake a PNW Regional Assessment of the Direct Use of Natural Gas as A Regional Resource Strategy (the "Assessment"). The Assessment's focus is on the residential sector, where the PNW has historically seen high penetrations of electric heating appliances, due to the availability of inexpensive hydroelectric power from federally owned facilities.

This report presents NCI's findings with a focus on the regional technical potential for energy and GHG emission reduction benefits in the service areas of the six NWGA natural gas utilities in the United States and British Columbia. The effort reviews the annual potential benefits *retrospectively* for 2002 to 2008, and *prospectively* from 2009 to 2029. The Assessment is timely in that in the US Pacific Northwest new hydroelectric power is no longer available to meet the region's growing demand for electricity.[3] In the US Northwest the marginal resource for electricity generation is projected to be a combination of natural gas and renewable energy sources, primarily wind.

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[1] On June 5, 2008 the Washington Utilities and Transportation Commission held a workshop on "Fuel Switching to Natural Gas for Direct End Use" re-opening the regional dialogue on the issue

[2] Navigant recently completed a study for Puget Sound Energy and Snohomish PUD on the ability of the utilities to displace electric generation load with the direct use of natural gas applications in an environmentally responsible and cost-effective manner

[3] This is not the case in British Columbia, Canada, where some hydroelectric resources are projected to be available on the margin

This report addresses the technical potential only for the region and does not address economic or achievable potential. Specifically, NCI evaluated direct use potential for three types of residential heating appliances: space heaters, water heaters, and clothes dryers in four types of residential households: single-family homes, town homes, apartments and manufactured housing.

To make the evaluation, NCI assessed first the potential for individual appliance direct use savings as compared to generation consumption to power the appliances in a Unitary Savings Analysis; NCI then developed a Projected Savings Analysis to assess the technical potential for energy and GHG reduction benefits.

Table 1 shows the overall results of the PNW Regional Direct Use Assessment and is followed by highlights of study findings. To put the data in context, single-family homes use about 1,000 therms per year for all uses. So the potential savings of 321M therms in 2025 is equivalent to serving 321,000 single-family homes.

Table 1
Potential PNW Regional Annual Direct Use Benefits (2002, 2008, 2025) by Utility

	Annual Natural Gas Savings ('000,000 therms/yr)			Annual Average Megawatt Savings (aMW/yr[4])			Annual GHG Emissions Reductions ('000,000 metric tonnes of CO_2/yr)		
	2002	2008	2025	2002	2008	2025	2002	2008	2025
PNW US & British Columbia	236	252	321	373	399	510	1.2	1.3	1.7
PNW US Only	212	226	288	335	358	456	1.1	1.2	1.5

Note: Savings calculations are based on net reductions to gas peaking plants, with megawatt and CO_2 savings calculated by therms savings

Key Findings

The Assessment affirms earlier studies that identified significant energy savings potential from conversions of electric heat applications to direct use of natural gas rather than use of natural gas to fire electric generation

Regional energy and environmental benefits accrue to all electric space and water heating and clothes drying appliance applications, except for residential heat pump applications, which show no direct use benefits[5]

[4] Average Megawatt: An average megawatt (aMW) is equivalent to 8,760,000 MWH or 1 aMW

[5] See footnote 19 for further discussion of the heat pump analysis

The regional technical potential for annual therm and megawatt savings are enough to replace the electricity generated space and water heating, and clothes drying needs of 372,300 households in the Pacific Northwest in the year 2025.[6]

Significant potential exists for the direct use of natural gas to reduce regional GHG emissions, with technical potential annual reductions of over 1.3M tonnes of CO2 beginning in 2009, rising to 1.7M metric tonnes in 2025

Energy and CO2 savings potential are high for clothes dryer conversions in both the US and Canadian Pacific Northwest, although the potential including British Columbia encompasses a full 10 percent more savings (38 percent) than savings in the US Pacific Northwest alone (28 percent) due to a deeper penetration of natural gas in the clothes dryer market in the US than in British Columbia.

In the US, both Intermountain (48 percent) and PSE (44 percent of utility direct use potential) show significant technical potential for clothes dryer direct use savings

Space heating savings potential represent the largest portion of savings for three utilities, with direct use conversion savings potential of 61 percent of Cascade Natural Gas service area potential, 46 percent of potential in NW Natural's service area, and 35 percent of direct use potential in Avista's territory

Key Recommendations

Based on the results of the Assessment, regional planners should consider:

Navigant recommends further review be undertaken of the economic and achievable potential for direct use of natural gas, to help the region better understand the overall costs and benefits of supporting a direct use approach. In this regard, Navigant recommends the Northwest Power Planning and Conservation Council consider updating its 1994 study, the most comprehensive of the past studies undertaken in the region

Should the region undertake a study of the economic and achievable potentials (and perhaps a re-look at the technical potential with expanded data), Navigant recommends that the study look at various technology adoption scenarios that may impact policy considerations regarding direct use of natural gas. For example, any significant increase in electric load caused by hybrid plug-ins

[6] The average PNW home uses approximately 12,000 kWh/yr. Based on this figure 730 homes could be served per year with a one aMW of savings. NCI's analysis identifies 510 aMWs of technical potential in the year 2025

over the next 20 years, could lead to increased costs for electricity and/or natural gas used to fire generation, consequently impacting any regional direct use policy

For individual utilities with needs to adopt programs to reduce GHG emissions and realize energy savings, a direct use residential savings program should be considered in areas of highest potential and benefit for their service territory i.e., space heat, water heat, and/or clothes dryer conversions

This study only reviews the direct use of natural gas in the residential sector in the Pacific Northwest. For a complete picture of the impacts of a direct use policy, Navigant recommends further review of the regional technical, economic and achievable potential for the non-residential sector for direct use of natural gas

Existing data is available in some areas of the region, but limited in others. This required Navigant to use available data from one utility, for instance, and scale that data to the potentials analyses for a second utility. Where possible, NCI used utility data for scaling with similar temperature and market profiles (i.e., west of the mountains or east of the mountains). NCI recommends further data gathering and refining be undertaken as part of any regional study to evaluate direct use economic and achievable potential benefits

INTRODUCTION

The Pacific Northwest faces difficult choices with increasing electricity demand, rising energy costs, national and regional pressure to reduce GHG emissions, and a regional electric system that relies on significant amounts of natural gas for marginal electricity generation.

The Northwest region of the US is unique in having for many decades, low-cost federally-built hydroelectric power for its homes and businesses, which fueled regional growth. Along with regional growth has come increasing demand for low-cost electricity, a demand that has outstripped the ability of the region's hydroelectric resource to meet future loads.

Natural gas-fired generation resources are now projected to be the region's primary marginal resource for meeting future growth, along with a mix of environmentally-friendly renewable resources, demand response and energy efficiency demand-side reductions.

The fact that natural gas is the region's marginal resource, when combined with the national imperative to reduce greenhouse gas (GHG) emissions, brings forth the need for regional

planners and utilities to look for innovative ways to meet energy needs while reducing CO2 impacts.

One such option relates to the potential reduction of environmental impacts and energy savings benefits of displacing gas-fired generation (with its attendant C02, energy use and cost impacts), with the direct use of natural gas in Northwest households, as a possible addition to the region's future resource mix. In this case, customers would use natural gas directly in their homes for heating, rather than indirectly to generate electricity. This would eliminate the losses associated with converting energy in natural gas to electric energy and its associated losses from distributing it to homes. Further, this would reduce the amount of natural gas burned, consequently reducing CO2 emissions.

This concept is not new to the Pacific Northwest. Studies on the subject have been undertaken as far back as the first NW Regional Power Plan in 1982, and more several others have taken place since that time, including a major assessment of the subject by the Power Council in 1994, and a 2001 Council staff issues paper revisiting the issue.[7]

What is new is the urgency of the need, as the Northwest looks to meet its expanding loads and at the same time ensure the region the best choices for an economically and environmentally sound future.

Prior Direct-use Potential Studies

The region has pondered the question of direct-use of natural gas as far back as the first Power Plan in 1982

As noted, a number of previous studies have been undertaken in the Northwest on the question of the potential benefits of a direct-use approach.
lists regional and local studies completed on the subject.

These studies generally focus on not only technical potential, but also on potential economic benefits to the region.

[7] Table 2 provides for an historic overview of the studies and results.

Table 2
Past PNW Regional Direct Use Studies

- 1994 – Power Council (2001 follow-on staff Issue Paper) – Comprehensive assessment of energy and economic benefits of direct use of natural gas compared to use for electric generation
- 1992 – WSEO study – Reviews Aos/Blackman and assesses regional cost and potential benefits
- 1992 – Bonneville Power Authority - Regional electricity savings from fuel conversion
- 1992 – Aos and Blackman –Regional Benefit of conversions to of gas space and water heaters (Single-Family, Multi-Family, Mobile Homes)
- 1992 – Portland General Electric - Staff report on fuel conversions
- 1991 – ODOE/OPUC – Limited study of cost-effectiveness of conversions
- 1991 – Pacific Power and Light (PP&L) - Analysis of ODOE/OPUC study
- 1992 – Washington Water Power – Market test analysis of customer fuel switching
- 1990 – Lazar Study – Regional Benefit of conversions to of both gas space and water heaters (residential and Single-Family)
- 1990 – Pacific Energy Systems – Regional Benefit of gas water heater conversion to natural gas
- 1990 – Oregon Energy Conservation Board – (Life-cycle cost analysis of relative benefits-residential sector)
- 1989 – WSEO study – Relative cost analysis of electric and natural gas (residential space & water heat)
- 1982 – Synergistic Resources Corporation (SRC) – Comprehensive assessment of fuel-switching and choice potential (Residential, Commercial and Industrial. sectors)

NWGA Regional Direct Use Assessment – 2008

This Assessment focuses on household appliances in analyzing regional technical energy and environmental potential

The need for innovative approaches to reducing both energy use and GHG emissions has raised questions in the region once again about the potential benefits of the direct use of natural gas.

At the state and service-area level, the Washington Utilities and Transportation Commission (WUTC) recently held a workshop on the subject, and several Northwest utilities (both investor owned and publicly owned)[8] have analyzed the potential for direct use of natural gas for meeting a larger portion of their customer's future energy needs.

To evaluate the issue from a regional point of view, at the request of the NWGA, in March 2008 NCI began a Pacific Northwest regional assessment of the technical potential[9] of benefits of the direct use of natural gas in the residential sector. Not surprisingly, the PNW has a high penetration of residential electric space and water heating appliances, driven by the region's long legacy of low-cost hydroelectric power. Similarly, electric dryers historically have been the norm in much of the region. This history of electric appliances supplying major portions of residential heating needs provides the backdrop for this study.

[8] Navigant Consulting recently completed a study for Puget Sound Energy and Snohomish PUD on the costs and benefits of displacing electric generation load with the direct use of natural gas.

[9] The term "Technical Potential" refers to the overall *possible* applications of a new technology that might take place in a sector or a region if there were absolutely no economic or implementation barriers to the technology being adopted in all applications identified. Technical Potential is typically reviewed and modified to account for issues of economic feasibility, i.e., "Economic Potential" and ability to realistically capture "Achievable Potential" to determine a reasonable expectation of the technology being adopted.

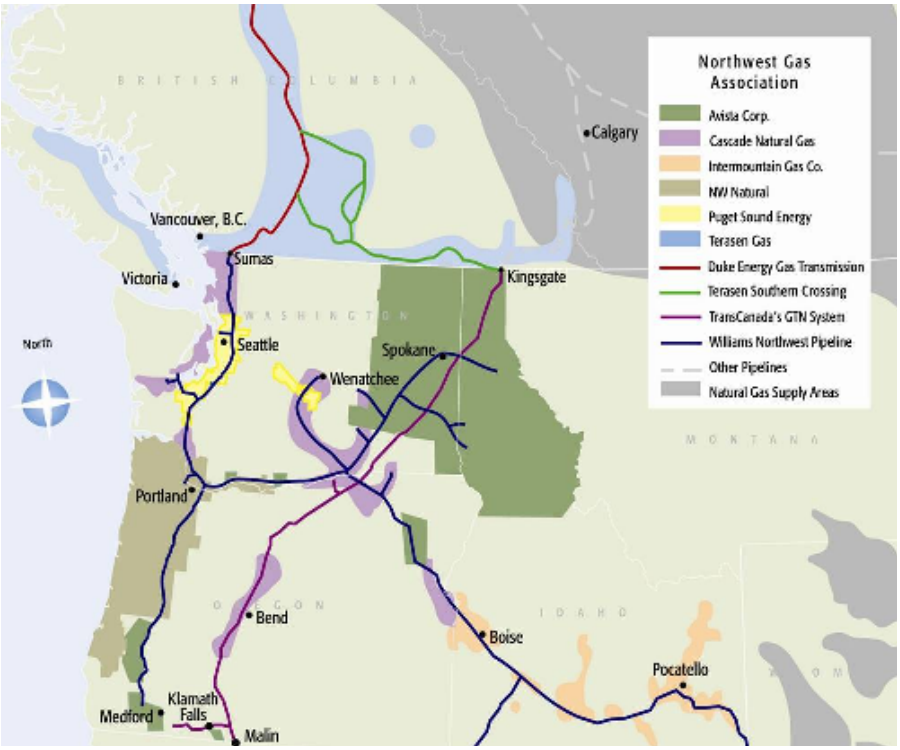
SCOPE

Navigant evaluated savings in natural gas utility service areas in the PNW United States and British Columbia, Canada

The Assessment analyzes the technical potential of savings from conversion to natural gas appliances in six participating Northwest Gas Association utility member service territories: Avista Corp., Cascade Natural Gas Co., Intermountain Gas Co., Northwest Natural Gas Co., Puget Sound Energy, Inc., and Terasen Inc. [10] Together, these utilities provide gas and in some cases electric services to over 2.9 million U.S. customers in Washington, Oregon, Montana, Idaho, with another 925,000 in British Columbia, Canada.

The map in Figure 1 shows the locations of the utility service areas, followed by a brief profile of each.

Figure 1
Service Area Map of PNW Participating Natural Gas Utilities.[11]



[10] Although Terasen serves most of the natural gas customers in BC (approximately 95 percent), its territory does not overlap completely with the with the electrical utility service areas.

[11] June 2008 from NWGA website: http://www.nwga.org/about_nwga.php

Utility Profiles

Avista Corp.	Serves 352,000 electric and 311,000 natural gas residential, commercial, and industrial customers in Washington, Oregon and Idaho.
Cascade Natural Gas Co.	Serves approximately 210,000 residential, commercial, and industrial customers in 91 communities in Oregon and Washington.
Intermountain Gas Co.	Serves more than 275,000 residential, commercial, and industrial customers, in an area that includes 75 cities and 23 counties in southern Idaho.
Northwest Natural Gas Co.	Serves more than 575,000 residential, commercial, and industrial customers in Oregon and southwest Washington.
Puget Sound Energy, Inc.	Serves more than 1.2 million electric and/or natural gas customers, primarily in Washington State's Puget Sound region.
Terasen Inc.	Serves more than 925,000 residential, commercial, and industrial customers in 125 communities across British Columbia.

APPROACH AND PARAMETERS

The Assessment looks at direct use potential for individual household heating needs in the Northwest and resulting potential energy and environmental benefits

The goal of the Regional Direct Use Assessment was twofold: first, to evaluate the technical potential for energy savings in potential therms of natural gas and equivalent average megawatts of electricity saved; and secondly, to assess the potential environmental benefits of a direct use approach (as compared to use of the same gas to fire generation) in reductions of metric tonnes of CO2 emissions.

Two Step Evaluation Process

To assess the potential for savings, Navigant built on the general approach it used in undertaking direct-use-of-gas studies for two Northwest utilities.[12]

Below is a description of the general approach, which involved development of a two-step process for analyzing potential benefits.

Step 1: Unitary Analysis -- NCI developed an analytical framework for evaluating total annual therms and GHG emissions for each appliance, housing type and climate zone for utility service areas. The results produced a list of applications where direct use of gas provides annual energy savings in therms, equivalent average megawatts of electricity, and GHG emission reductions.

Step 2: Projected Savings Analysis – Based on the unitary analysis, NCI estimated the projected energy savings and GHG emissions[13] reductions for all possible direct use appliances, based on study parameters and data elements described below.

Based on the results of the projections analysis, NCI then developed two estimates of the potential regional therm, equivalent average megawatt savings and GHG benefits of direct use of natural gas for those climate zones/utility service areas, housing types, and vintages where net savings were identified in Step 1:

- A high level *prospective* market penetration estimate (2009-2029) of overall regional energy and environmental implications[14]

[12] See footnote 8 for reference to these studies

[13] Throughout this report, GHG emissions are quantified in metric "tonnes," rather than English short "tons," as designated by the difference in spelling.

- A high level *retrospective* market penetration estimate (2002 to 2008) of overall regional energy and environmental implications

Table 3 provides a summary overview of the NCI Assessment approach.

Table 3
Analysis Approaches and Results.

Pacific Northwest Regional Assessment Study Approach	
Unitary Savings Analysis	Compared direct use energy and GHG impacts to electric generation impacts to identify annual energy and GHG savings (kWh, therms, and metric tonnes of CO2), if any, per heating application
Projected Savings Analysis	Evaluated savings of Unitary Analysis as applied to all possible appliance conversion within each gas utility service area for 2002 through 2029
Results Regional Projected Savings	Estimated regional energy savings (therms, aMW) and GHG emission reductions (tonnes of CO2) benefits for (1) U.S. Pacific Northwest only (2) U.S. Pacific Northwest & BC

Data Elements and Resource Characteristics

NCI used data provided by participating natural gas utilities, utility IRP forecasts, the Power Council, electric utilities and government databases for the Unitary and Projected Savings analyses

The unitary analysis evaluated direct use conversion potential from electric to natural gas heating for three end-use household appliances: residential space heaters, water heaters, and clothes dryers. Homes were considered to be "electric only" with potential conversion of space heat, water heat, and clothes dryers. "Mixed" homes already had natural gas space heat, so were only candidates for conversion of electric water heat and clothes dryers. Additionally, some homes had gas appliances for both space and water heat, but had electric clothes dryers.

Four types of homes were reviewed: single-family, town homes, apartments and manufactured housing. The analysis considers potential savings for three types of space heaters: forced air electric, heat pumps, and zonal (baseboard) electric along with single appliance type water heaters and clothes dryers.

[14] The NCI team accessed data from Power Council and utility forecasts where it was readily available. Where the assessment requires data of market share of electric heat by year and housing type, number of residence built by year, etc., NCI requested and received available data from NWGA member utilities

To account for differences in housing construction over time (e.g., code changes, housing size preferences, etc.), NCI looked at two periods of home vintages: pre-2002 homes and post-2002 homes.

Last, for the potential savings analysis, NCI identified the universe of appliances eligible for conversion by considering homes within 200 feet of an existing gas main with electric heating appliances. Although, NCI focused on homes within 200 feet, that data was not always available. In those cases, NCI used the best available data provided by the utility or estimated the number of homes based on another gas utility as a proxy. For instance, Puget Sound Energy had data for the percentage "of single-family residential electric customers within PSE's gas service area who live in the same ZIP+4 as at least 2 other gas customers," [15] [16] but not specifically for potential customers within 200 feet of main. In lieu of the original criterion, NCI used PSE's estimate of 8.4% single-family electric customers sharing the same ZIP+4 as two gas customers for all electric home types. Extensions to gas main lines were not considered as they were beyond the study scope.

Table 4 provides an overview of the study focus and data elements. These values varied for each utility.

[15] Email correspondence from Liz Norton (PSE) to Craig McDonald (NCI) on March 24, 2008.

[16] ZIP + 4 refers to the US postal ZIP code. ZIP codes are typically five digits, sometimes including four additional digits. Homes with the same ZIP+4 are in the close proximity.

Table 4
List of Data Elements Considered in the Analysis.

Data Elements	
Housing Types (4)	Single-family Town Home Apartment Manufactured Housing
Appliance Types (5)	Space Heating - Forced Air Furnace - Heat Pump - Zonal (baseboard) Water heating Clothes dryers
Vintage (2)	Pre-2002; Post- 2002
Eligible Households	Homes within 200 feet of an existing main No extensions considered

For the space heating and water heating appliances considered in the analysis, Table 5 lists the appliances' efficiencies and data sources. The analysis considered a high efficiency heat pump with a coefficient of performance (COP) of 176%[17], based on the same value used in prior NCI analysis for Puget Sound Energy.[18] This value includes backup heat sources, but does not address any "extra" cooling energy use that may occur from use of heat pumps.[19]

[17] Typical manufacturer "nameplate" efficiencies for heat pumps range from 2.50 COP to higher values

[18] Quantec draft PSE 2007 IRP Appendix K

[19] Three scenarios exist for a heat pump:
A) The house would have air conditioning regardless of the presence of a heat pump. If the home did use a heat pump, they would have installed a gas furnace with an electric air conditioner. In this scenario, one only needs to consider the heating energy, because the cooling energy is essentially the same whether it is being supplied by a heat pump or an electric AC.
B) The house installs a heat pump and uses it only for heating. This is an unlikely scenario as the heat pump is more expensive than a furnace, making scenario C the more likely possibility.
C) Households use air-conditioning from a heat pump because the air-conditioning is there as part of the package, when otherwise this energy would not have been used.

In our analysis, we implicitly assumed that the vast majority of heat pump installations would fall into scenario A. NCI notes as a caveat, however, that increased heat pump penetration, could result in some substantial increase in air-conditioning, electricity demand and GHG emissions, to the extent that heat pumps are installed in homes that would not otherwise have air conditioning. Further, our conclusion that heating with heat pumps has essentially the same GHG footprint as heating with gas furnaces assumes (simplistically) that the marginal fuel mix (80% CC, 3& peaker, 17% wind) is the same for all hours. If the

Table 5
Efficiencies of Gas and Electric Space Heaters and Water Heaters

Data Elements		
Appliance	**Efficiency**	**Source**
Gas Forced Air Furnace	92%	DOE Furnaces and Boilers Final Rule[20]
Electric Forced Air Furnace	100%	DOE Furnaces and Boilers Final Rule[21]
High Efficiency Heat Pump	176%	Quantec Puget Sound Energy IRP
Electric Baseboard	100%	Natural Resources Canada[22]
Ductwork	90%	Assumed 10% losses
Electric Water Heater	90%	ACEEE[23]
Gas Water Heater	65%	ACEEE[24]

To determine comparable energy use between gas and electric clothes dryers, NCI adapted data from a study by the Washington State University Extension Energy Program (data listed in Table 6). Using this data, NCI estimated the amount of electricity used specifically for drying clothes and for running the appliance. These estimates allow the analysis to calculate equivalent energy use between the two types of clothes dryers.

Table 6
Energy Use of Gas and Electric Dryers[25]

Data Elements	
Appliance	**Annual Energy Consumption**
Electric Clothes Dryer	996 kWh/yr
Gas Clothes Dryer	38 kWh/yr
Gas Clothes Dryer	37 therms/yr

Table 7 provides an overview of key resource characteristics used in the evaluation. Marginal resource values were derived from a recent Power Council paper forecasting marginal carbon

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wind is less during the cold winter days (often true), then more gas is being burned when the heat pumps are the least efficient.

[20] Technical Support Document, Chapter 12, P.12-17, Table 12.3.5 - 92% efficiency level used accounts for 23% of models
[21] Technical Support Document, Chapter 3, P.3-7
[22] Terasen submission to NCI of NRCan Residential Sector data for British Columbia, Table 26.
[23] Minimum efficiency. Taken in May 2008 from http://www.aceee.org/consumerguide/waterheating.htm
[24] Taken in May 2008 from http://www.aceee.org/consumerguide/waterheating.htm
[25] Taken in May 2008 from Washington State University Extension Energy Program http://www.energy.wsu.edu/documents/building/res/eff_appliances.pdf

dioxide (CO2) production rates for the Pacific Northwest power system.[26]. NCI assumed these values were the same for all utilities.

Table 7
List of Resource Characteristics Considered in the Analysis

Resource Characteristics	
Marginal Resource Mix	80% CCGT 17% renewables (wind) 3% peak load — coal/combustion turbine
GHG Emissions Production Rate	0.705 lbs/kWh based on weighted marginal resource mix (based on 0.005280 tonnes/therm for CO2 Emissions from natural gas combustion[27])
Electric T& D Losses	8 percent
Gas Distribution Losses	1.5 percent

[26] May 14, 2008 e-mail communication between NCI and Tom Eckman, Manager, Conservation Resource, Northwest Power and Conservation Council

[27] PSE EMOC memo on customer carbon emissions, 8/29/06

METHODOLOGY

Unitary Analysis with eligible households The Assessment evaluated annual therms and CO2 savings per appliance and integrated the estimates in the Projected Savings Analysis

Figure 2 and Figure 3 provide an overview of the methodological approach NCI used in the Assessment.

Figure 2 diagrams the calculations undertaken in the first phase of the Assessment, the Unitary Savings Analysis. Figure 3 shows the method and approach to the methodology for calculating the Projected Savings Analysis, the second phase of the evaluation, which resulted in the final Assessment results.

Figure 2
Methodology –Unitary Savings Analysis

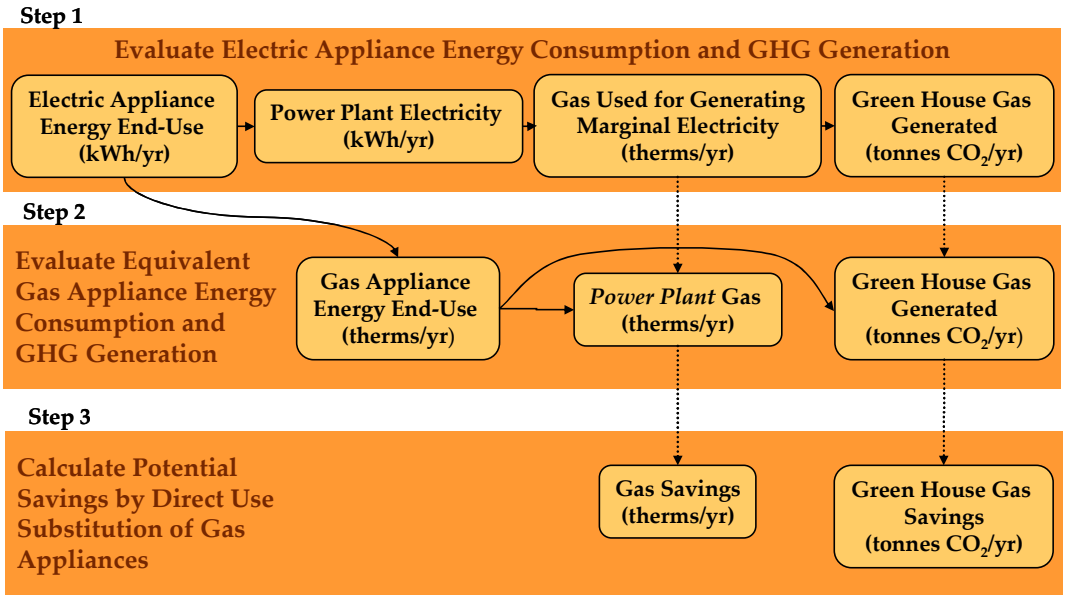
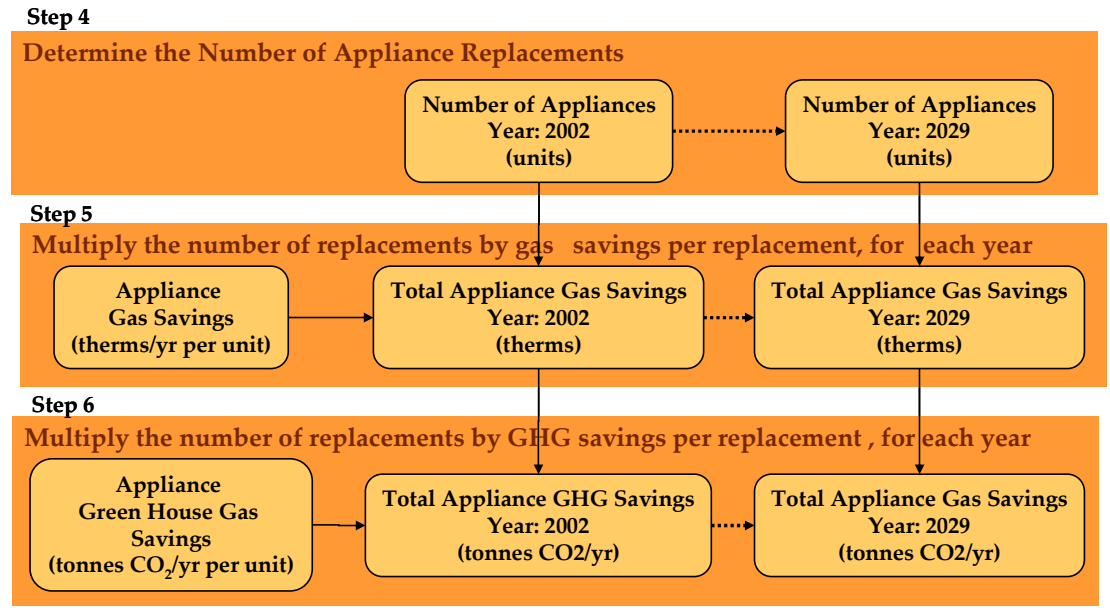


Figure 3
Methodology - Projected Savings Analysis



A complete description of the methodological approach used in the analysis is presented in Appendix A. In cases where data for a particular utility service area were limited, NCI made scaling and other assumptions to complete the analysis. A list of these assumptions is presented in Appendix A.

RESULTS -- UNITARY SAVINGS ANALYSIS

Direct use of gas provides energy and CO2 savings for most individual residential heating applications, except for residential heat pump applications

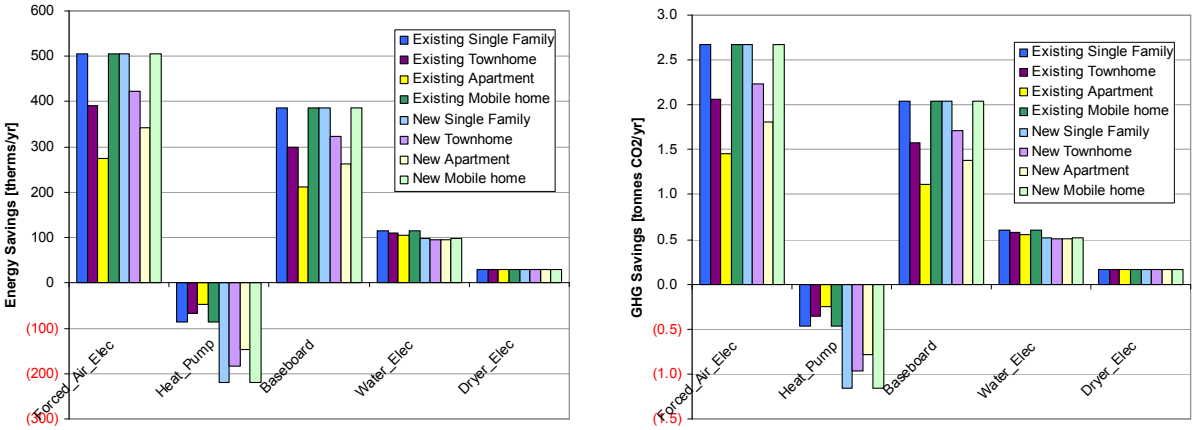
The figures below show the results from the Unitary Analysis of switching to gas appliances for each utility. For example, Figure 4 details the potential energy savings and GHG savings possible for different combinations of home type and appliance. In the Avista territory, an existing[28] townhome with an electric forced-air furnace could save almost 400 therms/yr and more than 2.0 tonnes of CO_2/yr. An electric clothes dryer in that same house could save more than 25 therms/yr and 0.2 tonnes of CO_2/yr. Alternatively, if the same house converted from a heat pump to a gas forced air furnace, the savings would be negative – indicating that it would be more efficient (in Avista's service area) not to replace the heat pump.[29]

The results show that direct use therm and CO2 savings exist in each utility service area for almost all applications: electric forced air space heaters, electric zonal (baseboard) heaters, electric water heaters, and electric clothes dryers. The one exception is electric heat pumps used for space heating. In this case for all utility service areas the direct use of natural gas does not provide energy or environmental benefits because of their high COP (176%).

Across all utilities, existing single-family homes with forced air heating show the highest savings potential.

Figure 4

Avista Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas



[28] "Existing" corresponds to homes built before 2002.

[29] See footnote 15 for further discussion of the heat pump analysis

Figure 5

Cascade Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas

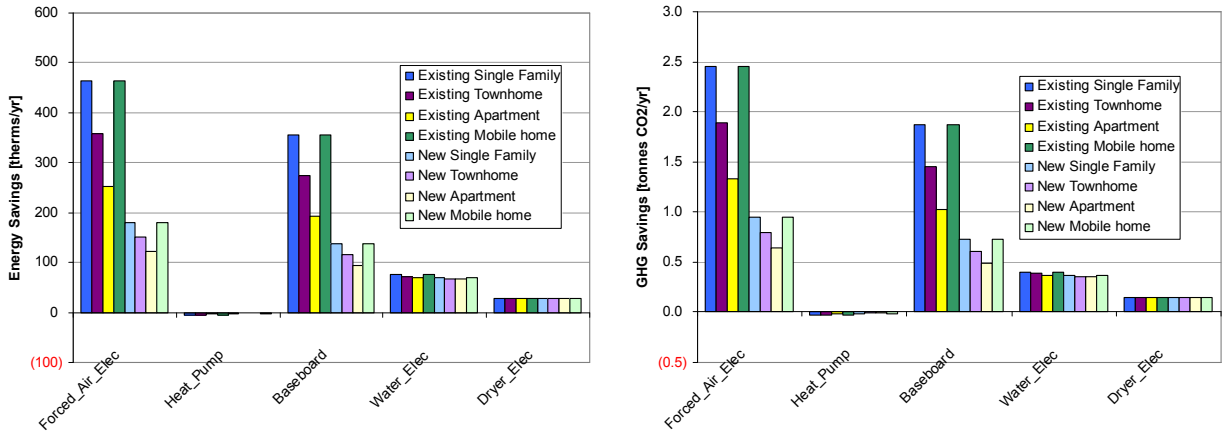


Figure 6

Intermountain Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas

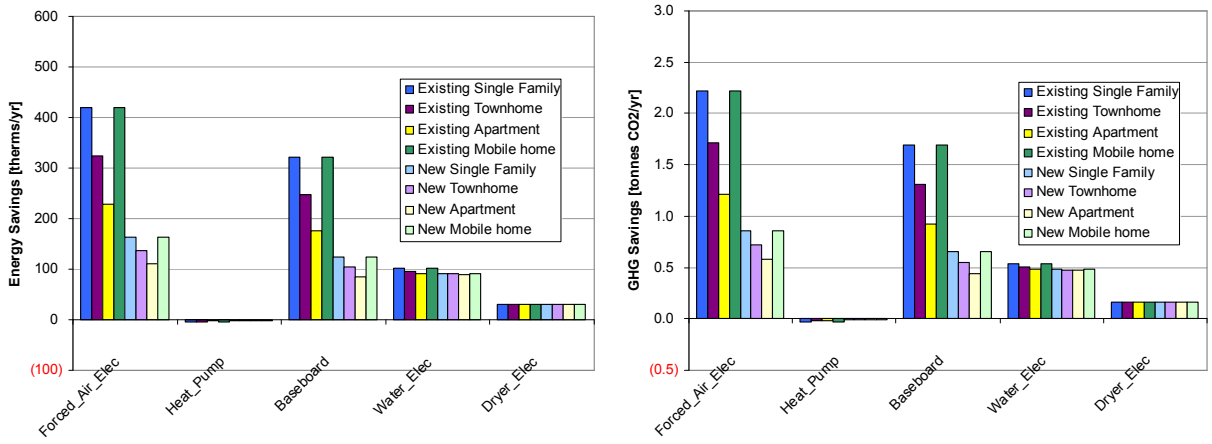


Figure 7

NW Natural Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas

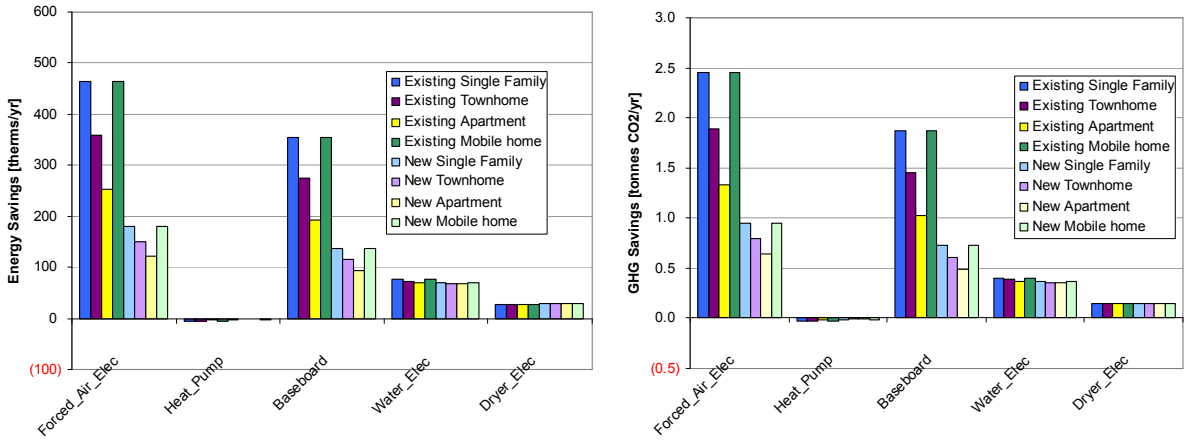


Figure 8

Puget Sound Energy Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas

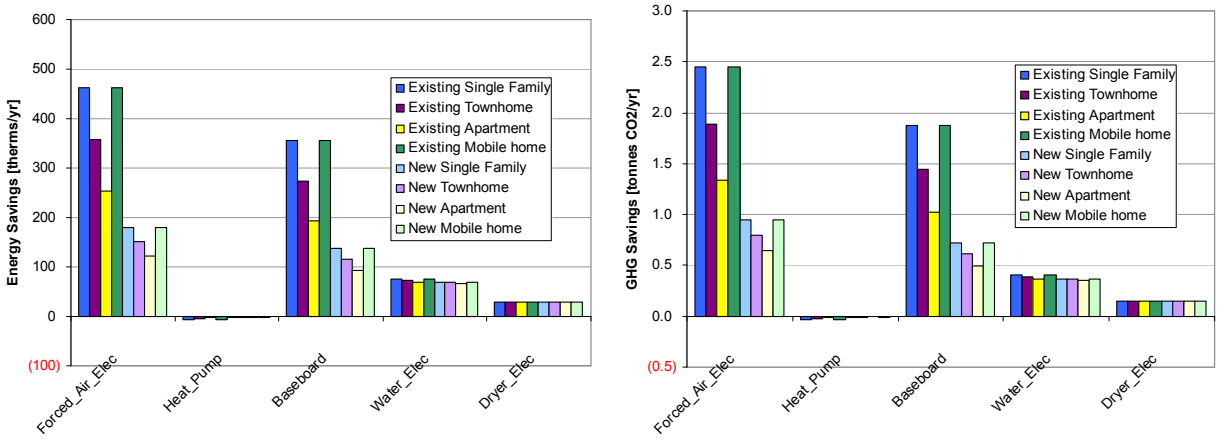
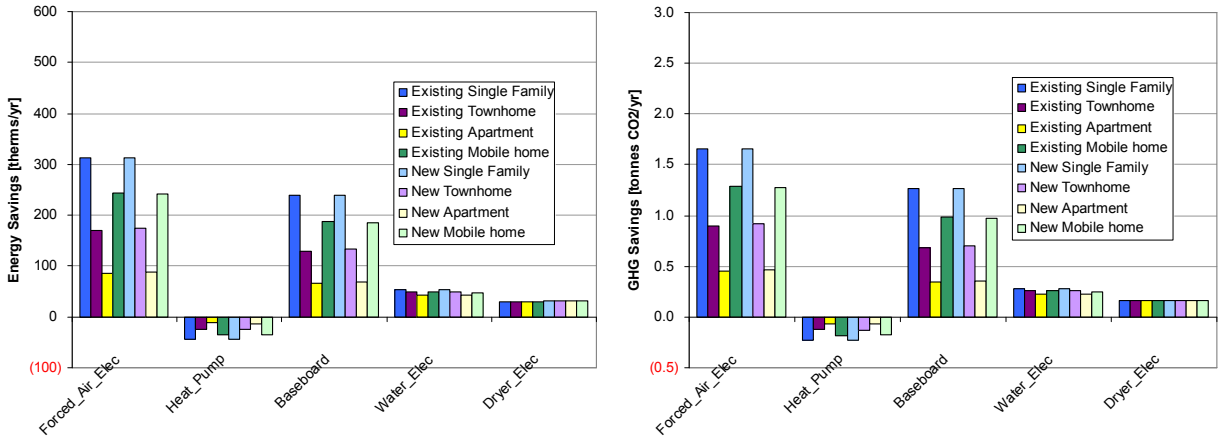


Figure 9

Terasen Unitary Analysis: Savings per Appliance for Direct Use of Natural Gas



RESULTS -- PROJECTED SAVINGS ANALYSIS

The Assessment identified a technical potential of over 3.9 million space heating, water heating, and clothes drying appliance units eligible for conversion in 2008, rising to 5.0 million eligible units in 2025

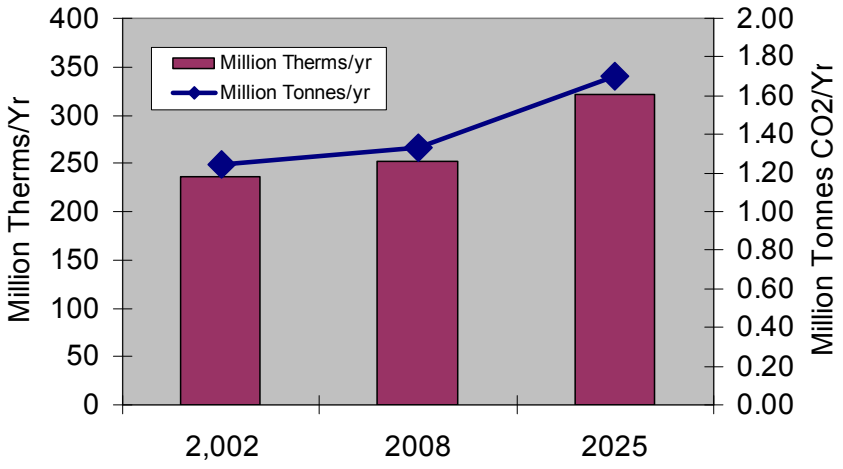
The Projected Savings Analysis integrated the Unitary Savings Analysis results with projected numbers of eligible utility households within 200 feet of a gas main. A regional demand growth rate of 1.5 percent[30] was used to estimate overall potential from 2009 though 2029.

Figure 10 through Figure 18 below show the projected overall annual savings for the region as a whole, including British Columbia, and for the U.S. Pacific Northwest only, for 2008 and 2025. Overall results are followed by tables showing space, water and dryer savings for both the region and for the U.S Pacific Northwest only for the same period.

Regional Savings Results - Overall

Annual overall PNW regional (United States and British Columbia) annual technical potential savings for energy beginning at 373 aMW in 2002 and then rise from 399 aMW in 2008 to 510 aMW in 2025, with a rise in CO2 reductions from 1.2M tonnes in 2002, to 1.3 million tonnes in 2008, to over 1.7 million tonnes of annual reductions in 2025.

Figure 10
Overall Savings Results - PNW United States and British Columbia, Canada



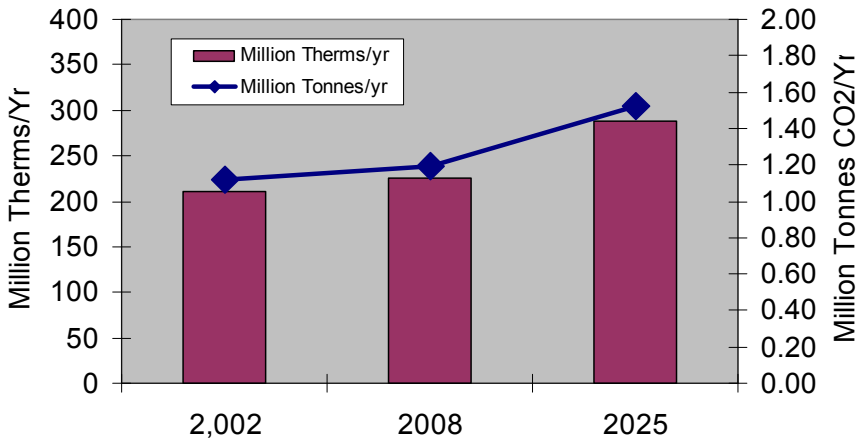
[30] Puget draft demand forecast, base case scenario, Page 4-1

U.S. & British Columbia, Pacific Northwest – Regional Results

- Annual gas savings: beginning at 236M therms in 2002, then 252M therms in 2008, rising to 321M therms in 2025
- Annual CO2 emissions savings: beginning at 1.2M tonnes in 2002, 1.3M tonnes in 2008, rising to 1.7M tonnes 2025
- Annual electric savings equivalency: 373 aMW in 2002, then 399 aMW 2008 rising to 510 aMW by 2025
- Total space heating, water heating and clothes drying appliances eligible for conversion beginning at 3.6 million units in 2002, and then rise from 3.9 million units in 2008 to 5.0 million units in 2025

Figure 11

Overall Savings Results - PNW United States Only



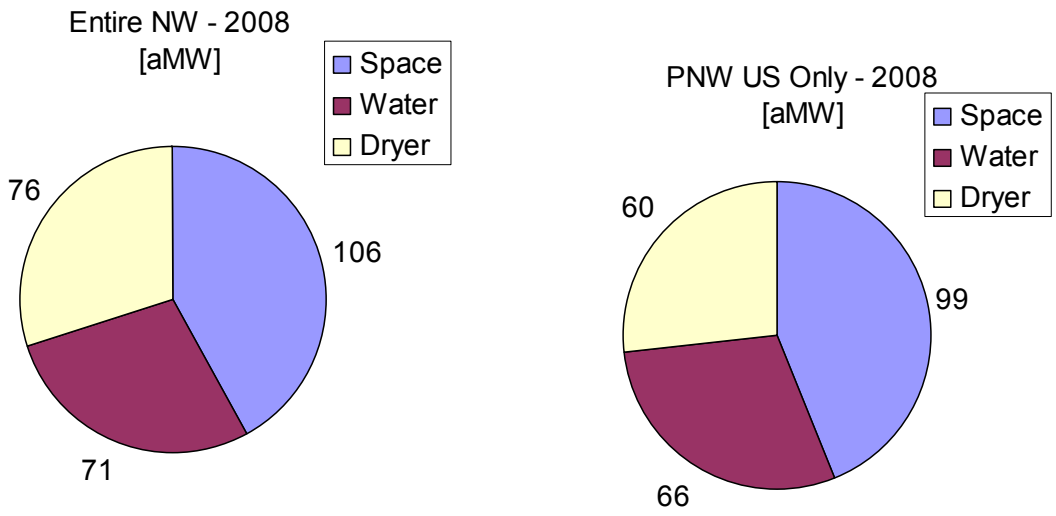
U.S. Pacific Northwest Only – Regional Results

- Annual gas savings: 211M therms in 2002, then 225M therms in 2008 rising to 288M therms in 2025.
- Annual CO2 emissions savings: 1.1M tonnes in 2002, then 1.2M tonnes /yr in 2008 rising to 1.5M tonnes/yr in 2025.
- Annual electric savings equivalency: 335 aMW in 2002, then 357aMW in 2008 rising to 456 aMW in 2025.
- Total space heating, water heating and clothes drying appliances, eligible for conversion, begin at 3.0 million in 2002, then rise from 3.3 million units in 2008 to 4.2 million units in 2025.

Space and Water Heating and Clothes Drying Savings Results

Figure 12 shows the relative proportions of the sources of energy savings for appliances in 2008. For all regional utilities, including British Columbia, the savings is approximately the same for space heating and clothes dryers, around 106 aMW (42%) each, with smaller savings for water heaters, 71 aMW (28%). Clothes dryers are 76 aMW (30%). Although the average megawatt values in Figure 12 are different for each year, the relative proportions are the similar for all years.

Figure 12
Regional Distribution of Direct Savings by Appliance

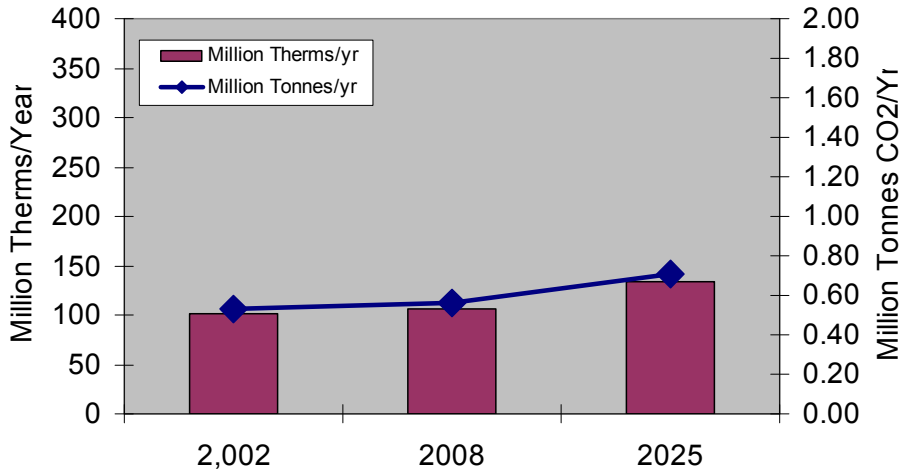


Space Heating Results

Space heat savings represent 42 percent Pacific Northwest overall technical direct use potential for the United States and British Columbia, and 44 percent of technical potential for the Pacific Northwest United States only[31]

[31] Variation in overall regional space heating savings percentages versus United States PNW percentages are due to deeper penetration of forced air electric systems in the United States as compared to minimal numbers of these types of systems in British Columbia, Canada

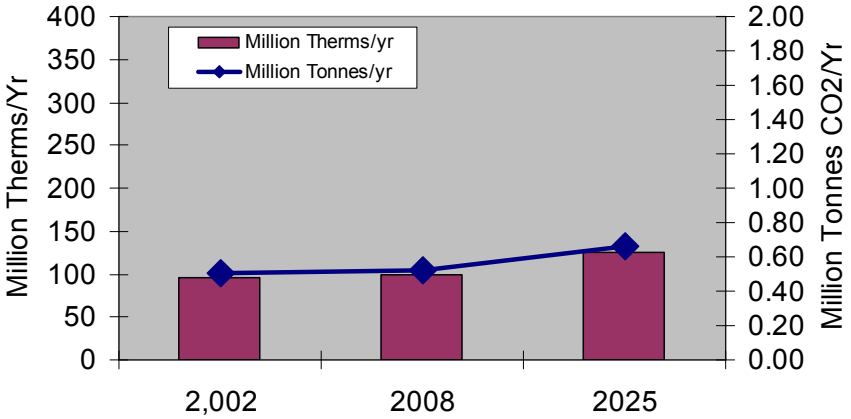
Figure 13
Space Heating Savings Results - PNW United States and British Columbia, Canada



U.S. & British Columbia, Pacific Northwest – Space Heating Results

- Annual gas savings: 101M therms in 2002, 106M therms in 2008, to 133M therms in 2025.
- Annual CO2 emissions savings: 533,000 tonnes in 2002, 558, 000 tonnes in 2008, rising to 705,000 tonnes in 2025.
- Annual electric savings equivalency: 160 aMW in 2002, 167 aMW in 2008 rising to 212 aMW by 2025.
- Total space heating appliances, eligible for conversion, begin at 336,000 in 2002, and then rise from 357,000 units in 2008 to 452,000 units in 2025

Figure 14
Space Heating Savings Results - PNW United States Only



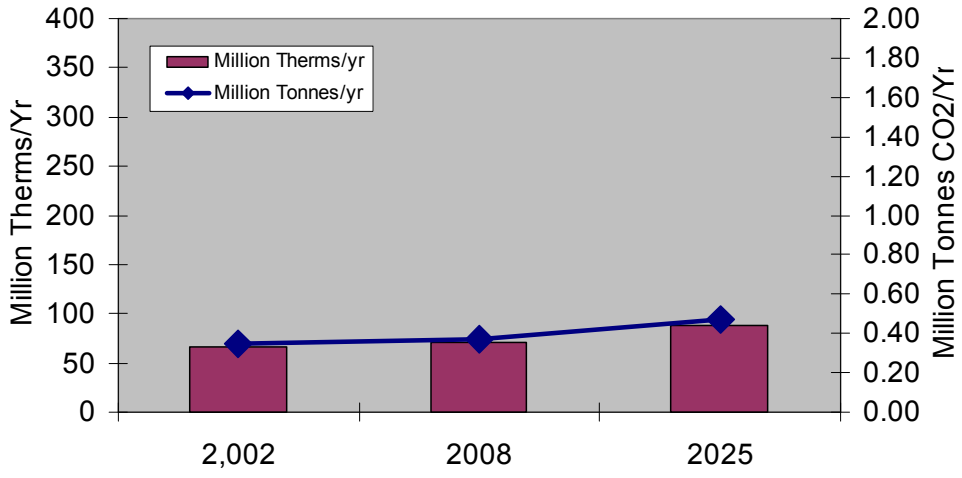
U.S. Pacific Northwest Only – Space Heating Results

- Annual gas savings: 95M therms in 2002, then 99M therms in 2008 rising to125M therms in 2025.
- Annual CO2 emissions savings: 501,000 tonnes in 2002, then 523,000 tonnes in 2008 rising to 660,000 tonnes in 2025.
- Annual electric savings equivalency: 150 aMW in 2002, then 157 aMW in 2008 rising to 198 aMW by 2025
- Total space heating appliances, eligible for conversion, begin at 303,000 in 2002, and then rise from 320,000 units in 2008 to 406,000 units in 2025

Water Heating Results

Water heat savings represent 28 percent of Pacific Northwest overall technical direct use potential for the United States and British Columbia, and 29 percent of technical potential for the Pacific Northwest United States only.

Figure 15
Water Heating Savings Results - PNW United States and British Columbia, Canada

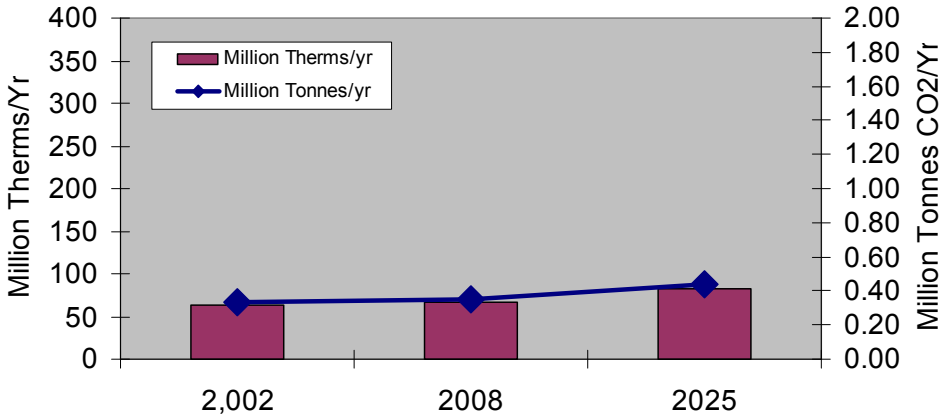


U.S. & British Columbia, Pacific Northwest - Water Heating Results

- Annual gas savings: 66M therms in 2002, then 71M therms in 2008 to 89M therms in 2025
- Annual CO2 emissions savings: 350,000 tonnes in 2002, then 373,000 tonnes in 2008 rising 469,000 tonnes in 2025

- Annual electric savings equivalency: 105 aMW in 2002, then 112 aMW in 2008 rising to 141 aMW by 2025
- Total water heating appliances, eligible for conversion, begin at 838,000 units in 2002, then rise from 898,000 units in 2008 to 1.14 million units in 2025

Figure 16
Water Heating Savings Results – PNW United States Only



U.S. Pacific Northwest Only –Water Heating Results

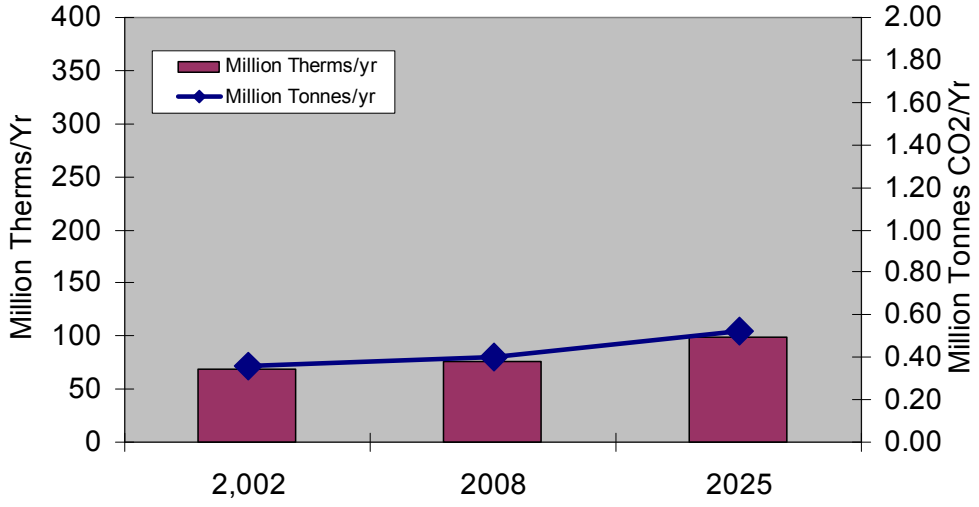
- Annual gas savings: 62M therms in 2002; then 66M therms in 2008 rising to 83M therms in 2025
- Annual CO2 emissions savings: 330,000 tonnes in 2002; then351,000 tonnes in 2008 rising to 440,000 tonnes in 2025
- Annual electric savings equivalency: 99aMW in 2002, then 105aMW in 2008 rising to 132aMW by 2025
- Total water heating appliances, eligible for conversion, begin at 760,000 in 2002, then rise from 814,000 units in 2008 to 1.03 million units in 2025

Clothes Dryer Results

Clothes dryer savings represent 30 percent Pacific Northwest overall technical direct use potential for the United States and British Columbia, and 27 percent of technical potential for the Pacific Northwest United States only.[32]

[32] Variation in clothes dryer savings between the overall region and the US PNW is due to the fact that nearly one-third of all electric clothes dryers in the region are in British Columbia (Terasen service area), with the other two-thirds are spread across the other five US based utilities, reflecting a deeper penetration of natural gas clothes dryers in the PNW-US

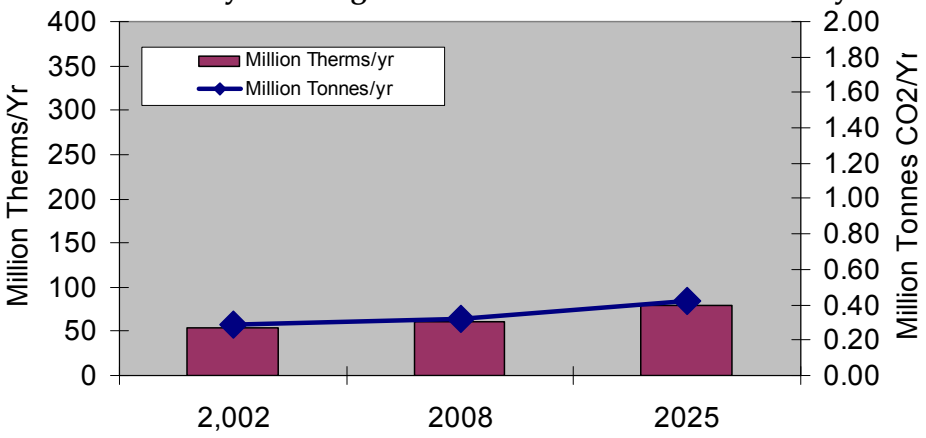
Figure 17
Clothes Dryer Savings Results – PNW United States and British Columbia, Canada



U.S. & British Columbia, Pacific Northwest - Clothes Dryer Savings Results

- Annual gas savings: 68M therms in 2002 ; then 76M therms in 2008 to 99M therms in 2025
- Annual CO2 emissions savings: 361,000 tonnes in 2002 ; then 399,000 tonnes in 2008 rising 524,000 tonnes in 2025
- Annual electric savings equivalency: 108 aMW in 2002, then 120 aMW in 2008 rising to 157 aMW by 2025
- Total clothes dryer appliances, eligible for conversion, begin at 2.4 million in 2002, then rise from 2.6 million units in 2008 to 3.4 million units in 2025

Figure 18
Clothes Dryer Savings Results – PNW United States Only



U.S. Pacific Northwest Only –Clothes Dryer Savings Results

- Annual gas savings: 54M therms in 2002 ; then 60M therms in 2008 rising to 79M therms in 2025
- Annual CO2 emissions savings: 287,000 tonnes in 2002 ; then 318,000 tonnes in 2008 rising to 419,000 tonnes in 2025
- Annual electric savings equivalency: 86 aMW in 2002, then 95 aMW in 2008 rising to 126 aMW by 2025
- Total clothes dryer appliances, eligible for conversion, begin at 1.9 million units in 2002, then rise from 2.1 million units in 2008 to 2.8 million units in 2025

FINDINGS AND RECOMMENDATIONS

Key Findings

The Assessment affirms earlier studies that identified significant energy savings potential from conversions of electric heat applications to direct use of natural gas rather than use of natural gas to fire electric generation

Regional energy and environmental benefits accrue to all electric space and water heating and clothes drying appliance applications, except for residential heat pump applications, which show no direct use benefits[33]

The regional technical potential for annual therm and megawatt savings are enough to replace the electricity generated space and water heating, and clothes drying needs of 372,300 households in the Pacific Northwest in the year 2025.[34]

Significant potential exists for the direct use of natural gas to reduce regional GHG emissions, with technical potential annual reductions of over 1.3M tonnes of CO2 beginning in 2009, rising to 1.7M metric tonnes in 2025

Energy and CO2 savings potential are high for clothes dryer conversions in both the US and Canadian Pacific Northwest, although the potential including British Columbia encompasses a full 10 percent more savings (38 percent) than savings in the US Pacific Northwest alone (28 percent) due to a deeper penetration of natural gas in the clothes dryer market in the US than in British Columbia.

In the US, both Intermountain (48 percent) and PSE (44 percent of utility direct use potential) show significant technical potential for clothes dryer direct use savings

Space heating savings potential represent the largest portion of savings for three utilities, with direct use conversion savings potential of 61 percent of Cascade Natural Gas service area potential, 46 percent of potential in NW Natural's service area, and 35 percent of direct use potential in Avista's territory

Key Recommendations

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[33] See footnote 19 for further discussion of the heat pump analysis

[34] The average PNW home uses approximately 12,000 kWh/yr. Based on this figure 730 homes could be served per year with a one aMW of savings. NCI's analysis identifies 510 aMWs of technical potential in the year 2025

Based on the results of the Assessment, regional planners should consider:

Navigant recommends further review be undertaken of the economic and achievable potential for direct use of natural gas as a means of helping the region better understand the overall costs and benefits of supporting a direct use approach. In this regard, Navigant recommends the Northwest Power Planning and Conservation Council consider updating its 1994 study, the most comprehensive of the past studies undertaken in the region

Should the region undertake a study of the economic and achievable potentials (and perhaps a re-look at the technical potential with expanded data), Navigant recommends that the study look at various technology adoption scenarios that may impact policy considerations regarding direct use of natural gas. For example, any significant increase in electric load caused by hybrid plug-ins over the next 20 years, could lead to increased costs for electricity and/or natural gas used to fire generation, consequently impacting any regional direct use policy

For individual utilities with needs to adopt programs to reduce GHG emissions and realize energy savings, a direct use residential savings program should be considered in areas of highest potential and benefit for their service territory i.e., space heat, water heat, and/or clothes dryer conversions

This Assessment reviews the direct use of natural gas in the residential sector only for the Pacific Northwest. For a complete picture of the impacts of a direct use policy, Navigant recommends further review of the Technical, Economic and Achievable potential for the non-residential sector in the region

Existing data is available in some areas of the region, but limited in others. This required NCI to use available data from one utility, for instance, to scale that data to the potentials analyses for another utility. Where possible, NCI used such data for scaling with utilities with similar temperature and market profiles (i.e., west of the mountains or east of the mountains). NCI recommends further data gathering and refining be undertaken as part of any regional study to evaluate direct use economic and achievable potential benefits

APPENDIX A – DETAILED METHODOLOGY AND ASSUMPTIONS

Summary

Members of the Northwest Gas Association (NWGA) provided NCI with data to conduct an analysis of the technical potential of conversions of space heat, water heat, and clothes dryers from electric heat to gas heat. NCI conducted two analyses for each utility member: (1) a unitary analysis of conversion potential for different appliances, and (2) projected savings from conversions for households that are within 200 ft. of the gas main. Below is a description of the unitary analysis, followed by the projected savings analysis. Last, this report includes a list of assumptions to address data gaps for each utility.

Unitary Analysis

The unitary analysis consisted of evaluating energy consumption of electric space heaters, water heaters, and dryers to determine potential energy savings from switching to gas appliances. The analysis considered the heat demands of four types of housing (single-family homes, town homes, apartments, and mobile homes) of two vintages: "existing," corresponding to pre-2002 appliances, and "new," corresponding to post-2002 appliances. NCI evaluated three types of space heaters: forced air electric resistance heating, heat pumps, and baseboard (zonal) heating. NCI evaluated only one type of water heater and dryer. For example, Table 8 shows annual electricity consumption for the combination of housing types, vintages, and appliances for homes in PSE service territory. Each utility provided electricity end-use data[35] that NCI utilized in the format in Table 8, which served as the key input to the analysis. Because the end-use electricity is specific to each utility, NCI assumed that the data already accounted for regional variations in energy use from house size and heat demand. Values for resource characteristics (Electric T&D losses, etc…) and appliance efficiencies were assumed to be constant for all utilities.

Table 8 Appliance end-use electricity for homes in Puget Sound Energy service territory (kWh/yr)

End-use Electricity (kWh/yr)	Existing (pre-2002)				New (post-2002)			
	Single-family	Town home	Apartment	Mobile home	Single-family	Town home	Apartment	Mobile home
Forced Air (Elec)	16,500	12,750	9,000	16,500	6,384	5,353	4,322	6,384
Heat Pump	9,375	7,244	5,114	9,375	3,627	3,041	2,456	3,627
Baseboard	14,850	11,475	8,100	14,850	5,746	4,818	3,890	5,746
Water (Elec)	4,300	4,100	3,900	4,300	3,900	3,850	3,800	3,900
Dryer (Elec)	1,089	1,089	1,089	1,089	1,109	1,109	1,109	1,109

NCI determined the therms of natural gas used to generate the electricity for each of the appliances, after accounting for losses in electrical transmission and distribution, estimated at

[35] In cases where there was incomplete data, NCI made assumptions that are listed at the end of this section.

8%[36]. The marginal source of electricity generation was a weighted average, based on the three sources shown in Table 9. In addition, NCI calculated metric tonnes of CO_2 released by using natural gas for electricity generation, estimated at 0.00528 tonnes of CO_2 per therm of natural gas[37].

Table 9 Sources for calculating marginal source of electricity generation

Source Type	Weighting	Electricity Generation
CCCT[38]	80 %	0.070 therms/kWh
Gas-fired Combustion Turbine	3 %	0.100 therms/kWh
Wind	17 %	0 therms/kWh
	Total: 100%	Weighted average: 0.061 therms/kWh

Next, the analysis considered energy use and CO2 emissions from using gas appliances instead of electric ones. NCI calculated energy consumption for the gas appliances by comparing the gas-appliance efficiencies to the electric ones, shown in Table 10, Table 11, and Table 12. The evaluation of use of natural gas included a 1.8%[39] gas distribution loss. The calculation of CO2 emissions accounted for end-use of natural gas (0.00528 tonnes of CO2 per therm of natural gas[40]) as well as equivalent CO2 emissions from natural gas lost during distribution[41].

[36] "Direct Use of Natural Gas: Analysis and Policy Options," Northwest Power Planning Council, Issue Paper 94-41, Page 2, Figure 1, August 11, 1994.
[37] Based on 0.00582 tons CO2/therm in PSE EMOC memo on customer carbon emissions, 8/29/06
[38] PSE EMOC memo on customer carbon emissions, 8/29/06. Assumes CCCT
[39] Puget Sound Energy IRP Modeling for avoided cost of gas
[40] Based on 0.00582 tons CO2/therm in PSE EMOC memo on customer carbon emissions, 8/29/06
[41] PSE IRP gas distribution loss

Table 10 Efficiencies of electric space heaters and water heaters

Heater type	Efficiency	Explanation
Electric Forced Air Furnace	90%	From 100%[42] efficient electrical resistance forced air furnace and 90% efficient ductwork.
Heat Pump	158%	From 176%[43] high-efficiency heat pump and 90% efficient ductwork.
Baseboard	100%	From 100%[44] electric baseboard (zonal) heating.
Electric Water Heater	90%	From 90%[45] efficient electric water heater.

Table 11 Efficiencies of gas space heaters and water heaters

Heater type	Efficiency	Explanation
Gas Forced Air Furnace	83%	From 92%[46] efficient gas forced air furnace and 90% efficient ductwork.
Gas Water Heater	65%	From 65%[47] efficient gas water heater.

Table 12 Comparison of energy usage for an electric dryer and gas dryer[48]

Annual Energy Use	Energy Type and Appliance
996 kWh/yr	Electricity use in an electric clothes dryer
38 kWh/yr	Electricity use in a gas clothes dryer
37 therms/yr	Gas use in a gas clothes dryer

After evaluating the total therms needed and CO2 generated by each appliance, the model analyzes potential savings from using gas appliances instead of electric appliances. There is a technical potential for energy savings and CO2 savings from replacement with gas appliances for all electric appliances, except for heat pumps.

Projected Savings Analysis

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[42] DOE Furnaces and Boilers Final Rule, Technical Support Document, Chapter 3, P.3-7
[43] PSE 2007 IRP Appendix K
[44] NRCan data for home energy use in British Columbia, Table 26, provided by Terasen
[45] Minimum electric water heater efficiency, from ACEEE analysis of water heater efficiency. Taken in March 2008 from http://www.aceee.org/consumerguide/waterheating.htm
[46] 92% AFUE (DOE Furnaces and Boilers Final Rule, Technical Support Document, Chapter 12, P.12-17, Table 12.3.5 - 92% efficiency level used accounting for 23% of models)
[47] High-efficiency gas storage, from ACEEE analysis of water heater efficiency (http://www.aceee.org/consumerguide/waterheating.htm)
[48] Washington State University Extension Energy Program. Taken in March 2008 from http://www.energy.wsu.edu/documents/building/res/eff_appliances.pdf

The projected savings analysis is an extrapolation of the unitary analysis to all possible appliances within a utility's service area. In addition to unitary data, NWGA member utilities provided NCI with estimates[49] of:

- Electric only homes – having electric space heat and electric water heat
- Gas space heat homes – having electric water heat
- Homes with electric dryers

These estimates spanned from 2002 to 2029, allowing NCI to do a retrospective analysis from 2002 to 2008 and a prospective analysis from 2009 to 2029. Most utilities did not have complete data for all appliances, all housing types, and all years. Therefore, NCI scaled the data between years using a gas sales forecast growth rate of 1.5%[50]. For example, Terasen referenced data from NRCan and BC Hydro that provide an estimate of how many electrical appliances existed in BC between 2002 and 2005. However, it is unknown how many of those appliances are in homes that have the potential for conversion (are in houses within 200 ft. of a gas main). Therefore, NCI estimated that 8.4% of those homes have the potential for conversion, based on a similar PSE estimate[51]. Although Terasen Gas feels that this value may be low for its service territory, a better proxy is not currently available and the 8.4% has been used to maintain consistency for the purpose of the technical evaluation. Table 13 shows how NCI extrapolated the data to the other years of the study using the gas sales forecast growth rate. NCI confirmed that few, if any, electric forced air furnaces exist in British Columbia by informally calling real estate brokers across the province.

[49] In cases where there was incomplete data, NCI made assumptions that are listed at the end of this section.
[50] Puget draft demand forecast, base case scenario, Page 4-1
[51] A PSE data response to NCI on March 24, 2008 estimates that 8.4% of single-family electric customers live within the same ZIP+4 as at least two gas customers.

Table 13 Number of appliances for potential conversions in the Terasen service territory[52].

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	0	0	0	0	0	0	0	0
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	19,592	19,885	20,184	20,486	20,794	21,106	21,422	21,744
Single-family	Water (Elec)	46,440	47,136	47,843	48,561	49,290	50,029	50,779	51,541
Single-family	Dryer (Elec)	275,729	279,865	284,063	288,324	292,649	297,038	301,494	306,016
Town home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	2,786	2,828	2,870	2,913	2,957	3,001	3,046	3,092
Town home	Water (Elec)	6,277	6,371	6,467	6,564	6,662	6,762	6,864	6,967
Town home	Dryer (Elec)	37,269	37,828	38,396	38,972	39,556	40,150	40,752	41,363
Apartment	Forced Air (Elec)	0	0	0	0	0	0	0	0
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	9,132	9,268	9,408	9,549	9,692	9,837	9,985	10,135
Apartment	Water (Elec)	20,111	20,413	20,719	21,030	21,345	21,665	21,990	22,320
Apartment	Dryer (Elec)	119,406	121,197	123,015	124,860	126,733	128,634	130,563	132,522
Mobile home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	1,882	1,910	1,939	1,968	1,997	2,027	2,058	2,089
Mobile home	Water (Elec)	4,842	4,915	4,988	5,063	5,139	5,216	5,295	5,374
Mobile home	Dryer (Elec)	28,749	29,180	29,618	30,062	30,513	30,971	31,435	31,907

Finally, NCI combined the unitary analysis of energy and CO2 savings for existing (pre-2002) appliances with the projected number of appliances to determine total potential savings per year. Table 14 shows potential natural gas savings for Intermountain Gas and Table 15 shows potential CO2 emissions savings for Avista. In both tables, no values are shown for electric heat pumps, because there is no estimated savings for those appliances. Intermountain Gas estimated that there are no homes within their service territory using baseboard space heat; thus, in Table 14 their savings is listed as zero.

[52] Data obtained from Natural Resources Canada, Comprehensive Energy Use Database - http://www.oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/databases.cfm?attr=0 . Data exists from 2002 to 2029, although data is only shown from 2002 to 2009

Table 14 Potential gas savings in the Intermountain Gas service territory (therms/yr)[53].

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	8,546,689	7,708,150	7,192,435	6,627,851	6,116,517	5,530,012	4,890,349	3,876,938
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	0	0	0	0	0	0	0	0
Single-family	Water (Elec)	9,389,691	9,270,861	9,116,267	9,133,700	8,955,856	8,638,953	8,463,107	7,974,804
Single-family	Dryer (Elec)	6,561,551	6,810,743	7,059,182	7,269,144	7,546,876	7,734,819	7,821,808	7,878,818
Town home	Forced Air (Elec)	97,015	94,505	93,098	91,623	87,620	82,959	75,071	61,069
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	0	0	0	0	0	0	0	0
Town home	Water (Elec)	57,739	61,136	62,964	64,917	65,185	64,965	62,054	53,450
Town home	Dryer (Elec)	96,388	108,062	118,248	130,044	139,907	150,162	155,386	160,609
Apartment	Forced Air (Elec)	342,407	357,718	363,431	369,572	365,942	359,574	338,554	287,386
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	0	0	0	0	0	0	0	0
Apartment	Water (Elec)	183,076	193,847	199,640	205,834	206,683	205,987	196,756	169,475
Apartment	Dryer (Elec)	119,318	128,916	138,419	149,056	156,632	163,720	164,403	149,262
Mobile home	Forced Air (Elec)	378,781	343,255	321,438	297,569	275,328	249,801	221,306	175,809
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	0	0	0	0	0	0	0	0
Mobile home	Water (Elec)	182,696	179,958	176,180	170,864	165,998	158,534	148,252	124,702
Mobile home	Dryer (Elec)	299,985	312,870	325,445	336,667	350,442	360,430	365,142	368,566

Table 15 Potential CO_2 emissions savings in the Avista service territory (tonnes/yr).

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	15,757	15,993	16,233	16,476	16,724	16,974	17,229	17,487
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	2,412	2,449	2,485	2,523	2,560	2,599	2,638	2,677
Single-family	Water (Elec)	35,946	36,486	37,033	37,588	38,152	38,724	39,305	39,895
Single-family	Dryer (Elec)	17,140	17,397	17,658	17,923	18,192	18,465	18,742	19,023
Town home	Forced Air (Elec)	179	182	184	187	190	193	196	199
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	27	28	28	29	29	30	30	30
Town home	Water (Elec)	503	511	519	526	534	542	551	559
Town home	Dryer (Elec)	252	256	259	263	267	271	275	279
Apartment	Forced Air (Elec)	1,285	1,304	1,323	1,343	1,363	1,384	1,405	1,426
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	15,735	15,971	16,210	16,454	16,700	16,951	17,205	17,463
Apartment	Water (Elec)	8,869	9,002	9,137	9,274	9,413	9,555	9,698	9,843
Apartment	Dryer (Elec)	2,704	2,745	2,786	2,828	2,870	2,913	2,957	3,001
Mobile home	Forced Air (Elec)	985	1,000	1,015	1,030	1,045	1,061	1,077	1,093
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	151	153	155	158	160	162	165	167
Mobile home	Water (Elec)	2,247	2,281	2,315	2,350	2,385	2,421	2,457	2,494
Mobile home	Dryer (Elec)	1,072	1,088	1,104	1,120	1,137	1,154	1,172	1,189

[53] Data exists from 2002 to 2029, although data is only shown from 2002 to 2009

Assumptions to Address Data Gaps

Although each utility provided data for the study, NCI made certain assumptions to address data gaps. Below is a list of data provided and assumptions for each utility for the two analyses.

Puget Sound Energy – Unitary Analysis

Data provided

- Electric FAF energy use in single-family home and apartment (existing and new).
- Electric water heater energy use in single-family home and apartment (existing and new).

NCI Assumptions

- Electricity consumption of heat pump is scaled from electric FAF, by ratio of efficiencies
- Electricity consumption of baseboard is scaled from electric FAF, by ratio of efficiencies
- Town home electricity consumption is the average of single-family and apartment electricity consumption.
- Mobile home electricity consumption is the same as single-family home electricity consumption.
- Dryer energy consumption in PSE territory is the same as in Terasen service territory.

Puget Sound Energy – Projected Savings Analysis

Data provided (for year 2006)

- In combined gas and electricity service territory, number of gas customers and potential gas customers by house type and appliance.
- In gas-only service territory, total number of gas customers by house type and appliance (except for mobile homes).[54]

NCI Assumptions

- NCI analysis did not consider potential conversions of non-gas customers in the gas-only service territory.

Intermountain Gas – Unitary Analysis

Data provided

- Gas FAF energy use in single-family home (existing only).
- Gas water heater energy use in single-family home (existing only).

NCI Assumptions

- Converted gas FAF to equivalent electric FAF in single-family home based on ratio of efficiencies

[54] The analysis considered conversions of gas customers who didn't use gas for space heating (e.g., oil, wood, etc…)

- Scaled all space heating values using equivalent electric FAF in single-family home and ratios in PSE analysis
- Converted gas water heat to equivalent electric water heat in single-family home based on ratio of efficiencies
- Scaled all water heating values using equivalent water heating in single-family home and ratios in PSE analysis
- Dryer energy consumption in Intermountain territory is the same as in Terasen service territory.

Intermountain Gas – Projected Savings Analysis

Data provided (for years 2002 to 2020)

- Total number of residential gas customers
- Number of residences within 200 feet of gas main
- Number of homes by type (single-family, town home, apartment, mobile home)
- Percentage of electrical appliances by home type, within 200 ft. of gas main.

NCI Assumptions

- Extrapolated percentage of appliance by home type to get total number of appliances.
- Projected analysis from 2021 to 2029

Terasen – Unitary Analysis

Data provided

- Natural Resources Canada (NRCan) data for total energy use in British Columbia by house type and appliance (not including electric FAF) (existing and new)

NCI Assumptions

- NCI analyzed the British Columbia data to determine energy use by individual appliance and home type
- Estimated electric FAF electricity consumption by scaling from baseboard and using ratio of efficiencies.
- Took values for 'existing' appliances from 2000 and 'new' appliances from 2005.

Terasen – Projected Savings Analysis

Data provided (for years 2002 to 2005)

- BC Hydro REUS data for total population, percentages for homes with natural gas and electric appliances for space heating, water heating, and clothes dryers.
- NRCan data for total number of appliances in British Columbia by house type and appliance (not including electric FAF)
- Percent of gas customers in British Columbia that are Terasen customers (95%).

NCI Assumptions

- Estimated percent of homes in British Columbia territory within 200 feet of a gas main to be the same as in PSE territory: 8.4%.

- Estimated numbers of potential conversion using the REUS data. Scaled the REUS data with the NRCan data to estimate different electric space heating appliances.
- Projected analysis from 2006 to 2029

Avista – Unitary Analysis

Data provided

- Electric FAF energy use in single-family home (existing and new).
- Electric heat pump energy use in single-family home (existing and new).
- Electric water heater energy use in single-family home (existing and new).

NCI Assumptions

- Electricity consumption of baseboard is scaled from electric FAF, by ratio of efficiencies
- Electricity consumption for town homes, apartments, and mobile homes are scaled by Avista single-family values and PSE ratios
- Dryer energy consumption in Avista territory is the same as in Terasen service territory.

Avista – Projected Savings Analysis

Data provided (for year 2007)

- Total number of customers, total potential customers within 200 ft. of main, total electric only homes in Avista territory, regardless of proximity to gas main.
- Within single-family homes (including town homes) and apartments, the percentage of electrical appliances.

NCI Assumptions

- For single-family homes and apartments, combined potential customers with percentage of electrical appliances to determine the total number of appliances with the potential for conversion.
- Divided single-family homes between detached and attached (town homes) based on their division in the Intermountain territory.
- Scaled data for mobile homes based on single-family homes within 200 ft. of main and total number of mobile homes in Avista territory.
- Projected analysis from 2002 to 2006 and from 2008 to 2029

Cascade – Unitary Analysis

Data provided

- No data provided

NCI Assumptions

- Used values from PSE analysis

Cascade – Projected Savings Analysis

Data provided (for year 2007)

- Total number of customers, total potential customers within 200 ft. of main.

NCI Assumptions

- Scaled data for all appliances and house types used Cascade total customers and potential customers by PSE ratios of appliances and house types.
- Projected analysis from 2002 to 2006 and from 2008 to 2029

Northwest Natural – Unitary Analysis

Data provided

- No data provided

NCI Assumptions

- Used values from PSE analysis

Northwest Natural – Projected Savings Analysis

Data provided (for year 2008)

- Total number of customers, total potential customers within 200 ft. of main.
- Breakdown of single-family, town home, and apartment space-heat potential conversions
- Total number of water heat and dryer potential conversions
- Included mobile homes within single-family homes

NCI Assumptions

- Scaled division of space heat appliances by PSE ratios for all house types
- Scaled potential conversions of water heaters and dryers by ratio of space-heat potential conversions.
- Did not separate out mobile homes from single-family homes because they have the same unitary analysis (no effect on savings).
- Projected analysis from 2002 to 2007 and from 2009 to 2029

APPENDIX B – UTILITY PROJECTED SAVINGS

Table 16 describes the projected energy and environmental savings for each participating utility for the years 2002, 2008 and 2025.

Table 16
Utility Potential Energy and Environmental Benefits (2002, 2008, 2025)

	Annual Natural Gas Savings ('000,000 therms/yr)			Average Megawatt Savings (aMW/yr)			GHG Emissions Reductions (metric tonnes of CO2/yr)		
	2002	2008	2025	2002	2008	2025	2002	2008	2025
Avista	20	22	28	32	35	44	105,264	115,100	148,252
Cascade Natural Gas	48	53	68	76	83	107	254,302	278,065	358,153
Intermountain Gas	26	23	27	42	36	42	138,707	129,080	140,018
NW Natural	83	91	117	132	144	185	438,200	479,147	617,151
Puget Sound Energy	34	37	48	54	59	76	180,795	197,689	254,628
Terasen (BC)	24	26	34	38	42	54	126,678	138,515	178,410

APPENDIX C – INDIVIDUAL UTILITY DATA

This appendix provides data for the appliances covered in this study, listed in four tables per utility:

(1) End-use electricity. These tables list the amount of electricity consumed by each appliance, accounting for different home types and vintages. This was the unique input data for each utility in the Unitary Analysis.[55]

(2) Number of electric appliances. These tables list the number of appliances for potential conversion in the utilities service area. This was the unique input data for each utility in the Projection Analysis.

(3) Natural gas savings. These tables list the potential natural gas savings from converting the appliances by older vintage (pre-2002) house type. This was an output of the Projection Analysis.

(4) Green house gas savings. These tables list the potential GHG savings from converting the appliances by older vintage (pre-2002) house type. This was the other output of the Projection Analysis.

For all utilities, data is shown for 2002 to 2009, although the study included data through 2029. Most utilities provided data for the number of appliances for a single year between 2006 and 2008. Intermountain gas provided data for the years from 2002 to 2020. For the years where the utilities did not provide data, NCI extrapolated the number of appliances using a 1.5% growth rate.

[55] NWGA utility members provided the data for the Assessment. See Appendix A, pages 37-40, for a list of assumptions made in the analysis to fill gaps in current information

Avista

Table 17 Appliance end-use electricity for homes in Avista service territory (kWh/yr)

End-use Electricity (kWh/yr)	Existing (pre-2002)				New (post-2002)			
	Single-family	Town home	Apartment	Mobile home	Single-family	Town home	Apartment	Mobile home
Forced Air (Elec)	18,000	13,909	9,818	18,000	18,000	15,093	12,186	18,000
Heat Pump	9,000	6,955	4,909	9,000	7,000	5,869	4,739	7,000
Baseboard	16,200	12,518	8,836	16,200	16,200	13,584	10,967	16,200
Water (Elec)	6,500	6,198	5,895	6,500	5,500	5,429	5,359	5,500
Dryer (Elec)	1,089	1,089	1,089	1,089	1,109	1,109	1,109	1,109

Table 18 Number of appliances for potential conversions in the Avista service territory

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	5,902	5,990	6,080	6,171	6,264	6,358	6,453	6,550
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	1,180	1,198	1,216	1,234	1,253	1,272	1,291	1,310
Single-family	Water (Elec)	59,017	59,902	60,801	61,713	62,638	63,578	64,531	65,499
Single-family	Dryer (Elec)	106,230	107,824	109,441	111,083	112,749	114,440	116,157	117,899
Town home	Forced Air (Elec)	87	88	89	91	92	93	95	96
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	17	18	18	18	18	19	19	19
Town home	Water (Elec)	867	880	893	907	920	934	948	962
Town home	Dryer (Elec)	1,561	1,584	1,608	1,632	1,656	1,681	1,706	1,732
Apartment	Forced Air (Elec)	882	895	909	922	936	950	965	979
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	14,114	14,326	14,541	14,759	14,980	15,205	15,433	15,664
Apartment	Water (Elec)	16,055	16,296	16,540	16,788	17,040	17,296	17,555	17,818
Apartment	Dryer (Elec)	16,760	17,012	17,267	17,526	17,789	18,056	18,327	18,601
Mobile home	Forced Air (Elec)	369	374	380	386	392	397	403	409
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	74	75	76	77	78	79	81	82
Mobile home	Water (Elec)	3,689	3,745	3,801	3,858	3,916	3,975	4,034	4,095
Mobile home	Dryer (Elec)	6,641	6,741	6,842	6,944	7,049	7,154	7,262	7,371

Table 19 Potential gas savings in the Avista service territory (therms/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	2,983,015	3,027,760	3,073,176	3,119,274	3,166,063	3,213,554	3,261,757	3,310,683
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	456,656	463,506	470,459	477,516	484,678	491,948	499,328	506,818
Single-family	Water (Elec)	6,802,279	6,904,313	7,007,878	7,112,996	7,219,691	7,327,987	7,437,906	7,549,475
Single-family	Dryer (Elec)	3,244,891	3,293,565	3,342,968	3,393,113	3,444,009	3,495,669	3,548,104	3,601,326
Town home	Forced Air (Elec)	33,861	34,369	34,884	35,408	35,939	36,478	37,025	37,580
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	5,184	5,261	5,340	5,420	5,502	5,584	5,668	5,753
Town home	Water (Elec)	95,277	96,706	98,156	99,629	101,123	102,640	104,180	105,742
Town home	Dryer (Elec)	47,667	48,382	49,108	49,844	50,592	51,351	52,121	52,903
Apartment	Forced Air (Elec)	243,204	246,852	250,555	254,313	258,128	261,999	265,929	269,918
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	2,978,476	3,023,154	3,068,501	3,114,528	3,161,246	3,208,665	3,256,795	3,305,647
Apartment	Water (Elec)	1,678,334	1,703,509	1,729,061	1,754,997	1,781,322	1,808,042	1,835,163	1,862,690
Apartment	Dryer (Elec)	511,962	519,641	527,436	535,347	543,378	551,528	559,801	568,198
Mobile home	Forced Air (Elec)	186,486	189,283	192,122	195,004	197,929	200,898	203,912	206,970
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	28,548	28,976	29,411	29,852	30,300	30,755	31,216	31,684
Mobile home	Water (Elec)	425,250	431,629	438,103	444,675	451,345	458,115	464,987	471,962
Mobile home	Dryer (Elec)	202,857	205,900	208,988	212,123	215,305	218,535	221,813	225,140

Table 20 Potential CO_2 emissions savings in the Avista service territory (tonnes/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	15,757	15,993	16,233	16,476	16,724	16,974	17,229	17,487
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	2,412	2,449	2,485	2,523	2,560	2,599	2,638	2,677
Single-family	Water (Elec)	35,946	36,486	37,033	37,588	38,152	38,724	39,305	39,895
Single-family	Dryer (Elec)	17,140	17,397	17,658	17,923	18,192	18,465	18,742	19,023
Town home	Forced Air (Elec)	179	182	184	187	190	193	196	199
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	27	28	28	29	29	30	30	30
Town home	Water (Elec)	503	511	519	526	534	542	551	559
Town home	Dryer (Elec)	252	256	259	263	267	271	275	279
Apartment	Forced Air (Elec)	1,285	1,304	1,323	1,343	1,363	1,384	1,405	1,426
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	15,735	15,971	16,210	16,454	16,700	16,951	17,205	17,463
Apartment	Water (Elec)	8,869	9,002	9,137	9,274	9,413	9,555	9,698	9,843
Apartment	Dryer (Elec)	2,704	2,745	2,786	2,828	2,870	2,913	2,957	3,001
Mobile home	Forced Air (Elec)	985	1,000	1,015	1,030	1,045	1,061	1,077	1,093
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	151	153	155	158	160	162	165	167
Mobile home	Water (Elec)	2,247	2,281	2,315	2,350	2,385	2,421	2,457	2,494
Mobile home	Dryer (Elec)	1,072	1,088	1,104	1,120	1,137	1,154	1,172	1,189

Cascade

Table 21 Appliance end-use electricity for homes in Cascade service territory (kWh/yr)

End-use Electricity (kWh/yr)	Existing (pre-2002)				New (post-2002)			
	Single-family	Town home	Apartment	Mobile home	Single-family	Town home	Apartment	Mobile home
Forced Air (Elec)	16,500	12,750	9,000	16,500	6,384	5,353	4,322	6,384
Heat Pump	9,375	7,244	5,114	9,375	3,627	3,041	2,456	3,627
Baseboard	14,850	11,475	8,100	14,850	5,746	4,818	3,890	5,746
Water (Elec)	4,300	4,100	3,900	4,300	3,900	3,850	3,800	3,900
Dryer (Elec)	1,089	1,089	1,089	1,089	1,109	1,109	1,109	1,109

Table 22 Number of appliances for potential conversions in the Cascade service territory

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	8,680	8,810	8,943	9,077	9,213	9,351	9,491	9,634
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	15,659	15,894	16,133	16,375	16,620	16,870	17,123	17,380
Single-family	Water (Elec)	54,060	54,871	55,694	56,530	57,378	58,238	59,112	59,998
Single-family	Dryer (Elec)	173,843	176,451	179,098	181,784	184,511	187,279	190,088	192,939
Town home	Forced Air (Elec)	670	680	690	700	711	722	732	743
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	17,233	17,492	17,754	18,020	18,291	18,565	18,843	19,126
Town home	Water (Elec)	18,056	18,327	18,602	18,881	19,164	19,452	19,744	20,040
Town home	Dryer (Elec)	23,976	24,336	24,701	25,071	25,447	25,829	26,217	26,610
Apartment	Forced Air (Elec)	4,006	4,066	4,127	4,189	4,252	4,316	4,380	4,446
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	64,928	65,902	66,890	67,894	68,912	69,946	70,995	72,060
Apartment	Water (Elec)	71,295	72,364	73,450	74,551	75,670	76,805	77,957	79,126
Apartment	Dryer (Elec)	75,482	76,614	77,763	78,929	80,113	81,315	82,535	83,773
Mobile home	Forced Air (Elec)	3,483	3,535	3,588	3,642	3,697	3,752	3,808	3,866
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	203	206	209	212	215	218	222	225
Mobile home	Water (Elec)	4,303	4,368	4,433	4,500	4,567	4,636	4,705	4,776
Mobile home	Dryer (Elec)	4,376	4,442	4,509	4,576	4,645	4,715	4,785	4,857

Table 23 Potential gas savings in the Cascade service territory (therms/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	4,021,840	4,082,168	4,143,400	4,205,551	4,268,635	4,332,664	4,397,654	4,463,619
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	5,553,567	5,636,871	5,721,424	5,807,245	5,894,354	5,982,769	6,072,511	6,163,598
Single-family	Water (Elec)	4,122,038	4,183,869	4,246,627	4,310,326	4,374,981	4,440,606	4,507,215	4,574,823
Single-family	Dryer (Elec)	4,834,265	4,906,779	4,980,381	5,055,086	5,130,913	5,207,876	5,285,994	5,365,284
Town home	Forced Air (Elec)	239,813	243,411	247,062	250,768	254,529	258,347	262,222	266,156
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	4,722,660	4,793,500	4,865,402	4,938,383	5,012,459	5,087,646	5,163,961	5,241,420
Town home	Water (Elec)	1,312,752	1,332,444	1,352,430	1,372,717	1,393,307	1,414,207	1,435,420	1,456,951
Town home	Dryer (Elec)	666,734	676,735	686,886	697,189	707,647	718,262	729,036	739,971
Apartment	Forced Air (Elec)	1,012,410	1,027,596	1,043,010	1,058,655	1,074,535	1,090,653	1,107,013	1,123,618
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	12,559,848	12,748,246	12,939,469	13,133,561	13,330,565	13,530,523	13,733,481	13,939,483
Apartment	Water (Elec)	4,930,468	5,004,425	5,079,491	5,155,684	5,233,019	5,311,514	5,391,187	5,472,055
Apartment	Dryer (Elec)	2,099,005	2,130,490	2,162,448	2,194,884	2,227,808	2,261,225	2,295,143	2,329,570
Mobile home	Forced Air (Elec)	1,613,791	1,637,998	1,662,568	1,687,507	1,712,819	1,738,511	1,764,589	1,791,058
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	71,899	72,977	74,072	75,183	76,311	77,456	78,617	79,797
Mobile home	Water (Elec)	328,099	333,021	338,016	343,086	348,232	353,456	358,758	364,139
Mobile home	Dryer (Elec)	121,699	123,524	125,377	127,258	129,166	131,104	133,071	135,067

Table 24 Potential CO_2 emissions savings in the Cascade service territory (tonnes/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	21,244	21,562	21,886	22,214	22,547	22,886	23,229	23,577
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	29,339	29,779	30,225	30,679	31,139	31,606	32,080	32,561
Single-family	Water (Elec)	21,783	22,109	22,441	22,778	23,119	23,466	23,818	24,175
Single-family	Dryer (Elec)	25,536	25,919	26,308	26,703	27,103	27,510	27,922	28,341
Town home	Forced Air (Elec)	1,267	1,286	1,305	1,325	1,344	1,365	1,385	1,406
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	24,949	25,323	25,703	26,089	26,480	26,877	27,280	27,689
Town home	Water (Elec)	6,937	7,041	7,147	7,254	7,363	7,473	7,585	7,699
Town home	Dryer (Elec)	3,522	3,575	3,628	3,683	3,738	3,794	3,851	3,909
Apartment	Forced Air (Elec)	5,348	5,428	5,509	5,592	5,676	5,761	5,847	5,935
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	66,351	67,347	68,357	69,382	70,423	71,479	72,552	73,640
Apartment	Water (Elec)	26,055	26,446	26,842	27,245	27,654	28,068	28,490	28,917
Apartment	Dryer (Elec)	11,088	11,254	11,423	11,594	11,768	11,945	12,124	12,306
Mobile home	Forced Air (Elec)	8,524	8,652	8,782	8,914	9,047	9,183	9,321	9,461
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	380	386	391	397	403	409	415	422
Mobile home	Water (Elec)	1,734	1,760	1,786	1,813	1,840	1,868	1,896	1,924
Mobile home	Dryer (Elec)	643	652	662	672	682	693	703	713

Intermountain Gas

Table 25 Appliance end-use electricity for homes in Intermountain Gas service territory (kWh/yr)

End-use Electricity (kWh/yr)	Existing (pre-2002)				New (post-2002)			
	Single-family	Town home	Apartment	Mobile home	Single-family	Town home	Apartment	Mobile home
Forced Air (Elec)	14,956	11,557	8,158	14,956	5,787	4,852	3,918	5,787
Heat Pump	8,498	6,566	4,635	8,498	3,288	2,757	2,226	3,288
Baseboard	13,460	10,401	7,342	13,460	5,208	4,367	3,526	5,208
Water (Elec)	5,712	5,446	5,180	5,712	5,180	5,114	5,048	5,180
Dryer (Elec)	1,089	1,089	1,089	1,089	1,109	1,109	1,109	1,109

Table 26 Number of appliances for potential conversions in the Intermountain Gas service territory

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	20,350	18,354	17,126	15,781	14,564	13,167	11,644	9,231
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	0	0	0	0	0	0	0	0
Single-family	Water (Elec)	92,707	91,534	90,008	90,180	88,424	85,295	83,559	78,738
Single-family	Dryer (Elec)	214,810	222,968	231,101	237,975	247,067	253,220	256,068	257,934
Town home	Forced Air (Elec)	299	291	287	282	270	256	231	188
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	0	0	0	0	0	0	0	0
Town home	Water (Elec)	598	633	652	672	675	673	643	553
Town home	Dryer (Elec)	3,156	3,538	3,871	4,257	4,580	4,916	5,087	5,258
Apartment	Forced Air (Elec)	1,495	1,562	1,586	1,613	1,597	1,570	1,478	1,255
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	0	0	0	0	0	0	0	0
Apartment	Water (Elec)	1,993	2,110	2,173	2,241	2,250	2,242	2,142	1,845
Apartment	Dryer (Elec)	3,906	4,220	4,532	4,880	5,128	5,360	5,382	4,886
Mobile home	Forced Air (Elec)	902	817	765	709	656	595	527	419
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	0	0	0	0	0	0	0	0
Mobile home	Water (Elec)	1,804	1,777	1,739	1,687	1,639	1,565	1,464	1,231
Mobile home	Dryer (Elec)	9,821	10,243	10,654	11,022	11,473	11,800	11,954	12,066

Table 27 Potential gas savings in the Intermountain Gas service territory (therms/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	8,546,689	7,708,150	7,192,435	6,627,851	6,116,517	5,530,012	4,890,349	3,876,938
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	0	0	0	0	0	0	0	0
Single-family	Water (Elec)	9,389,691	9,270,861	9,116,267	9,133,700	8,955,856	8,638,953	8,463,107	7,974,804
Single-family	Dryer (Elec)	6,561,551	6,810,743	7,059,182	7,269,144	7,546,876	7,734,819	7,821,808	7,878,818
Town home	Forced Air (Elec)	97,015	94,505	93,098	91,623	87,620	82,959	75,071	61,069
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	0	0	0	0	0	0	0	0
Town home	Water (Elec)	57,739	61,136	62,964	64,917	65,185	64,965	62,054	53,450
Town home	Dryer (Elec)	96,388	108,062	118,248	130,044	139,907	150,162	155,386	160,609
Apartment	Forced Air (Elec)	342,407	357,718	363,431	369,572	365,942	359,574	338,554	287,386
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	0	0	0	0	0	0	0	0
Apartment	Water (Elec)	183,076	193,847	199,640	205,834	206,683	205,987	196,756	169,475
Apartment	Dryer (Elec)	119,318	128,916	138,419	149,056	156,632	163,720	164,403	149,262
Mobile home	Forced Air (Elec)	378,781	343,255	321,438	297,569	275,328	249,801	221,306	175,809
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	0	0	0	0	0	0	0	0
Mobile home	Water (Elec)	182,696	179,958	176,180	170,864	165,998	158,534	148,252	124,702
Mobile home	Dryer (Elec)	299,985	312,870	325,445	336,667	350,442	360,430	365,142	368,566

Table 28 Potential CO_2 emissions savings in the Intermountain Gas service territory (tonnes/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	45,145	40,715	37,991	35,009	32,308	29,210	25,831	20,478
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	0	0	0	0	0	0	0	0
Single-family	Water (Elec)	49,619	48,991	48,175	48,267	47,327	45,652	44,723	42,143
Single-family	Dryer (Elec)	34,659	35,975	37,287	38,397	39,864	40,856	41,316	41,617
Town home	Forced Air (Elec)	512	499	492	484	463	438	397	323
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	0	0	0	0	0	0	0	0
Town home	Water (Elec)	305	323	333	343	344	343	328	282
Town home	Dryer (Elec)	509	571	625	687	739	793	821	848
Apartment	Forced Air (Elec)	1,809	1,890	1,920	1,952	1,933	1,899	1,788	1,518
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	0	0	0	0	0	0	0	0
Apartment	Water (Elec)	967	1,024	1,055	1,088	1,092	1,089	1,040	896
Apartment	Dryer (Elec)	630	681	731	787	827	865	868	788
Mobile home	Forced Air (Elec)	2,001	1,813	1,698	1,572	1,454	1,319	1,169	929
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	0	0	0	0	0	0	0	0
Mobile home	Water (Elec)	965	951	931	903	877	838	783	659
Mobile home	Dryer (Elec)	1,585	1,653	1,719	1,778	1,851	1,904	1,929	1,947

Northwest Natural

Table 29 Appliance end-use electricity for homes in Northwest Natural service territory (kWh/yr)

End-use Electricity (kWh/yr)	Existing (pre-2002)				New (post-2002)			
	Single-family	Town home	Apartment	Mobile home	Single-family	Town home	Apartment	Mobile home
Forced Air (Elec)	16,500	12,750	9,000	16,500	6,384	5,353	4,322	6,384
Heat Pump	9,375	7,244	5,114	9,375	3,627	3,041	2,456	3,627
Baseboard	14,850	11,475	8,100	14,850	5,746	4,818	3,890	5,746
Water (Elec)	4,300	4,100	3,900	4,300	3,900	3,850	3,800	3,900
Dryer (Elec)	1,089	1,089	1,089	1,089	1,109	1,109	1,109	1,109

Table 30 Number of appliances for potential conversions in the Northwest Natural service territory [56]

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	32,832	33,325	33,824	34,332	34,847	35,369	35,900	36,439
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	59,230	60,118	61,020	61,935	62,865	63,807	64,765	65,736
Single-family	Water (Elec)	289,384	293,725	298,131	302,603	307,142	311,749	316,425	321,171
Single-family	Dryer (Elec)	671,471	681,543	691,766	702,142	712,674	723,365	734,215	745,228
Town home	Forced Air (Elec)	83	84	85	87	88	89	91	92
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	2,132	2,164	2,197	2,230	2,263	2,297	2,332	2,367
Town home	Water (Elec)	5,460	5,542	5,625	5,709	5,795	5,882	5,970	6,060
Town home	Dryer (Elec)	12,669	12,859	13,052	13,248	13,447	13,648	13,853	14,061
Apartment	Forced Air (Elec)	504	511	519	527	534	543	551	559
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	8,162	8,284	8,409	8,535	8,663	8,793	8,925	9,059
Apartment	Water (Elec)	21,840	22,168	22,500	22,838	23,181	23,528	23,881	24,239
Apartment	Dryer (Elec)	50,677	51,437	52,209	52,992	53,787	54,594	55,412	56,244
Mobile [57]home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	0	0	0	0	0	0	0	0
Mobile home	Water (Elec)	0	0	0	0	0	0	0	0
Mobile home	Dryer (Elec)	0	0	0	0	0	0	0	0

[56] In the data provided by Northwest Natural, the number single family homes includes mobile homes. Because the unitary analysis is the same for both, this did not affect the analysis.

[57] Single family home data includes all mobile home data.

Table 31 Potential gas savings in the Northwest Natural service territory (therms/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	15,212,118	15,440,300	15,671,904	15,906,983	16,145,588	16,387,771	16,633,588	16,883,092
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	21,005,688	21,320,773	21,640,584	21,965,193	22,294,671	22,629,091	22,968,528	23,313,055
Single-family	Water (Elec)	22,065,242	22,396,220	22,732,164	23,073,146	23,419,243	23,770,532	24,127,090	24,488,996
Single-family	Dryer (Elec)	18,672,369	18,952,455	19,236,742	19,525,293	19,818,172	20,115,445	20,417,176	20,723,434
Town home	Forced Air (Elec)	29,673	30,118	30,570	31,028	31,494	31,966	32,446	32,932
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	584,349	593,115	602,011	611,042	620,207	629,510	638,953	648,537
Town home	Water (Elec)	396,961	402,916	408,960	415,094	421,320	427,640	434,055	440,566
Town home	Dryer (Elec)	352,309	357,593	362,957	368,402	373,928	379,537	385,230	391,008
Apartment	Forced Air (Elec)	127,269	129,178	131,116	133,082	135,079	137,105	139,161	141,249
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	1,578,884	1,602,567	1,626,605	1,651,004	1,675,770	1,700,906	1,726,420	1,752,316
Apartment	Water (Elec)	1,510,390	1,533,045	1,556,041	1,579,382	1,603,072	1,627,118	1,651,525	1,676,298
Apartment	Dryer (Elec)	1,409,235	1,430,374	1,451,830	1,473,607	1,495,711	1,518,147	1,540,919	1,564,033
Mobile home[58]	Forced Air (Elec)	0	0	0	0	0	0	0	0
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	0	0	0	0	0	0	0	0
Mobile home	Water (Elec)	0	0	0	0	0	0	0	0
Mobile home	Dryer (Elec)	0	0	0	0	0	0	0	0

Table 32 Potential CO_2 emissions savings in the Northwest Natural service territory (tonnes/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	80,352	81,557	82,781	84,023	85,283	86,562	87,861	89,178
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	110,969	112,634	114,323	116,038	117,779	119,545	121,339	123,159
Single-family	Water (Elec)	116,603	118,352	120,127	121,929	123,758	125,614	127,499	129,411
Single-family	Dryer (Elec)	98,634	100,114	101,615	103,139	104,687	106,257	107,851	109,468
Town home	Forced Air (Elec)	157	159	161	164	166	169	171	174
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	3,087	3,133	3,180	3,228	3,276	3,326	3,375	3,426
Town home	Water (Elec)	2,098	2,129	2,161	2,194	2,226	2,260	2,294	2,328
Town home	Dryer (Elec)	1,861	1,889	1,917	1,946	1,975	2,005	2,035	2,065
Apartment	Forced Air (Elec)	672	682	693	703	714	724	735	746
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	8,341	8,466	8,593	8,722	8,853	8,986	9,120	9,257
Apartment	Water (Elec)	7,982	8,101	8,223	8,346	8,471	8,598	8,727	8,858
Apartment	Dryer (Elec)	7,444	7,556	7,669	7,784	7,901	8,019	8,140	8,262
Mobile home[59]	Forced Air (Elec)	0	0	0	0	0	0	0	0
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	0	0	0	0	0	0	0	0
Mobile home	Water (Elec)	0	0	0	0	0	0	0	0
Mobile home	Dryer (Elec)	0	0	0	0	0	0	0	0

[58] Single family home data includes all mobile home data.

[59] Single family home data includes all mobile home data.

Puget Sound Energy

Table 33 Appliance end-use electricity for homes in Puget Sound Energy service territory (kWh/yr)

End-use Electricity (kWh/yr)	Existing (pre-2002)				New (post-2002)			
	Single-family	Town home	Apartment	Mobile home	Single-family	Town home	Apartment	Mobile home
Forced Air (Elec)	16,500	12,750	9,000	16,500	6,384	5,353	4,322	6,384
Heat Pump	9,375	7,244	5,114	9,375	3,627	3,041	2,456	3,627
Baseboard	14,850	11,475	8,100	14,850	5,746	4,818	3,890	5,746
Water (Elec)	4,300	4,100	3,900	4,300	3,900	3,850	3,800	3,900
Dryer (Elec)	1,089	1,089	1,089	1,089	1,109	1,109	1,109	1,109

Table 34 Number of appliances for potential conversions in the Puget Sound Energy service territory

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	2,988	3,033	3,078	3,124	3,171	3,219	3,267	3,316
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	5,390	5,471	5,553	5,637	5,721	5,807	5,894	5,983
Single-family	Water (Elec)	85,204	86,482	87,779	89,095	90,432	91,788	93,165	94,563
Single-family	Dryer (Elec)	475,240	482,369	489,604	496,948	504,403	511,969	519,648	527,443
Town home	Forced Air (Elec)	231	234	238	241	245	248	252	256
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	5,932	6,021	6,111	6,203	6,296	6,391	6,486	6,584
Town home	Water (Elec)	6,409	6,505	6,603	6,702	6,802	6,904	7,008	7,113
Town home	Dryer (Elec)	25,685	26,070	26,461	26,858	27,261	27,670	28,085	28,506
Apartment	Forced Air (Elec)	1,379	1,400	1,421	1,442	1,464	1,486	1,508	1,530
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	22,350	22,685	23,026	23,371	23,721	24,077	24,438	24,805
Apartment	Water (Elec)	25,898	26,286	26,680	27,081	27,487	27,899	28,318	28,742
Apartment	Dryer (Elec)	39,531	40,124	40,726	41,336	41,957	42,586	43,225	43,873
Mobile home	Forced Air (Elec)	1,199	1,217	1,235	1,254	1,273	1,292	1,311	1,331
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	70	71	72	73	74	75	76	77
Mobile home	Water (Elec)	1,693	1,719	1,745	1,771	1,797	1,824	1,852	1,879
Mobile home	Dryer (Elec)	1,932	1,961	1,991	2,021	2,051	2,082	2,113	2,145

Table 35 Potential gas savings in the Puget Sound Energy service territory (therms/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	1,384,432	1,405,198	1,426,276	1,447,671	1,469,386	1,491,426	1,513,798	1,536,505
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	1,911,696	1,940,371	1,969,477	1,999,019	2,029,004	2,059,440	2,090,331	2,121,686
Single-family	Water (Elec)	6,496,685	6,594,135	6,693,047	6,793,443	6,895,344	6,998,774	7,103,756	7,210,312
Single-family	Dryer (Elec)	13,215,559	13,413,792	13,614,999	13,819,224	14,026,512	14,236,910	14,450,464	14,667,221
Town home	Forced Air (Elec)	82,551	83,789	85,046	86,321	87,616	88,930	90,264	91,618
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	1,625,674	1,650,059	1,674,810	1,699,932	1,725,431	1,751,313	1,777,582	1,804,246
Town home	Water (Elec)	465,958	472,948	480,042	487,243	494,551	501,969	509,499	517,141
Town home	Dryer (Elec)	714,247	724,960	735,835	746,872	758,075	769,446	780,988	792,703
Apartment	Forced Air (Elec)	348,500	353,728	359,034	364,419	369,886	375,434	381,065	386,781
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	4,323,458	4,388,309	4,454,134	4,520,946	4,588,760	4,657,592	4,727,455	4,798,367
Apartment	Water (Elec)	1,790,985	1,817,850	1,845,118	1,872,795	1,900,886	1,929,400	1,958,341	1,987,716
Apartment	Dryer (Elec)	1,099,278	1,115,767	1,132,504	1,149,491	1,166,734	1,184,235	1,201,998	1,220,028
Mobile home	Forced Air (Elec)	555,513	563,846	572,303	580,888	589,601	598,445	607,422	616,533
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	24,750	25,121	25,498	25,880	26,268	26,662	27,062	27,468
Mobile home	Water (Elec)	129,119	131,056	133,021	135,017	137,042	139,098	141,184	143,302
Mobile home	Dryer (Elec)	53,733	54,539	55,357	56,188	57,030	57,886	58,754	59,636

Table 36 Potential CO_2 emissions savings in the Puget Sound Energy service territory (tonnes/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	7,313	7,422	7,534	7,647	7,761	7,878	7,996	8,116
Single-family	Heat Pump		0	0	0	0	0	0	0
Single-family	Baseboard	10,099	10,251	10,404	10,560	10,719	10,880	11,043	11,208
Single-family	Water (Elec)	34,331	34,846	35,369	35,900	36,438	36,985	37,540	38,103
Single-family	Dryer (Elec)	69,809	70,856	71,919	72,998	74,093	75,204	76,332	77,477
Town home	Forced Air (Elec)	436	443	449	456	463	470	477	484
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	8,588	8,717	8,848	8,980	9,115	9,252	9,391	9,532
Town home	Water (Elec)	2,462	2,499	2,537	2,575	2,613	2,653	2,692	2,733
Town home	Dryer (Elec)	3,773	3,829	3,887	3,945	4,004	4,064	4,125	4,187
Apartment	Forced Air (Elec)	1,841	1,868	1,896	1,925	1,954	1,983	2,013	2,043
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	22,840	23,183	23,530	23,883	24,242	24,605	24,974	25,349
Apartment	Water (Elec)	9,464	9,606	9,750	9,897	10,045	10,196	10,349	10,504
Apartment	Dryer (Elec)	5,807	5,894	5,982	6,072	6,163	6,256	6,349	6,445
Mobile home	Forced Air (Elec)	2,934	2,978	3,023	3,068	3,114	3,161	3,208	3,257
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	131	133	135	137	139	141	143	145
Mobile home	Water (Elec)	682	693	703	713	724	735	746	757
Mobile home	Dryer (Elec)	284	288	292	297	301	306	310	315

Terasen

Table 37 Appliance end-use electricity for homes in Terasen service territory (kWh/yr)

End-use Electricity (kWh/yr)	Existing (pre-2002)				New (post-2002)			
	Single-family	Town home	Apartment	Mobile home	Single-family	Town home	Apartment	Mobile home
Forced Air (Elec)	11,158	6,036	3,054	8,670	11,137	6,195	3,165	8,607
Heat Pump	5,730	3,099	1,568	4,452	5,719	3,181	1,625	4,419
Baseboard	10,043	5,432	2,749	7,803	10,024	5,576	2,849	7,746
Water (Elec)	3,034	2,791	2,358	2,714	3,004	2,781	2,445	2,684
Dryer (Elec)	1,089	1,089	1,089	1,089	1,109	1,109	1,109	1,109

Table 38 Number of appliances for potential conversions in the Terasen service territory

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	0	0	0	0	0	0	0	0
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	19,592	19,885	20,184	20,486	20,794	21,106	21,422	21,744
Single-family	Water (Elec)	46,440	47,136	47,843	48,561	49,290	50,029	50,779	51,541
Single-family	Dryer (Elec)	275,729	279,865	284,063	288,324	292,649	297,038	301,494	306,016
Town home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	2,786	2,828	2,870	2,913	2,957	3,001	3,046	3,092
Town home	Water (Elec)	6,277	6,371	6,467	6,564	6,662	6,762	6,864	6,967
Town home	Dryer (Elec)	37,269	37,828	38,396	38,972	39,556	40,150	40,752	41,363
Apartment	Forced Air (Elec)	0	0	0	0	0	0	0	0
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	9,132	9,268	9,408	9,549	9,692	9,837	9,985	10,135
Apartment	Water (Elec)	20,111	20,413	20,719	21,030	21,345	21,665	21,990	22,320
Apartment	Dryer (Elec)	119,406	121,197	123,015	124,860	126,733	128,634	130,563	132,522
Mobile home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	1,882	1,910	1,939	1,968	1,997	2,027	2,058	2,089
Mobile home	Water (Elec)	4,842	4,915	4,988	5,063	5,139	5,216	5,295	5,374
Mobile home	Dryer (Elec)	28,749	29,180	29,618	30,062	30,513	30,971	31,435	31,907

Table 39 Potential gas savings in the Terasen service territory (therms/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	0	0	0	0	0	0	0	0
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	4,698,750	4,769,231	4,840,769	4,913,381	4,987,082	5,061,888	5,137,816	5,214,883
Single-family	Water (Elec)	2,498,716	2,536,197	2,574,240	2,612,853	2,652,046	2,691,827	2,732,204	2,773,187
Single-family	Dryer (Elec)	8,422,377	8,548,713	8,676,944	8,807,098	8,939,204	9,073,292	9,209,392	9,347,533
Town home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	361,433	366,855	372,357	377,943	383,612	389,366	395,207	401,135
Town home	Water (Elec)	310,627	315,287	320,016	324,816	329,688	334,634	339,653	344,748
Town home	Dryer (Elec)	1,138,420	1,155,496	1,172,829	1,190,421	1,208,278	1,226,402	1,244,798	1,263,470
Apartment	Forced Air (Elec)	0	0	0	0	0	0	0	0
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	599,483	608,475	617,602	626,866	636,269	645,813	655,500	665,333
Apartment	Water (Elec)	840,877	853,490	866,293	879,287	892,476	905,864	919,452	933,243
Apartment	Dryer (Elec)	3,647,343	3,702,053	3,757,584	3,813,948	3,871,157	3,929,224	3,988,163	4,047,985
Mobile home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	350,685	355,946	361,285	366,704	372,205	377,788	383,454	389,206
Mobile home	Water (Elec)	233,014	236,509	240,057	243,657	247,312	251,022	254,787	258,609
Mobile home	Dryer (Elec)	878,163	891,335	904,705	918,276	932,050	946,031	960,221	974,624

Table 40 Potential CO_2 emissions savings in the Terasen service territory (tonnes/yr)

House type	Appliance type	Year							
		2002	2003	2004	2005	2006	2007	2008	2009
Single-family	Forced Air (Elec)	0	0	0	0	0	0	0	0
Single-family	Heat Pump	0	0	0	0	0	0	0	0
Single-family	Baseboard	24,823	25,195	25,573	25,957	26,346	26,741	27,142	27,549
Single-family	Water (Elec)	13,204	13,402	13,603	13,808	14,015	14,225	14,438	14,655
Single-family	Dryer (Elec)	44,488	45,155	45,833	46,520	47,218	47,926	48,645	49,375
Town home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Town home	Heat Pump	0	0	0	0	0	0	0	0
Town home	Baseboard	1,909	1,938	1,967	1,997	2,027	2,057	2,088	2,119
Town home	Water (Elec)	1,641	1,666	1,691	1,716	1,742	1,768	1,795	1,822
Town home	Dryer (Elec)	6,013	6,103	6,195	6,288	6,382	6,478	6,575	6,674
Apartment	Forced Air (Elec)	0	0	0	0	0	0	0	0
Apartment	Heat Pump	0	0	0	0	0	0	0	0
Apartment	Baseboard	3,167	3,214	3,263	3,312	3,361	3,412	3,463	3,515
Apartment	Water (Elec)	4,444	4,510	4,578	4,647	4,716	4,787	4,859	4,932
Apartment	Dryer (Elec)	19,266	19,555	19,848	20,146	20,448	20,755	21,066	21,382
Mobile home	Forced Air (Elec)	0	0	0	0	0	0	0	0
Mobile home	Heat Pump	0	0	0	0	0	0	0	0
Mobile home	Baseboard	1,853	1,880	1,909	1,937	1,966	1,996	2,026	2,056
Mobile home	Water (Elec)	1,231	1,250	1,269	1,288	1,307	1,327	1,346	1,367
Mobile home	Dryer (Elec)	4,639	4,708	4,779	4,850	4,923	4,997	5,072	5,148