CustomerSolutions

Energy Efficiency

Attachment 4

DNV KEMA Energy & Sustainability's

"*Puget Sound Energy's Home Energy Reports Program: Three Year Impact, Behavioral and Process Evaluation*"

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PSE PUGET SOUND ENERGY

The Energy To Do Great Things

Puget Sound Energy's Home Energy Reports Program

Three Year Impact, Behavioral and Process Evaluation

Puget Sound Energy
Prepared by DNV KEMA Energy & Sustainability
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1. Executive Summary

1.1 Program Background

In 2008, Puget Sound Energy (PSE) became the second utility in the U.S. to implement an innovative program designed to conserve energy. The program, referred to as the Home Energy Reports (HER) program, utilizes a social marketing campaign, with normative messaging techniques, to encourage responsible energy behavior and choices. The campaign, administered by OPOWER, provides Home Energy Reports to households in PSE's combined gas and electric service territory. The current program serves dual fuel, single family households. The Home Energy Reports provide recipients with feedback on their household energy use by comparing the recipient household's energy usage with that of neighboring homes, essentially using peer pressure to achieve energy savings. In addition, the reports provide tips regarding steps households can take to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.

After the second year of the PSE HER Program, a subset (approximately 10,000) of the original HER treatment group were randomly selected for program suspension; the sending of Home Energy Reports was suspended to these households. The estimation of program savings among the suspended treatment group is important to include for several reasons:

- To the extent that there are continued energy savings program effects on the suspended group beyond the years for which they received reports, the suspended group represents cost-free retention of savings. It is essential to understand the magnitude of those cost-free savings and potentially deal with them separately from the perspective of cost-effectiveness
- Understanding the impacts of suspending program treatment on energy usage will assist utilities in making more informed decisions regarding optimal deployment of the HER program; providing a possible avenue to maximize savings with a fixed expenditure.

1.2 Evaluation Overview

The evaluation included impact, behavioral and process evaluation components designed to address multiple objectives, which are outlined in Table 1-1.

Table 1-1: Evaluation Objectives by Research Type

Research Type	Objective
Impact Evaluation	Determine HER program savings based on consumption analysis
	Assess whether, and to what extent, there may be double counting of energy savings in the billing analysis estimates, due to coincident participation in other PSE programs (rebate and upstream)
	Determine HER program savings net of any double counting
	Quantify program savings for current treatment vs. suspended treatment groups
	Quantify program savings for households receiving Home Energy Reports monthly vs. quarterly
Process and Behavioral Evaluation	Assess how HER treatment households are saving energy by examining program effects on: • Household purchase/installation of energy efficiency measures, with a focus on purchases outside of PSE rebate programs, and • Household energy saving behaviors
	Assess customer response to HER reports

To meet the objectives, several analysis techniques and data sources were required to complete the evaluation. The programs savings, or consumption reduction, analysis used daily billing data to measure the difference in consumption between the following groups: current and suspended treatment vs. control group; current treatment vs. suspended; and monthly vs. quarterly. To quantify the potential for double counting of energy savings in the billing analysis due to participation in PSE rebate programs, KEMA utilized PSE tracking data and end-use load shape data. To examine double counting due to participation in upstream lighting programs, for which there is no tracking data, we used household survey data. Additionally, surveys were used to gather information on participant attitudes, behaviors, and energy related purchases outside of PSE programs. The survey instrument was also utilized to gather information on consumer responses toward receiving reports.

1.3 Key Findings

1.3.1 Impact Evaluation Results

KEMA conducted two separate evaluations on the HER program for PSE. We first conducted an evaluation of the savings which occurred during the calendar year 2011, which assisted PSE in supporting HER savings claims for 2011. We then conducted a complete longitudinal study over the three HER programs years. This second component assists in understanding how savings persist over time when people continue receiving reports and when households are suspended from the program. For clarity, the impact results are summarized separately for calendar year 2011 and for the three year program evaluation. A summary of results of the 2011 calendar year savings are reported in 1.3.1.1. The summary Results from the three year study are presented in section 1.3.1.2

A Primary overall objective for this evaluation was the development of estimates free of any double counting of savings that were credited to other PSE energy efficiency programs. The savings that may be double counted are produced and tracked through activity in PSE rebate and upstream programs but are influenced by the HER program. We refer to these savings as "joint" savings. The initial HER program savings estimates include these joint savings. To avoid double counting them, they must be removed from the estimates of HER Program measured savings. This evaluation develops the correct way to measure joint savings and uses this approach to develop credited savings estimates (measured savings with joint savings removed) for calendar year 2011.

1.3.1.1 Calendar Year 2011 Impact Results Summary

Both continued and suspended treatment groups generated statistically significant energy savings in calendar year 2011. Table 1-2 summarizes the household level measured savings generated by the HER program and the savings credited to the program after removing joint savings claimed by other PSE programs.

Table 1-2: Calendar Year 2011 PSE HER Program per Household Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Measured Savings	278.4 (241.00 , ∞)	12.9 (10.34 , ∞)
	Credited Savings	276.4 (195.38 , ∞)	11.6 (9.05 , ∞)
Suspended Reports	Measured Savings	208.1 (159.88 , ∞)	12.0 (8.65 , ∞)
	Credited Savings	164.3 (82.71 , ∞)	10.9 (7.62 , ∞)

Table 1-3 summarizes the HER program results with respect to average consumption for participating households. The continued treatment group produced credited savings at 2.6 and 1.3 percent for electric and gas, respectively. The suspended treatment group produced credited at 1.6 and 1.2 percent, for electric and gas, respectively.

Table 1-3: Calendar Year 2011 PSE HER
Credited Savings (Joint Savings Removed) as a Percent of Consumption

Her Treatment Group	Electric (kWh)			Gas (therms)		
	Consumption*	Savings	Percent	Consumption*	Savings	Percent
Continued Reports	10,596	276.4	2.6%	920	11.6	1.3%
Suspended Reports		164.3	1.6%		10.9	1.2%

*Control Group calendar year 2011 consumption

Table 1-4 summarizes the total program savings for all households in the two treatment groups and for the full program.

Table 1-4: Calendar Year 2011 Final PSE HER
Overall Program Credited Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Total Group Credited Savings	5,443,983 (3,848,433 , ∞)	228,479 (178,298 , ∞)
Suspended Reports	Total Group Credited Savings	1,589,582 (800,117 , ∞)	105,554 (73,744 , ∞)
Total Program Credited Savings		7,033,565 (4,866,495 , ∞)	334,033 (267,373 , ∞)

Other calendar year 2011 findings:

- Table 1-2 reports the relative levels of continued and suspended treatment group saving for both measured and credited savings.
    - Suspension of reports resulted in a decrease in measured savings by 25 and 7 percent for electric and gas, respectively. The electric difference was statistically significant at a 90 percent confidence level while the gas difference was not.
    - For credited savings, the suspension of reports resulted in a decrease in credited savings (measured savings with joint savings removed) of 41 and 6 percent for electric and gas, respectively. Neither of these differences was statistically significant due to the additional variability from the incorporation of the joint savings estimates
- The HER Reports had a positive influence on participation in other PSE programs. The reports increased savings produced by gas measures from rebate programs. For the continued group, 10 percent of measured savings was due to participation in other PSE programs. For the suspended group, 9 percent of the measured savings was due to participation in other program. The percent savings which are due to joint program participation are statistically significant for both the continued and suspended treatment groups. Neither group experienced statistically significant electric savings due to joint program participation.
- The HER Reports did not increase savings produced by electric measures from rebate programs. Less than one percent of measured savings was due to participation in other PSE programs for both treatment groups. Neither estimate was statistically significant.
- Upstream CFL program joint savings were not statistically significant. Survey results indicated that suspended treatment households purchased about a half bulb more of program CFLs than the control households. Expanded to three years, this amounted to 43 kWh in joint savings for the upstream CFL programs for this group. Upstream joint savings was only 2 kWh for the continued treatment group.

1.3.1.2 Three Year Impact Evaluation Findings

Table 1-5 presents a summary of the three year impact evaluation results. The PSE HER Program generated statistically significant savings for all three years. The suspended group,

which did not receive reports in year three, continued to generate savings even without the report.

Table 1-5: PSE HER Program per Household Weather Normalized Savings

Year and Group	Electric (kWh)	Gas (therms)
Year 1	169.7 (149.70 , ∞)	10.7 (9.27 , ∞)
Year2	234.5 (207.25 , ∞)	13.5 (11.61 , ∞)
Year 3 - Continued	274.2 (238.01 , ∞)	11.9 (9.59 , ∞)
Year 3- Suspended	216.4 (169.77 , ∞)	11.9 (8.85 , ∞)

The weather normalized electric results show savings increasing each year, although the savings appear to be increasing at a slower rate between years two and three. Weather normalized gas results show gas savings increasing from year one to year two but dropping slightly in the third year.

The normalized, third year results indicate a more moderate effect of suspension of the reports on savings. Suspending Home Energy Reports lowered measured savings in the first year post suspension by 21 and 0 percent for electric and gas, respectively. The electric result was statistically significant. The difference between these results and the 2011 results is primarily explained by the different time period. The third year results look at the first 12 months of report suspension (November, 2010 to October, 2011), whereas the 2011 results look at months three through thirteen.

The three year impact evaluation also considered the differences between monthly and quarterly mailings across the three years. Less frequent quarterly reports continue to generate fewer savings than monthly reports in the third year. In addition, visual evidence suggests that the quarterly reports may also level out and/or decline sooner than the monthly reports. When reports were suspended, households receiving monthly reports reduced electric savings more than household receiving quarterly reports. Gas results were inconclusive.

1.3.2 Behavior and Process Evaluation Results

1.3.2.1 Behavior Evaluation Results

The primary objective of the behavior analysis was to better understand how HER treatment households save energy. This is a challenging endeavor as HER program-related savings are a small percentage of overall consumption and could be generated by energy-related purchases and behaviors across all categories of energy use.

The survey results indicate increased HER Program purchase of energy efficient products outside of PSE programs across a range of specific measures including tank water heater, clothes washer, TVs, computers and insulation. The differences in purchases of these specific measures, between treatment and control households, were small but statistically significant. These results drove statistically significant increases in energy efficient purchases in the broader, measure-related categories of water heat, electronics and appliances. All of these results were for either the continued or suspended report treatment groups. While there was evidence of energy efficient purchasing behavior in general there was little similarity between the two treatment groups as to where it took place.

Similarly, the survey results also show an increase in measure-related behaviors and energy use behaviors for the HER Program treatment groups. There were a limited number of specific behaviors for which there was a statistically significant increase for at least one of the treatment groups. Overall, the measure-related and energy saving behaviors showed a more consistent pattern of increase energy saving behaviors across both groups than the energy efficient purchases.

Given the survey results presented here, the observed consumption reduction of the treatment group is the cumulative effect of a number of small differences in energy related behavior and purchases. Although the small differences in energy usage behavior may be too small to observe individually, without impractically large samples, they create a measureable difference in energy savings on the aggregate.

1.3.2.2 Home Energy Report Response Summary

The survey asked HER report recipients what they thought of the reports. The data indicates that respondents are aware of the reports. Most respondents spend a few minutes reading every report their household receives but home occupants do not appear to be overwhelmed with the usefulness of the reports. The most useful component of the reports is the comparison

of the respondents' continued energy usage to the previous year. About one-third of respondents said the reports caused them to adopt new energy saving habits or install energy efficient equipment.

2. Introduction

2.1 Program Description

In 2008, Puget Sound Energy (PSE) became the second utility in the U.S. to implement an innovative program designed to conserve energy, which is referred to as the Home Energy Reports Program (HER). The program utilizes a social marketing campaign, with normative messaging techniques, to encourage responsible energy behavior and choices. The campaign, administered by OPOWER, provides Home Energy Reports to households in PSE's combined gas and electric service territory. The current program serves, dual fuel, single family structures. The Home Energy Reports provide recipients with feedback on their household energy use by comparing the receiving household's energy usage with that of neighboring homes, essentially using peer pressure to achieve energy savings. In addition, the reports provide tips households can take to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.

After the second year of the PSE HER Program, a subset (approximately 10,000) of the original HER treatment group were randomly selected for program suspension; the sending of Home Energy Reports was suspended to these households. The estimation of program savings among the suspended treatment group is important to include for several reasons:

- To the extent that there are continued energy savings program effects on the suspended group beyond the years for which they received reports, the suspended group represents cost-free retention of savings. It is essential to understand the magnitude of those cost-free savings and potentially deal with them separately from the perspective of cost-effectiveness
- Understanding the impacts of suspending program treatment on energy usage will assist utilities in making more informed decisions regarding optimal deployment of the HER program; providing a possible avenue to maximize savings with a fixed expenditure.

2.1.1 Home Energy Report

Appendix D contains a copy of a monthly report generated though the HER program. The reports contain an individualized bar graph of the receiving household's gas and electric usage from the prior month, a rolling twelve month average of the electric and gas usage in separate graphs, and plots of the receiving household's gas and electric usage compared to that of their

average neighboring homes. During the months the receiving home uses less energy than the average of their defined neighbor group, an emoticon of a smiling face is displayed on the report. When the receiving household's energy usage is higher than the average of the defined neighbor group, the report indicates that the receiving home's usage is above average.

In addition to the usage information, the report provides customized tips on lowering household usage by doing a variety of things from small behavior changes to taking advantage of retrofit opportunities

Each month, the report provides three tips, which are different from tips received in prior months. Tips almost always include a no-cost behavior modification, a low-cost equipment change, and a medium cost appliance upgrade. Sample tips include: lowering the temperature of the water heater serving the home, installing a programmable thermostat, installing compact fluorescent lighting, and upgrading to a more efficient furnace. Tips also direct recipients to a website (www.pse.opower.com) that provides other useful tips, tools and forums for conserving energy.

When the report provides a tip that is supported by a PSE rebate program, additional details about the rebates PSE offers are included. The objective of the tips, along with the rebate information, is to increase participation in PSE programs. Therefore, these reports serve the dual purpose of encouraging people to save energy through behavior modification and through participation in other PSE programs.

2.2 Evaluation Objectives

The specific objectives of the evaluation are provided in Table 2-1.

Table 2-1: Evaluation Objectives by Research Type

Research Type	Objective
Impact Evaluation	Determine HER program savings based on billing data analysis of consumption reduction
	Assess whether, and to what extent, there may be double counting of energy savings in the billing analysis estimates due to coincident participation in other PSE programs (rebate and upstream)
	Determine HER program savings net of any double counting
	Quantify program savings for continued treatment vs. suspended treatment (dropped from program after two years)
	Quantify program savings for households receiving Home Energy Reports monthly vs. quarterly
Behavioral and Process Evaluation	Assess how HER participants are saving energy by examining program effects on: • Household purchase/installation of energy efficiency measures, with a focus on purchases outside of PSE rebate programs, and • Household energy saving behaviors
	Assess customer response to HER reports

2.3 Overview of Approach

This section provides a high level synopsis of the impact evaluation and the behavioral and process evaluation approaches.

2.3.1 Impact Evaluation Overview

To meet the impact evaluation objectives, KEMA analyzed consumption data provided by PSE. KEMA used consumption data read on a daily basis for the analysis, and used two different approaches to measure impact. A difference-of-differences approach is a simple, robust approach to measuring actual (as opposed to typical year) impacts. This approach is the basis for PSE savings claims. KEMA also conducted individual household regression analysis,

allowing us to estimates of savings for a normal weather year. These results are used for additional analysis of the program.

KEMA also analyzed PSE rebate program tracking data to identify possible increased uptake of other PSE energy efficiency programs by the treatment group. For this analysis, KEMA compiled data on all rebated installations, for both the treatment group and the control group, and measured the associated savings in two different ways:(1) assigning all first year savings to the day of installation, and (2) spreading savings over the first year of installation using a measure-specific load shape as a guide to specify when savings would be credited. These estimates represent the potential overlap between the HER program and the PSE rebate programs

Finally, using data collected for the process evaluation, KEMA developed estimates of increased uptake of CFL bulbs and fixtures that were supported by the PSE upstream lighting program. These estimates represent the potential overlap between the HER program and the upstream light programs.

2.3.2 Behavioral and Process Evaluation Overview

The meet the behavioral and process evaluation objectives, KEMA conducted a customer survey of households, including continued treatment group, suspended treatment group and control group households. KEMA compared the survey results for each of the three groups to assess the extent and nature of HER program effects on household energy efficiency equipment purchases and energy saving behaviors.

2.4 Overview of This Report

Section 3 of the report presents the overall research design and data collection activities. Section 4 and Section 5 present the approach and results for the impact evaluation and behavioral and process evaluation, respectively.

3. Research Design and Data Collection Activities

3.1 Experimental Design

Before the program launched, a group of 83,811 single family homes, located in PSE's combined gas and electric service territory, were selected to participate in the test and control group based on the following criteria:

- Dual Fuel (home uses both natural gas and electricity, which are both provided to the service address by Puget Sound Energy)
- Single family residential home
- Uses more than 80 MBtu of energy per year
- Home does not utilize a Solar PV system
- Address must be available with parcel data from the county assessor
- Has a bill history that starts on or before January 1, 2007
- Home must have 100 similar sized homes (neighbors) within a two mile radius
- Home must have automatic daily meter reads

After selection of the participating households was complete, 39,755 homes were randomly assigned to participate in the treatment group and the remaining homes were used to serve as a control group. Of the selected treatment homes, 9,949 (25%) were randomly selected to receive Home Energy Reports on a quarterly basis, while the remaining 29,806 (75%) homes are participating as monthly report recipients. The random assignment of monthly and quarterly reports allows both Puget Sound Energy and OPOWER to test the effect of report frequency on energy savings.

The program was implemented in October 2008 and for the first two program years (November 2008 – October 2010) the 39,755 treatment group households received a Home Energy Report on the monthly or quarterly schedule per their assignment. In Program Year 3- beginning November 2010- 9,674 treatment group homes were randomly assigned to stop receiving the Home Energy Reports (suspended treatment group).

The impact and process evaluation used information collected from customer billing data, program tracking data and customer survey data. These data collection activities are described in the following sections.

3.1.1 Billing Data

The data used in analysis included daily electric and gas consumption, frequency of report delivery, site-level characteristics, and actual and normal weather data. Daily billing data were provided by PSE's Meter Data Warehouse for each home included in the treatment and control groups from January 2007 to December 2011. PSE also provided data on move-out dates, monthly and quarterly assignments, and a report delivery suspension indictor for home suspended from the program after year two, and household square footage information. .

Table 3-1 summarizes the data received from PSE. Household where occupancy changes occurred during the analysis period were removed from the final HERS population, as PSE indicated they will not be seeking to claim savings homes which experienced occupancy changes. Roughly 15 percent of the households in the treatment and control groups moved or changed accounts since the program began. In addition, households in zip codes where no control group was assigned were also removed from the analysis. Approximately 12 percent of the treatment group was located in zip codes that did not have an assigned control group. Table 3-1 provides a summary of the program population, counts of removed households, and the final sample used in the billing analysis.

Table 3-1: Consumption Data Disposition

Groups	Initial Program Population	Non-Randomly Assigned	Other Opower Program	Moved out	2011 HERS population	Data Issues	Final Analysis Sample
All Control	44,089	-	114	6,531	37,452	358	37,094
All Treatment	39,715	4,861	-	5,858	29,675	304	29,371
Monthly - Not suspended					*14,274*		*14,128*
Monthly - Suspended					*5,625*		*5,569*
Quarterly - Not suspended					*6,981*		*6,903*
Quarterly - Suspended					*2,795*		*2,771*
Total	83,804				67,127		*66,465*

For this evaluation, the data for billing analysis was divided into five periods: October 2007 to September 2008 (Pre-program), November 2008 to October 2009 (Post Year 1), November 2009 to October 2010 (Post Year 2), November 2010 to October 2011 (Post Year 3) and January 2011 to December 2011 (Post Year 3). The month of October 2008 was excluded from the analysis because of a mixture of pre and post-report period for some households in the treatment group.

Prior to analysis, KEMA examined the billing data of HERS population for data issues such as duplicates, extreme values, missing observations and inconsistencies. Data preparation steps included:

- Duplicate reads
  - When meters produced two identical reads in one day, one read was excluded from the analysis.
  - When a meter produced two different reads in a day, both reads were excluded from the analysis.
- Negative reads were excluded from the analysis.
- Extreme values, greater than 100kWh per day or 20 therms per day, were excluded from the analysis.
- Missing daily observations, caused by missed daily reads, were generally followed by a single read that covered the multiple missing days. Data imputation was employed by distributing energy consumption of that next non-missing meter read. Imputation was only done when the next non-missing read covered the missing period as indicated by start and end read dates.
- All households with less than 122 days of data during any of the four years (one pre- and 3 post-program) were removed from the final analysis dataset.

3.1.2 Participant Survey

The KEMA team utilized a Computer Aided Telephone Interview (CATI) survey to collect data used in the analysis of upstream lighting program participation and the energy efficiency purchases and behaviors associated with the HER program . KEMA selected a random sample of 5,966 households from the HER treatment (continued and suspended) and control groups for possible interview; a total of 1,369 interviews (502 control, 373 continued treatment, and 494 suspended treatment) for a final response rate of 27 percent. All respondents were called eight times over at least two weeks before being considered unreachable. Table 3-2 provides counts of surveyed households and response rates.

Table 3-2: Survey Dispositions

Sample Description	Number	Percent
Starting Sample	**5,966**	
Never Called	-	
Sample Used	**5,966**	
Known Not Eligible	528	
Estimated additional not eligible	348	
Sample-Valid	**5,090**	
Complete	1,369	27%
Refused	1,540	30%
Not Completed - Eligible	158	3%
Not Completed - Est. Eligible	2,023	40%

Ineligible sample consisted of completed calls with respondents who were not HER treatment or control group participants or not able to answer questions as HER participants. This happened largely because of changed telephone numbers.

The survey addressed the following key topics:

- Energy efficiency equipment purchases including: CFLs (bulbs and fixtures), heating and cooling system purchases, water heating systems, insulation, appliances, and electronic equipment
- Energy saving behaviors in the areas of home heating, air conditioning, lighting, hot water, appliances, and electronics
- Responses to the Home Energy Reports
- Respondent demographics

4. Impact Evaluation

This impact evaluation provides estimates of energy savings over the three years of HER program implementation and for calendar year 2011. The evaluation provides total energy savings estimates for the HER program and an estimate of the portion of those savings that will be credited to HER program.

Savings for the HER program are expected to be small, as a percentage of overall consumption, and the exact source of savings is not explicitly known. The program experimental design, a large population with randomly assigned treatment and control groups, makes it possible to develop precise and unbiased savings estimates despite these challenges. Because of the experimental design, the HER program impact evaluation can claim impact evaluation results that are more robust than most other energy efficient evaluations despite the small magnitude of the savings.

The Home Energy Report program has a secondary objective of promoting other energy efficiency programs within PSE. If this promotion is successful, some portion of the true savings, measured by the basic HER Program impact estimates, will include part or all of the savings claimed by those other programs. We refer to this as joint program savings because the ownership of these savings are shared by both the HER program and other PSE programs. A key part of a HER Program impact evaluation is identifying joint savings and clarifying how PSE accounts for these savings. For PSE, there are potential joint savings with rebate programs and upstream CFL and Fixture programs. These sources and identification of joint savings are addressed separately for rebate programs and upstream CFL and Fixture programs.

Finally, it is important to note that because of the experimental design framework of the HER program, freeridership is not an issue.

4.1 Billing Analysis Approach

The impact evaluation uses an analysis of daily household energy consumption data (billing analysis) to estimate the reduction in energy consumption resulting from HER. This consumption reduction is the full measure of savings caused by the mailing of Home Energy Reports and is referred to here as measured savings. This measure savings will include any joint savings with other PSE programs. Joint savings are discussed in the subsequent sections, and are ultimately removed from this initial estimate of measured savings to avoid double

counting. The measured savings- net of the joint savings- will be referred to as "credited savings".[1]

The billing analysis uses two different approaches, a difference in differences technique and a site-level modeling approach, to estimate savings. The approach we refer to as the difference-in-difference technique provides estimates of actual annual and monthly savings during the three program years. The site-level modeling approach produces estimates of savings that are normalized to reflect typical weather year data. The former approach provides the basis for ex post savings claims, and the latter approach facilitates general analysis of program performance over time

4.1.1 Difference in differences Approach

The difference-in-differences approach is a simple, robust approach to measuring program-related savings in a randomized experimental design framework. The approach compares mean energy consumption between the pre- and post-report periods for both the treatment and the control groups.

A simple pre-post comparison of treatment group consumption- without a control group- does not account for systemic effects (economic factors, fuel prices, etc) that impact all households' consumption patterns during the measurement periods. It is possible that these systemic effects will increase or decrease consumption in the post-report period unrelated to the effects of the reports. This would bias the estimate of consumption reduction, a particular concern when expected reduction is relatively small. The control group, pre-post difference provides a robust estimate of the non-program, systemic effects on consumption that are observed in the post-report period. Because the control group was randomly assigned, their response to the systemic effects is representative of the treatment group response. The term "difference-in-differences" refers to the removal of the of the control group difference (systemic effects only) from the treatment group difference (program effects and systemic effects).

A full discussion of the difference in difference approach can be found in Appendix A.1

[1] We explicitly avoid using the gross/net terminology here to avoid confusion with the more typical freeridership/spillover usage of those terms.

4.1.2 Regression Approach

A second approach, based on regressions performed for each individual household, was applied to the data to develop more in-depth estimate of the HER Program savings over time. The regression-based approach allowed KEMA to estimate weather impacts on energy consumption, which could not be done in a difference-in-difference approach. Estimating the weather impacts on consumption allowed KEMA to compare real year-to-year program savings estimates by modeling each year's savings under the same normal weather conditions. Without doing this, it is difficult to judge whether trends are real or the impact of variable weather.

A full discussion of the site-level modeling approach can be found in Appendix A.2.

4.2 Joint Savings Analysis Approach

The goal of the joint savings[2] analysis is to quantify savings that are included in the measured savings but that are already credited to other PSE energy efficiency programs.

4.2.1 What are Joint Savings

Because the HER program participants are not barred from participating in other PSE programs, there is potential for both treatment and control households take part in energy efficiency programs. If savings from participating in other PSE programs were the same between the treatment and control groups, those savings would not be captured as HER savings in the difference of difference analysis. With the HER program promoting the energy efficiency programs, it is expected that the treatment group would take greater advantage of the energy efficiency programs. That incremental activity will be captured in the difference of difference analysis. The energy efficiency programs are credited for all the savings the energy program participants create through program measures. This includes all the savings generated by both groups as well as those incremental savings caused by the HER program. It is only this incremental part of the savings that are joint savings and need to be removed from consumption analysis

The reduction in consumption associated with HER program participation, as measured in the consumption analysis, may be roughly categorized into savings from the following sources:

[2] Sometimes referred to as uplift in other evaluations.

- Behavioral changes.
- Energy efficient installations and activities performed outside of PSE energy efficiency programs
- Energy efficient installations and activities rebated through PSE energy efficiency programs

The full amount of savings from the first two sources are uniquely attributable to the HER Program. The last source, HER program savings generated through PSE energy efficiency programs, are not uniquely attributable to the HER program. These savings are generated in concert with the other PSE sponsored programs. For PSE, the decision has been made to assign the credit for these savings to the rebate program. This means these savings must be removed from the HER program measured savings before the HER savings can be claimed by PSE.

Joint savings occur when recipients of Home Energy Reports (the treatment group) yield a higher savings from other PSE Programs compared to the control group. Increased savings from other PSE programs occur when recipients:

- Install rebate program measures in greater numbers
- Install rebate program measures generating greater savings, and/or
- Install any rebate program measures earlier than control households, regardless of the level of savings.

These effects, measured on a day by day basis, will generate additional savings among treatment households that will be captured in the measured consumption reduction. Where these savings have already been credited to another PSE program, they must be removed from measured savings to avoid giving double credit for those savings.

4.2.2 Accounting for Joint savings

The first priority with regards to accounting for joint savings is recognizing that these joint savings with other utility energy efficiency programs need to be accounted for at all. Programs like the Opower program are relatively new and the joint savings are somewhat unique to this kind of program. The potential for double counting due to the way HER program savings are measured, however, is real and must be addressed.

The next priority is determining the appropriate way to account for joint savings, given the way HER Program savings are measured.

Energy efficiency program savings are generally reported on an annual basis. For this kind of accounting, it does not matter when during the year measures are installed or when during the year the savings actually happen. This level of energy efficiency program accounting makes it difficult to measure joint savings in a way that allows for their removal from HER program savings.

In contrast to a simplified annual savings accounting process, the overall savings generated by the HER program are changing day to day. For example, over the course of the first year of the program savings increased from zero to a substantial level of savings. HER Program savings are a flow of savings that increases or decreases as the consumption of the treatment group changes compared to the control group. The consumption analysis captures these savings on a day to day basis.

To integrate energy efficiency program savings into the framework of the HER consumption analysis, the program savings also need to be captured as flow of savings. In this case, it is a flow of program-related savings that will increase or decrease as the participation of the treatment group in the energy efficiency programs changes compared to the control group on a day to day basis. To account for energy efficiency program savings in a way that is consistent with the measured HER program savings we need to take into consideration

- When savings start (installation dates)
- When during the year savings actually occur (load shape of yearly savings)
- How long the savings will last (persistence of savings or measure life).

Taking these aspects of energy efficiency program savings into consideration highlights two important characteristics of joint savings.

- Joint savings may last for many years up to the measure life of the specific measure.
- Joint savings increase (or decrease) on a daily basis based on the relative activity in energy efficiency programs between the treatment and control groups.

Nothing has changed in the structure of energy efficiency program savings, but the need to deal with the dynamic nature of joint savings is new. The following scenarios give simplified examples of the practical implications of quantifying savings in this more exacting way.

Consider a scenario where a HER household installs a new lighting system on January 1st, 2009 while a control group household installs the same lighting system on December 31st, 2009. If that system saves 1kwh per day (365kWh per year), the consumption analysis will capture the

entire 365 kwh for the HER household and only one kWh for the control household. Therefore, the savings analysis will include 364 kWh due to the lighting program (365 kWh treatment minus 1 kWh control). However, the program tracking data will contain the entire yearly savings estimate for the lighting system in the treatment household and in the control household. Addressing joint savings as a pure difference in participation rates, multiplied by claimed savings, is inconsistent with the consumption analysis because it would assign zero joint savings in this scenario. Therefore, to be correct, joint savings estimates must consider the time of installation.

Consider another scenario where the HER household installs an efficient furnace on June 1st and the control group household installs an efficient furnace on September 1st. This scenario illustrates that the calculation of savings, which must start at the time of installation, must also consider the load shape of savings, or when savings occur during the measurement period. This is done using loads shapes to expand annual savings across the year. In this case, the furnace load shape reflects the fact that furnaces are not used during the summer months and therefore yield no savings during the summer. For this scenario, despite the installation of the HER furnace three months prior than the control furnace, the joint savings are negligible because the HER household furnace is not in use during those three months. In contrast, if the two furnaces were installed January 1st and April 1st, respectively, the joint savings from that period would likely approach half the annual savings for the furnace – this because almost half of the annual usage of furnace takes place during these months.

Finally, consider a scenario where an efficient furnace is installed in a HER household on June 1st and there are no efficient furnaces installed in control group households. In this scenario, all the savings generated by that furnace are joint savings. In the first calendar year, approximately half of the annual savings will count as joint savings (the first part of the heating season up through December 31st). The following year, that furnace will generate a full year of savings. In fact, that furnace will generate joint savings until it is replaced, or from the utilities perspective, until it reaches its measure life.

In reality, both HER program and control households are participating in multiple programs with multiple measures throughout each year for multiple years. The simple two-household scenarios discussed above are repeated thousands of times. They result in an ongoing stream of program savings for HER program households and control group households. The difference between these two streams (HER household savings minus control group savings) represents the joint savings that must be quantified and removed from the estimate of consumption

reduction. If the Home Energy Reports have little or no effect on adoption of PSE programs, the difference could be zero or even negative given the natural variability in the two groups[3].

4.2.3 Joint Savings for PSE Programs

The approach for quantifying joint savings depends on whether the PSE program in question is a rebate program or an upstream program. Rebate programs record savings in PSE data tracking systems. The systems track who installed what measures and the date of installation. For upstream programs, such as for CFLs, there is no customer data maintained by PSE due to the program structure (lowering the price at the point of purchase). Who installed the measures and the installation dates are unknown. Section 4.2.3.1 outlines the approach to estimate double counted savings from PSE rebate programs, and section 4.2.3.2 outlines the approach taken to estimate double counted savings from PSE upstream programs.

4.2.3.1 PSE Rebate Programs

Energy efficiency purchases that occur directly through a Puget Sound Energy rebate programs are tracked in PSE data systems. Of particular importance to the analysis of joint program savings, the tracking system includes the measure installed, yearly savings of the measure installed, household addresses for all installed rebate measures, and rebate date. For these purchases, customers receive rebates from Puget Sound Energy and those savings are credited to the PSE program providing the rebate. These programs include clothes washers, energy efficient heating systems, weatherization, etc. In these program data tracking systems, rebate program participation and associated savings are tied directly to the customer within the HER program treatment and control groups. The experimental design framework makes it possible to accurately measure any increased activity in programs by the HER program group.

The joint savings analysis calculates the stream of savings for the HER households and control group households. Savings for all measures start on the day of installation (or rebate date) and are projected forward from that day based on daily load shapes provided by PSE and measure life. At present, the measure lives for all installed measures are greater than the life of the HER program. Therefore, joint savings are savings are debited from the HER program beginning at the date of installation though the end of the three year evaluation. If joint savings continue to

[3] A more detailed explanation of joint savings is contained in a separate memo on joint savings at https://conduitnw.org/Pages/File.aspx?rid=786

be measured in future years, measure savings will continue to be projected forward up to the measure life for that measure.

4.2.3.2 PSE Upstream Programs

Upstream programs support measures with a direct buy down to promote purchases. In the case of CFL bulbs and fixtures, for example, there is a direct buy down resulting in lower prices for consumers at the point of purchase. PSE claims 24 kWh for each CFL bulb purchased through the upstream CFL program, but these savings are not tracked to individual household units[4].

To estimate joint savings associated with the upstream CFL bulb and fixture programs, KEMA utilized customer survey data. The survey was conducted to gather information on the purchase and installation of CFLs for HER program treatment and control groups in calendar year 2011. In particular, survey data on the specific store and location of a respondent's CFL purchase (bulbs or fixtures), combined with the PSE participating retailer data, was used to calculate the number CFLs from PSE participating retailers.

To develop an estimate of upstream program joint savings, KEMA first calculated the number of CFL bulbs and fixtures from participant retailers that were purchased by the HER program households and the control group households. KEMA then calculated the difference in PSE sponsored CFLs between the treatment and control group households. This determined the amount of CFL savings produced by CFLs purchased in 2011. To expand these results to all three years of the program, so as to capture ongoing savings from previous years' upstream CFL joint savings, KEMA assumed these bulbs were all installed on the first day of each program year (November 1st) and the joint savings carried forward on a load shape-weighted basis. The resulting estimates of joint savings for different time periods were then multiplied by the "savings per CFL" value of 24 kWh provided to KEMA by PSE.

[4] PSE savings claims for upstream CFL are calculated on a per purchased bulb or fixture basis. The estimate of savings incorporates an estimate installation rate. As a result, joint savings for the upstream program is calculated using the relative purchases of program CFLs between treatment and control groups.

4.3 Results

Results of the impact evaluation are first provided for calendar year 2011, followed by results from each of the three program years. These results will be used to support PSE savings claims for the HER Program. Results are also provides for the first three program years to understand program-related savings through the history of the program.

Table 4-1 provides the counts of households in each treatment category that were analyzed during this evaluation.

Table 4-1: Participating HER Households by Report Status and Mailing Frequency

	Monthly	Quarterly	Total
Current	14,128	5,569	19,697
Suspended	6,903	2,771	9,674
Total	21,031	8,340	29,371

Section 4.3.1 provides the overall savings achieved in calendar year 2011. The results include average household and total savings for continued and suspended Report groups as well as total PSE HER savings. Sub-sections discuss each of the components of the overall savings – the measured savings, the rebate program joint savings and the upstream joint savings.

Section 4.3.2 provides additional results across all program years. The remaining sections of the impact results explore the implications of monthly and quarterly mailings for savings, joint savings, and retention of savings after the suspension of the reports.

4.3.1 Calendar year 2011 Savings

Table 4-2 provides the household- and program-level savings for the HER Program for calendar year 2011. These impact results are calculated separately for continued Report households and the suspended Report households, as they represent separate treatment groups. There are three components to household level credited savings:

- **Measured Savings or Consumption reduction** is the average household difference in consumption between HER participants and the control group. It is calculated using a difference-in-differences approach that compares participants and control group consumption in the pre- and post-Report periods. The savings are highly statistically

significant for both fuels and both groups. In all cases, the one-sided 95 percent lower confidence interval does not include zero.

- **Rebate program joint savings** represent the increased activity in PSE rebate programs as a result of receiving the Home Energy Report. This is the difference in PSE rebate program savings between the two PSE HER treatment groups (continued Reports and suspended Reports) and the control group.

  The gas rebate program savings are statistically significant for both HER program treatment groups. The rebate program electric savings are not statistically significant for either group. For the current Reports treatment group, the joint savings is negative indicating that the control group has generated slightly more savings than the treatment group.

- **Upstream Program Joint savings** represent the increased use of PSE-supported CFL bulbs and fixtures as a result of receiving the Home Energy Report. This is the difference in PSE upstream program savings between the two PSE HER treatment groups (continued Reports and suspended Reports) and the control group. Joint upstream savings is positive for both groups, but neither estimate is statistically significant.

Table 4-2: Calendar Year 2011 HER Savings

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Per Household Measured Savings	278.4 (241.00 , ∞)	12.9 (10.34 , ∞)
	Per Household Joint Rebate Program Savings	-0.3 (-3.37 , ∞)	1.3 (0.78 , ∞)
	Per Household Joint Upstream Savings	2.3 (-69.72 , ∞)	n/a
	Per Household Savings, Joint Savings Removed	276.4 (195.38 , ∞)	11.6 (9.05 , ∞)
	Total Group Credited Savings	5,443,983 (3,848,433 , ∞)	228,479 (178,298 , ∞)
Suspended Reports	Per Household Measured Savings	208.1 (159.88 , ∞)	12.0 (8.65 , ∞)
	Per Household Joint Rebate Program Savings	0.5 (-3.52 , ∞)	1.0 (0.34 , ∞)
	Per Household Joint Upstream Savings	43.3 (-22.65 , ∞)	n/a
	Per Household Savings, Joint Savings Removed	164.3 (82.71 , ∞)	10.9 (7.62 , ∞)
	Total Group Credited Savings	1,589,582 (800,117 , ∞)	105,554 (73,744 , ∞)
Total Program Credited Savings		7,033,565 (4,866,495 , ∞)	334,033 (267,373 , ∞)

These components are combined regardless of whether the joint savings components are statistically significant individually. For average per household credited electric savings, rebate and upstream joint savings are subtracted from the measured savings derived by the consumption analysis. For average per household credited gas savings, rebate joint savings are subtracted from the measure savings derived by the consumption analysis. Per household credited savings are expanded to the full populations for the continued and suspended Report groups using the counts from section 4.3. Total program savings are the combination of the continued and suspended Report group savings.

Table 4-3 summarizes the HER program results with respect to average consumption. The continued treatment group produced credited savings at 2.6 and 1.3 percent for electric and gas, respectively. The suspended treatment group produced credited at 1.6 and 1.2 percent, for electric and gas, respectively.

Table 4-3: Calendar Year 2011 HER Savings
Credited Savings (Joint Savings Removed) as a Percent of Consumption

Her Treatment Group	Electric			Gas		
	Consumption*	kWh	Percent	Consumption*	kWh	Percent
Continued Reports	10,596	276.4	2.6%	920	11.6	1.3%
Suspended Reports		164.3	1.6%		10.9	1.2%

*Control Group calendar year 2011 consumption

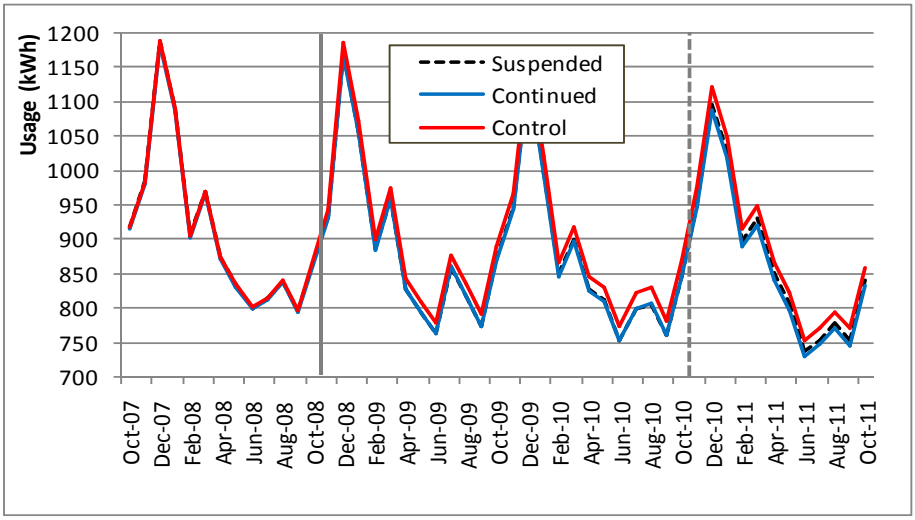
4.3.1.1 HER Program Measured Savings

Measure Savings represents the difference in consumption between the HER program treatment groups and the control group. The following figures are designed to put 2011 measured savings into the context of measured consumption through the three years of the program.

4.3.1.1.1 Treatment and Control group Consumption

Figure 4-1shows electric consumption starting a year prior to the Program period (up to October 2008) and covering the first three years of the Program thereafter. The first year displayed in the figure (October, 2007 to October 2008), is the pre-Program period. In this period the treatment and control groups are expected to be statistically identical and they appear effectively identical in the plot.

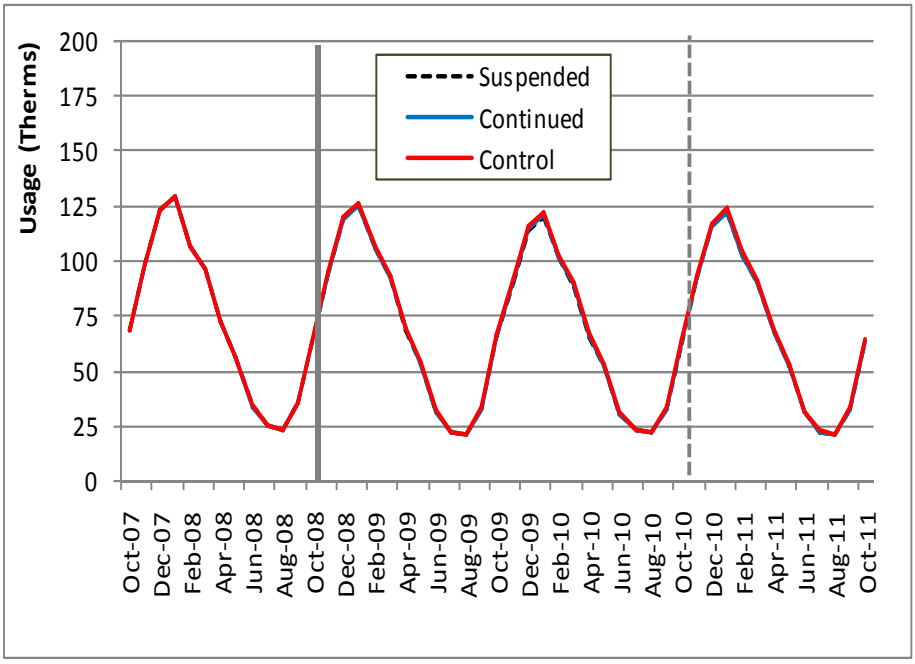
Figure 4-1: Monthly Electric Consumption
Control Group and Continued and Suspended Treatment Groups



After October, 2008, the control group consumption is clearly higher than treatment group consumption in every month. Continued and suspended treatment groups are statistically identical through this period. After October 2010, the suspended Report treatment group came into existence. As expected, the suspended Report treatment group consumption is higher than the continued Report treatment group, moving upwards slightly toward the control group consumption.

Figure 4-2 shows the same plot for gas consumption. It shows gas consumption starting a year prior to the Program period (up to October 2008) and covering the first three years of the Program thereafter. The transition to the lower HER program-related consumption for the treatment groups is more difficult to illustrate in the gas figure because gas savings is a smaller percent of consumption and gas consumption varies so much from month to month range of the Y-axis must be wide. The figure does, however, illustrate gas consumption for typical control and treatment groups.

Figure 4-2: Monthly Gas Consumption
Control Group and Continued and Suspended Treatment Groups

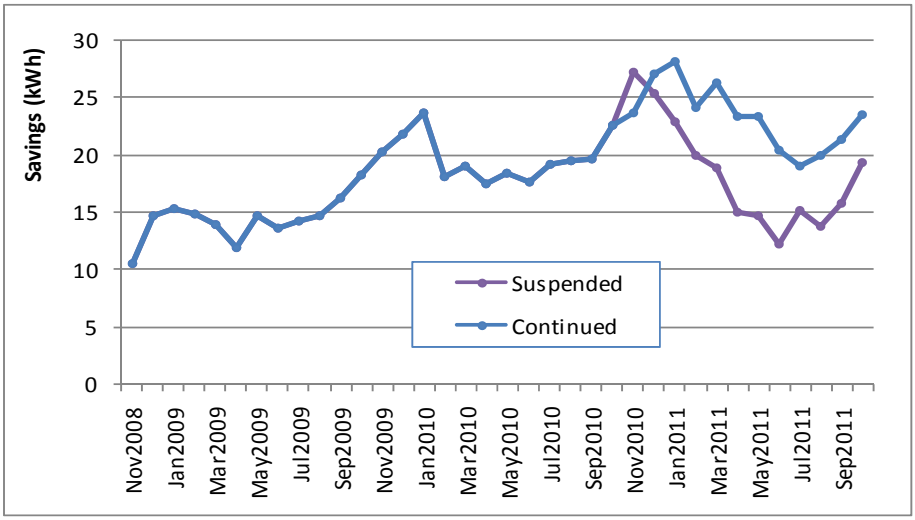


4.3.1.1.2 Monthly measured savings

Figure 4-3 provides a plot of the measured savings for continued and suspended treatment groups. The plot captures the differences in consumption between the treatment and control

groups illustrated in Figure 4-1 during the program period. All report recipients are in the continued treatment group for the first two years. The suspended group is plotted separately after October, 2010. The program savings are statistically significantly different than zero across all months. Year over year, there is an increase in savings through all three years of reported savings.

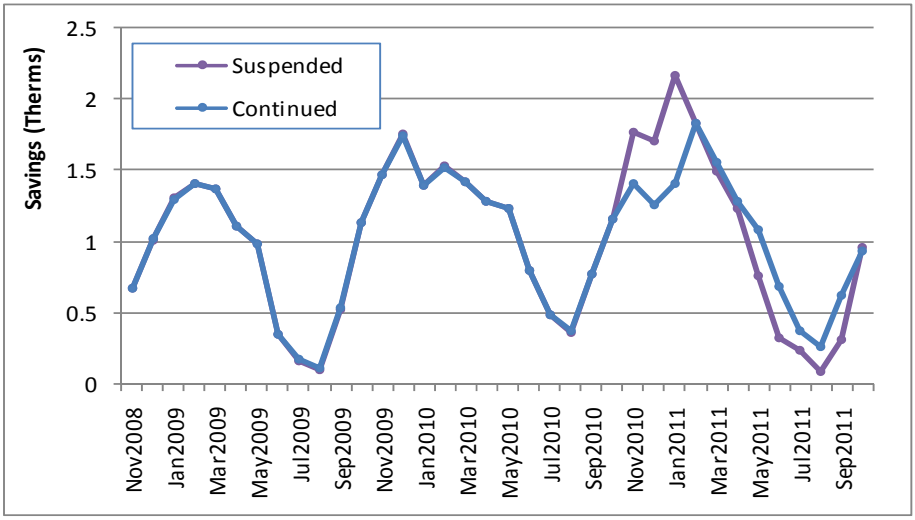
Figure 4-3: Monthly Electric Measured Savings



The monthly savings estimates diverge in November 2010 reflecting the subset of treatment households for which the mailing of Reports was suspended. On an annual basis, the third year difference between the continued and suspended Reports group's savings are statistically significant at a 90 percent confidence level(Section 4.3.1.1.3).

Figure 4-4 provides a plot of the monthly difference in therm consumption between the treatment and control groups. Once again, all report recipients are in the continued treatment group for the first two years. The suspended group is plotted separately after October, 2010. As with consumption, the measured savings is highly seasonal.

Figure 4-4: Monthly Gas Measured Savings

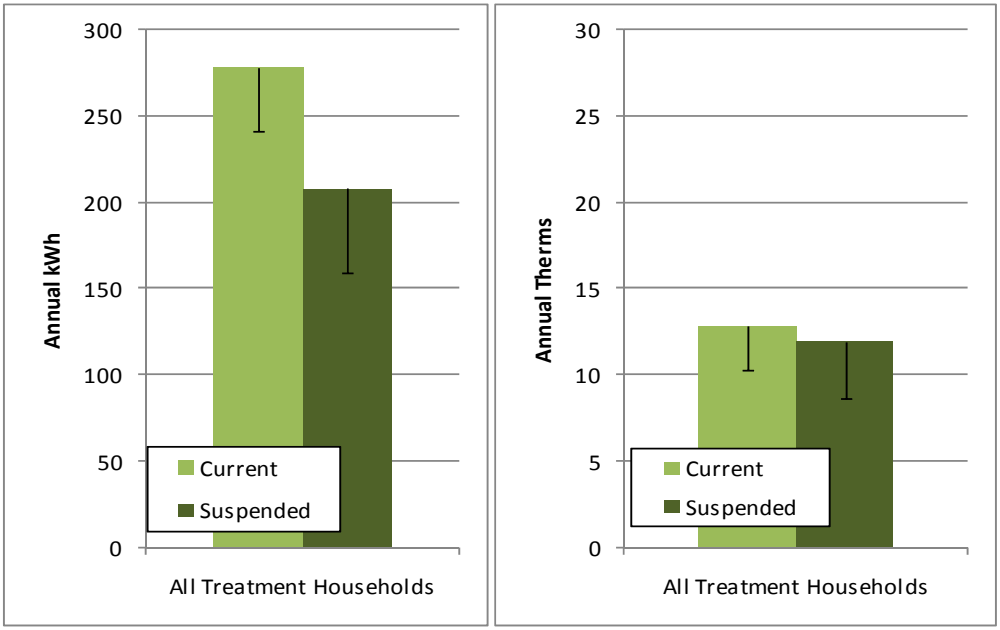


The program savings are statistically significantly different than zero across most months. During the summer periods both gas consumption and savings are lower and as a result the difference from zero is also smaller.

4.3.1.1.3 Continued vs Suspended Reports Annual Savings

Figure 4-5 summarizes the calendar year 2011 measured savings for the continued and suspended treatment groups. Savings for both the suspended and continued report groups are significantly different than zero, using a 95 percent one-tail test.

Figure 4-5: Average Annual Savings Continued vs. Suspended Treatment Groups



On the electric side, the savings for the suspended group are approximately 25% lower than those of the continued group, and the savings between those two groups is statistically significant at the 90% level. Although suspended households saved 7% fewer therms in 2011 than the homes which continued to receive reports, there is no statistical difference in gas savings between the suspended and continued groups in 2011.

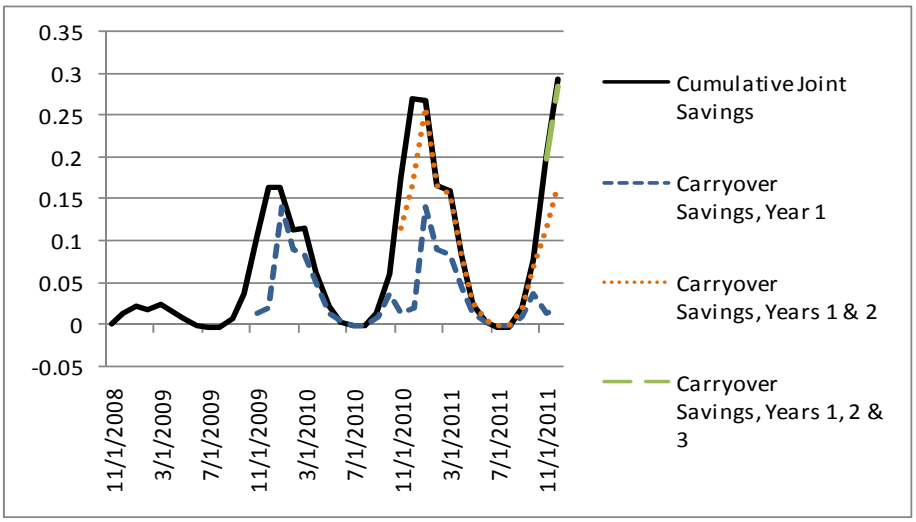
4.3.1.2 2011 Program Joint Savings

4.3.1.2.1 PSE Rebate Program Joint Savings

As discussed in section 4.2.3.1, joint savings are the difference between the dynamic flows of savings from the treatment and control groups. These plots are designed to illustrate the ongoing flow of savings over time. Where the underlying dynamic is simple, (eg. consistently increasing savings), these plots are relatively easy to understand. Where the savings are more variable, the visual representation is more challenging to interpret.

Joint gas savings for the continued treatment group have increased consistently and thus provide a relatively simple plot of the savings flows. Figure 4-6 provides monthly gas joint savings for the continued reports treatment group.

Figure 4-6: Monthly Gas Joint Savings for the Continued Reports Treatment Group



The solid black line traces the total monthly joint savings over the first three years and two months of the program. During the first year of the program, the monthly joint savings line only reflects the joint savings generated by measures installed during the first year of the program. After the first year, those first year measures continue to produce savings for each of the subsequent years, as captured by the blue dashed line and referred to as carryover savings. The first year savings (solid line in the first year) are less than the subsequent year carryover savings (blue dashed line) because the measures were installed throughout the year and the relative levels of installation in the treatment and control groups. For this plot, first year joint savings are fixed after the end of the first year. Those first year joint savings have a monthly load shape and will generate those savings until reaching their measure lives.

Table 4-4 provides the associated annual breakouts of joint savings. The joint savings in the first year only amounted to 0.15 therms per household because of when the occurred. On a full year basis, those first year savings represented 0.45 therms per household and those savings are carried forward for each year through the timeframe of the is evaluation.

Table 4-4: Annual Gas Joint Savings for the Continued Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.15		
PY2	0.83	0.45	
PY3	1.25	0.45	1.06
2011	1.30	0.45	1.06

In the second year of the program, still more additional measures were installed by the treatment group. The increase from the carryover first year savings (blue dashed line) to the cumulative joint savings (solid black line) shows the joint savings from the additional measures installed in the second year. These second year joint savings will also carry forward into the third year. The carryover from first and second year savings combined are represented by the dotted orange line.

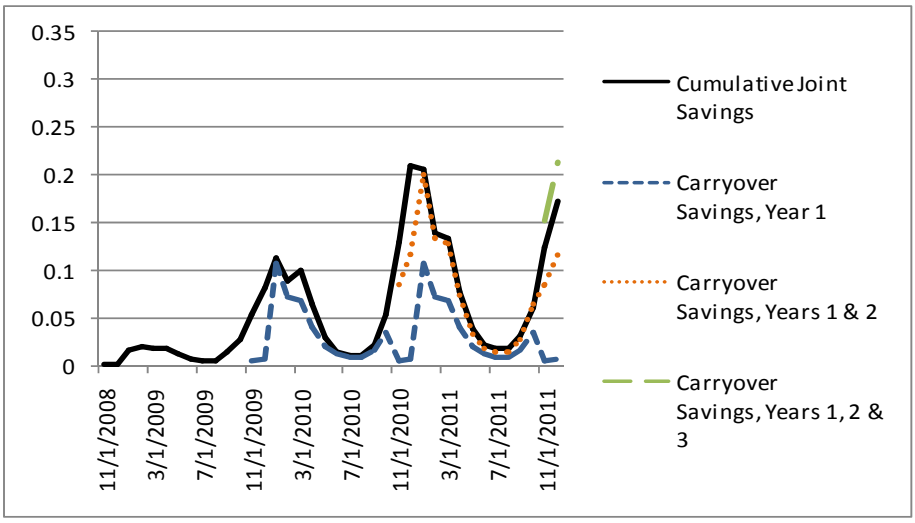
In annual terms, total joint savings in year two was 0.83 therms per household. Of that, 0.45 was carryover from year one. In the third year, first and second year carryover savings represented 0.45 and 0.61 therms per household, respectively, or a total carryover savings of 1.06 therms per household.

Figure 4-6 nicely illustrates the way joint savings carry forward. When additional joints savings are generated every year, the prior year joint savings provide the baseline from which additional savings grow.

Figure 4-7 shows the same gas joint savings plot for the suspended treatment group. While this plot is, as expected, similar to the previous plot for the first two years, the magnitude of savings is smaller than that of the continued savings group through the period. These differences are

not statistically significant but make it difficult to identify lower savings as the effects of the suspension of Reports in the third year.

Figure 4-7: Monthly Gas Joint Savings for the Suspended Reports Treatment Group



The last two months of the plot provide some suggestive evidence that joint savings are dropping for the suspended treatment group. The total monthly joint savings (solid black line) drops below the expected carryover from the first three years of joint savings (dashed green). This indicates that, during this period, joint savings are actually dropping indicating greater control group than suspended treatment group program activity.

Table 4-5 gives the annual gas joint savings for suspended treatment group.

Table 4-5: Annual Gas Joint Savings for the Suspended Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.15		
PY2	0.64	0.40	
PY3	1.09	0.40	0.91
2011	1.04	0.40	0.91

The electric joint savings plots (Figure 4-8 and Figure 4-9) and annual joint savings results (Table 4-6 and Table 4-7) illustrate the lack of meaningful electric joint savings. There is no clear trend in savings and scale is extremely small at a fraction of a kWh.

Figure 4-8: Monthly Electric Joint Savings for the Continued Reports Treatment Group

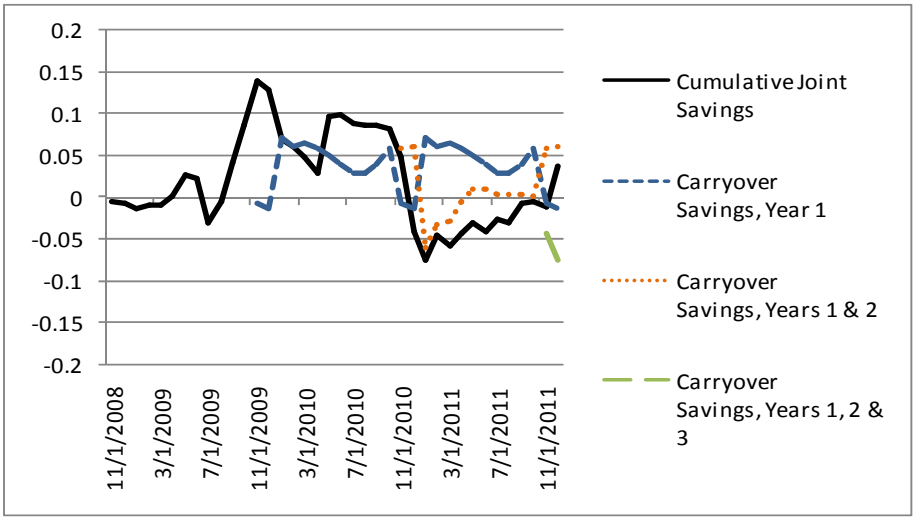


Table 4-6: Annual Electric Joint Savings for the Continued Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.10		
PY2	1.01	0.48	
PY3	-0.36	0.48	0.02
2011	-0.34	0.48	0.02

Figure 4-9 : Monthly Electric Joint Savings for the Suspended Reports Treatment Group

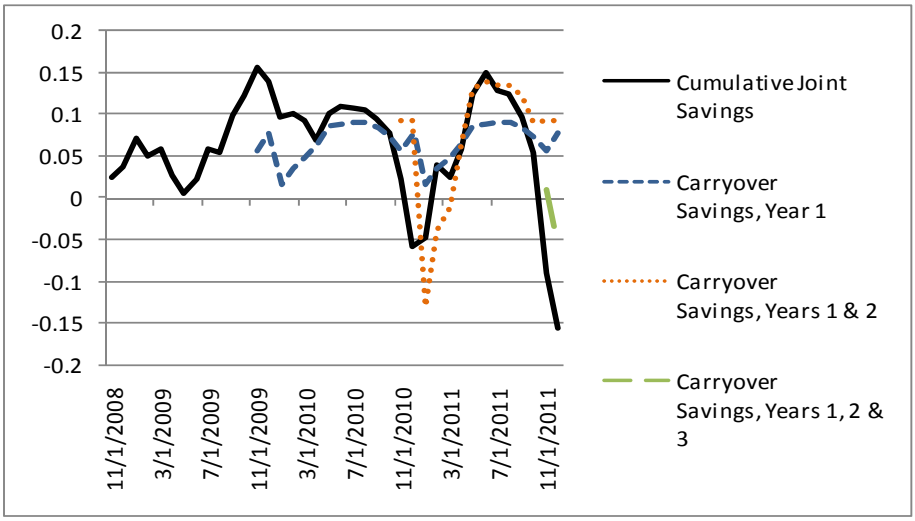


Table 4-7: Annual Electric Joint Savings for the Suspended Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.63		
PY2	1.25	0.82	
PY3	0.72	0.82	0.83
2011	0.51	0.82	0.83

4.3.1.2.2 PSE Upstream Programs

Table 4-8 provides the estimates of CFL purchases for the survey sample of the continued report treatment and the control group households. The difference between the savings resulting from participation in the CFL program, between the continued group and the control group, is a fraction of a single light bulb. The number of CFL fixtures purchased or installed was small compared to CFL bulbs; though, in terms of percentages, the differences are bigger. None of the differences are statistically significantly different from zero.

Table 4-8: Continued Report Treatment Group CFL Bulb and Fixture Counts

Average # per household	Control Group	Current Treatment Group	Joint Bulbs or Fixtures (T - C)	Confidence Interval*
Program CFL Bulbs				
Purchased	5.97	5.94	-0.03	(-0.97 , ∞)
Installed	4.01	4.12	0.12	(-0.55 , ∞)
Total CFL Bulbs				
Purchased	7.22	7.22	0.00	(-0.98 , ∞)
Installed	4.85	5.00	0.15	(-0.55 , ∞)
Program CFL Fixtures				
Purchased	0.09	0.15	0.06	(-0.08 , ∞)
Installed	0.08	0.09	0.01	(-0.08 , ∞)
Total CFL Fixtures				
Purchased	0.17	0.20	0.03	(-0.13 , ∞)
Installed	0.14	0.14	0.00	(-0.12 , ∞)

Survey Responses: Control Group counts range from 443 to 488; Continued Participant counts,from 336 to 365

The key values are difference in the purchased CFL bulb and fixtures. PSE upstream savings are assigned per purchased bulb which means the 24 kWh value already incorporates an implied installation rate. Because installation and location are challenging information for a survey recipient to provide, we report results for purchased and installed and for both program-supported and for all bulbs and fixtures. The results are consistent across purchased and installed bulbs as well as program-supported and all bulbs.

Table 4-9 provides the same results for the suspended treatment group. The estimate of upstream joint savings is actually higher than for the suspended group. Though, consistent with the continued treatment group findings, none of the results for the suspended group were statistically different than zero.

Table 4-9: Suspended Report Treatment Group
CFL Bulb and Fixture Counts

Average # per household	Control Group	Suspended Treatment Group	Joint Bulbs or Fixtures (S - C)	Confidence Interval*
Program CFL Bulbs				
Purchased	5.97	6.54	0.57	(-0.30 , ∞)
Installed	4.01	4.48	0.47	(-0.16 , ∞)
Total CFL Bulbs				
Purchased	7.22	7.61	0.40	(-0.51 , ∞)
Installed	4.85	5.24	0.39	(-0.29 , ∞)
Program CFL Fixtures				
Purchased	0.09	0.09	0.00	(0.00 , ∞)
Installed	0.08	0.08	0.00	(-0.08 , ∞)
Total CFL Fixtures				
Purchased	0.17	0.13	-0.04	(-0.14 , ∞)
Installed	0.14	0.12	-0.02	(-0.11 , ∞)

Survey Responses: Control Group counts range from 443 to 488; Suspended Participant counts,from 442 to 485

These findings represent savings of CFLs installed during calendar year 2011. From the survey data, we know when during the year CFLs were purchased. To simulate CFL joint savings through the program period, we must expand 2011 savings to all program years. To do this we assume that all CFLs were purchased on the first day of the program year, and that purchases have been steady each year the program period.

This approach implies a constant but lo-level trend, and is supported by the pattern of joint savings produced by the electric rebate program. Electric joint savings have remained very small with no apparent trend through the duration of the program.

4.3.2 Yearly Program Results

This section uses results from the site-level modeling approach to compare HER savings across the three years of the program, using weather normalized data. These figures remove the effects of weather thus making it possible to discern trends across the three years.

Figure 4-10 shows the normalized consumption reduction of households receiving the Report across the three years of the HER program. The first two years include the full HER treatment

group. Only the continue Report group is included for year three. All three years for both gas and electric are clearly statistically different from zero.

Figure 4-10: Normalized Measured Savings over Three Program Years

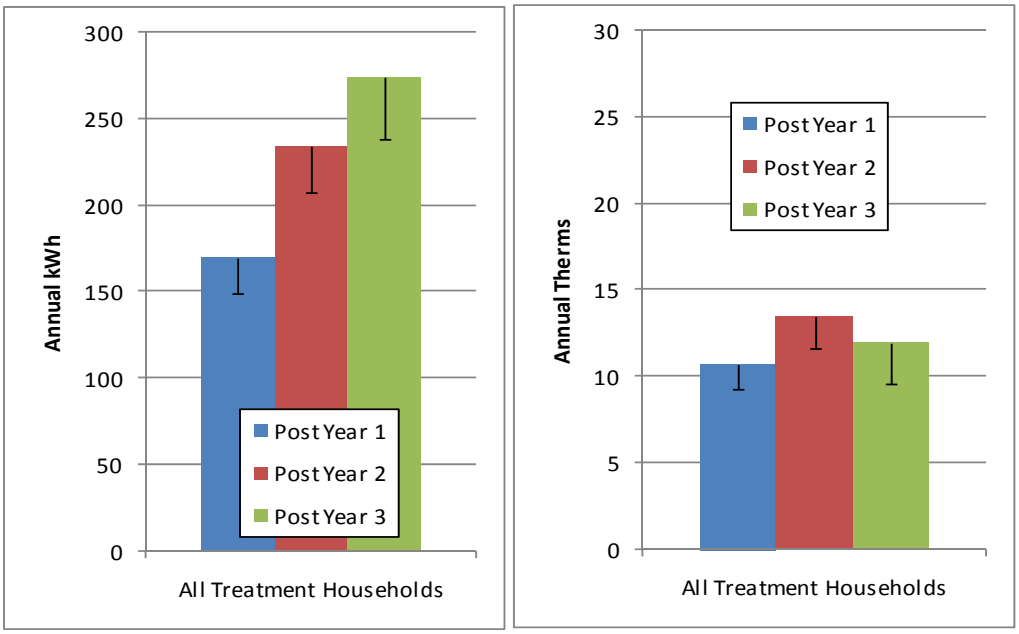


Figure 4-10 illustrates the change from year to year over the three years of the program. Electric measured savings show a clear upward trend across the three years with an apparent slowing down in the increase from year two to year three. Statistical significance tests are not able to confirm all of these observations. The difference between the first and second year is statistically significant at a 95 percent confidence level. This is not the case for the difference between the second and third year[5]. The real question is at what level will electric savings level off.

Gas savings demonstrate a less dramatic trend than electric savings. The decrease between years two and three is small and not statistically significant. However this could indicate that HER related gas savings have already reached a plateau.

Figure 4-11 shows the third year results from Figure 4-10 and adds the estimated consumption reduction of the suspended Report households. The reduction in electric savings is statistically

[5] In addition to the smaller increment, the standard errors are higher for year three because of the split of the treatment group into continued and suspended Report groups.

significant at the 90 percent confidence level while the gas reduction is not statistically significant.

Figure 4-11: Normalized Consumption Reduction, Continued vs Suspended Reports

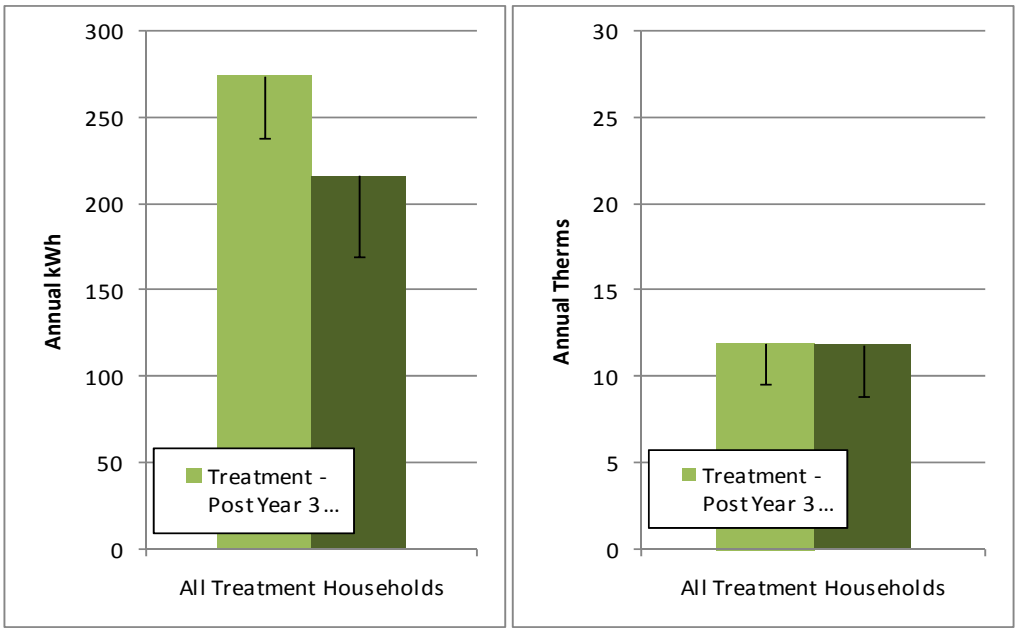


Table 4-10 provides the tabular results for that last two figures. Confidence intervals are one-side, 95 percent confidence intervals.

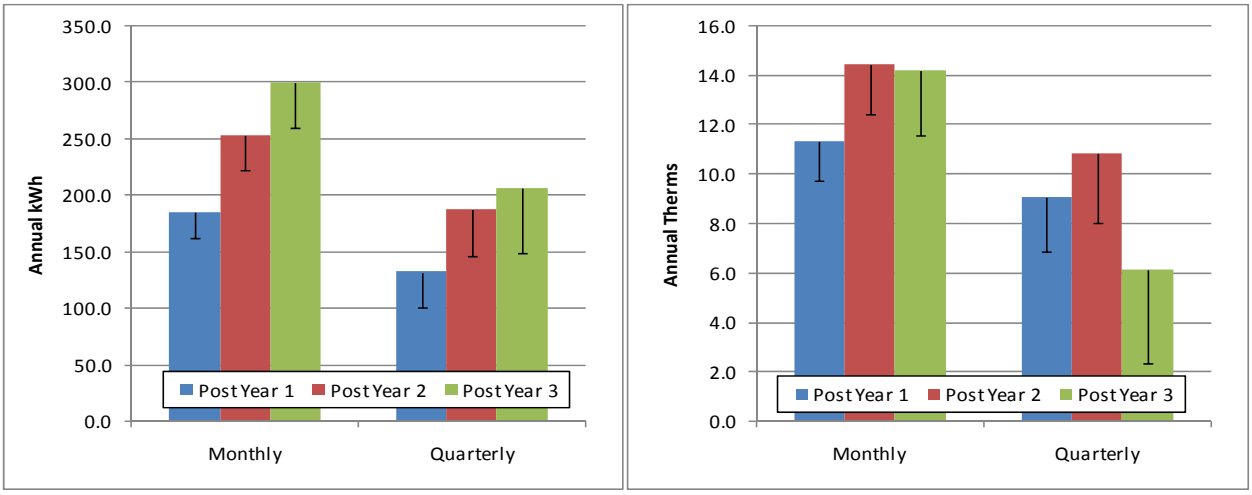
Table 4-10: PSE HER Program per Household Weather Normalized Savings

Year and Group	Electric (kWh)	Therms (therms)
Year 1	169.7 (149.70 , ∞)	10.7 (9.27 , ∞)
Year2	234.5 (207.25 , ∞)	13.5 (11.61 , ∞)
Year 3 - Continued	274.2 (238.01 , ∞)	11.9 (9.59 , ∞)
Year 3- Suspended	216.4 (169.77 , ∞)	11.9 (8.85 , ∞)

Figure 4-12 provides the same results as Figure 4-10, but separates the consumption reduction estimates for households that received monthly and quarterly reports. The separate monthly and quarterly year results are still individually statistically significant. These figures also illustrate the different savings levels over the three years for monthly and quarterly reports for each fuel. For measured electric savings, the quarterly HER group savings are lower than the monthly HER groups savings for all three years. These differences are statistically significant at a 95 percent confidence level. Quarterly Report group measured gas savings are also

consistently lower than the monthly Report group savings. For gas savings, only the difference in year three is statistically significant.

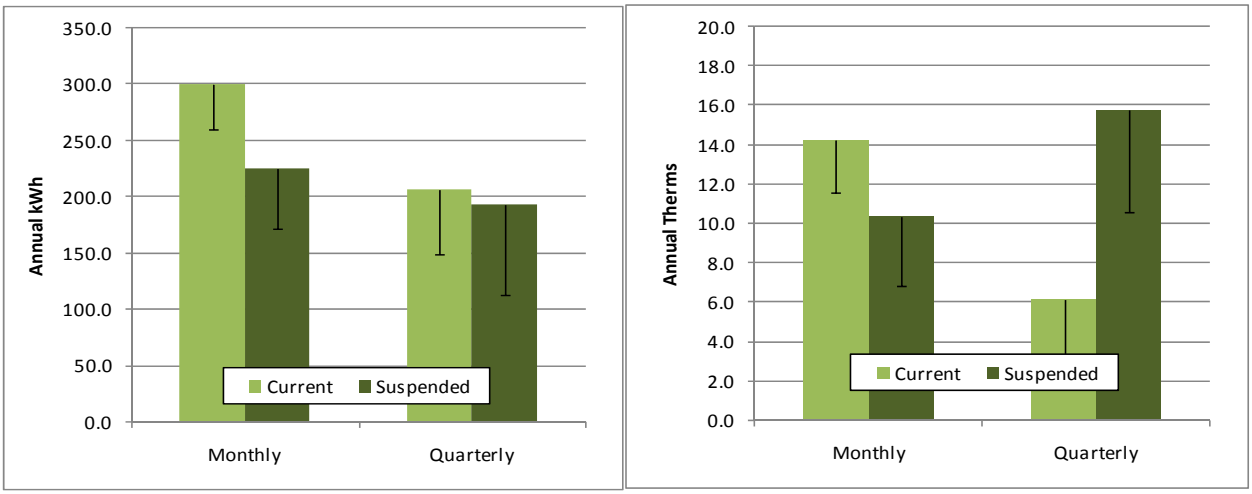
Figure 4-12: Normalized Consumption Reduction over Three Program Years, Monthly vs Quarterly



Looking past statistical significance at point estimate trends offers some tentative insights. In addition to the general reduction in savings, it appears that the change over time may also differ. The rate of increase in electricity consumption reduction for quarterly Report households appears to be slowing compared to the monthly Report households. Gas consumption reduction remained steady in the third year for households receiving monthly Reports and dropped by a statistically significant margin in the third year for households receiving Quarterly Reports.

Figure 4-13 provides the third year results for both electric and gas with the suspended treatment household results included. The electricity measured savings results generally conform to expectation, with suspended treatment households generating fewer savings than continued treatment households. The monthly report household difference is statistically significant at the 90 confidence level. Though the quarterly electric difference is not statistically significant, the decrease in quarterly report household savings is smaller than the decrease for monthly report household savings. It is not surprising that quarterly report household have greater staying power in the short run, because those savings were established with less frequent treatment all along. If the quarterly report households continue to maintain savings levels in the second year of suspended reports, relative to the monthly report households, this will bolster the overall cost-effectiveness of the quarterly reports approach.

Figure 4-13: Normalized Consumption Reduction In Year 3
Continued vs Suspended Reports, Monthly vs Quarterly



The monthly gas results are similar to the electric monthly results. The reduction is savings is not statistically significant but shows an approximately 30 percent reduction. The quarterly gas results appear anomalous and are also not statistically significant. The quarterly suspended treatment group is relative small which may explain the unexpected result.

Table 4-11 provides the tabular results for that last two figures. Confidence intervals are one-side, 95 percent confidence intervals.

Table 4-11: PSE HER Program per Household Weather Normalized Savings, Monthly and Quarterly Reports

Report Frequency	Year and Group	Electric (kWh)	Gas (therms)
Monthly	Year 1	184.6 (162.46 , ∞)	11.3 (9.76 , ∞)
	Year2	253.0 (222.99 , ∞)	14.5 (12.46 , ∞)
	Year 3 - Continued	300.6 (260.11 , ∞)	14.2 (11.60 , ∞)
	Year 3- Suspended	225.7 (172.29 , ∞)	10.3 (6.85 , ∞)
Quarterly	Year 1	132.3 (101.50 , ∞)	9.1 (6.89 , ∞)
	Year2	187.9 (145.84 , ∞)	10.9 (8.03 , ∞)
	Year 3 - Continued	207.0 (148.37 , ∞)	6.1 (2.35 , ∞)
	Year 3- Suspended	193.3 (112.81 , ∞)	15.8 (10.59 , ∞)

4.3.3 Impact Results Summary

The impact results are summarized separately for calendar year 2011 and for the three year program evaluation.

4.3.3.1 Calendar Year 2011 Impact Results Summary

Both continued and suspended treatment groups generated statistically significant energy savings in calendar year 2011. Table 4-12 summarizes the household level measured savings generated by the HER program and the savings credited to the program after removing joint savings claimed by other PSE programs.

Table 4-12: Calendar Year 2011 PSE HER Program per Household Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Measured Savings	278.4 (241.00 , ∞)	12.9 (10.34 , ∞)
	Credited Savings	276.4 (195.38 , ∞)	11.6 (9.05 , ∞)
Suspended Reports	Measured Savings	208.1 (159.88 , ∞)	12.0 (8.65 , ∞)
	Credited Savings	164.3 (82.71 , ∞)	10.9 (7.62 , ∞)

Table 4-13 summarizes the HER program results with respect to average consumption for participating households. The continued treatment group produced credited savings at 2.6 and 1.3 percent for electric and gas, respectively. The suspended treatment group produced credited at 1.6 and 1.2 percent, for electric and gas, respectively.

Table 4-13: Calendar Year 2011 PSE HER
Credited Savings (Joint Savings Removed) as a Percent of Consumption

Her Treatment Group	Electric			Gas		
	Consumption*	kWh	Percent	Consumption*	kWh	Percent
Continued Reports	10,596	276.4	2.6%	920	11.6	1.3%
Suspended Reports		164.3	1.6%		10.9	1.2%

*Control Group calendar year 2011 consumption

Table 4-14 summarizes the total program savings for all households in the two treatment groups and for the full program.

Table 4-14: Calendar Year 2011 Final PSE HER
Overall Program Credited Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Total Group Credited Savings	5,443,983 (3,848,433 , ∞)	228,479 (178,298 , ∞)
Suspended Reports	Total Group Credited Savings	1,589,582 (800,117 , ∞)	105,554 (73,744 , ∞)
Total Program Credited Savings		7,033,565 (4,866,495 , ∞)	334,033 (267,373 , ∞)

Other calendar year 2011 findings:

- Table 1-2 reports the relative levels of continued and suspended treatment group saving for both measured and credited savings.
    - For measured savings suspension of reports resulted in a decrease in savings of 25 and 7 percent for electric and gas, respectively. The electric difference was statistically significant at the 90 percent confidence level while the gas difference was not.
    - For credited savings, the suspension of reports resulted in a decrease in credited savings (measured savings with joint savings removed) of 41 and 6 percent for electric and gas, respectively. Neither of these differences was statistically significant due to the additional variability from the incorporation of the joint savings estimates
- The HER Reports increased savings produced by gas measures from rebate programs. For the continued group, 10 percent of measured savings was due to participation in other PSE programs. For the suspended group, 9 percent of the measured savings was due to participation in other program. Both gas joint savings estimates were statistically significant. Neither electric joint savings estimate was statistically significant.
- The HER Reports did not increase savings produced by electric measures from rebate programs. Less than one percent of measured savings was due to participation in other PSE programs for both treatment groups. Neither estimate was statistically significant.

- Upstream CFL program joint savings were not statistically significant. Survey results indicated that suspended treatment households purchased about a half bulb more of program CFLs than the control households. Expanded to three years, this amounted to 43 kWh in joint savings for the upstream CFL programs for this group. Upstream joint savings was only 2 kWh for the continued treatment group.

4.3.3.2 Three Year Impact Evaluation Findings

The PSE HER Program generated statistically significant savings for all three years. The suspended group, which did not receive reports in year three continued to generate savings even without the report.

The weather normalized electric results show savings increasing each year, although the savings appear to be increasing at a slower rate between years two and three. Weather normalized gas results show gas savings increasing from year one to year two but dropping slightly in the third year.

The normalized, third year results indicate a more moderate effect of suspension of the reports on savings. Suspending Home Energy Reports lowered measured savings in the first year post suspension by 21 and 0 percent for electric and gas, respectively. The electric result was statistically significant at the 90 percent confidence level. The difference between these results and the 2011 results is primarily explained by the different time period. The third year results look at the first 12 months of report suspension (November, 2010 to October, 2011), whereas the 2011 results look at months three through thirteen.

The three year impact evaluation also considered the differences between monthly and quarterly mailings across the three year. Less frequent quarterly reports continue to generate fewer savings than monthly reports in the third year. In addition, visual evidence suggests that the quarterly reports may also level out and/or decline sooner than the monthly reports. When reports were suspended, households receiving monthly reports reduced electric savings more than household receiving quarterly reports. Gas results were inconclusive.

5. Behavioral and Process Evaluation

The behavioral and process evaluation examined the nature and extent of the influence of the Home Energy Reports on household energy-related purchases and behaviors, through a customer survey. The principal research objectives were to:

- Assess effects of the HER program on self-reported purchase/installation of energy efficient equipment or measures, with a focus on non-program purchases[6].
- Assess effects of the HER program on household energy saving behaviors
- Assess customer response to HER reports.

The behavioral and process evaluation leverages the extensive customer surveys that were required to quantify the upstream program joint savings for the impact evaluation. The behavioral portion of the survey expands the attempt to quantify upstream joint savings to the full range of energy-related behaviors. At the highest level, the behavioral and process evaluation attempts to answer the question, "Where do HER Program savings come from?"

The survey, performed early in the fourth program year, asked respondents about purchases and behaviors that took place during the preceding year, approximately calendar year 2011. This limited timeframe for the survey questions was necessary for the sake of respondent recall. As the results are developed, it's important to remember the limited one year timeframe in the program's third year. By the third year of a HER-type program, savings are generally starting to level off. Purchases and behaviors that produced the savings may also be leveling off, or alternatively, becoming unremarkable. This makes it more difficult to distinguish purchases and behaviors in general and more difficult to establish whether the responses truly represent the actions that produced the savings.

[6] With the exception of CFL bulbs and fixtures, PSE tracking data was used to identify installations of efficient equipment inside of PSE programs. Therefore, the survey focused on non-program purchases and installations as well as installation and purchases of CFLs and Fixtures inside of PSE programs.

5.1 Overview of Approach

To address the Behavioral and Process evaluation objectives, KEMA conducted a customer survey of households from the HER Program, as described in section 3.1.2. In the analysis of survey data, we compared the survey responses across the following groups of households:

- **Control group** (never received Home Energy Reports)
- **Continued treatment group** (received Reports continuously since start of program)
- **Suspended treatment group** (received Reports in Year 1 and Year 2 but stopped receiving that at start of Year 3)

The evaluation team compared the continued treatment group to the control group to assess differences in household purchases and behaviors associated with ongoing receipt of the Home Energy Reports. We also compared the suspended treatment group to the control group to assess whether there are sustained effects after the reports are discontinued. Finally, where relevant, we note the differences between the continued and suspended report groups. In general, the continued and suspended groups represent two different levels of treatment. Because both groups continued to generate savings in year three and because of the general challenge of establishing any link between purchases/behaviors and savings, the first step is identify whether either group shows evidence of purchases and behaviors that support the observed savings.

Consistent with the research objectives, analysis of survey data is organized into the following sections:

- **Energy efficient purchases** (Section 5.2) – Distinct actions involving payment of money for an item that have an associated stream of energy savings resulting from that single action.
- **Energy related behaviors** (Section 5.3), including**:**
    - **Measure-related behaviors** -- Actions or installations with a measure specific component, which may add a degree of persistence to the behavior (e.g. “insulate hot water pipes”).
    - **Energy saving behaviors** -- Ongoing behavioral choices (e.g. “regularly turn down heat at night”).
- **Response to Home Energy Reports** (Section 5.4)

This section also looks at differences in the level of non-energy efficient purchases as well as whether purchases were replacement of existing measures or additional purchases. These results combine with the energy-efficiency related purchase data to give a more refined picture of the effect of energy-related behaviors on energy consumption. A key finding is that consumer behavior is more than a matter of choices between options (energy efficient or not). It may be just as much about the choice of whether to purchase at all.

5.2 Energy Efficient Purchases

This section reports the findings of the survey research regarding the question as to whether HER participants purchased more energy efficient measures outside of rebate programs than the control group.. This is a key hypothesis regarding how HER participants generate savings. It is particularly important because of the implications for the retention of savings with or without the reports. Equally important, understanding retention of savings due to hard measure installations allow us to more easily understand persistence of savings from behaviors.

In addition to discussing household purchases, this section will discuss the effect of replacing old energy-related equipment with new equipment versus the addition of a completely new energy-related measure on household consumption. Replacing existing measures with even a standard efficiency unit can generate substantial savings. This is particularly true for some of the higher energy using measures in the household like furnaces and refrigerators. The improvements in standard efficiency units are such that simply an increase in the replacement rate among HER program participants would generate savings. On the other hand, additional measures, whether energy efficient or not, will increase household consumption effectively undermining savings. Electronic purchases are the best example of this scenario. Additional TVs and computers will increase household consumption whether they are energy efficient or not.

5.2.1 Approach

To examine the influence of the HER program on household decisions to purchase or install energy efficiency measures, we compared differences between continued treatment, suspended treatment and control groups in the proportion of households reporting the purchase/installation of specific energy-using equipment and energy efficiency measures. For each item, the survey asked whether the item purchased/installed was PSE rebated energy efficient equipment, a non-program (non-rebated) energy efficient measure, or something else (i.e. not identified as energy efficient). We examined the frequency of these three outcomes across the three groups.

In addition, for key measures we asked if a non-energy efficient measure purchase was a replacement or additional purchase.

Table 5-1 presents the list of measures which were asked about during the survey, by measure type.[7]

Table 5-1: Measures Included in Purchase/Installation Analysis

Measure Type	Specific Measures Examined
Heating and Cooling	Furnace, boiler, Central air conditioner, Room air conditioner, Air source heat pump, Geothermal heat pump, Ductless heat pump
Water Heater	Storage tank water heater, Tankless water heater
Appliances	Refrigerator, Freezer, Clothes washer, Clothes dryer, Dishwasher, Dehumidifier
Consumer Electronics	Television, Computer, Computer monitor, Digital video recorder (DVR)
Insulation	Attic insulation, Wall insulation, Floor insulation, Insulation of ducts in unheated spaces

To make the overall length of the survey feasible, not all respondents were asked all questions. The following table summarizes the number of completed surveys for each area.

Table 5-2: Survey Complete Counts for Measure Categories

Survey Section	Continued Treatment	Suspended Treatment	Control
CFL (All)	373	494	502
Heating	220	259	254
Cooling	211	240	255
Lighting (non-CFL)	229	233	256
Water Heating	229	233	256
Appliance	244	256	239
Electronics	229	233	256

[7] The analysis of CFL purchases is presented in the Impact Evaluation results.

The survey asked respondents to report on purchases or installations of energy efficient equipment during calendar year 2011.

5.2.2 Results

Figure 5-1 provides a high-level summary of measure category results. Relative results are presented on left side of the figure and absolute results are presented on the right side.

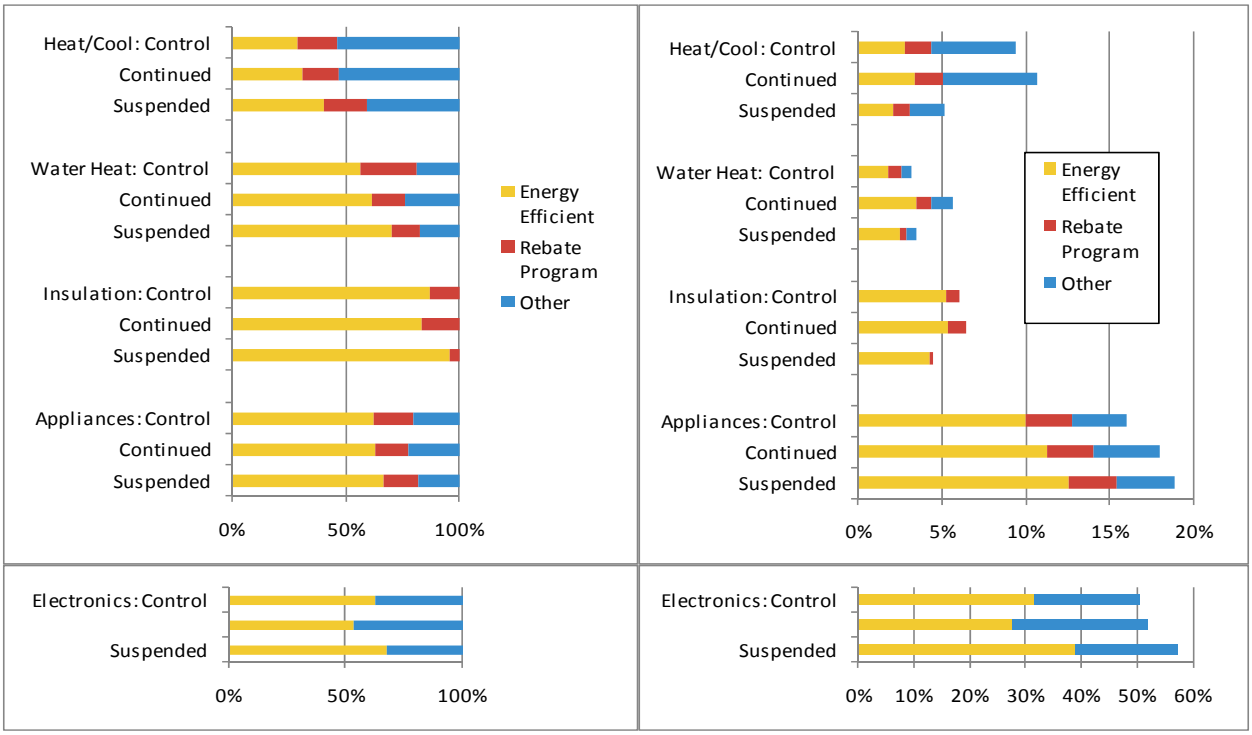
- The results are grouped by measure category (heat/cool, water heat, etc). The three analysis groups (control, continued Reports, and suspended Reports) are represented for each measure category.

- The relative results illustrate the breakout into purchase categories for all households **that made a purchase**. Purchases were put into three categories: energy efficient through a PSE rebate program, energy efficient not through a rebate program, and other, non-energy efficient. We refer to these as percentage of purchasing households

- The absolute results show the same data with the actual percentages of households that purchased any measure (whole bar) along with the category breakouts (colors). We refer to these as percentage of all (group) households.

This figure is designed to provide high-level summaries without tests for statistical significance. The key results with tests for statistical significance are provided following the discussion of this figure.

Figure 5-1: Energy Efficient Purchases
Summary of Relative and Absolute Measure Type-Level Results



The relative and absolute results both provide a perspective on the data that is instructive. The relative results facilitate comparing category breakouts across the different analysis groups. Across all the measure-type categories, the continued group only exhibits a clear increase over the control group in the water heater category. Interestingly, the suspended group shows an increase over control for almost every measure category.

The absolute results display the percent of purchasing household results in the context of the overall data. This is the perspective that is probably more relevant to the generation of savings. The bars and colors indicate the actual magnitude of the purchases within the group. In most instances, more energy efficient measures will generate more savings, even if they are a smaller percentage of the overall measure purchases. This distinction highlights the importance of two further considerations:

- Is a measure is a replacement or additional unit, and
- If it is a replacement, what is the relative efficiency of standard efficiency replacement versus the existing measure?

Purchases of heating and cooling measures provide a good example of these issues. The relative results seem to indicate the suspended and continued treatment groups are similar with respect to the breakout to different purchase types. The absolute results show that there was half as much activity among suspended group households across all three kinds of purchases compared to either the control or continued treatment group. Despite a similar percentage of purchasing households opting for energy efficient measures, the suspended group likely generated less savings relative to the control group because of the lower level of measure category purchasing activity.

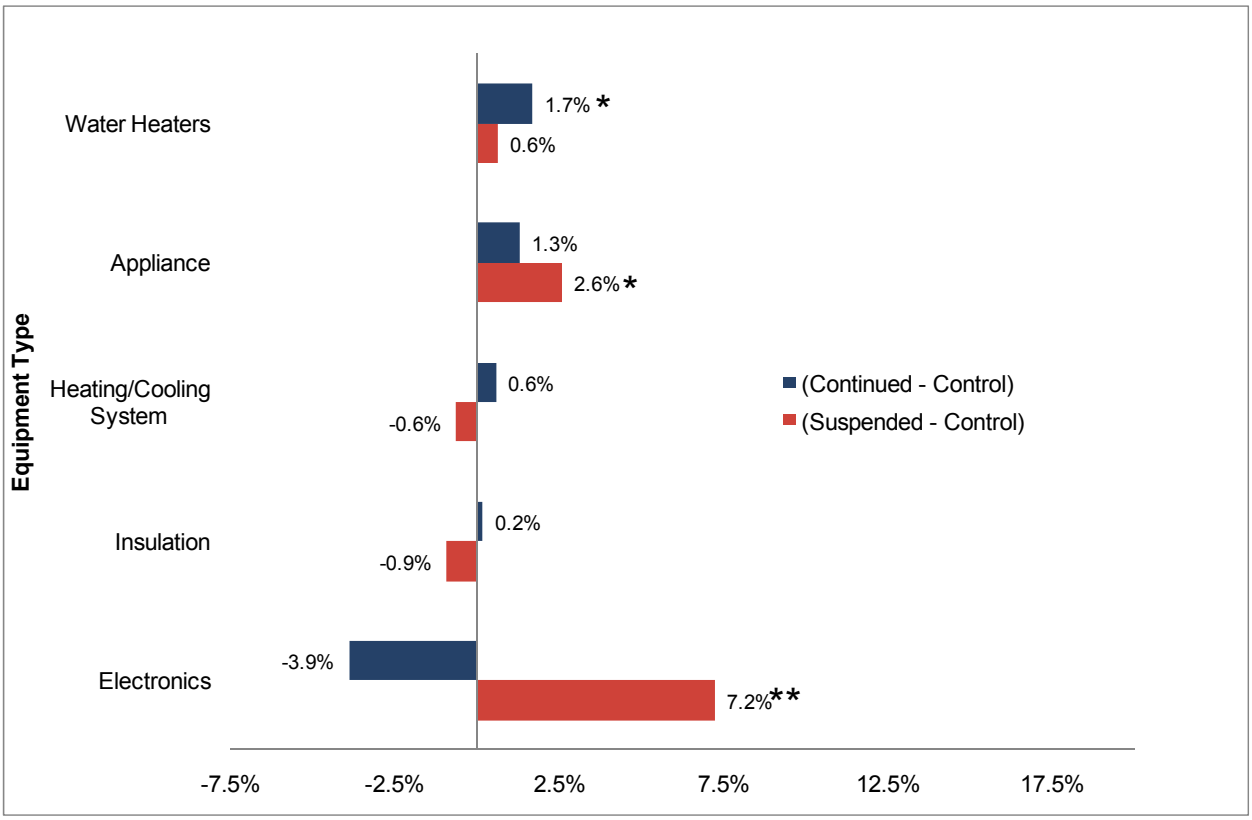
This should be particularly true in the heating-related category because most furnaces are replacements (rather than additional) and standard efficiency furnace replacements generally offer improved efficiency compared to most existing furnaces. The non-energy efficient furnaces will generate savings at a lower rate (lower savings per unit). However, a greater amount of activity in any of the three purchase categories should generate savings when considering furnaces.

Across all the categories, there is more variability across the different groups with regard to the absolute level of the three purchase activities than with regard to the relative share of the three purchase activities among purchasers. The results in the next section, where we focus on the results for which the difference between treatment (either continued or suspended) and control is statistically significant, support this conclusion. Statistically significant results indicate an effect that is distinguishable given the size of the survey sample.

5.2.2.1 Purchases by Measure Category

Figure 5-2 provides the difference in purchases of non-program energy efficient measures between the two treatment groups and the control group from Figure 5-1(yellow bars). These results all come from the absolute results in Figure 5-1 – percent of households overall. None of the associated percent of purchaser results (relative results) were statistically significant.

Figure 5-2: Non-program, Energy Efficient Purchases
Treatment group Differences by Measure Category



At the measure-category level, the only statistically significant difference between continued treatment and control groups is the higher rate of purchases of energy efficient water heating equipment. There are two statistically significant differences between suspended treatment and control groups – the higher rate of purchase of energy efficient appliances and electronics. Table 5-3 provides the actual treatment and control percentages, the differences and the associated P-value. The three P-values with confidence exceeding one-sided 95 percent statistical significance (< 0.05) are shaded dark gray in the P-value column.

Table 5-3 :Non-program, Energy Efficient Purchases
Treatment group Differences by Measure Category

Treatment Group	Measure Category	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Water Heaters	1.8%	3.5%	1.7%	0.06
	Appliance	10.0%	11.3%	1.3%	0.27
	Heating/Cooling System	2.7%	3.3%	0.6%	0.33
	Insulation	5.2%	5.4%	0.2%	0.45
	Electronics	31.5%	27.6%	-3.9%	0.83
Suspended	Water Heaters	1.8%	2.4%	0.6%	0.24
	Appliance	10.0%	12.6%	2.6%	0.10
	Heating/Cooling System	2.7%	2.1%	-0.6%	0.73
	Insulation	5.2%	4.3%	-0.9%	0.76
	Electronics	31.5%	38.8%	7.2%	0.04

As discussed above, the implications of these results are informed by whether the purchases were replacements of existing measures or additional measures. The only statistically significant result relating to additional purchases was in the electronics category. The continued treatment group made substantially fewer additional electronic purchases than the control group (18.6 percent for continued treatment group compared to 25.4 percent for the control group). The suspended treatment group, on the other hand, made more purchases that were additional relative to the control group. These data combine to suggest a different interpretation of the purchase decision results in Table 5-3. The continued treatment group was less likely to purchase energy efficient electronics, but was also less likely to purchase additional measures. In balance, they may have saved relative to the control group because new electronic purchases did not increase consumption because they were replacements. Similarly, the suspended treatment group was more likely to buy energy efficient electronics, but those purchases were also more likely to be additional purchases increasing electric consumption in the household. This example highlights the challenge of connecting behavior change back to specific changes in consumption at the household.

5.2.2.2 Purchase of Individual Measures

The aggregate measure level results summarize purchase patterns across a range of individual measures within the category. The survey analysis of individual measure purchases shows statistically significant higher rate of purchases for only 3 of the 23 individual measures for both

the continued treatment group and the suspended treatment group compared to the control group. Purchases significant at a 90 percent, one-tailed level were included in this group. Table 5-4 lists these results.

Table 5-4: Non-Program, Energy Efficient Purchases
Specific Measures Items with Statistically Significant Treatment Group Differences

Treatment Group	Individual Items	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Water heater with storage tank	1.6%	3.2%	1.6%	0.06
	Clothes Washer	0.8%	2.1%	1.3%	0.05
	Attic Insulation	1.4%	3.5%	2.1%	0.02
Suspended	Clothes Washer	0.8%	3.2%	2.4%	0.00
	TV	16.0%	22.5%	6.4%	0.03
	Computer	16.0%	21.4%	5.4%	0.05

When we restrict the analysis to purchasers, as opposed to all members of the group, we find no statistically significant differences between treatment and control groups in the rate of energy efficient non-rebated purchases in the five broad measure categories or for any of the 23 individual measures.

5.2.2.3 Self-reported Rebate Purchases

We looked at the self-reported purchases of energy efficient equipment through PSE rebate programs and found no evidence of increased PSE rebate program purchases in the treatment group relative to the control group. The survey-based differences between treatment and control groups in self-reported PSE rebate program purchases are both positive and negative and are not statistically significant across all measure categories and both gas and electric. This is consistent with the electric results of the analysis of PSE rebate program tracking data as presented in the Impact Evaluation. The gas joint savings analysis showed some increase in year three of the program, but it was small and would not necessarily be distinguishable with the present sample sizes.

5.2.2.4 Non-Energy Efficient Purchases

As discussed earlier, there are situations where non-energy efficient purchases could result in energy savings when they replace existing equipment. When they are non-replacements, they would result in increased consumption.

Table 5-5 provides measure category-level results for non-energy efficient purchases. The only statistically significant difference between either of the treatment group and the control group was continued treatment group electronics. Furthermore, this difference was significant at only the 90 percent, one-sided level. This parallels the result shown above in Table 5-2 where the continued treatment group installed fewer energy efficient electronics (though the result was not statistically significant).

Table 5-5: Non-Energy Efficient Purchases
Treatment group Differences by Measure Category

Treatment Group	Individual Items	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Water Heaters	0.6%	1.3%	0.7%	0.13
	Appliance	3.2%	4.0%	0.8%	0.25
	Heating/Cooling System	5.0%	5.6%	0.6%	0.36
	Insulation				
	Electronics	19.0%	24.3%	5.3%	0.08
Suspended	Water Heaters	0.6%	0.6%	0.0%	0.49
	Appliance	3.2%	3.4%	0.3%	0.41
	Heating/Cooling System	5.0%	2.1%	-2.9%	0.99
	Insulation				
	Electronics	19.0%	18.6%	-0.4%	0.55

The survey data indicates three statistically significant increases in the purchase of specific non-energy efficient measures for the continued group and one for the suspended group. Table 5-6 provides these results.

Table 5-6: Non-Energy Efficient Purchases
Specific Measures Items with Statistically Significant Treatment Group Differences

Treatment Group	Individual Items	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Air source heat pump	0.2%	1.3%	1.1%	0.04
	Dishwasher	0.4%	1.3%	0.9%	0.06
	TV	7.2%	11.0%	3.8%	0.07
Suspended	Dishwasher	0.4%	1.2%	0.8%	0.07

Both treatment groups purchased more non-energy efficient dishwashers than the control group. All of the dishwashers were replacements, however, so it's unlikely that this finding affected consumption substantially in either direction.

The increase in continued group, non-energy efficient TVs has already been discussed in the context of the electronics category group. However, TVs, as a specific measure, are not less likely to be additional purchases for continued group than the control group. These results point to an increase in TV-related electric consumption for the continued group.

The increase in air-source heat pumps is more challenging to evaluate with respect to energy consumption. A heat pump may replace some other form of heating (gas or electric), some form of cooling (central or room AC) both or neither. The counts are too small to explore this results further.

5.2.2.5 Energy Efficient Purchases Findings

These results, in combination, paint a mixed picture of the effect of the HER program on the purchase of energy efficient measures outside of rebate programs. There are relatively few statistically significant increases in purchases of energy efficient measures. There is no apparent pattern in the non-significant results. Overall, there is no evidence in these results that increased purchases of energy efficient measures in 2011 explained a substantial portion of the overall estimated HER Program savings.

The statistically significant results that we did find are absolute differences, differences in the percentage of energy efficient purchases as a percentage of all households, rather than relative

differences, difference in the percentage of energy efficient purchases of those who made purchases. These results reflect different levels of purchase activity across the groups rather than different allocations of purchases to energy efficient measures.

This indicates that the absolute level of activity overall is as important a focus as the relative level of difference purchase types. This conclusion is further enhanced by recognizing that, for measures with low adoption rates, it is relatively more difficult to attain statistical significance for results that are an absolute percentage of all household than the relative percentage of purchasers. This further highlights the presence of only absolute, statistically significant results.

This section also discussed the difference between purchases that replace other measures and those purchases that are additions to the household stock. In this context, energy efficient purchases that are additions to the household stock may actually decrease household-level savings. At the same time, in a replacement scenario, even non-efficient installations have the potential to generate savings as shown by the example of the standard efficiency furnace. These results remind us that consumer behavior is not just a matter of choices between options (energy efficient or not) but whether or when to purchase at all. This is particularly important to consider given that these results indicate that absolute levels of purchases vary more than relative breakouts.

If surveys are repeated in the future, it might be worth gathering greater sample sizes so as to generate more statistically significant results. It's unclear from the results from this evaluation whether greater sample sizes will reveal more clear patterns of purchase decisions between the two treatment groups and the control group with regard to either absolute or relative purchase decisions. This could be a result of the taking place in the fourth year of the program. In the early years of a program, HER participants may be more active in their response to the Reports as well be better able to identify differences in purchase behavior.

5.3 Energy Related Behaviors

5.3.1 Approach

For the energy saving and measure-related behavior analysis, the analysis of the survey data focused on whether receiving Home Energy Reports is associated with a higher incidence of self-reported behaviors to reduce energy usage within the household. Table 5-7 presents the list of behaviors which were asked about during the survey,

Table 5-7: Energy-Related Behaviors

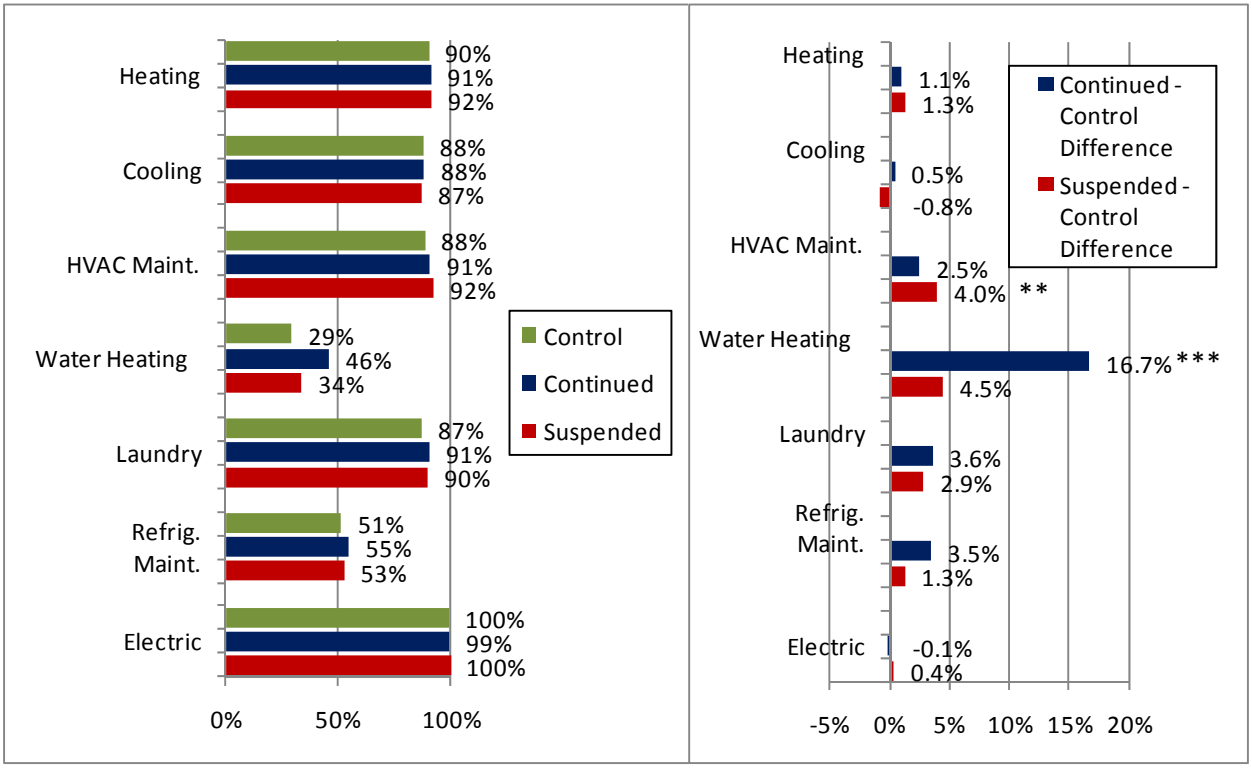
Category	Behavior
Water heating	Turn down water temp when away 2+ days
	Keep WH at lower temp setting
Laundry	Wash clothes in cold water
	Hand dry laundry
	Use dryer moisture sensor
Refrigerator maintenance	Tighten refrigerator seal
	Clean refrigerator coils
HVAC maintenance	Clean/replace air filters on heating system
	Professional heating system maintenance
	Clean area around window AC
Heating behaviors	Turn down heat at night
	Turn down heat daytime unoccupied
	Run ceiling fans reverse in winter
	Turn down tstat when running fireplace
Cooling behaviors	Regularly use ceiling fan
	Regularly close shades in summer
	Turn off AC when unoccupied
	Keep doors/windows closed when AC on
Electronics behaviors	Manually turn off power strips
	Use smart power strips
	Regularly unplug electronics when idle
	Use computer power-save mode
	Turn off computer at night
	Regularly turn off lights

To test the effect of increased uptake of energy saving behaviors resulting from HER, KEMA compared the proportion of respondents in the continued treatment, suspended treatment and control groups who answered yes to one or more of the behaviors listed in Table 5-7.

5.3.2 Energy Saving Behaviors

Figure 5-3 provides the energy saving behavior results at the category level. The percentages in the left panel reflect the number of households that reported at least one of the specific behaviors in that category. Most of the categories show a high level activity among all three groups. In all categories other than water heating, the variation between groups is small compared to the level of activity.

Figure 5-3: Energy Saving Behaviors
Activity Levels and Treatment Group Differences



The right panel focuses on the differences between the two treatment groups and the control group. Those differences are expanded and, in two instances, marked to indicate statistical significance. Overall, the energy savings behaviors are more consistent than the energy efficient purchases results. The treatment groups showed an increase in energy saving behaviors for all but two of the fourteen comparisons across the two treatment groups. The continued treatment group shows a greater difference in more than half of the categories. While only two differences reached the level of statistical significance, there is a general pattern that indicates a general HER Program-related increase in energy savings behaviors.

The survey analysis of individual behaviors, as opposed to composite groups of behaviors, only one showed statistically significant differences in uptake between the continued treatment and control groups. Specifically, a greater proportion of the treatment group reported keeping their water heater at a lower temperature (11% difference, significant at the 95% confidence level). Comparing differences between the suspended and control groups for individual behaviors, the suspended group (92%) was more likely than the control group (87%) to say they regularly changed their heating system's air filters.

5.3.3 Measure Related Behaviors

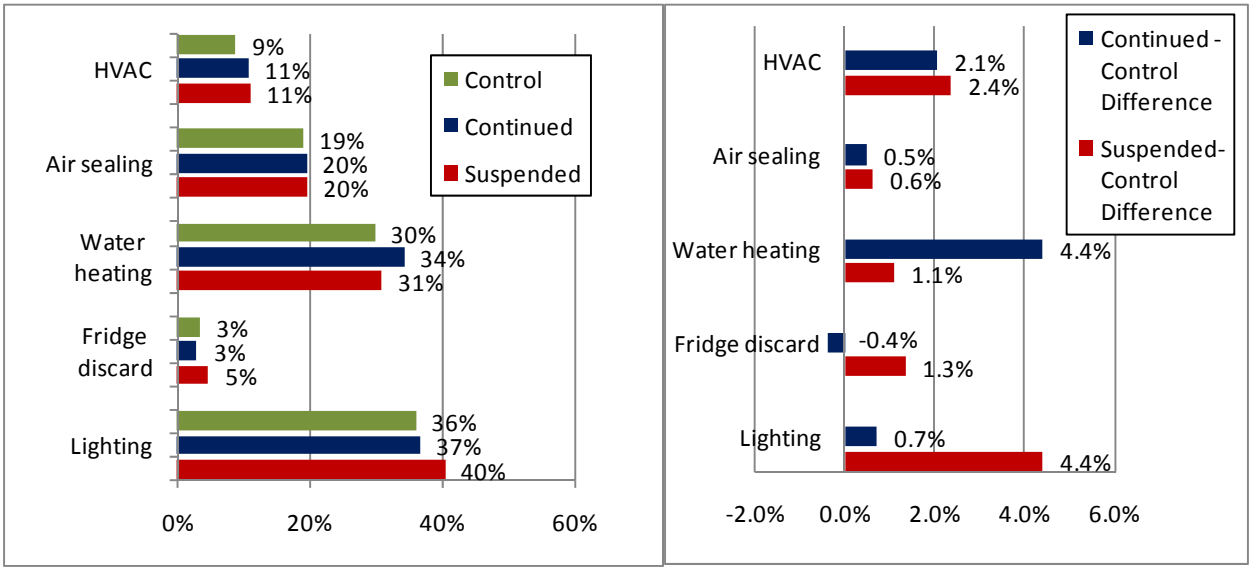
For the measure-related behavior analysis, the analysis of the survey data focused on whether receiving Home Energy Reports was associated with a higher incidence of self-reported behaviors to reduce energy usage that involved more permanent, measure-related changes. Table 5-8 presents the list of measure-related behaviors which were asked about during the survey.

Table 5-8: Measure-Related Behaviors

Category	Behavior
Water heating measures	Insulate hot water pipes
	Install low flow showerheads
HVAC measures	Seal leaky ducts
	Install fireplace insert
	Install ceiling fan
Air sealing	Install storm windows
	Improve fireplace sealing
	Seal area around window AC
Refrigerator discard (non-rebated)	Non-rebated refrigerator discard
	Non-rebated freezer discard
Lighting measures	Install outdoor motion detectors
	Install outdoor solar lights
	Install LED lights

Figure 5-4 presents the survey results for measure-related behavior in the same format as the energy saving behavior results in the previous section. The left panel plots the percentage of households adopting at least one specific measure-related behavior within the category. The adoption rate of these measure-related behaviors is substantially lower than the energy savings behaviors and more variable across the different categories. Once again, the apparent differences between the two treatment groups and the control are small relative to the level of adoption. The right panel expands the differences evident in the left panel. Once again, the trend is more consistent than the energy efficient purchases results. All but one of the ten differences across the two treatment groups are positive. The suspended treatment group has higher adoption of the measure-related behaviors than the continued treatment group in 4 of the 5 categories. None of the results for measure-related behaviors are statistically significant.

Figure 5-4: Measure-related Behaviors: Activity Levels and Treatment Group Differences



When KEMA examined the differences between the suspended and control groups for individual measure related behaviors, one achieved statistical significance. The suspended group (3%) was more likely than the control group (1%) to say they installed and used a fireplace insert.

5.3.4 Summary

Energy saving Behaviors and measure related behavior results are more consistently positive than the energy efficient purchases results, though there are still only a handful of statistically significant results.

Given the survey results presented here, the observed consumption reduction of the treatment groups appears to be the cumulative effect of a number of small differences. The small differences may be too small to observe individually without impractically large samples, but

There are at least two other hypotheses than need to be considered as possible explanation for the indeterminate behavioral survey results.

Timing of the survey --These behavioral surveys were fielded in the fourth year after participants started receiving Home Energy Reports. Out of necessity, they focused on the actions respondents took during the prior year. It is possible that many of the energy efficiency purchases, energy saving behaviors or measure-related behaviors that account for continued HER-related energy savings occurred in the first or second year of the program. The surveys

would not identify energy efficiency purchases and measure-related behaviors that occurred in the first or second year of the program. Even behaviors (lowering of heating set points) that were established within the first two years might not register as differences by the third year.

Measurement Distortion Caused by Home Energy Reports -- It's possible that the receiving of Home Energy Reports may distort the way continued or suspended treatment respondents answered the questions. The Home Energy Reports are designed to increase participants' awareness of home energy use, and this increased awareness could affect the way participants answered questions. It is plausible that increased awareness could push the results in either direction – towards greater or lesser differences with the control groups. For example, increased awareness might create a social desirability effect where treatment/suspended participants over-report their energy-saving behaviors. On the other hand, it is possible that respondents in the control group overstate their energy-saving behaviors because they do not know as much about the subject. At this point, it is impossible to measure if or how the Home Energy Reports distorted participants' answers.

To improve the survey results, it is essential to increase the effective sample size supporting the estimates. This can be achieved by simplifying and shortening the survey as well as increasing the targets. Developing an exhaustive list of possible behaviors and action with non-statistically significant results is not useful. Focusing the results on the most likely sources of savings and maximizing the likelihood of achieving statistically significant results may describe a more limited set of potential savings more effectively.

5.4 Response to Home Energy Reports

After completion of the survey questions related to purchases and behaviors, all of the continued and suspended treatment group survey respondents were asked a series of questions about their recollection and use of the Home Energy Reports. Section 5.4 of this report provides a summary of these results.

This section highlights the recollection and use of the Home Energy Reports by the treatment condition.

5.4.1 Recollection of Reports

The survey asked respondents if they remembered receiving reports from Puget Sound Energy about their in-home energy use. Almost all of the treatment condition (92%) said they remembered the reports. For any respondent who said they did not remember the reports, the

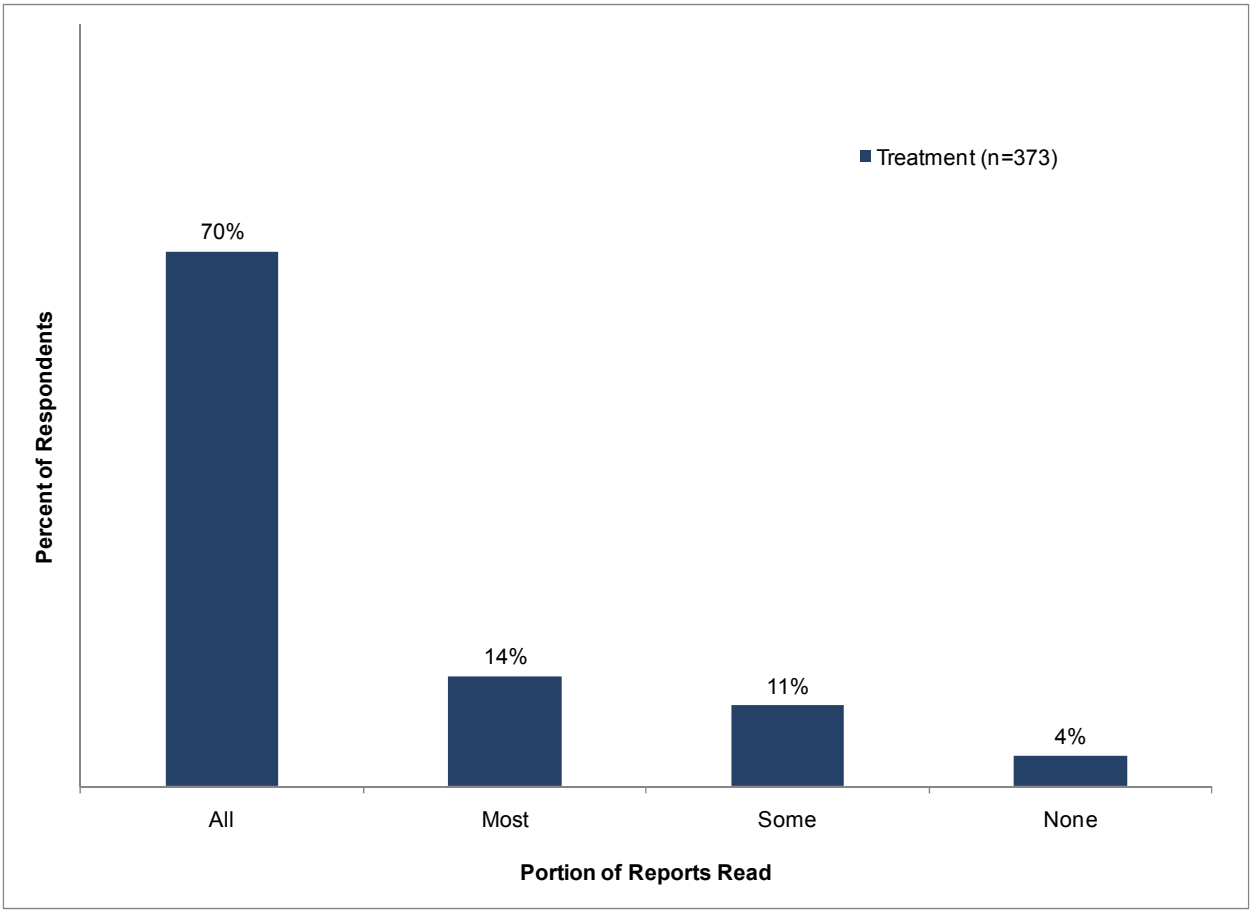
survey included a follow-up question that provided a brief description of the reports. It then gave the respondents a second chance to say whether they remembered the report. Most of the treatment group (74%) said they remembered the reports after getting the description. Overall, 98 percent of the treatment condition remembered the reports.

Only respondents who remembered receiving the reports in one of these two questions were asked the remaining questions in this section of the survey.

5.4.2 Use of Reports

The survey asked a series of questions to assess how often someone in the respondent's household read the reports. About three-fourths (70%) of the treatment condition said they read every report (Figure 5-5).

Figure 5-5: Portion of Reports Read



There were several statistically significant differences in the reported portions of reports read depending on whether the respondents who received monthly or quarterly reports, number of household residents, and the presence of children (Table 5-9).

- *Report frequency:* Monthly recipients were more likely than quarterly to say they read every report. Conversely, quarterly recipients were more likely than monthly to say they read some of the reports. Note, these differences may be caused by the difference in report receipt frequency affecting respondents' memory or the way they answer this question.

- *Number of residents:* Households with two or fewer residents were more likely than those with three or more residents to say they read every report.

- *Children:* Households without children were more likely than those with children to say they read every report. Note, there is likely a substantial amount of overlap among these latter two categories – households with children are likely to also have three or more residents.

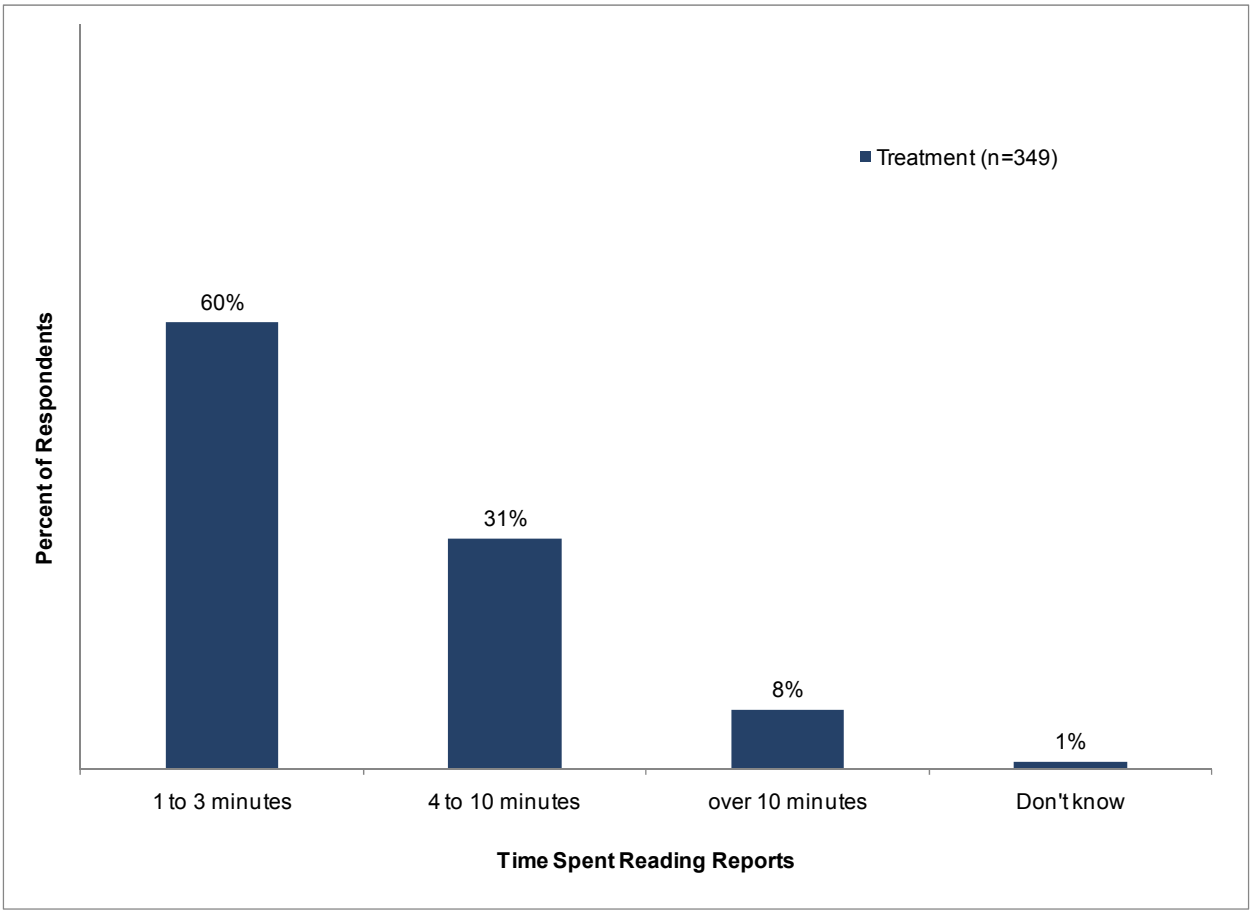
Table 5-9: Portion of Reports Read Categorical Differences

Categories		Portion of Reports Read		
		All	Most	Some
Report Frequency	Monthly (n=268)	10%	14%	77%
	Quarterly (n=105)	16%	19%	65%
	sig.	*		**
Number residents	2 or less (n=177)	81%	14%	5%
	3 or more (n=171)	65%	16%	19%
	sig.	**		**
Children	no children (n=230)	78%	15%	7%
	children (n=119)	64%	16%	20%
	sig.	**		**

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

About two-thirds (60%) of the households which indicated they read at least some of the reports said they spent one to three minutes on the reports. Another 31 percent said they spent four to ten minutes reading the reports (Figure 5-6).

Figure 5-6: Time Spent Reading Reports



There were several statistically significant differences in the reported time spent reading reports depending on whether the respondents who received monthly or quarterly reports, number of household residents, education, and whether they discussed the reports with household members (Table 5-10).

- *Report frequency:* Quarterly recipients spent more time reading the reports than monthly recipients. Quarterly recipients were more likely than monthly recipients to report spending over 10 minutes or four to 10 minutes reading the reports, and less likely to say they spent one to three minutes reading the reports.

- *Number of residents:* Households with three or more residents were more likely than those with fewer residents to say they spent over 10 minutes on the reports and less likely to spend four to ten minutes on the reports.

- *Education:* Respondents with four-year college degrees were more likely than those with less education to say they spent one to three minutes on the reports.

- *Discussed reports:* Respondents who shared the reports with household members spent a little more time reading the reports than those who did not share the reports with household members. Respondents who discussed their home's energy use with household members were more likely than those who did not discuss energy use with the household to spend four to ten minutes on the report and less likely to spend one to three minutes.

Table 5-10: Time Spent Reading Reports Categorical Differences

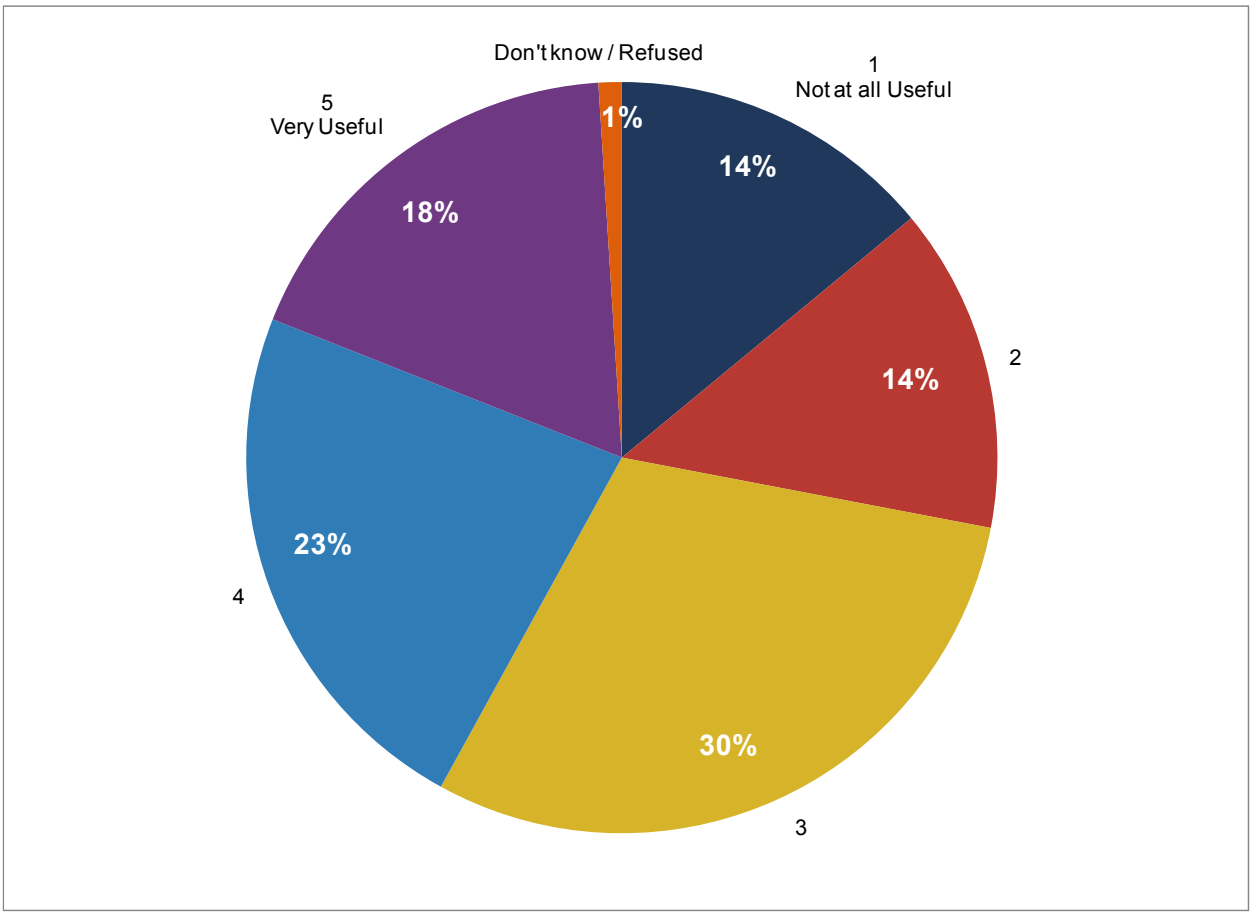
Categories		Time Spent Reading Reports		
		1 to 3 min	4 to 10 min	>10 min
Report Frequency	Monthly (n=268)	66%	28%	7%
	Quarterly (n=105)	49%	39%	12%
	sig.	**	**	*
Number residents	2 or less (n=177)	58%	36%	6%
	3 or more (n=171)	63%	25%	11%
	sig.		**	*
Education	Less than 4yr degree (n=133)	55%	33%	11%
	4 yr college degree (n=117)	68%	25%	7%
	sig.	**		
Discussed Report with Household	No (n=85)	72%	19%	7%
	Yes (n=263)	57%	35%	8%
	sig.	**	**	

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

5.4.3 Usefulness of Reports

Respondents rated the usefulness of the reports on a five-point scale anchored at 1 for "not at all useful" and 5 for "very useful." The results of this question are reported in Figure 5-7. Quarterly report recipients had similar usefulness ratings as monthly recipients.

Figure 5-7: Usefulness of Reports



There were several statistically significant differences depending on the number of household residents and respondent education (Table 5-11).

- *Number of residents:* Respondents with three or more household residents were more likely than those with fewer residents to give a rating of 1 on the five-point scale. Respondents with more household members may feel as though they have less control over their household's energy use than those with fewer members.

- *Education:* Respondents with four-year college degrees found the reports less useful than those with graduate training. Respondents with four-year college degrees were more likely than those with graduate training to give a rating of 1 and less likely to give a rating of 4. Respondents with more education may have more practice reading and interpreting data, and thus find the reports more useful.

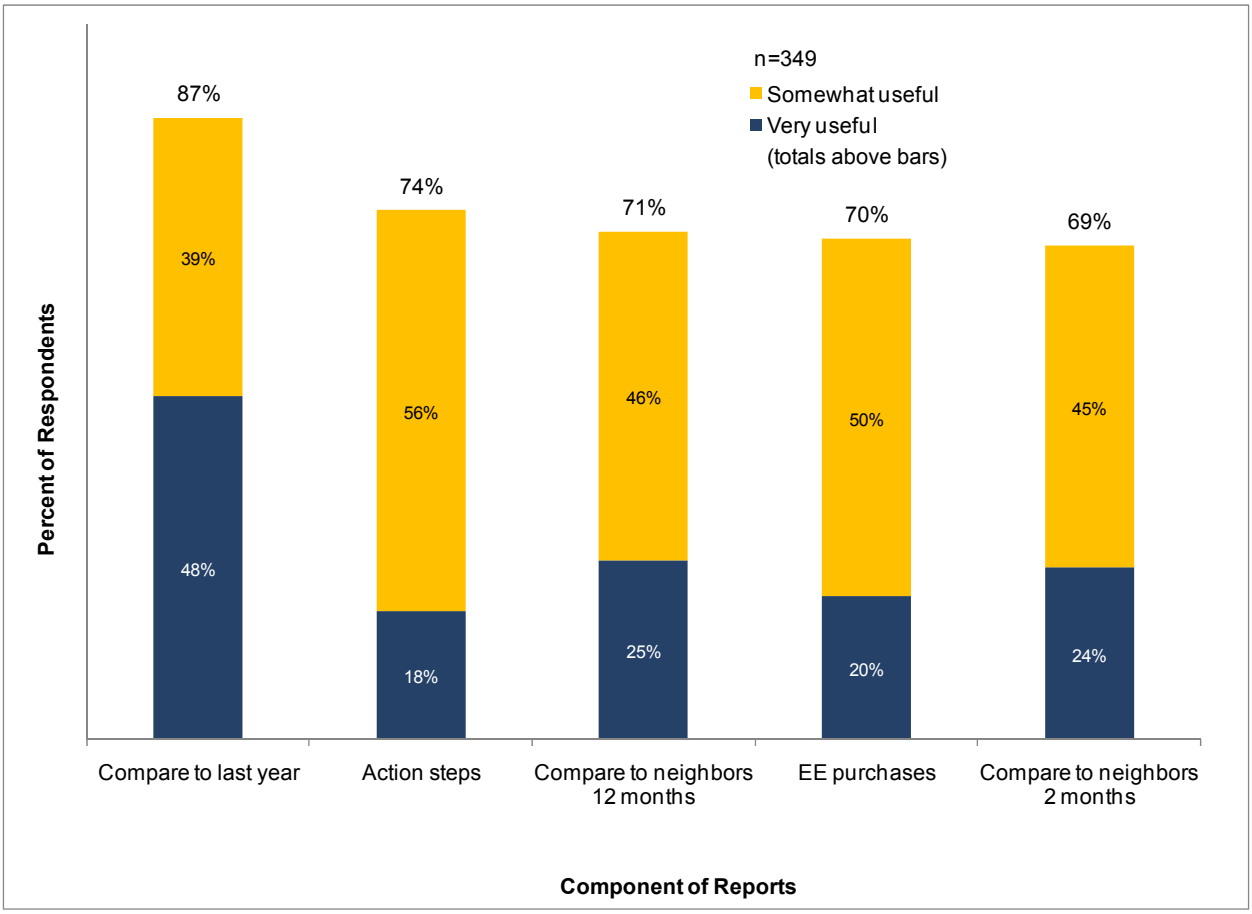
Table 5-11: Usefulness of Reports Categorical Differences

Categories		Usefulness Rating				
		1 not at all useful	2	3	4	5 very useful
Age	2 or less (n=176)	9%	13%	35%	24%	20%
	3 or more (n=169)	19%	13%	26%	22%	18%
	sig.	**		*		
Children	No	19%	14%	34%	16%	16%
	Yes	8%	9%	26%	32%	22%
	sig.	**			**	

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

All survey respondents were asked to rate the usefulness of several specific components of the reports. These components consisted of: comparison to own house last year, action steps for reducing energy use, comparison to neighbors' energy use for the last 12 months, comparison to neighbors' energy use for the last two months, and suggestions for energy efficiency (EE) purchases. The usefulness ratings were made on three point scales: very useful, somewhat useful, and not at all useful. Overall, each component was found to be very or somewhat useful by most respondents (Figure 5-8). Comparison to the respondents' own homes was the most useful component.

Figure 5-8: Report Component Usefulness



There were several statistically significant differences in usefulness ratings of the components based on respondent demographics. These included age and presence of children (Table 5-12).

- *Age:* Respondents age 55 or older tended to find the three comparison components less useful than younger respondents. Respondents in the 55 or older age category were more likely than those 35 to 54 category to give a “not at all useful” rating to all three of the comparison components.

- *Children:* Households with children tended to find the comparisons and the purchase tips more useful than those without children. Households with children were more likely than those without children to say the comparisons to neighbors, comparisons to their own household, and the energy efficient purchase recommendations were “very useful”.

Note, these two sets of differences are probably opposite sides of the same coin. Respondents over 55 years old are less likely than younger respondents to have children in their household.

Table 5-12: Component Usefulness Categorical Differences

Component Usefulness		Age			Children		
		35 to 54 (n=133)	55+ (n=179)	*sig.*	No (n=230)	Yes (n=119)	*sig.*
Last Year	Not at all useful	8%	15%	*	13%	8%	
	Somewhat useful	32%	44%	*	46%	27%	**
	Very useful	61%	40%	**	40%	63%	**
Neighbor (12 month)	Not at all useful	22%	31%	*	30%	20%	*
	Somewhat useful	49%	43%		48%	44%	
	Very useful	29%	24%		21%	34%	**
EE Purchases	Not at all useful	30%	25%		26%	28%	
	Somewhat useful	49%	52%		54%	43%	**
	Very useful	20%	20%		17%	26%	**
Neighbor (2 month)	Not at all useful	23%	34%	**	32%	23%	*
	Somewhat useful	51%	41%	*	45%	45%	
	Very useful	24%	24%		22%	29%	

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

5.4.4 Effects of Reports

Finally, the survey asked whether the reports had caused the respondents to adopt new energy saving habits or purchase more efficient energy using equipment. About one-third (37%) of respondents said the reports caused them to adopt new energy-saving habits and 29 percent said the reports caused them to purchase energy efficient equipment. These results do not completely match the results reported above for the purchases of individual equipment. This discrepancy may be due to the difference in level of abstraction – the previous questions asked about specific types of equipment whereas these questions asked about energy using equipment in general. It is possible the respondents mentally aggregated the earlier responses. It could also be due to the inherent variability in self-reports.

5.4.5 Response to Reports Summary

Respondents are aware of the reports. Most respondents spend a few minutes reading every report their household receives. Respondents are not overwhelmed with the usefulness of the reports. The most useful component of the reports is the comparison of the respondents'

continued energy usage to the previous year. About one-third of respondents said the reports caused them to adopt new energy saving habits or install energy efficient equipment.

There were few differences between monthly and quarterly recipients. Monthly report recipients are more likely than quarterly recipients to read every report, but quarterly recipients spend a little more time reading the reports when they do read them.

Respondents with fewer household members read more reports, spend more time when they read them, and find the reports more useful than respondents with more household members. Older respondents appear to be less interested than younger respondents in any of the comparisons provided in the reports. Older respondents also tend to have smaller households, so these findings are a bit mixed.

Respondents with children read fewer reports and spend less time reading them when they do. However, these households do find the comparisons and purchase tips useful.

A. Impact Methodology

A.1 Difference-of-Differences

The difference-of-differences approach is the most direct and simple way of leveraging the experimental design of the HER program. The approach compares the difference in treatment group average consumption between pre- and post-report period with the same difference for the control group. The treatment group pre-post difference captures all changes between the two periods including those related to receiving the reports. The control group captures all changes with the exception of those related to the report, because the control group did not receive the reports. The random selection of the treatment and control groups ensures that, on average, the control group will appropriately reflect the non-report related changes experienced by treatment and control group alike between the pre-and post-report periods. Removing the non-report differences, as represented by the control group difference, from the treatment difference produces an estimate of the report's isolated effect on consumption.

It's extremely important to remember that impacts are unlikely to be evenly distributed across the year, so it is essential that pre- and post-report periods cover the same number of months and the same months of the year. Furthermore, some portion of impact is likely to be weather-correlated. Despite the presence of the control group, difference-of-differences impact estimates reflect the observed weather during the analysis period. This is one of the two primary limitations of the difference of difference approach – it always reflects actual weather.

The average consumption of energy for the treatment group in the pre-report period is calculated with the equation

$$\overline{E}_{Trmt\ \mathrm{Pr}\,e} = \frac{1}{n_{Trmt}} \sum_{i \in Trmt} E_i$$

$\overline{E}_{Trmt\ \mathrm{Pr}\,e}$ = Average energy consumption in the pre-report period for the treatment group;

n_{Trmt} = Count of households in the treatment group;

E_i = Energy consumption for household *i*;

Using this equation structure, average energy consumption is calculated for both treatment and control groups in both the pre- and post-report periods. The difference of difference is then produced with the following equation.

$$\Delta E = \left(\overline{E}_{Trmt\,\mathrm{Pr}\,e} - \overline{E}_{TrmtPost}\right) - \left(\overline{E}_{Cont\,\mathrm{Pr}\,e} - \overline{E}_{ContPpost}\right)$$

The difference-of-differences approach can be applied on a monthly or seasonal basis. As long as time periods are balance in the pre- and post-report periods the savings estimate will be consistent for that time period.

A.2 Regression models

For each control and treatment customer, a PRISM-like- heating and cooling model was estimated for each HER period. The generalized site-level model for Stage 1 is:

$$E_{im} = \mu_i + \beta_H H_{im}(\tau_H) + \beta_C C_{im}(\tau_C) + \varepsilon_{im} \qquad \text{Equation 1}$$

where

E_{im}	=	Energy consumption during day *m* for customer *i*;
$H_{im}(\tau_H)$	=	Heating degree-days at the heating base temperature τ_H during day m, based on daily temperature, for customer i's meter reading;
$C_{im}(\tau_c)$	=	Cooling degree-days at the cooling base temperature τ_C during day m, based on daily temperatures, for customer i's meter reading;
μ_i	=	Baseload usage estimate for customer i;
$\beta_{H,}\beta_C$	=	Heating and cooling coefficients, determined by the regression;
τ_H,τ_C	=	Heating and cooling degree-day base temperatures, determined by choice of the optimal regression; and
ε_{im}	=	Regression residual.

Equation 1 shows that daily energy consumption (E_{im}) is a function of an intercept which represents baseload (μ_i), daily HDD, $H_{mi}(\tau_H)$, which correlates with heating usage and daily CDD, $C_{mi}(\tau_C)$, which correlates with cooling usage. If using monthly billing data, monthly bill readings are divided by the number of days in the billing period to get the daily consumption (E_{im}). Average daily degree days for the billing period are calculated by dividing the sum of daily HDD or CDD during the billing period by the number of days in the billing period. It is best to use raw consumption data by bill period rather than calendarized billing data. This maintains full correlation between consumption and degree days over the period.

We estimated consumption across a range of heating and cooling degree day bases instead of fixing degree day base temperatures to 65°F. Heating degree day bases covered 50°F to 70°F while cooling degree day bases covered 64°F to 84°F. Aside from the full model specification[8], we also fit the model with only baseload and heating or cooling term across the same range of base temperatures. Finally, we fit the intercept alone and chose the best heating and cooling degree base combination for each model specification. The F-test was used to determine whether the specification including either heating or cooling or both in the model is superior.

The distributions of cooling and heating base temperatures selected by the model were examined. If either heating or cooling degree day base temperature is on the border, we force the degree day bases to the mean. Instead of considering a range of degree day base temperature, we estimated consumption as a function of cooling and heating using the central base (67 °F for cooling and 61 °F for heating). Similarly, we estimated the following models: heating and cooling, heating-only, and intercept-only. This was done to avoid odd model fit to the data.

Normalized energy consumption

We also estimated consumption on a typical meteorological year. The normalized consumption was estimated using cooling and heating degree days from a typical year, which is provided by TMY3. Weather-normalized daily consumption was computed as follows:

$$NC_{im} = \hat{\mu}_{im} + \hat{\beta}_H \tilde{H}_{im}(\hat{\tau}_H) + \hat{\beta}_C \tilde{C}_{im}(\hat{\tau}_C)$$

where

[8] For modeling of gas consumption, heating-only and intercept-only models were used.

NC_{im}	=	Normalized daily consumption for customer *i*;
$\tilde{H}_{im}(\hat{\tau}_H)$	=	Normal heating degree-days calculated at the optimal heating base temperature $\hat{\tau}_H$ of customer i;
$\tilde{C}_{im}(\hat{\tau}_C)$	=	Normal cooling degree-days calculated at the optimal cooling base temperature $\hat{\tau}_C$ of customer i;
$\hat{\mu}_{im}, \hat{\beta}_H, \hat{\beta}_C$	=	Baseload, heating and cooling parameter estimates from the site-level models.

B. Survey Methodology

The KEMA team fielded 1,448 computer-aided telephone interview (CATI) surveys to address the research objectives identified earlier. Prior to designing the CATI instruments, KEMA completed 11 in-depth interviews with program participants. The results of the in-depth interviews informed the design of the CATI instrument.

The in-depth interviews covered the same topics as we planned for the surveys. However, the in-depth interviews were semi-structured and open-ended to allow for a better understanding of how customers think about the issues and the language that they use. It also helped us assess how well participants and non-participants could address the survey questions, and how well they recalled purchases.

To avoid respondent fatigue, KEMA designed the CATI surveys to last 15 minutes. To accomplish a shorter overall survey length while still asking the many questions necessary to cover the research objectives, KEMA grouped the survey into modules. Each module contained a set of questions specific to a content area, so that anyone asked about that content area was asked all the appropriate questions. For example, one module covered appliance purchases – what the participant purchased in the past year and whether or not it was Energy Star. Approximately one half of each study group (control and the two treatment groups) was asked each module.

The KEMA team used the following procedures for survey data collection.

- Sent an advance letter to sampled customers informing them of the study.
- Made at least five attempts for each sampled customer over multiple days and at different times.
- Instituted procedures and scripts for handling answering machines.
- Conducted project specific training of interviewers.
- Provided an FAQ sheet to interviewers to ensure consistent answers to common questions. It included a PSE contact person's name and number for verification.
- Monitored 10 percent of all calls.

During the first week of fielding, it became clear that the survey was taking significantly more than 15 minutes to complete. KEMA made several changes to the instrument to try to reduce

the total survey time, but average times still approached 20 minutes. In order to maintain the evaluation budget and timeline, KEMA had to reduce the number of completes from the original target of 1,800 (600 in each condition) to 1,448 (about 500 in each condition).

An additional complication occurred during data analysis. Seventy-nine respondents in the treatment condition were from a group that was chosen to receive the report outside of the regular random assignment procedure for the entire experiment. Because of the absence of random assignment, KEMA had to remove these respondents from the analysis. This reduced KEMA's final number of completed surveys to 1,369.

C. Survey Instrument

Puget Sound Energy
Home Energy Report Savings Double Counting
CATI Survey
(REVISIONS FOR PROGRAMMING 020212)

I INTRODUCTION – ASK ALL – ASK ALL

[READ]: "May I please speak with <Contact Name>?"

[IF CONTACT NAME IS AVAILABLE, READ I1]
[IF CONTACT NAME IS NOT AVAILABLE ARRANGE FOR CALLBACK]

I1 Hello, my name is _____ from the Blackstone Group calling on behalf of Puget Sound Energy. We are conducting a survey about how your household uses energy and purchases energy using equipment.

I'd like to talk about purchases of energy using equipment that you may have made in 2011.

[IF NECESSARY]:

Puget Sound Energy is interested in hearing what you have to say in order to improve the programs they offer to residential customers.

This is NOT a sales call and the information that you provide will be kept strictly confidential. This call may be monitored or recorded for quality purposes, but all of your responses are confidential and will only be reported in the aggregate.

CELL1. First, have you received this call on a wireless phone or on a landline phone?

1	WIRELESS	
2	LANDLINE	
96	REFUSED	**TERMINATE**
97	DON'T KNOW	**TERMINATE**

[IF CELL1=1, ASK CELL2; OTHERWISE GO TO I2]

CELL2. Are you driving a vehicle or using any equipment or machinery that requires your attention?

[INTERVIEWER: IF RESPONDENT SAYS YES, READ] Due to safety reasons we will need to call you back at a more convenient time. Thank you very much.

1	YES	**[SET AS SOFT CALLBACK]**
2	NO	
96	REFUSED	**TERMINATE**
97	DON'T KNOW	**TERMINATE**

I2. Do you or anyone else in your household work for a gas or electric utility, including Puget Sound Energy?

1 YES ➔**THANK & TERMINATE**
2 NO
96 REFUSED
97 DON'T KNOW

I3. Do you or anyone else in your household work for a market research company, or conduct market research as part of their job?

1 YES ➔**THANK & TERMINATE**
2 NO
96 REFUSED
97 DON'T KNOW

I4. Are you a person in this house who knows about your household's energy using purchases in 2011?

1 YES
2 NO ➔ [**ASK:** May I speak to that person?] **[SCHEDULE INTERVIEW IF PERSON NOT AVAILABLE OR ARRANGE FOR CALLBACK]**
96 REFUSED ➔**THANK & TERMINATE INTERVIEW**
97 DON'T KNOW ➔**THANK & TERMINATE INTERVIEW**

PS POPULATION SCREENING – ASK ALL

PS1 I am calling about [**READ CUSTOMER ADDRESS**]. Do you live at this address?

1 YES ➔**SKIP TO C1**
2 NO
96 REFUSED
97 DON'T KNOW

PS2 Do you own this address and rent it out to others?

1 YES ➔ **THANK & TERMINATE INTERVIEW**
2 NO ➔ **THANK & TERMINATE INTERVIEW**
96 REFUSED ➔ **THANK & TERMINATE INTERVIEW**
97 DON'T KNOW ➔ **THANK & TERMINATE INTERVIEW**

[THANK & TERMINATE SCRIPT]: Those are all the questions I have for you today. Thank you very much for your time.

C CFL PURCHASE(S) -- ASK ALL

C1 Have you heard of compact fluorescent light bulbs, usually called CFLs?

1 YES ➔ **SKIP TO C3**
2 NO
96 REFUSED
97 DON'T KNOW

C2 Compact fluorescent light bulbs, or CFLs, are small fluorescent bulbs that typically fit in regular light bulb sockets. CFLs are often "twisty" in shape. Have you heard of these? **[READ IF NECESSARY]:** Some of them resemble a soft serve ice-cream cone**.**

1 YES
2 NO ➔**SKIP TO X1**
96 REFUSED ➔**SKIP TO X1**
97 DON'T KNOW ➔**First time = Repeat C2. Second time = SKIP TO X1**

C3 Did you or anyone in your household purchase any CFLs in the past year?

1 YES
2 NO ➔ **SKIP TO X1**
96 REFUSED ➔ **SKIP TO X1**
97 DON'T KNOW ➔ **SKIP TO X1**

C4 Approximately, how many compact fluorescent bulbs did you or someone else in your household purchase in 2011? **[IF NECESSARY]:** Your best estimate is fine**.**

1 _____ # of bulbs
96 REFUSED
97 DON'T KNOW

IF C4=1 BULB SKIP TO C8; ELSE ASK C5

C5 Did you purchase all the CFLs on the same shopping trip?

1 YES ➔ **SKIP TO C8**
2 NO
96 REFUSED
97 DON'T KNOW

C6 REMOVED

C7 On how many different trips did you purchase CFLs in 2011? **[IF NECESSARY SAY –** Your best estimate is fine]

1_____ [RECORD # OF TRIPS]
96 REFUSED ➔ **SKIP TO X1**
97 DON'T KNOW ➔ **SKIP TO X1**

[IF C4_bulb OR C5 = 1 ASK C8-C12 ONCE, ELSE READ INTRO AND LOOP THROUGH C8-C12 THE NUMBER OF TIMES IN C7. MAX LOOPS = 6]

IF C7=2+ READ INTRO: Now I'd like to ask you about each shopping trip on which you purchased CFLs for your household in 2011, starting with the first one.

C8 At what store did you **<IF C7=2+ READ first/next>** buy the CFLs? **[DO NOT READ] [ACCEPT ONLY ONE RESPONSE]**

1 ACE HARDWARE
2 ARIRANG ORIENTAL MARKET
3 BARTELL DRUGS
4 BEST BUY
5 CARNICERIA LA CHIQUITA
6 COSTCO
7 DO IT BEST HARDWARE CENTER

8 DOLLAR PLUS
9 DOLLAR TREE
10 FOSS' GROCERY
11 FRED MEYER
12 FRY'S ELECTRONICS
13 GOODWILL
14 GROCERY OUTLET
15 HADLOCK BUILDING SUPPLY
16 HAGGEN
17 HARDWARE SALES
18 LA TEJANA MEXICAN STORE
19 LAKE SAWYER GROCERY
20 LOWE'S
21 LUMBERMENS
22 MAPLE VALLEY MARKET
23 MCLENDON HARDWARE
24 MERCADITO DEL VALLE
25 OAK HARBOR MARKETPLACE
26 OLYMPIA LIGHTING CENTER
27 ONLY A DOLLAR PLUS
28 PORT ORCHARD MARKETPLACE
29 PUGET PANTRY
30 RITE AID
31 SEBO'S DO IT CENTER
32 THE MARKETS
33 THE STAR STORE, INC.
34 TRUE VALUE HARDWARE
35 VALLEY HARVEST MARKET / VALLEY HARVEST II INTERNATIONAL MARKET
36 VILLAGE LIGHTING
37 WALGREENS
38 WALMART
39 WALT'S LYNWOOD CENTER MARKET
40 WESTSIDE BUILDING SUPPLY DO IT CENTER
41 WINCO
42 HOME DEPOT
95 OTHER (SPECIFY) _____
96 REFUSED
97 DON'T KNOW

C9 In what city or town is this store located? **[DO NOT READ] [ACCEPT ONLY ONE RESPONSE]**

1 ANACORTES
2 AUBURN
3 BAINBRIDGE ISLAND
4 BELLEVUE
5 BELLINGHAM
6 BLACK DIAMOND
7 BLAINE
8 BONNEY LAKE
9 BOTHELL
10 BREMERTON
11 BURIEN
12 BURLINGTON
13 CLINTON
14 COVINGTON
15 DES MOINES
16 EDGEWOOD
17 ELLENSBURG
18 ENUMCLAW
19 EVERSON
20 FEDERAL WAY
21 FERNDALE
22 FREELAND
23 GRAHAM
24 ISSAQUAH
25 KENMORE
26 KENT
27 KINGSTON
28 KIRKLAND
29 LACEY
30 LANGLEY
31 LYNDEN
32 MAPLE VALLEY
33 MERCER ISLAND
34 MOUNT VERNON
35 NEWCASTLE
36 NORTH BEND
37 OAK HARBOR
38 OLYMPIA
39 PORT HADLOCK

40 PORT ORCHARD
41 PORT TOWNSEND
42 POULSBO
43 PUYALLUP
44 REDMOND
45 RENTON
46 SAMMAMISH
47 SEDRO WOOLLEY
48 SILVERDALE
49 SUMNER
50 TUKWILA
51 TUMWATER
52 WOODINVILLE
53 YELM
95 OTHER (SPECIFY) _____
96 REFUSED
97 DON'T KNOW

C10 In approximately what month did you make this purchase? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.]**

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
13 WINTER
14 SPRING
15 SUMMER
16 FALL
17 FIRST HALF OF THE YEAR
18 SECOND HALF OF THE YEAR
96 REFUSED

97 DON'T KNOW

AUTO FILL WITH RESPONSE FROM C4_NUM IF C5=1 [ONE TRIP] AND SKIP TO C12

C11 And how many bulbs did you purchase in <month in C10>? **[IF NECESSARY]:** Your best estimate is fine.

1_____ # of bulbs
96 REFUSED ➔ **SKIP TO C13**
97 DON'T KNOW ➔ **SKIP TO C13**

C12 How many of these bulbs are currently installed in or around your home?

1_____ [RECORD #]
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: CAP C12 SO THAT IT DOES NOT EXCEED C11]

SKIP C13 IF C12=0 BULBS; ELSE ASK C14

C13 You indicated that you purchased [INSERT RESPONSE FROM C4, IF DK OR REF INSERT 'some'] CFL bulbs in 2011. What type of bulb did **[IF C12_NUM >1: *the majority* of these CFLs /IF C12_NUM=1, DK, REF: *the CFL*>** replace . . .? **[READ 1-94] [DO NOT ACCEPT MULTIPLE REPLIES].**

1 Other CFLs,
2 Regular/incandescent bulbs,
3 Halogen bulbs,
4 A mix of CFL and other bulbs, or
94 They did not replace other bulbs?
95 SOMETHING ELSE
96 REFUSED
97 DON'T KNOW

ASK ALL

C14 I'd like to know what you did with the bulbs you did **not** install. Did you . . .? **[READ LIST]**

1 store them in your home,
2 give them away,

3 return them to the store, or
95 do something else with them? (SPECIFY: _____)
94 I INSTALLED THEM ALL
96 REFUSED
97 DON'T KNOW

ASK ONCE FOR ALL BULBS

C15 What, if anything, influenced your household to purchase the CFLs? Anything else?
[DO NOT READ] [ACCEPT MULTIPLE REPLIES]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. ANY REBATE
4 LETTER OR BILL INSERT FROM PSE
5 PSE WEBSITE, PSE ADVERTISING
6 SALESPERSON
7 MANUFACTURER ADVERTISING, NEWS, OR OTHER MEDIA
8 HOME ENERGY REPORT
9 LAST LONGER
10 PRICE OF BULB (ON SALE/WAS FREE)
11 ONLY TYPE AVAILABLE/PHASING OUT OF INCANDESCENT LIGHT BULBS
12 LIGHT QUALITY
13 WANTED TO TRY THEM/TRY SOMETHING NEW/SEE HOW THEY WORK
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

X Compact Fluorescent Fixtures -- ASK ALL

X1 Have you ever heard of compact fluorescent fixtures?

1 YES ➔ **SKIP TO X3**
2 NO
96 REFUSED
97 DON'T KNOW

X2 Compact fluorescent fixtures use pin-based CFLs that plug into the fixture. You don't screw them in. These fixtures often have an Energy Star label. Have you heard of these?

1 YES
2 NO ➔**SKIP TO HC1**
96 REFUSED ➔**SKIP TO HC1**
97 DON'T KNOW ➔**First time = Repeat X2. Second time = SKIP TO HC1**

X3 Did you or someone in your household buy any CFL *fixtures* in 2011?

1 YES
2 NO ➔ **SKIP TO HC1**
96 REFUSED ➔ **SKIP TO HC1**
97 DON'T KNOW ➔ **SKIP TO HC1**

X4 How many CFL *fixtures* did you buy in 2011?

1 ONE ➔**SKIP TO X8**
2 TWO
3- THREE OR MORE
96 REFUSED
97 DON'T KNOW

X5 Did you purchase all the CFL fixtures on the same shopping trip?

1 YES ➔ **SKIP TO X8**
2 NO
96 REFUSED ➔ **SKIP TO X8**
97 DON'T KNOW ➔ **SKIP TO X8**

X6 REMOVED

X7 On how many different trips did you purchase CFL fixtures in 2011?

1_____ [RECORD # OF TRIPS]
96 REFUSED ➔ **SKIP TO HC1**
97 DON'T KNOW ➔ **SKIP TO HC1**

[IF X5=YES ASK X8-X14 ONCE. IF X7=2+ READ INTRO AND LOOP THROUGH X8-X14 FOR EACH TRIP. MAX LOOPS=6]: INTRO: Now I'd like to ask you about each shopping trip when you purchased a CFL fixture, starting with the first one.

X8 At what store did you **<IF X7=2+ READ first/ next>** purchase a CFL fixture in 2011? **[DO NOT READ. ACCEPT ONLY ONE RESPONSE]**

1 ACE HARDWARE
2 ARIRANG ORIENTAL MARKET
3 BARTELL DRUGS
4 BEST BUY
5 CARNICERIA LA CHIQUITA
6 COSTCO
7 DO IT BEST HARDWARE CENTER

8 DOLLAR PLUS
9 DOLLAR TREE
10 FOSS' GROCERY
11 FRED MEYER
12 FRY'S ELECTRONICS
13 GOODWILL
14 GROCERY OUTLET
15 HADLOCK BUILDING SUPPLY
16 HAGGEN
17 HARDWARE SALES
18 LA TEJANA MEXICAN STORE
19 LAKE SAWYER GROCERY
20 LOWE'S
21 LUMBERMENS
22 MAPLE VALLEY MARKET
23 MCLENDON HARDWARE
24 MERCADITO DEL VALLE
25 OAK HARBOR MARKETPLACE
26 OLYMPIA LIGHTING CENTER
27 ONLY A DOLLAR PLUS
28 PORT ORCHARD MARKETPLACE
29 PUGET PANTRY
30 RITE AID
31 SEBO'S DO IT CENTER
32 THE MARKETS
33 THE STAR STORE, INC.
34 TRUE VALUE HARDWARE
35 VALLEY HARVEST MARKET / VALLEY HARVEST II INTERNATIONAL MARKET
36 VILLAGE LIGHTING
37 WALGREENS
38 WALMART
39 WALT'S LYNWOOD CENTER MARKET
40 WESTSIDE BUILDING SUPPLY DO IT CENTER
41 WINCO
42 HOME DEPOT
95 OTHER (SPECIFY) _____
96 REFUSED
97 DON'T KNOW

X9 In what city or town is this store located? **[DO NOT READ. ACCEPT ONLY ONE RESPONSE]**

1 ANACORTES
2 AUBURN
3 BAINBRIDGE ISLAND
4 BELLEVUE
5 BELLINGHAM
6 BLACK DIAMOND
7 BLAINE
8 BONNEY LAKE
9 BOTHELL
10 BREMERTON
11 BURIEN
12 BURLINGTON
13 CLINTON
14 COVINGTON
15 DES MOINES
16 EDGEWOOD
17 ELLENSBURG
18 ENUMCLAW
19 EVERSON
20 FEDERAL WAY
21 FERNDALE
22 FREELAND
23 GRAHAM
24 ISSAQUAH
25 KENMORE
26 KENT
27 KINGSTON
28 KIRKLAND
29 LACEY
30 LANGLEY
31 LYNDEN
32 MAPLE VALLEY
33 MERCER ISLAND
34 MOUNT VERNON
35 NEWCASTLE
36 NORTH BEND
37 OAK HARBOR
38 OLYMPIA
39 PORT HADLOCK
40 PORT ORCHARD

41 PORT TOWNSEND
42 POULSBO
43 PUYALLUP
44 REDMOND
45 RENTON
46 SAMMAMISH
47 SEDRO WOOLLEY
48 SILVERDALE
49 SUMNER
50 TUKWILA
51 TUMWATER
52 WOODINVILLE
53 YELM
95 OTHER (SPECIFY) _____
96 REFUSED
97 DON'T KNOW

X10 In approximately what month did you make this purchase? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.]**

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

[ASK IF (X4=2 & X5≠1), OR X4=3] AUTO-FILL A "1" IF X4=1 AND AUTOFILL A "2" IF X4=2 AND X5=1

X11 How many CFL fixtures did you purchase at that time?

1_____ [RECORD #]

96 REFUSED➔ **SKIP TO X13**
97 DON'T KNOW➔ **SKIP TO X13**

X12 **<IF X11=1 Is this CFL fixture/IF x11=2+ Are all of these CFL fixtures>** currently installed in your home?

1 YES ➔ **SKIP TO X13**
2 NO
96 REFUSED ➔ **SKIP TO X13**
97 DON'T KNOW ➔ **SKIP TO X13**

IF X11=1 FIXTURE AND X12=NO, SKIP TO X14

X12a How many of the fixtures purchased on this shopping trip are currently installed in your home?

1 _____ [RECORD #]
96 REFUSED
97 DON'T KNOW

PROGRAMMER: FOR X13 TEXT INSERTION, AUTO-FILL X12a=X11 IF X12=YES

IF X12a=0 FIXTURES, SKIP TO X14

X13 What did the new CFL **<IF X12a=1: fixture/IF X12a=2+fixtures>** replace? **<IF X12a=1:** Was it/ **IF X12a=2+**Were they> . . . **[READ LIST]**

1 Regular/incandescent fixture with regular bulbs,
2 Regular fixture with CFLs,
3 A halogen fixture,
4 A CFL fixture,
94 It was an additional fixture, or
95 Something else? (SPECIFY_____)
96 REFUSED
97 DON'T KNOW

[IF X11 >X12a (NUMBER PURCHASED > NUMBER INSTALLED ASK X14, ELSE SKIP TO X15]
X14 I'd like to know what you did with the fixture(s) you did not install. Did you ? **[READ LIST]**

1 Store it/them in your home,
2 Give it/them away,

3 Return it/them to the store, or
95 Do something else? (SPECIFY _____)
96 REFUSED
97 DON'T KNOW

[ASK ONE TIME FOR ALL FIXTURES]

X15 What influenced your household to purchase a CFL fixture? **[DO NOT READ. ACCEPT MULTIPLE RESPONSES]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

HC Heating and Cooling System – ASK ONLY IF BEHAVIOR SEQUENCE = 1, 2, 4, 5 or 6

[READ]: Now, I'd like to ask you a few questions about purchases related to your home heating and cooling.

HC1. In 2011, did your household purchase and install any of the following? … **[READ]**

a A furnace
b A boiler
c a central air conditioner
d a room air conditioner
e an air source heat pump
f a geothermal heat pump
g ductless heat pump

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]

HCTYPE	= "Furnace"	if HC1a= 1
	= "boiler"	if HC1b = 1
	= "central air conditioner"	if HC1c = 1
	= "room AC"	if HC1d = 1
	= "air source heat pump"	if HC1e = 1
	= "geothermal heat pump	if HC1f = 1
	= "ductless heat pump	if HC1g = 1

IF BEHAVIOR SEQUENCE = 2 OR 5, SKIP TO INSTRUCTIONS BEFORE HC10

HEATING Section only

[ASK IF HC1a, HC1b, HC1e OR HC1f=1]
First, I'm going to ask you specific questions about your <HCTYPE>

ASK HC2-HC9 AND HC18 IF BEHAVIOR SEQUENCE = 1, 4 OR 6; ELSE SKIP TO INSTRUCTIONS BEFORE HC10

HC2 In approximately what month did you install the <HCTYPE>? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

[ASK IF HC1a=1 OR HC1b= 1], FURNACE OR BOILER

HC3 What fuel does your new <HCTYPE> use? **[SELECT ONE RESPONSE] [READ]**

1 Natural gas,
2 Electricity, ➔ **SKIP TO HC7**
3 Propane or
95 something else? (SPECIFY:_____)
96 REFUSED
97 DON'T KNOW ➔

HC4 Did you get a rebate from Puget Sound Energy for the <HCTYPE>?

1 YES ➔ **SKIP TO HC7**
2 NO
96 REFUSED
97 DON'T KNOW

HC4a Will you apply for a 2011 Federal Tax Credit for this <HCTYPE>?

1 YES ➔ **SKIP TO HC7**
2 NO
96 REFUSED
97 DON'T KNOW

HC5 Does your <HCTYPE> have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 Yes ➔ **SKIP TO HC7**
2 No
96 REFUSED
97 DON'T KNOW

[ASK ONLY IF HC1a=1 or HC1b = 1, AND HC3=1 AND HC4 ≠ 1 AND HC4a ≠ 1 AND HC5 ≠ 1], IF IT IS A NATURAL GAS FURNACE OR BOILER, AND THEY SAY THAT IT DID NOT HAVE AN ENERGY STAR LABEL

HC6 Does your new <HCTYPE> have an exhaust vent that… **[READ]**

1 Goes up through the roof, or
2 Is plastic and goes out the side of the house?
96 REFUSED
97 DON'T KNOW

HC7 Approximately how old was the heating system that it replaced **[USE BRACKETING IF SAY DON'T KNOW]**

1 _____ approximate age in years
96 REFUSED
97 DON'T KNOW

HC8 What fuel did your *old* heating system use? Was it . . . **[READ] [ACCEPT ONLY ONE RESPONSE]**

1 Natural gas,
2 Electricity,
3 Propane or
95 something else? (SPECIFY:_____)
96 REFUSED
97 DON'T KNOW

[ASK IF HC8 = 1]
HC9 Did the old heating system have an exhaust vent that…**[READ]**

1 Went up through the roof, or
2 Was plastic and went out the side of the house?
96 REFUSED
97 DON'T KNOW

CENTRAL AC AND DUCTLESS HEAT PUMP QUESTIONS
[ASK IF (HC1c=1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5]

HC10 In approximately what month did you install the <HCTYPE>? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.]**

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER

96 REFUSED
97 DON'T KNOW

[ASK IF HC1c = 1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5]
HC10a Will you apply for a 2011 Federal Tax Credit for this <HCTYPE>?
1 YES ➔ **SKIP TO HC12**
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF (HC1c =1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT CENTRAL AIR CONDITIONER OR DUCTLESS HEAT PUMP
HC11 Does your new <HCTYPE> have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]
1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF (HC1c =1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT CENTRAL AIR CONDITIONER OR DUCTLESS HEAT PUMP

HC12 Did your new <HCTYPE> replace… **[READ]**
1 A central air conditioner,
2 an air source heat pump,
3 a geothermal heat pump,
4 one or more room air conditioners. or ➔ **SKIP TO HC14**
5 is this additional cooling? ➔ **SKIP TO HC14**
96 REFUSED
97 DON'T KNOW

[ASK IF (HC1c =1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT CENTRAL AIR CONDITIONER OR DUCTLESS HEAT PUMP

HC13 Approximately how old was the unit it replaced?
1 _____ APPROXIMATE AGE IN YEARS
96 REFUSED
97 DON'T KNOW

END of CENTRAL AC AND DUCTLESS HEAT PUMP QUESTIONS

ROOM AC QUESTIONS
[ASK IF HC1d= 1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5]

[ASK IF HC1d=1] BOUGHT ROOM AIR CONDITIONER
HC14 How many new room ACs did you install in 2011?

1 _____ #
96 REFUSED
97 DON'T KNOW

[ASK IF HC1d=1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT ROOM AIR CONDITIONER
HC15 Did the new room air conditioner(s) replace . . .?

1 another room air conditioner,
2 a ductless heat pump,
3 or is it additional cooling?
96 REFUSED
97 DON'T KNOW

[ASK IF HC1d=1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT ROOM AIR CONDITIONER
HC16 Did the new room air conditioner(s) have an Energy Star label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF HC15=1 OR HC15=2] REPLACED CONDITIONING UNIT
HC17 Approximately how old was/were the unit(s) replaced?

1 _____ APPROXIMATE AGE OF ROOM AC
96 REFUSED
97 DON'T KNOW

END OF ROOM AC QUESTIONS

ASK HC18 IF BEHAVIOR SEQUENCE = 1, 2, 4, 5 OR 6

[ASK if HC4 = 1 or HC4a =1 or HC5 =1 or HC6 =2 or HC10a=1 or HC11 = 1 or HC16 = 1]

HC18 What, if anything, influenced your decision to purchase an ***energy efficient*** heating or cooling system? [DO NOT READ] [ACCEPT MULTIPLE REPLIES]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

W Water Heater – ASK ONLY IF BEHAVIOR SEQUENCE = 3, 4 OR 5

W1. Did your household install a new water heater in 2011?

1 YES
2 NO → **SKIP TO IS1**
96 REFUSED → **SKIP TO IS1**
97 DON'T KNOW → **SKIP TO IS1**

W2 In what month did you install your new water heater? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY

2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

W3 Is your new water heater a . . .? **[READ] [SELECT ONE ANSWER]**

1 Storage tank water heater,
2 whole house tankless or on-demand water heater,
3 heat pump water heater, ➔ **SKIP TO W5**
4 Solar water heater, or ➔ **SKIP TO W6**
95 some other type of water heater? (SPECIFY _____) ➔ **SKIP TO W6**
96 REFUSED ➔ **SKIP TO W8**
97 DON'T KNOW ➔ **SKIP TO W8**

[ASK IF W3 = 1 OR W3 = 2] STORAGE TANK OR, TANKLESS

W4 What is the primary fuel used by your new water heater? Is it. . . **[READ] [DO NOT ACCEPT MULTIPLE REPLIES]**

1 Natural gas.
2 Electricity,
3 Propane, or
95 Something else (SPECIFY:_____)
96 REFUSED
97 DON'T KNOW

[ASK IF W3=1, 2, 3] STORAGE TANK, WHOLE HOME TANKLESS OR HEAT PUMP WATER HEATER

W5 Did you get a rebate from Puget Sound Energy for your new water heater?

1 YES ➔ **SKIP TO W8**
2 NO
96 REFUSED

97 DON'T KNOW

[ASK IF (W3=1, 2, 3, AND W5 ≠1), OR W3 = 4, 95] NO PSE REBATE FOR TANK OR HEAT PUMP, OR TYPE NOT ELIGIBLE FOR PSE REBATE

W6 Did your <TYPE> have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES ➔ **SKIP TO W8**
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF W3 = 3 AND W5≠1 AND W6≠1] FEDERAL TAX CREDITS AVAILABLE ONLY FOR HEAT PUMP WATER HEATERS.

W6a Will you apply for a 2011 Federal Tax Credit for this water heater?

1 YES ➔ **SKIP TO W8**
2 NO ➔ **SKIP TO W8**
96 REFUSED ➔ **SKIP TO W8**
97 DON'T KNOW ➔ **SKIP TO W8**

[ASK IF W4 = 1 AND W6 = 2] (NATURAL GAS AND NO TO ENERGY STAR)

W7 Does your new <TYPE> have a . . .

1 flue that goes up through the roof, or
2 a plastic pipe that goes out the side of the house?
96 REFUSED
97 DON'T KNOW

W8 Did your new water heater replace a . . .? **[READ]**

1 Storage tank,
2 heat pump
3 tankless /on demand
4 Solar, or
95 Something else (SPECIFY)_____
94 NOTHING / DID NOT REPLACE ANYTHING ➔**SKIP W11**
96 REFUSED
97 DON'T KNOW

W9 Approximately how old was the water heater that you replaced **[USE BRACKETING IF SAY DON'T KNOW] [INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES BEFORE ACCEPTING A DON'T KNOW RESPONSE]**

1 _____ APPROXIMATE AGE IN YEARS
96 REFUSED
97 DON'T KNOW

W10 What fuel did your old water heater use? **[READ. DO NOT ACCEPT MULTIPLE REPLIES]**

1 Natural gas,
2 Electricity,
3. Propane, or
95 Something else
96 REFUSED
97 DON'T KNOW

[ASK IF W5=1 OR IF W6=1 OR W6a= 1 OR W7 = 2] ASK IF THEY GOT A PSE REBATE AN ENERGY STAR RATED WATER HEATER OR THE FLUE IS A PLASTIC PIPE THAT GOES OUT THE SIDE]

W11 What, if anything, influenced your decision to purchase an ***energy efficient*** water heater [DO NOT READ] [ACCEPT MULTIPLE REPLIES]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

IS Insulation – ASK ONLY IF BEHAVIOR SEQUENCE = 2 , 3 OR 6

IS1 In 2011, did your household add any new insulation to the…How about the . . . **[READ EACH]**

a Attic
b Walls
c Floors
d Ducts in unheated spaces

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]
ISTYPE =

"attic insulation"	if IS1a = 1
"wall insulation"	if IS1b = 1
'floor insulation"	if IS1c = 1
"insulation to ducts in unheated spaces"	if IS1d = 1

[ASK FOR EACH IS1a-ISd = 1] [IF NONE INSTALLED – SKIP TO IS4]

IS2 In what month did you install [ISTYPE]? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

IS3 Did you get a rebate from PSE for the [ISTYPE]?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

IS4 In 2011, did your household add any caulking or weather-stripping?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK ONE TIME FOR ALL INSULATION AND CAULKING WEATHERSTRIPPING.]
[ASK IF ANY IS1a-IS1d = 1 OR IS4 = 1]

IS5 What, if anything, influenced your decision to install the insulation, caulk or weatherstripping?

[DO NOT READ] [ACCEPT MULTIPLE REPLIES]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

A Appliances – ASK ONLY IF BEHAVIOR SEQUENCE = 2, 3 OR 6

[READ]: Now, I'd like to ask you a few questions related to any appliances you may have purchased in the past year.

A1 In 2011, did your household purchase a . . .? **[READ LIST]**

a Refrigerator
b Freezer
c Clothes washer
d Clothes Dryer
e Dishwasher
f Dehumidifier

1 Yes
2 No
96 REFUSED
97 DON'T KNOW

[IF NONE PURCHASED, SKIP TO EE1]

[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]
ATYPE =

" refrigerator"	A1a=1
"freezer "	A1b=1
"clothes washer"	A1c=1
"clothes dryer "	A1d=1
"dishwasher "	A1e=1
"dehumidifier"	A1f=1

[ASK IF A1a=1, REFRIGERATOR]
A2 Did you get a rebate from PSE for the new refrigerator?
1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IFA1c = 1, CLOTHES WASHER]
A3 Did you get a WashWise rebate for the new clothes washer?
1 YES
2 NO
96 REFUSED
97 DON'T KNOW

LOOP A4-A6 FOR EACH APPLIANCE PURCHASED
A4 In what month did you purchase your new <appliance>? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

[ASK A5 IF A2≠1 AND A3 ≠ 1, ELSE SKIP TO A6]
(DID NOT GET A PSE REBATE, DID NOT GET A WASHWISE REBATE, OR WAS NOT A REFRIGERATOR OR CLOTHES WASHER)
A5 Does your new <ATYPE> have an ENERGY STAR label? [**INTERVIEWER NOTE: YOU CAN ENCOURAGE CLIENTS TO SEE IF THEIR APPLIANCE HAS AN ENERGY STAR LABEL] [READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES
2 NO
96 REFUSED ➔ **SKIP TO EE1**
97 DON'T KNOW

A6 Did your new <ATYPE> replace an existing <ATYPE>?

1 YES
2 NO
96 REFUSED ➔ **SKIP TO EE1**
97 DON'T KNOW

[ASK IF A2=1, A3=1 OR A5=1]
A7 What, if anything, influenced your decision to buy an ***energy efficient*** appliance? **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

EE Electronic Equipment – ASK ONLY IF BEHAVIOR SEQUENCE = 3, 4 OR 5

[READ]: Now, I'd like to ask you a few questions related to electronic equipment you may have purchased in the past year.

EE1 In 2011, did your household buy a . . .? **[READ LIST]**

a TV
b Computer **[INCLUDES LAPTOPS]**
c Computer monitor
d Digital video recorder **(DVR, like TeVO)**

1 Yes
2 No
96 REFUSED
97 DON'T KNOW

[REPEAT FOR EACH EE1a-d = 1]
[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]

ETYPE = "TV" if EE1a = 1
= "Computer" if EE1b = 1
= "Computer monitor" if EE1c = 1
= DVR" if EE1d = 1

[SKIP TO B1 IF EE1a-EE1d≠1]

EE2 How many [ETYPEs] did you buy?

1 _____# [ETYPE] PURCHASED

96 REFUSED
97 DON'T KNOW

[IF EE2>1, READ]: "Now I'd like to ask about each [ETYPE] you bought separately"

[REPEAT EE3-EE4 FOR EACH EE2=1]
EE3 Does your **<IF EE2>1, USE first/next>** new [ETYPE] have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

EE4 Did your new [ETYPE] replace an existing [ETYPE] or was it additional equipment?

1 REPLACED
2 ADDITIONAL EQUIPMENT
96 REFUSED
97 DON'T KNOW

[ASK IF EE3=1 FOR ANY EETYPE; ONLY ASK ONCE]
EE5 What, if anything, influenced your decision to buy ***Energy Star*** equipment? **[DO NOT READ. ACCEPT MULTIPLE RESPONSES]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BG Behavior – ASK ALL

BG1 Do you discuss with other members of your household how your household uses energy?

1 YES
2 NO ➔ **SKIP TO BHH1**
96 REFUSED ➔ **SKIP TO BHH1**
97 DON'T KNOW ➔ **SKIP TO BHH1**

BG2 What types of things do you discuss? (anything else) **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2 SAVING ENERGY
3 TURNING THINGS OFF (LIGHTS, COMPUTERS, OTHER)
4 ENVIRONMENT, GLOBAL WARMING, CLIMATE CHANGE
5 HOW MUCH ENERGY DIFFERENT APPLIANCES USE
6 CLOSING DOORS/WINDOWS/SHADES
7 HOME ENERGY REPORT AND OTHER ENERGY USE COMPARISONS
8 SAVING WATER/HOT WATER USAGE
9 THERMOSTAT SETTINGS/TURNING DOWN THE HEAT
10 LIGHT BULBS
11 CLOSE FRIDGE DOOR
12 BUILDING SHELL IMPROVEMENTS
95 OTHER (SPECIFY _____)
96 REFUSED
97 DON'T KNOW

BHH Behavior-Home Heating – ASK IF BEHAVIOR SEQUENCE = 1, 4 OR 6

[READ]: I'd like to know if there are any things that you have done in the past year to keep your heating costs down. These are things that some people do, but that some do not. There are no right or wrong answers.

BHH1 In the past year, did you regularly turn down the heat at night?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

BHH2 In the past year, did you regularly turn down the heat during the day when no one was home?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

BHH4 In the past year, did you regularly run ceiling fans in reverse during the winter?

1 YES
2 NO
3 NOT RECOMMENDED [IF VOLUNTEERED]
99 NOT APPLICABLE – DOES NOT OWN CEILING FAN
96 REFUSED
97 DON'T KNOW

BHH5 In the past year, did you regularly turn down the thermostat when using your fireplace?

1 YES
2 NO
3 NOT RECOMMENDED [IF VOLUNTEERED]
99 NOT APPLICABLE – DOES NOT OWN FIREPLACE
96 REFUSED
97 DON'T KNOW

BHH6 In the past year, did you clean or replace air filters for you heating system, as recommended?

1 YES
2 NO
3 NOT RECOMMENDED [IF VOLUNTEERED]
99 NOT APPLICABLE – NO AIR FILTERS
96 REFUSED
97 DON'T KNOW

BHH7 Now, I'm going to read a list of additional actions you may have taken. In the past year, did you… **[READ] [CHECK ALL THAT APPLY]**

a. seal leaky ducts?
b. install storm windows?
c. **[SKIP IF BHH5=99]** improve your fireplace sealing?
d. Have a professional do a service check on your heating system?
e. **[SKIP IF BHH5=99]** Install a fireplace insert?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: BHH8-11 WERE REMOVED]

[ASK IF ANY YES TO ANY BHH ITEMS]

BHH12 What, if anything, influenced you to take any of these actions we just discussed? **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
9 EQUIPMENT MAINTENANCE/REGULAR CLEANING
10 FIX BROKEN EQUIPMENT
11 HABIT/COMMON SENSE
12 HEALTH AND SAFETY
13 MAKE HOME MORE COMFORTABLE
14 RECOMMENDED BY MANUFACTURER
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BAC Behavior-Air Conditioning – ASK IF BEHAVIOR SEQUENCE = 1, 2 OR 5

[READ]: I'd like to know if there are any things that you have done to keep your cooling costs down. These are things that some people do, but that some do not. There are no right or wrong answers.

BAC1 In the past year did you…**[READ]**

a **[SKIP IF BHH4=99]** regularly use a ceiling fan for home cooling?
b **[SKIP IF BHH4=99]** install a ceiling fan for home cooling?
c regularly close your shades in the summer?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE BA2-BA3 NO LONGER IN SURVEY]

BAC4 Did your household own and use at least one air conditioner in the past year?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF BAC4=1]
BAC5 In the past year did you…[**READ]**

a regularly turn off the air conditioner when no one was at home?
b regularly keep the doors and windows closed when the air conditioner was on?
c seal the area around window air conditioners?
d clean the area around your air conditioner?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE – NO ROOM AC

[ASK IF ANY OF THE FOLLOWING WERE YES (=1), BAC1a-BAC1c, BAC5a–BAC5d]

BAC6 What, if anything, influenced you to take any of these actions we just discussed? (anything else)?

[DO NOT READ]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
9 HABIT/COMMON SENSE
10 EQUIPMENT MAINTENANCE
11 KEEP THE HOUSE COOL
12 KEEP SUN OUT
13 MAKE HOME MORE COMFORTABLE
14 COOLING NOT REQUIRED IN WASHINGTON STATE
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BL Behavior-Lighting – ASK IF BEHAVIOR SEQUENCE = 3, 4 OR 5

[READ]: Now I'd like to talk about steps you may have taken to reduce your home lighting use. Some people do these things, some do not.

BL1 In the past year did you . . . **[READ]**

a Regularly turn off lights when not needed?
b Install outdoor motion detectors instead of keeping lights on at night?
c Replace electric outdoor lighting with solar lights?
d Install any LED lights in or around your home?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF ANY OF THE ANSWERS FOR BL1a-d=1]

BL2 What, if anything, influenced you to take any of these actions we just discussed? (anything else)

[DO NOT READ]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BHW Behavior-Hot Water – ASK IF BEHAVIOR SEQUENCE = 3, 4 OR 5

[READ]: Now I'd like to talk about steps you may have taken to reduce your water heating costs. Some people do these things, some do not.

BHW1 In the past year, did you…**[READ]**

a regularly turn down the water heater temperature to a very low setting when you were away for two or more days?
b Lower your water heater temperature and keep it at the lower setting?
c Insulate your hot water pipes?
d Install showerheads that had a lower flow than what they replaced?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF ANY BHW1a-d=1]

BHW2 What, if anything, influenced you to take any of these actions we just discussed? **[DO NOT READ]**

[CHECK ALL THAT APPLY]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BA Behavior-Appliances – ASK IF BEHAVIOR SEQUENCE = 2 ,3 OR 6

[READ]: Now I'd like to talk about steps you may have taken to reduce your appliance use. Some people do these things, some do not.

BA1 In the past year, did you reduce the number of working refrigerators in your house?

1 YES
2 NO ➔ **SKIP TO BA4**
96 REFUSED ➔ **SKIP TO BA4**
97 DON'T KNOW ➔ **SKIP TO BA4**

BA2 Did you get cash back from PSE for discarding the refrigerator?

1 YES
2 NO
96 REFUSED ➔ **SKIP TO BA4**
97 DON'T KNOW

BA3 In what month did you discard the refrigerator? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.]**

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL

5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

BA4 In the past year, did you reduce the number of standalone freezers in your house?

1 YES
2 NO ➔ **SKIP TO BA7**
96 REFUSED ➔ **SKIP TO BA7**
97 DON'T KNOW ➔ **SKIP TO BA7**

BA5 Did you get cash back from PSE for discarding the freezer?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

BA6 In what month did you discard the freezer? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER

96 REFUSED
97 DON'T KNOW

BA7 In the past year did you . . .

a regularly wash clothes with cold water?
b hang laundry to dry?
c use the moisture sensor on your clothes dryer?
d tighten your refrigerator seal
e clean your refrigerator coils?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF YES TO ANY BA1, BA4, BA7a-e]
BA8 What, if anything, influenced you to take any of these actions we just discussed? **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
9 BETTER FOR CLOTHES
10 HABIT/COMMON SENSE
11 EQUIPMENT MAINTENANCE/REGULAR CLEANING
12 FIX BROKEN EQUIPMENT
13 IMPROVE EFFICIENCY OF EQUIPMENT
14 PERSONAL PREFERENCE
15 RECOMMENDED BY MANUFACTURER/OTHER
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BE Behavior-Electronics and Other – ASK IF BEHAVIOR SEQUENCE = 3, 4 OR 5

BE1 In the past year, did you . . .**[READ]**

a plug some equipment into power strips that you turn off when you are not using the equipment?
b install any "smart" power strips that turn off multiple items when one item is turned off?
c regularly unplug electronics when not in use?
d regularly use computer power-saving modes?
e regularly turn off your computer at night?
f install solar photovoltaic panels?

1 YES
2 NO ➔ **SKIP TO M1**
96 REFUSED ➔ **SKIP TO M1**
97 DON'T KNOW ➔ **SKIP TO M1**

[ASK IF ANY OF BE1a-f=1]
BE2 What, if anything, influenced you to take any of these actions we just discussed? [DO NOT READ. ACCEPT MULTIPLE RESPONSES.]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

M HERS Report – Response to Mailings – ASK M1-M10 OF SAMPLE GROUP 2 ONLY

M1 Did your household receive a Home Energy Report from Puget Sound Energy about your in-home energy use?

1 YES ➔ **SKIP TO M3**
2 NO
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW

M2 The Home Energy Report is sent by Puget Sound Energy, separate from your bill. It breaks down your energy use and your neighbors' energy use and highlights tips about saving energy. Do you recall receiving the Home Energy Reports?

1 YES
2 NO ➔ **SKIP TO D1**
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW ➔ **SKIP TO D1**

M3 How frequently **<2 - do/3 – did>** you receive these reports? **[READ]**

1 Monthly
2 Every other month
3 Quarterly, or
4 Annually?
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW

M4 Did you or someone else in your household read the reports?

1 YES
2 NO ➔ **SKIP TO D1**
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW ➔ **SKIP TO D1**

M4a Would you say that someone in your household read . . .**[READ]**?

1 some of the reports,
2 most of the reports,
3 or every Home Energy Report that you received?
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW ➔ **SKIP TO D1**

M5 About how much time did you or someone else in your household spend reading each report? **[READ] [DO NOT ACCEPT MULTIPLE REPLIES]**

1 One to three minutes,
2 Four to ten minutes, or
3 More than 10 minutes
96 REFUSED
97 DON'T KNOW

M6 On a scale of 1 to 5, where 1 is "not at all useful" and 5 is "very useful," how useful have you found the Home Energy Reports?

1 NOT AT ALL USEFUL
2
3 I
4
5 VERY USEFUL
96 REFUSED
97 DON'T KNOW

M7 Now I'm going to ask you about how useful each of the components of the Home Energy Report is. **First/Next** is the **<INSERT COMPONENT HERE>.** Is it…**[READ]**?

1 very useful,
2 somewhat useful, or
3 not at all useful?
96 REFUSED
97 DON'T KNOW

a. Last 2 Months Overall Usage Comparisons to your neighbors' energy use
b. Last 12 Months Comparison to Neighbors for Gas and Electricity
c. Comparison to your Household's Usage the Year Before
d. Action Step – Tips to Save Energy
e. Recommendations For Energy Efficient Purchases

M8 [PROGRAMMER NOTE: M8 REMOVED]

M9 Did any of the energy saving tips in the Home Energy Report cause you to adopt new energy saving habits?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

M10 Did the Home Energy Report cause you to purchase more efficient energy using equipment?

1 YES
2 NO
96 REFUSED

97 DON'T KNOW

D DEMOGRAPHICS – ASK ALL

[READ]: I have few final questions about your household. We're almost done.

D1. Which of the following best describes the type of home you live in? Is it a… [READ]
01 Single family, detached,
02 Single family attached, such as town house or row house,
03 Apartment in multi-unit structure of 2–4 units,
04 Apartment in multi-unit structure of 5 or more units, or
05 Mobile Home?
96 REFUSED
97 DON'T KNOW

D2 Do you own or rent your home?
1 OWN
2 RENT
96 REFUSED
97 DON'T KNOW

D3. How many years have you lived in your current home?

01___ years **[IF <1 YEAR, RECORD 0]**
96 REFUSED
97 DON'T KNOW

D4. Approximately what year was your home built? **[DO NOT READ]**
01 2006 OR LATER
02 2000 TO 2005
03 1990 TO 1999
04 1980 TO 1989
05 1970 TO 1979
06 1950 TO 1969
07 EARLIER THAN 1950
96 REFUSED
97 DON'T KNOW

D5. What is the approximate finished square footage of your home? Your best estimate is fine. **[DO NOT READ]**

01 LESS THAN 1,2000 SQUARE FEET
02 1,200 TO LESS THAN 1,800 SQUARE FEET
03 1,800 TO LESS THAN 2,400 SQUARE FEET
04 2,400 TO LESS THAN 3,000 SQUARE FEET
05 3,000 SQUARE FEET OR MORE
96 REFUSED
97 DON'T KNOW

D6. What is the **primary** fuel used to heat your home? **[DO NOT READ]**

01 NATURAL GAS
02 ELECTRICITY
03 PROPANE
04 OIL
05 WOOD
06 SOLAR
96 REFUSED
97 DON'T KNOW

D7. What is the **primary** fuel used to heat your hot water (water heater)? **[DO NOT READ]**

01 NATURAL GAS
02 ELECTRICITY
03 PROPANE
04 OIL
05 WOOD
06 SOLAR
96 REFUSED
97 DON'T KNOW

D8 How many working refrigerators do you have in your home?

01 ___ RECORD NUMBER OF WORKING REFRIGERATORS
96 REFUSED
97 DON'T KNOW

D9. Including yourself and children, how many people live in your home at least six months of the year?

01___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

[IF D9 = 96/97/1 PERSON, SKIP TO D15, ELSE ASK D10]

D10. How many people in your household, excluding yourself, are under 5 years of age?

01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D11. How many people in your household, excluding yourself, are 5 to 17 years of age?

01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D12. How many people in your household, excluding yourself, are 18 to 64 years of age?
01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D13. How many people in your household, excluding yourself, are 65-79 years of age?
01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D14. How many people in your household, excluding yourself, are 80 years of age or older?
01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

[CHECK THAT D9 = D10-D14 MINUS 1]
[IF THEY DON'T ADD UP, VERIFY RESPONSES TO D10 THROUGH D14 UNTIL THEY DO]

D15 What is *your* age?
01 ___ RECORD AGE
96 REFUSED
97 DON'T KNOW

D16 What is the highest level of education you have obtained? **[READ LIST]**
1 Some high school,
2 High school graduate, including GED,
3 Some college or an Associate's degree,
4 Bachelor's degree,
5 Some graduate school,
6 Graduate or professional degree,
96 REFUSED
97 DON'T KNOW

D17 Next, for statistical purposes only, I'd like to know your household's total 2011 annual income before taxes. Please stop me when I reach the category that best describes your household's income. **[READ IF NECESSARY:** This information is confidential and will only be used for characterizing respondents to this study.] **[READ LIST]**

1 Less than $25,000,
2 $25,000 to $49,999,
3 $50,000 to $74,999,
4 $75,000 to $99,999, or
5 $100,000 or more?
96 REFUSED
97 DON'T KNOW

W WRAP UP – ASK ALL

[READ]: Those are all the questions I have for you. Is there anything that you want me to pass on to PSE? Thank you very much for your time and opinions.

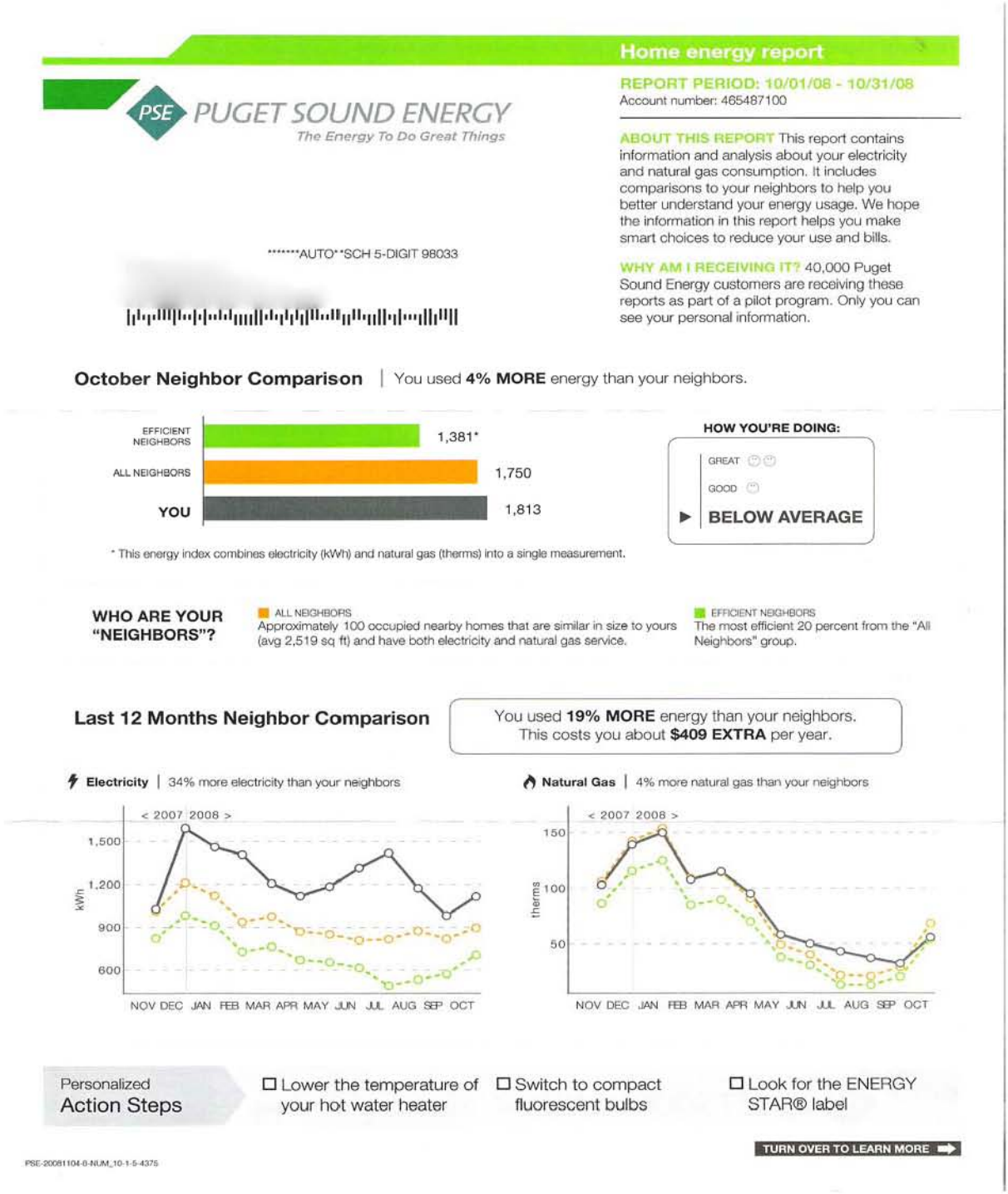
YES, RECORD:_____

NO

RECORD GENDER

1 MALE
2 FEMALE
97 CAN'T DETERMINE

D. OPOWER Home Energy Report Example



Home energy report

PUGET SOUND ENERGY
The Energy To Do Great Things

REPORT PERIOD: 10/01/08 - 10/31/08
Account number: 465487100

ABOUT THIS REPORT This report contains information and analysis about your electricity and natural gas consumption. It includes comparisons to your neighbors to help you better understand your energy usage. We hope the information in this report helps you make smart choices to reduce your use and bills.

WHY AM I RECEIVING IT? 40,000 Puget Sound Energy customers are receiving these reports as part of a pilot program. Only you can see your personal information.

*******AUTO**SCH 5-DIGIT 98033

October Neighbor Comparison | You used 4% MORE energy than your neighbors.

EFFICIENT NEIGHBORS 1,381*
ALL NEIGHBORS 1,750
YOU 1,813

HOW YOU'RE DOING:
GREAT
GOOD
▶ BELOW AVERAGE

* This energy index combines electricity (kWh) and natural gas (therms) into a single measurement.

WHO ARE YOUR "NEIGHBORS"?

ALL NEIGHBORS
Approximately 100 occupied nearby homes that are similar in size to yours (avg 2,519 sq ft) and have both electricity and natural gas service.

EFFICIENT NEIGHBORS
The most efficient 20 percent from the "All Neighbors" group.

Last 12 Months Neighbor Comparison

You used 19% MORE energy than your neighbors.
This costs you about $409 EXTRA per year.

Electricity | 34% more electricity than your neighbors

< 2007 2008 >
kWh
1,500
1,200
900
600
NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT

Natural Gas | 4% more natural gas than your neighbors

< 2007 2008 >
therms
150
100
50
NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT

Personalized Action Steps

☐ Lower the temperature of your hot water heater
☐ Switch to compact fluorescent bulbs
☐ Look for the ENERGY STAR® label

TURN OVER TO LEARN MORE ➡

PSE-20081104-0-NUM_10-1-5-4375

Personal Comparison | How your energy use this year compares to last year.

About This Graph
This section shows how much energy you've used so far this year and compares that amount to the same period last year.

As the months go by you can see how your progress compares to last year.

Your Progress
So far this year, you've used **16% MORE** energy than last year.

* This energy index combines electricity (kWh) and natural gas (therms) into a single measurement.

Action Steps | Personalized tips chosen for you based on your energy use and housing profile

Quick Fixes
Things you can do right now

☐ **Lower the temperature of your hot water heater**
Lowering the water heater temperature from 140°F to 120°F can result in a 10% savings in hot water costs.

Most households find 120°F to be sufficient for their needs. As an added benefit, this temperature is helpful for preventing scalding.

Note that if your dishwasher does not have a booster heater, a water temperature of 130°F to 140°F may be necessary—consult your owner's manual for information.

SAVE UP TO
$25 ANNUALLY

Smart Purchases
Save a lot by spending a little

☐ **Switch to compact fluorescent bulbs**
Compact fluorescent light bulbs (CFLs) use 75% less energy and last up to 10 times longer than standard incandescent light bulbs. Replace a few 100-watt incandescent bulbs and start saving money now.

Today's CFLs provide high-quality light and are available in a variety of sizes and shapes.

PSE offers a discount of up to $3 on certain bulbs—find participating retailers at PSE.com.

SAVE
$60 OR MORE SAVED OVER THE LIFE OF A BULB

Great Investments
Big ideas for big savings

☐ **Look for the ENERGY STAR® label**
The Department of Energy tests the energy efficiency of many home appliances and electronics, and the best earn the official ENERGY STAR® label. In 2007 Americans saved $16 billion on their energy bills thanks to this program.

The ENERGY STAR label can be found on efficient models of clothes washers, refrigerators, televisions, computers and many other products.

Visit www.energystar.gov for more details.

SAVE UP TO
40% ON APPLIANCE ENERGY COST

To find more ways to save energy and money and for more information about this report visit: **www.psereports.com**

PSE PUGET SOUND ENERGY
The Energy To Do Great Things

1-800-562-1482 (M-F 8am–5pm)
energyreports@pse.com

powered by Positive Energy

PSE-20051104-6-NUM_10-1-5-4375

Home energy report

PUGET SOUND ENERGY
The Energy To Do Great Things

REPORT PERIOD: 09/01/08 - 09/30/08
Account number: 465487100

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*******AUTO**SCH 5-DIGIT 98033

September Neighbor Comparison | You used **17% MORE** energy than your neighbors.

HOW YOU'RE DOING:
GREAT
GOOD
▶ **BELOW AVERAGE**

* This energy index combines electricity (kWh) and natural gas (therms) into a single measurement.

WHO ARE YOUR "NEIGHBORS"?

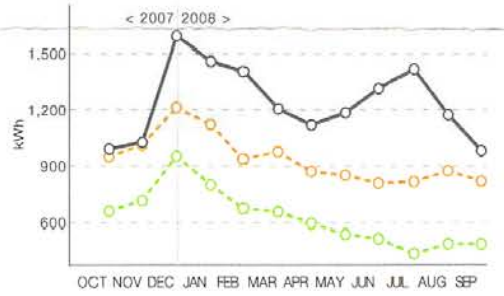
ALL NEIGHBORS
Approximately 100 occupied nearby homes that are similar in size to yours (avg 2,519 sq ft) and have both electricity and natural gas service.

EFFICIENT NEIGHBORS
The most efficient 20 percent from the "All Neighbors" group.

Last 12 Months Neighbor Comparison

You used **18% MORE** energy than your neighbors.
This costs you about **$397 EXTRA** per year.

Electricity



Natural Gas

Personalized Action Steps

- ☐ Find more ways to save
- ☐ Install a programmable thermostat
- ☐ Choose an ENERGY STAR® furnace

TURN OVER TO LEARN MORE ➡

PSE-20081009-5-NUM_10-1-7-3060

Evaluation Report Response

Program: 2011 Home Energy Reports Program

Program Manager: Joel Smith

Study Report Name: Puget Sound Energy's Home Energy Reports Program Three Year Impact, Behavioral and Process Evaluation

Report Date: April 20, 2012

Evaluation Analyst: Bobette Wilhelm

Date ERR Provided to Program Manager: May 4, 2012

Date of Program Manger Response: May 1, 2012

Please describe in detail, action plans to address the evaluation study's key findings and recommendations.

Date of Program Action: Home Energy Report program management has approved of the findings in the HER Evaluation and require no corrections or additional actions. The findings in the evaluation will be used for our ex-post savings claim for 2011. This evaluation and the methodologies within should be used for future HER evaluations.