2013–2014 Washington Home Energy Savings Program Evaluation

December 21, 2016

Pacific Power
825 NE Multnomah
Portland, OR 97232

The Cadmus Group, Inc.
An Employee-Owned Company • www.cadmusgroup.com

This page left blank.

CADMUS

Prepared by:
Danielle Kolp
Ann Sojka
Emily Miller
Kaylee Shalett
Andrew Carollo
Jason Christensen
Matt Gluesenkamp
Matei Perussi
Steve Cofer
Karen Horkitz

Cadmus

This page left blank.

CADMUS

Table of Contents

Glossary of Terms

Analysis of Covariance (ANCOVA)
An ANCOVA model is an Analysis of Variance (ANOVA) model with a continuous variable added. An ANCOVA model explains the variation in the independent variable, based on a series of characteristics (expressed as binary variables equaling either zero or one).

Evaluated Savings
Evaluated savings represent the total program savings, based on the validated savings and installations, before adjusting for behavioral effects such as freeridership or spillover. They are most often calculated for a given measure 'i' as:

$$Evaluated\ Savings_i = Verified\ Installations_i * Unit\ Consumption_i$$

Realization Rate
The ratio of evaluated savings and the savings reported (or claimed) by the program administrator.

Regional Technical Forum (RTF)
The RTF is an advisory committee to the Northwest Power and Conservation Council established in 1999 to develop standards to verify and evaluate energy efficiency savings.

In-Service Rate (ISR)
The ISR (also called the installation rate) is the proportion of incented measures actually installed.

P-Value
A p-value indicates the probability that a statistical finding might be due to chance. A p-value less than 0.10 indicates that, with 90% confidence, the finding was due to the intervention.

T-Test
In regression analysis, a t-test is applied to determine whether the estimated coefficient differs significantly from zero. A t-test with a p-value less than 0.10 indicates there is a 90% probability that the estimated coefficient is different from zero.

Trade Ally
For the process evaluation's purposes, trade allies are respondents of the participant retailer/contractor survey. Trade allies include retailers and contractors who supply and install discounted light bulbs and fixtures, appliances, HVAC, or insulation through the program.

CADMUS

Executive Summary

In 2006, Pacific Power first offered the Home Energy Savings (HES) program in Washington. The program provides residential customers with incentives to facilitate their purchases of energy-efficient products and services through upstream (manufacturer) and downstream (customer and contractor) incentive mechanisms. During the 2013 and 2014 program years, Pacific Power's HES program reported electricity savings of 21,159,434 kWh. The largest of Pacific Power's Washington residential programs, the HES program contributed 63% of the reported Washington residential portfolio savings and 20% of Washington's total energy efficiency portfolio savings in 2013 and 2014.[1]

During the evaluation period (2013–2014), the HES program included energy efficiency measures in six categories:

- ***Appliances:*** Pacific Power provided customer incentives for efficient clothes washers, dishwashers, refrigerators, freezers, room air conditioners, light fixtures, and high-efficiency electric storage water heaters.
- ***Heating, ventilation, and air conditioning (HVAC):*** Pacific Power provided customer incentives for high-efficiency heating and cooling equipment (including central air conditioners and evaporative coolers) and services (including tune-ups and best practice installation), and heat pump water heaters.
- ***wattsmart Starter Kits:*** In 2014, Pacific Power introduced low-cost (or for some configurations, no cost) mailed kits, containing various combinations and quantities of CFLs, LEDs, faucet aerators, and high-efficiency showerheads.
- ***Lighting:*** Pacific Power provided upstream incentives for manufacturers to reduce retail prices on CFLs, and LEDs.
- ***New Homes:*** Pacific Power provided new home customer incentives, including energy-efficient dishwashers, refrigerators, and windows, and a builder option package with heat pump installation.
- ***Weatherization:*** Pacific Power provided customer incentives for attic, wall, and floor insulation, air sealing, and high-efficiency windows.

Pacific Power contracted with Cadmus to conduct impact and process evaluations of the Washington HES program for program years 2013 and 2014. For the impact evaluation, Cadmus assessed energy impacts and program cost-effectiveness. For the process evaluation, Cadmus assessed program delivery and efficacy, bottlenecks, barriers, best practices, and opportunities for improvements. This document presents the results of Cadmus' impact and process evaluations.

[1] Residential portfolio and total portfolio savings (at the customer site), sourced from the 2013 and 2014 Pacific Power Washington annual reports.

Key Findings

Cadmus' impact evaluation addressed over 99%[2] of the HES program savings by collecting primary data on the top savings measures, performing billing analyses for insulation and HVAC measures, and completing engineering reviews using secondary data for the remaining measures.

Key Impact Evaluation Findings

In general, Cadmus deferred to current Regional Technical Forum (RTF) measure workbooks and savings estimation methodologies where available. The RTF uses a market baseline to calculate evaluated measure level savings – a baseline more efficient than federal or state minimum code requirements. This market baseline provides a snapshot in time, and represents values such as the average efficiency of clothes washer shipments. In using a time-dependent market baseline, Cadmus referred to RTF market baselines in place on January 1, 2013. Where RTF market baselines were not apparent, Cadmus defaulted to equipment code. Given this market baseline approach used in Washington, this report does not present gross and net savings—only evaluated savings. While Cadmus used 2013 market baselines, Cadmus used updated workbook versions where engineering assumptions may differ from that used when Pacific Power designed its program.

Cadmus decided to use updated RTF workbooks but keep the 2013 baseline to stay current with updated engineering inputs and assumptions. In some instances, using the current RTF measure workbook negatively impacted savings estimates, as updated non-baseline assumptions in the workbook differed than program implementation estimates. This report analyzes the impacts of changes in each of these assumptions on program savings. In some instances, Cadmus deviated from RTF workbook assumptions (as noted in the report).

Key evaluation findings (summarized in Table 1) include the following:

- ***Appliances:*** Overall, Cadmus estimated an 85% realization rate of reported savings for the appliance measure category. Incented appliances showed an overall weighted average installation rate of 100%. Evaluated savings realization rates were 56% for light fixtures and 101% for clothes washers. The realization rate for light fixtures was lower because the reported assumptions stated that each fixture contained two bulbs, but the vast majority of fixtures in the tracking database were single-bulb fixtures.
- ***HVAC****:* Overall, the HVAC measure category realized 83% of reported savings. Evaluated savings realization rates ranged from 9% for heat pump upgrades installed in 2013 to 117% for heat pump conversions installed in 2014. Cadmus estimated these realization rates using RTF workbooks and engineering analysis.

[2] The remaining 1% represented measures with small enough savings not warranting the cost of evaluation to verify.

- ***wattsmart Starter Kits:*** Kit measures (e.g., lighting and water saving devices) were evaluated separately, but, when combined at the kit level, these measures realized 150% of reported savings. Installation rates varied from 61% for bathroom faucet aerators to 90% for LEDs.
- ***Lighting:*** The HES lighting component realized 93% of reported savings. Incented CFL and LED bulbs realized 70.5% and 84.8% installation rates, respectively, based on installation, storage, and removal practices reported through telephone surveys. The evaluation estimated lower savings variables for LEDs than planned (i.e., in-service rates [ISRs], hours-of use, and delta watts); the program realized only 78% of reported savings for LEDs, while realizing 95% for CFLs.
- ***Weatherization:*** Overall, Cadmus estimated a 96% realization rate for the weatherization measure category through a billing analysis, consisting of attic, wall, and floor insulation as well as windows.

Table 1. 2013 and 2014 HES Program Savings*

Measure Category	Evaluated Units**	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate	Precision (at 90% Confidence)
Appliances	4,506	356,094	302,165	85%	±0.6%
HVAC	1,079	2,942,293	2,462,464	84%	±6%
Kits	12,357	4,298,641	6,465,955	150%	±15%
Lighting	634,928	12,339,393	11,436,081	93%	±5%
New Homes***	4,671	139,933	139,933	100%	N/A
Weatherization	897,071	1,083,080	1,044,011	96%	±8%
Total	**1,554,611**	**21,159,434**	**21,850,609**	**103%**	**±5%**

*Totals in tables may not add exactly due to rounding.

**Cadmus counted each square foot of incented insulation or windows as one unit.

***New Homes measures fell below the 99% savings threshold and were not evaluated, therefore Cadmus applied a 100% realization rate.

Table 2 and Table 3 show impact evaluation findings by program year. The change in overall realization rates mainly resulted from the addition of ***watt***smart Starter Kits in 2014. The HVAC realization rate increased significantly from 2013 to 2014 due to the mix of measures incented. In 2013, savings were dominated by heat pump measures with low realization rates. In contrast, 2014 savings were dominated by duct-sealing measures with relatively high realization rates.

Table 2. 2013 HES Program Savings*

Measure Category	Evaluated Units**	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Appliances	2,080	198,514	171,727	87%
HVAC	217	730,938	455,498	62%
Kits***	0	0	0	N/A
Lighting	327,637	6,859,203	6,526,248	95%
New Homes	3,435	10,226	10,226	100%
Weatherization	428,825	602,584	580,723	96%
Total	**762,194**	**8,401,465**	**7,744,422**	**92%**

*Totals in tables may not add exactly due to rounding.

**Cadmus counted each square foot of incented insulation or windows as one unit.

***Pacific Power did not have a kit measure category in 2013.

Table 3. 2014 HES Program Savings*

Measure Category	Evaluated Units**	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Appliances	2,426	157,580	130,438	83%
HVAC	862	2,211,355	2,006,967	91%
Kits	12,357	4,298,641	6,465,955	150%
Lighting	307,291	5,480,190	4,909,832	90%
New Homes	1,236	129,707	129,707	100%
Weatherization	468,246	480,496	463,288	96%
Total	**792,418**	**12,757,969**	**14,106,187**	**111%**

*Totals in tables may not add exactly due to rounding.

**Cadmus counted each square foot of incented insulation or windows as one unit.

Key Process Evaluation Findings

Key process evaluation findings include the following:

- Retailers (32%) served as the most commonly cited sources of program awareness for non-lighting participants. The general population most commonly cited bill inserts (52%) and TV (14%) as ways they learned about ***watt***smart offerings. ***watt***smart Starter Kit participants learned about the program through bill inserts (62%) and print ads (11%).
- Non-lighting participants expressed satisfaction with the program, with 86% reporting satisfaction with the program overall. In addition, non-lighting customers expressed high satisfaction levels with measures they installed, their contractors, and incentive amounts they received.
- Non-lighting participants reported participating as they sought to replace old equipment, save energy, and reduce costs. Energy efficiency ***watt***smart Starter Kit participants said price and energy efficiency motivated them to order kits.

- General population survey respondents consistently expressed higher satisfaction levels for LED purchases than for CFL purchases.
- The introduction of ***watt***smart Starter Kits proved successful, with the program distributing over 12,000 kits in 2014, and customers reported high satisfaction levels with the program, the kit contents, and the ease of ordering a kit.

Cost-Effectiveness Results

As shown in Table 4, the program proved cost-effective (including non-energy benefits) across the 2013–2014 evaluation period from all test perspectives, except for the Ratepayer Impact Measure (RIM) test. The program proved cost-effective from the PacifiCorp Total Resource Cost Test (PTRC) perspective, with a benefit-cost ratio of 1.81.

Table 4. 2013–2014 Evaluated HES Program Cost-Effectiveness Summary (Including Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit-Cost Ratio
PacifiCorp Total Resource Cost Test (PTRC) (TRC + 10% Conservation Adder)	$0.047	$7,354,151	$13,335,771	$5,981,620	1.81
Total Resource Cost (TRC) No Adder	$0.047	$7,354,151	$12,191,039	$4,836,888	1.66
Utility Cost Test (UCT)	$0.022	$3,451,791	$11,447,329	$7,995,538	3.32
Ratepayer Impact Measure (RIM) Test		$17,165,165	$11,447,329	($5,717,836)	0.67
Participant Cost Test (PCT)		$6,091,657	$16,646,380	$10,554,724	2.73
Life Cycle Revenue Impacts ($/kWh)					$0.000098312
Discounted Participant Payback (years)					2.71

The RIM test measures program impacts on customer rates. Most energy efficiency programs do not pass the RIM test because, although energy efficiency programs reduce energy delivery costs, they also reduce energy sales. As a result, the average rate per unit of energy may increase in the short term. A RIM benefit-cost ratio greater than 1.0 indicates that rates (as well as costs) will reduce in the short term due to the program. Typically, this only happens for demand-response programs or programs targeted to the highest marginal cost hours (i.e., when marginal costs are greater than rates).

Table 5 shows the HES program proved cost-effective (excluding non-energy benefits) across the 2013–2014 evaluation period from all test perspectives, except the RIM test. The program proved cost-effective from the PTRC perspective, with a benefit-cost ratio of 1.71.

Table 5. 2013–2014 Evaluated HES Program Cost-Effectiveness Summary (Excluding Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit-Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.047	$7,354,151	$12,592,061	$5,237,911	1.71
TRC No Adder	$0.047	$7,354,151	$11,447,329	$4,093,178	1.56
UCT	$0.022	$3,451,791	$11,447,329	$7,995,538	3.32
RIM		$17,165,165	$11,447,329	($5,717,836)	0.67
PCT		$6,091,657	$15,902,671	$9,811,014	2.61
Lifecycle Revenue Impacts ($/kWh)					$0.000098312
Discounted Participant Payback (years)					2.82

Summary and Recommendations

From impact and process evaluation interviews, surveys, and other analyses, Cadmus drew the following conclusions and recommendations (this report's Conclusions and Recommendations section provides a more complete discussion of these findings):

- **Measure Categorization:** For some measures (such as light fixtures and evaporative coolers), measure categories were assigned in the program administrator's tracking database by delivery channels rather than end uses. Cadmus also found inconsistent use of measure categories between the participant tracking database and annual report cost-effectiveness assumptions.
  - ***Recommendation:*** Assign measure categories by end use to ensure use of the most appropriate cost-effectiveness results. Ensure consistent applications of measure categories in all data tracking and reporting efforts.
- **Upstream Lighting Database:** Cadmus experienced difficulty in mapping the program administrator's lighting tracking database to the price-scheduling database (for example, inconsistent use of SKUs and model numbers). Data tracking, however, improved significantly between 2013 and 2014.
  - ***Recommendation:*** Going forward, track data in the 2014 format, where product and price schedule data were more consistent.
- **Lighting Cross-Sector Sales**: Cadmus estimated that 3.9% of efficient bulbs purchased at retail stores ultimately would be installed in commercial applications. Bulbs installed in commercial spaces produce higher first-year savings than bulbs installed in residential spaces as commercial locations typically experience higher daily hours-of-use than residential locations. Currently, Pacific Power does not account for cross-sector sales from upstream lighting incentives.
  - ***Recommendation:*** Consider accounting for commercial installation of upstream bulbs in the reported savings.
- **Customer Outreach:** Retailers constituted the most commonly cited sources of program awareness for non-lighting participants, and bill inserts served as influential awareness sources for ***watt***smart Starter Kits.

- ***Recommendation:*** Pacific Power should continue to pursue a multi-touch marketing strategy, using a mix of bill inserts and retailer training. Given the large percentage of customers learning of ***watt***smart offerings through bill inserts, Pacific Power should examine the proportion of customers electing to receive online bills, ensuring these online channels advertise the programs. Messages conveyed should motivate customers to participate (e.g., recommendations for long-lasting products, saving energy, replacing equipment, and reducing costs).

- **Satisfaction with Program Experience:** Participants in all program categories expressed high satisfaction levels with their program experience: non-lighting customers expressed high satisfaction levels with their contractors, measures installed, and incentive amounts. Cadmus could not verify the efficacy of the program administrator's efforts to reach out to non-registered contractors who worked with customers seeking a rebate. (The program accepts applications only from trade allies registered with the program.) Customers' reported satisfaction responses appears to support the program's efforts to lessen contractors' confusion about tariff changes.
  - ***Recommendation:*** Pacific Power should continue regular training sessions with trade allies (e.g., distributors, retailers, sales associates, contractors), updating them on tariff changes and, where appropriate, supporting them with sales and marketing training.
- ***watt*smart Starter Kits:** The kit rollout in 2014 proved successful, with over 12,000 kits distributed. Participants generally expressed satisfaction with the ordering process and the equipment in the kit; however, installation of the water-saving measures proved more limited than other measures. Many participants stored extra faucet aerators or showerheads as the measure did not fit, they had trouble installing the equipment, or they already had the equipment.
  - ***Recommendation:*** To reduce unnecessary program costs, Pacific Power should consider allowing customers to opt out of either the showerhead or faucet aerator offering. Lighting only kits are already available.

Introduction

Program Description

Pacific Power contracted with CLEAResult to administer the Home Energy Savings (HES) Program during 2013 and 2014 program years, and to provide prescriptive incentives to residential customers who purchased qualifying, high-efficiency appliances; heating, ventilation, and air conditioning (HVAC); and weatherization measures.[3] The HES program also included an upstream lighting component, which provided high-efficiency lighting options by offering incentives for eligible CFLs and LEDs at the manufacturer level. In 2014, the program introduced low- and no-cost ***watt***smart Starter Kits.

The HES program offered the following measures for part or all of the 2013–2014 evaluation period:

- Appliances:
  - Clothes washer
  - Dishwasher
  - Electric water heater
  - Freezer
  - Light fixture
  - Refrigerator
  - Room air conditioner
  - Ceiling fan
- HVAC:
  - Central air conditioner
  - Ductless and ducted heat pump
  - Evaporative cooler
  - Duct sealing
  - Heat pump conversion
  - Heat pump water heater
- Low- and no-cost kits:
  - ***watt***smart Starter Kits (CFLs, LEDs, aerators, high-efficiency showerheads)
- Lighting:
  - CFLs
  - LEDs
  - Light fixtures
- New homes:
  - CFLs
  - Attic insulation
  - Windows
  - Refrigerator
  - Dishwasher
  - Ductless and ducted heat pump
- Weatherization:
  - Insulation (attic, floor, wall)
  - Windows
  - Air sealing

[3] Before the 2013–2014 program year, the HES Program was administered by Portland Energy Conservation, Inc., which CLEAResult acquired in 2014.

Program Participation

During the 2013–2014 HES program years, Pacific Power provided prescriptive incentives to over 2,400 residential customers, ***watt***smart Starter Kits to over 12,000 customers, and upstream discounts for over 600,000 products. Table 6 shows participation and savings by measures and measure categories for this period.

Table 6. HES Program Reported Quantity and Savings by Measure, 2013–2014*

Measure Category	Measure Name	Reported Quantity	Quantity Type	Reported kWh Savings
Appliance	Ceiling Fan	1	Units	107
	Clothes Washer	992	Units	168,154
	Dishwasher	324	Units	13,019
	Electric Water Heater	194	Units	25,897
	Freezer	85	Units	3,127
	Light Fixture	2,627	Units	128,426
	Refrigerator	230	Units	14,873
	Room Air Conditioner	53	Units	2,491
HVAC	Central Air Conditioner Best Practice Install	5	Projects	520
	Central Air Conditioner Equipment	83	Units	24,077
	Duct Sealing and Insulation	366	Projects	1,179,942
	Duct Sealing—Manufactured Homes	171	Projects	229,907
	Ductless Heat Pump	106	Units	372,379
	Evaporative Cooler	7	Units	7,139
	Heat Pump	184	Units	495,743
	Heat Pump Best Practice Install	26	Projects	20,072
	Heat Pump System Conversion	37	Projects	397,306
	Heat Pump Upgrade	32	Projects	75,168
	Heat Pump Water Heater	33	Units	32,827
	Single Head Ductless Heat Pump	29	Units	107,213
Kits	***watt***smart Starter Kits	12,357	Kits	4,298,641
Lighting	CFL Bulbs	582,242	Units	10,658,429
	LED Bulbs	48,085	Units	1,455,515
	Light Fixtures	4,601	Units	225,449
New Homes	New Homes—Builder Option Package (BOP) 1 w/ Heat Pump	71	Projects	135,031
	New Homes—Attic Insulation	4,255	Square Feet	472
	New Homes—CFL—Spiral	1	Units	931
	New Homes—Ductless Heat Pump	1	Units	2,837
	New Homes—Energy Efficient Dishwasher	1	Units	47
	New Homes—Energy Efficient Refrigerator	1	Units	54
	New Homes—Heat Pump	1	Units	388

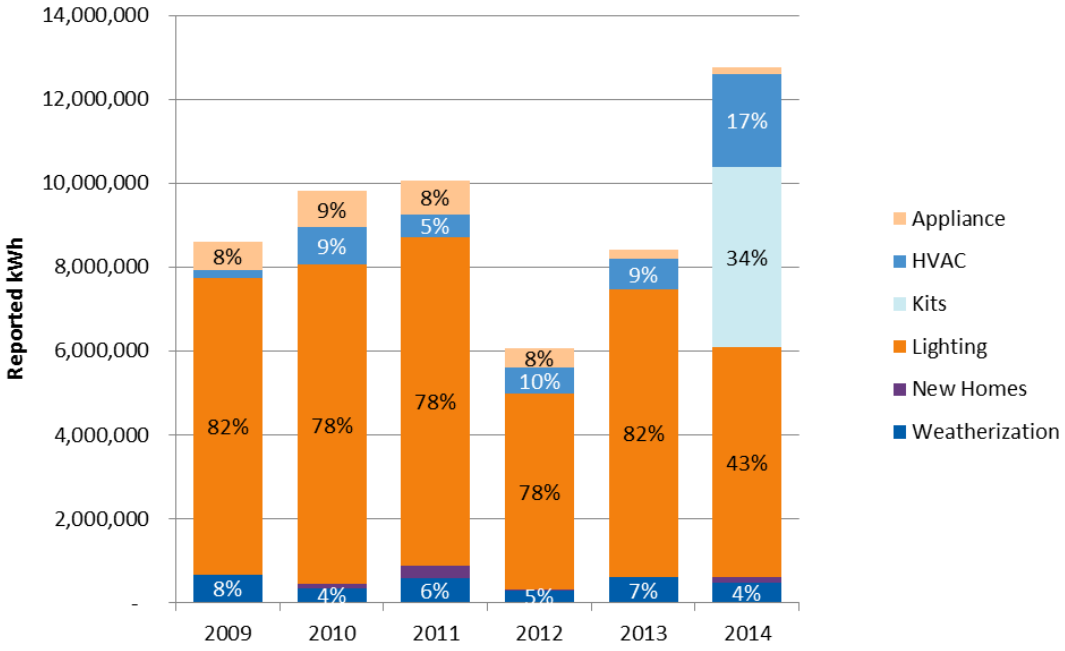
Measure Category	Measure Name	Reported Quantity	Quantity Type	Reported kWh Savings
	New Homes—Windows	340	Square Feet	173
Weatherization	Air Sealing	1,242	Square Feet	571
	Attic Insulation	661,997	Square Feet	512,976
	Floor Insulation	96,243	Square Feet	316,460
	Wall Insulation	102,765	Square Feet	230,743
	Windows	34,824	Square Feet	22,330
Total				**21,159,434**

Source: Pacific Power 2013 and 2014 annual reports and 2013-2014 non-lighting and lighting databases, provided by the program administrator.

*Reported participation was not included in the Pacific Power 2013 and 2014 annual reports.

Historically, lighting savings have comprised a large majority of HES program savings. The 2013 program year was no exception; upstream lighting measures contributed 82% of HES annual reported program savings, as shown in Figure 1. In 2014, however, reported savings from CFL and LED bulbs decreased by roughly 20% from 2013 levels as the total number of CFL program bulbs dropped by 29%. In 2014, the program launched ***watt***smart Starter Kits, which contributed 34% of total 2014 HES savings. Lastly, HVAC participation increased drastically in 2014 due to increases in heat pump and heat pump water heater incentive amounts, leading to higher energy savings.

Figure 1. Reported kWh Savings by Measure Category from 2009–2014*



*Percentages may not add to 100% due to rounding.

Data Collection and Evaluation Activities

For the impact evaluation, Cadmus assessed energy impacts and program cost-effectiveness. For the process evaluation, Cadmus assessed program delivery and efficacy, bottlenecks, barriers, best practices, and opportunities for improvements.

Table 7 lists evaluation activities that supported these evaluations. Appendix A provides survey and data collection instruments used.

Table 7. Evaluation Activities

Activities	Impact	Process
Program Staff and Program Administrator Interviews		X
Participant Non-Lighting Surveys	X	X
Participant Kit Surveys	X	X
General Population Surveys	X	X
Weatherization and HVAC Billing Analysis	X	
Engineering Reviews	X	
Intercept Surveys	X*	X
Logic Model Review		X

*This activity provided an estimate of cross-sector lighting sales that was not applied to program savings.

Sample Design and Data Collection Methods

Cadmus developed samples, designed to achieve precision of ±10% with 90% statistical confidence for each surveyed population (sample sizes assumed a 0.5 coefficient of variation [CV]).[4] For small population sizes, Cadmus applied a finite population adjustment factor; this reduced the necessary completion target to achieve precision of ±10% with 90% statistical confidence.

Table 8 shows the final sample disposition for various data collection activities. For nearly all data collection (except administrator and management staff interviews), Cadmus drew samples using simple or stratified random sampling.[5]

[4] The CV equals the ratio of standard deviation (a measure of the dispersion of data points in a data series) to the series mean.

[5] Simple random samples are drawn from an entire population, whereas stratified random samples are drawn randomly from subpopulations (strata), and are then weighted to extrapolate to the population.

Table 8. Sample Disposition for Various HES Program Data Collection Activities in Washington

Data Collection Activity	Population	Sampling Frame	Target Completes	Achieved Completes
Program Staff Interview	N/A	N/A	1	1
Program Administrator Interviews	N/A	N/A	1	1
Non-Lighting Participant Surveys	2,492*	1,683	204	204
Participant Kit Surveys	11,361	10,033	130	130
General Population Surveys	106,503**	10,000	250	250
Intercept Surveys***	57 stores	57 stores	600 surveys	5 stores representing 175 surveys

*Non-lighting population represents all unique participants by account number.

**The lighting population derived from Pacific Power's average 2014 residential customers in Washington. Customer data provided by Pacific Power.

***The target goal of 600 survey completes was established prior to learning the actual number of stores and the foot traffic of each store in the targeted areas of Washington. Through discussions with Pacific Power, Cadmus agreed to accrue as many completed surveys as proved reasonably feasible. Cadmus collected as much data in stores as possible, given the available resources, and met the confidence and precision targets within achieved completes.

Non-Lighting Participant Telephone Surveys

Cadmus surveyed 204 non-lighting participants, gathering measure-level and measure-category-level information on installations, program awareness and satisfaction, and demographics.

In developing the survey targets by measure category, Cadmus used the measure mix from the 2013–2014 non-lighting database and randomly selected participants and measures within each measure category. Table 9 provides the population of non-lighting participants, targets, and numbers of surveys achieved.

Table 9. Non-Lighting Participant Survey Sample

Measure Category	Population	Targeted	Achieved
Appliances	1,693	68	68
HVAC	429	68	68
Weatherization	476	68	68
Total	**2,598***	**204**	**204**

*The total population differs from total population in Table 8 because some participants participated in multiple measure categories.

Participant Kit Surveys

Cadmus surveyed 130 customers who received ***watt***smart Starter Kits in 2014 and gathered measure-level information on installations, program awareness and satisfaction, and demographics.

Cadmus targeted samples to achieve statistically significant measure-level results for each kit item offered. Cadmus stratified the sample into two groups: participants who received LEDs, and participants who received CFLs (all kit types contained only one type of lighting). Cadmus then randomly selected participants for the survey. Table 10 lists the population of kit participants, targets, and numbers of surveys achieved.

Table 10. Participant Kit Survey Sample

Lighting Type	Population	Targeted	Achieved
CFL	10,758	70	70
LED	603	60	60
Total	**11,361**	**130**	**130**

General Population Surveys

The general population survey collected information on HES program awareness and key lighting metrics from a random group of customers in Washington. Cadmus drew the general population survey sample from a random list of 10,000 Washington residential customers, provided by Pacific Power, and achieved 250 completed responses.

Intercept Surveys

Cadmus conducted intercept surveys at stores in Washington to determine how many light bulbs being purchased within Pacific Power's territory were being installed outside of the territory (leakage), with the primary purpose to evaluate the accuracy of the Retail Sales Allocation Tool (RSAT).

Cadmus targeted 20 stores in Washington—15 stores within Pacific Power service territory and five stores outside its territory—and attempted to administer 600 surveys. However, Cadmus had difficulty in achieving the targeted number of stores due to limited rosters of stores by territory and RSAT score, as well as achieving targets for surveys per store (as shown in Table 11) due to low volumes of customer traffic in some stores. Nevertheless, the surveys produced sufficient results regarding leakage to achieve the intended precision of ±10% with 90% statistical confidence at the customer level, though the sample of available stores was too small to draw statistically significant conclusions on the RSAT tool for Washington only.

Table 11. Intercept Store and Survey Samples in Washington

Store Location	RSAT Score	Target Stores	Accessed Stores*	Target Surveys**	Achieved Surveys
Within Pacific Power	Greater or equal to 96%	8	5	450	112
	Less than 96%	7	0		
Outside of Pacific Power	N/A	5	5	150	63
Total		**20**	**10**	**600**	**175**

*Includes one store outside of Pacific Power's territory in which Cadmus achieved access to the store but could not administer surveys.

**The survey target was set prior to knowledge of the actual number of stores in and outside of the territory, but was not officially reduced.

Impact Evaluation

This chapter provides the HES program impact evaluation findings resulting from Cadmus' data analysis, which used the following methods:

- Participant surveys
- General population surveys
- Intercept surveys
- Billing analysis
- Engineering reviews

Reported savings represent electricity savings (kWh) reported by Pacific Power in the 2013 and 2014 Pacific Power Energy Efficiency and Peak Reduction Annual Reports (i.e., annual reports).[6] To determine evaluated savings, Cadmus applied steps 1 through 3, as described in greater detail following Table 12.

Table 12. Impact Steps to Determine Evaluated Savings

Step	Action
1	Tracking Database Review: validate accuracy of data in the participant database
2	Verification: adjust reported savings with the actual installation rate
3	Unit Energy Savings: validate saving calculations (i.e., billing analysis and engineering reviews)

The following three steps determined evaluated savings:

- **Step one** (verify participant database) included reviewing the program tracking database to ensure participants and reported savings matched 2013 and 2014 annual reports.
- **Step two** (adjust savings using the actual installation rate), using telephone surveys, determined the number of program measures installed and those remaining installed.
- **Step three** (estimate unit energy savings [UES]) included reviews of measure saving assumptions, equations, and inputs (e.g., engineering reviews for lighting and appliances, billing analysis for weatherization and HVAC measures).

By measure, Table 13 lists the methodologies used for each evaluation savings step in the 2013–2014 HES program.

[6] Pacific Power Washington Annual Reports: 2013–2014. Available online:

http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2014/WA_AnnualReport_FINAL%20Report_032714.pdf

http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2015/WA_AnnualReport_FINAL-Report-CORRECTED_050815.pdf

Table 13. 2013–2014 HES Impact Methodology by Measure*

Measure Category	Measure Name	% of Savings	Method		
			Step 1: Database Review	Step 2: Verification	Step 3: UES
Appliance	Ceiling Fan	0.0%	Non-Lighting Tracking Database Review	In-Service Rate: Non-Lighting Survey	Reported
	Dishwasher	0.1%			
	Electric Water Heater	0.1%			
	Freezer	0.0%			
	Refrigerator	0.1%			
	Room Air Conditioner	0.0%			
	Light Fixture	0.6%			Engineering Review
	Clothes Washer	0.8%			
HVAC	Ductless Heat Pump	1.8%			
	Heat Pump	2.3%			
	Heat Pump Best Practice Install	0.1%			
	Heat Pump System Conversion	1.9%			
	Heat Pump Upgrade	0.4%			
	Heat Pump Water Heater	0.2%			Reported
	Single Head Ductless Heat Pump	0.5%			
	Evaporative Cooler	0.0%			
	Central Air Conditioner Best Practice Install	0.0%			
	Central Air Conditioner Equipment	0.1%			
	Duct Sealing—Manufactured Homes	1.1%		Billing Analysis	
	Duct Sealing and Insulation	5.6%			
Weatherization	Attic Insulation	2.4%			
	Floor Insulation	1.5%			
	Wall Insulation	1.1%			
	Windows	0.1%		In-Service Rate: Non-Lighting Survey	Reported
	Air Sealing	0.0%			
New Homes	All measures	0.7%			
Kits	***watt***smart Starter Kit	20.3%	Kit Tracking Database Review	In-Service Rate: Kit Participant Survey	Engineering Review
Lighting	CFL Bulb	50.4%	Upstream Lighting Tracking Database Review	In-Service Rate: General Population Survey	
	LED Bulb	6.9%			
	Light Fixtures	1.1%			

* Sum of column may not add to 100% due to rounding.

Evaluated Savings

To calculate evaluated savings for HES program measures, Cadmus reviewed the tracking database, verified measures, and conducted either engineering reviews or billing analyses of the measures accounting for 99% of program savings. Table 14 presents the share of savings and the evaluated savings evaluation methods used for measures representing the applicable percentage during the 2013–2014 period. The remaining measures constituted too little savings to evaluate cost-effectively.

Table 14. Measure Selection for Step 3: Engineering and Billing Analysis

Measure Category	Measure	Percentage of Reported kWh Savings	Step 3: Evaluation Method
Appliances	Clothes Washer	0.8%	Engineering Review
	Light Fixture	0.6%	Engineering Review
HVAC	Duct Sealing and Insulation	5.6%	Billing Analysis
	Duct Sealing (Manufactured Homes)	1.1%	Billing Analysis
	Ductless Heat Pump	1.8%	Engineering Review
	Heat Pump	2.3%	Engineering Review
	Heat Pump System Conversion	1.9%	Engineering Review
	Heat Pump Upgrade	0.4%	Engineering Review
	Single Head Ductless Heat Pump	0.5%	Engineering Review
Kits	***watt***smart Starter Kits	20.3%	Engineering Review
Lighting	CFL Bulbs	50.4%	Engineering Review
	LED Bulbs	6.9%	Engineering Review
	Light Fixture	1.1%	Engineering Review
Weatherization	Attic, Floor & Wall Insulation	5.0%	Billing Analysis
Sum % of Reported Savings Evaluated		**98.7%**	

Table 15 provides evaluation results for evaluated quantities, evaluated savings, and realization rates by measure type.

Table 15. Reported and Evaluated HES Program Savings for 2013–2014

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
Appliance	Ceiling Fan	1	107	107	100%
	Clothes Washer	992	168,154	170,224	101%
	Dishwasher	324	13,019	13,019	100%
	Electric Water Heater	194	25,897	25,897	100%
	Freezer	85	3,127	3,127	100%
	Light Fixture	2,627	128,426	72,427	56%
	Refrigerator	230	14,873	14,873	100%
	Room Air Conditioner	53	2,491	2,491	100%

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
HVAC	Central Air Conditioner Best Practice Installation	5	520	520	100%
	Central Air Conditioner Equipment	83	24,077	24,077	100%
	Duct Sealing—Manufactured Homes	171	229,907	1,048,197	89%
	Duct Sealing and Insulation	366	1,179,942	219,663	96%
	Ductless Heat Pump	106	372,379	289,454	78%
	Evaporative Cooler	7	7,139	7,139	100%
	Heat Pump	184	495,743	503,980	102%
	Heat Pump Best Practice	26	20,072	20,072	100%
	Heat Pump System Conversion	37	397,306	231,131	58%
	Heat Pump Upgrade	32	75,168	6,402	9%*
	Heat Pump Water Heater	33	32,827	32,827	100%
	Single Head Ductless Heat Pump	29	107,213	79,002	74%
Kits	***watt***smart Starter Kits	12,357	4,298,641	6,465,955	150%
Lighting	CFL Bulbs	582,242	10,658,429	10,181,205	96%
	LED Bulbs	48,085	1,455,515	1,129,052	78%
	Light Fixture	4,601	225,449	125,824	56%
New Homes**	New Homes—Attic Insulation	4,255	472	472	100%
	New Homes—BOP 1 w/ Heat Pump	71	135,031	135,031	100%
	New Homes—CFL—Spiral	1	931	931	100%
	New Homes—Ductless Heat Pump	1	2,837	2,837	100%
	New Homes—Energy Efficient Dishwasher	1	47	47	100%
	New Homes—Energy Efficient Refrigerator	1	54	54	100%
	New Homes—Heat Pump	1	388	388	100%
	New Homes—Windows	340	173	173	100%
Weatherization***	Air Sealing	1,242	571	571	100%
	Attic Insulation	661,997	512,976	494,072	96%
	Floor Insulation	96,243	316,460	304,798	96%
	Wall Insulation	102,765	230,743	222,240	96%
	Windows	34,824	22,330	22,330	100%
Total**			**21,159,434**	**21,850,609**	**103%**

* See Heat Pumps section within the Step 3 section for a description of evaluated savings.

**New Homes measures fell below the 99% savings evaluation threshold, and therefore were assigned a 100% realization rate.

***Quantities for weatherization measures are in square feet.

****Savings may not add exactly to the total row due to rounding.

Step 1: Tracking Database Reviews

The program administrator provided three tracking databases containing Washington data that covered all 2013 and 2014 participation for the three delivery methods: upstream (lighting), mail delivery (kits), and downstream (HVAC, appliance, and weatherization).

The upstream lighting measures database collected meaningful information, such as tracking lighting at a per-bulb level and including data about retailers, electric savings, purchase dates, and stock keeping units (SKUs).[7] Cadmus' review of database tracking for 2013 and 2014 found no discrepancies in total reported quantities or total savings compared to the 2013 and 2014 annual reports. The tracking data and price scheduling database contained some inconsistencies with respect to bulb type definitions, SKUs, and model numbers. Data tracking, however, improved significantly between 2013 and 2014.

The ***watt***smart Starter Kit database provided names and quantities of kit types, but the program administrator did not track or provide phone numbers from 2013 to 2014 (as required for conducting the participant kit survey)[8]. Pacific Power, however, could provide participant phone numbers using customer account numbers. Cadmus' review of database tracking for 2013 and 2014 found no discrepancies in total reported quantities or total savings when compared to the 2013 and 2014 annual reports.

Cadmus also reviewed the program administrator's tracking of 2013 and 2014 non-lighting measures. This database collected measure-level information (e.g., efficiency standards, quantities of units, purchase dates, incentive amounts). Cadmus found total quantities and savings exactly matched the 2013 and 2014 annual reports.

Though the upstream lighting and the non-lighting databases yielded total quantities in agreement with annual reports, two delivery channels were employed for light fixtures, which were first classified as a downstream measure before later moving to an upstream measure.

Step 2: Verification

To verify in-service rates (ISRs) (i.e., installation rates), Cadmus used the non-lighting participant survey for non-lighting measures, the participant kit survey for kit measures, and the general population survey for upstream CFLs and LEDs.

Non-Lighting ISR

For each measure category, Cadmus asked survey respondents a series of questions designed to determine if they installed products for which they received incentives. Table 16 shows ISRs for each measure. Although light fixtures are evaluated very similarly to light bulbs in this evaluation, the program implementer classified them as non-lighting, and their ISRs were evaluated along with non-lighting measures. All survey respondents reported installing all measures listed in the survey, resulting

[7] SKU numbers represent unique make and model indicators for a specific retailer.

[8] The implementer has started tracking this information in 2016.

in 100% ISRs for all non-lighting measures. Table 16 also shows the breadth and quantity of measures addressed by the survey.

Table 16. ISR by Measure Category, 2013–2014

Measure Category	Measure	2013 and 2014			
		Total Surveyed Measures	Installed Measures	Percentage Installed	Percentage Average Weighted Installation
Appliances	Clothes Washer	34	34	100%	100%
	Dishwasher	17	17	100%	
	Electric Water Heater	2	2	100%	
	Freezer	4	4	100%	
	Light Fixture	5	5	100%	
	Refrigerator	6	6	100%	
	Room Air Conditioner	2	2	100%	
HVAC	Central Air Conditioner Equipment	7	7	100%	100%
	Duct Sealing and Insulation	7	7	100%	
	Ductless Heat Pump	8	8	100%	
	Evaporative Cooler	8	1	100%	
	Heat Pump	23	23	100%	
	Heat Pump Best Practice	14	14	100%	
	Heat Pump Water Heater	8	8	100%	
Weatherization*	Attic Insulation	43,453	43,453	100%	100%
	Floor Insulation	20,590	20,590	100%	
	Wall Insulation	4,418	4,418	100%	
	Windows	2,892	2,892	100%	

*Quantities for weatherization measures are in square feet.

wattsmart Starter Kit ISRs

Cadmus calculated ISRs for each kit measure using data collected through a survey Cadmus conducted with 130 Washington kit recipients. The survey, conducted six months to one year after kit delivery, verified the number of kit measures received and asked survey respondents how many measures they had installed by the time of the survey. If respondents reported that measures were not currently installed, the survey asked additional questions addressing reasons for not installing the measures and the measures' ultimate fate (e.g., stored, discarded).

Table 17 shows measure-level ISR results for kit measures, along with total measures surveyed and reported installed.

Table 17. ISRs by Kit Measure, 2014

Measure	Total Surveyed Measures	Measures Reported Installed	ISR
Bathroom Aerator	152	93	61%
CFLs*	248	210	85%
Kitchen Aerator	96	60	63%
LEDs*	212	190	90%
Showerheads	160	101	63%

*Consistent with upstream CFL and LED ISR analysis, bulbs removed as they burned out were considered installed and not counted as removed.

CFLs and LEDs achieved the highest ISRs of the five measures reported installed at the time of the survey, with 85% ISRs for CFLs and 90% ISRs for LEDs. LED ISRs may be higher than CFL ISRs because kits with LEDs required a small monetary contribution from the customer. Aerators and showerheads experienced the lowest ISRs, with 61% ISRs for bathroom aerators and 63% ISRs for kitchen aerators and showerheads installed at the time of the survey.

Cadmus compared HES program kit ISRs with those of two other utilities' residential energy efficiency kit programs. As shown in Table 18, ISRs from the other kit programs were slightly lower to those from the HES program.

Table 18. Mailed-In Kit Program ISRs Comparison

Measure	Ameren IL 2013*	Ameren MO 2014**	Washington HES 2013–2014
Faucet Aerators	49%	52%	61%–63%
Showerheads	41%	47%	63%
CFLs	66%	75%	85%
LEDs	N/A	92%	90%

*Opinion Dynamics. *Impact and Process Evaluation of 2013 (PY6) Ameren Illinois Company Residential Energy Efficiency Kits Program*. 2015. Available online: http://ilsagfiles.org/SAG_files/Evaluation_Documents/Ameren/AIU%20Evaluation%20Reports%20EPY6/AIC_PY6_EEKits_Report_FINAL_2015-07-20.pdf

**Cadmus and Nexant. *Efficient Products Impact and Process Evaluation: Program Year 2014*. 2015. Available online: https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=935933387

CFL and LED ISRs

Cadmus calculated CFL and LED first-year ISRs for 2013–2014 using data collected through the general population survey of 250 Pacific Power Washington customers. The survey asked participants about the number of CFL and LEDs bulbs they purchased, installed, removed, and stored within the prior 12 months. If respondents reported removing bulbs, the survey asked why the removal took place and adjusted the ISRs accordingly. The calculated ISRs did not account for installations occurring after the first year of purchase.

CFL

Of 250 customers surveyed, 55 said they did not purchase CFLs, and 16 could not confirm or estimate how many CFLs they purchased; consequently, the analysis excluded these data. The analysis also removed an additional 31 responses for other reasons (e.g., not knowing how many bulbs were installed, removed, or stored; reporting inconsistent bulb quantities). Cadmus used data from the remaining 148 respondents to calculate the ISR.

Cadmus implemented two changes in the methodology used for the 2011–2012 HES program evaluation, which proved important when comparing ISRs across years and for other jurisdictions:

- The first change affecting ISR calculations was to include a bulb that burned out as having been installed as the burnout rate was considered in the assumed effective useful life.
- The second change occurred in the survey's phrasing about timing. This evaluation's survey asked customers to consider bulbs purchased in the past 12 months rather than those purchased during the entire two-year evaluation period. Cadmus revised this question due to concerns about a customer's ability to recall purchases occurring more than two years before the survey.

Table 19 provides ISR results for 2013–2014 CFLs.

Table 19. 2013 and 2014 First-Year CFL ISR*

Bulb Status	Bulbs Reported	ISR
Purchased	**1,195**	70.5%
Installed	888	
Stored	337	
Removed	106	
Removed After Burning Out	60	
In-Service Bulbs (including burned out)	**842**	

*n = 148 respondents

Cadmus used the following formula for calculating the lighting ISR:

$$ISR = \frac{Installed\ in\ first\ year - (Removed - Removed\ After\ Burning\ Out)}{Purchased}$$

Table 20 compares first-year ISRs evaluated for similar programs across the country (and for some past HES program evaluations in Washington). As shown, Washington's CFL ISR has fluctuated slightly year to year.

Table 20. Comparison of Evaluated First-Year CFL ISR Estimates

Source	Data Collection Method	Reported Year	ISR
Midwest Utility 1	Self-reporting: determined by interview during home inventory site visits	2016	86%

Avista 2012-2013 Electric Impact Report	Regional Technical Forum*	2014	75%
Northeast Utility	Self-Reporting: 200 telephone surveys	2012	73%
Pacific Power Washington 2013–2014 HES Evaluation	**Self-reporting: 148 in-territory lighting surveys**	**2016**	**70.5%**
Pacific Power Washington 2009-2010 HES Evaluation	Self-reporting: 250 in-territory lighting surveys	2011	69%
Midwest Utility 2	Self-reporting: 301 customer surveys	2012	68%
Pacific Power Washington 2011–2012 HES Evaluation	Self-reporting: 245 in-territory lighting surveys	2014	65%

*An advisory committee in the Northwest, the Regional Technical Forum (RTF) develops standards to verify and evaluate conservation savings.

LED

Cadmus calculated the first-year LED ISR using the same methodology and customer sample as that used for CFLs. After filtering survey results for those purchasing LEDs and providing reliable responses, 79 customers remained for inclusion in the LED ISR analysis. Table 21 lists LED ISR results and shows a higher LED ISR compared to the CFL ISR. The higher cost of LEDs most likely drove the higher ISR; customers proved more likely to install bulbs right after purchasing it if spending significant money on the bulb (compared to CFL or other bulb costs).

Table 21. 2013–2014 First-Year LED ISR*

Bulb Status	Bulbs Reported	ISR
Purchased	**539**	84.8%
Installed	459	
Stored	154	
Removed	11	
Removed After Burning Out	9	
In-Service Bulbs (including burned out)	**457**	

* n = 79 respondents

Table 22 compares LED ISR values to those calculated for LEDs in other jurisdictions. Fewer comparable studies have assessed LED ISRs compared to CFL ISRs due to the more recent emergence of LED technology. Consequently, Table 22 just compares one self-report LED ISR value to the Pacific Power 2013–2014 LED ISR value. The other LED ISR values were determined from data collected through site visits.

Table 22. Comparison of Evaluated LED ISR Estimates

Source	Data Collection Method	Reported Year	ISR
Arkansas 2013 Evaluation Report	75 Residential Site Visits	2014	100%
Midwest Utility 1	Self-reporting: determined by interview during home inventory site visits	2016	99%
Midwest Utility 2	103 Residential Site Visits	2013	96%

Northeast Utility	70 Residential Site Visits	2015	96%
Pacific Power Washington 2013–2014 HES Evaluation	**Self-reporting: 79 General Population Survey**	**2016**	**84.8%**
Southwest Utility	70 Residential Site Visits	2015	84%

Step 3: UES Reviews

Cadmus conducted either an engineering review or a billing analysis to estimate UES values for measures representing 99% of program-reported savings. Engineering reviews addressed the following program measures:

- Upstream CFL and LED bulbs
- Light fixtures
- Clothes washers
- ***watt***smart Starter Kits (including CFLs, LEDs, faucet aerators, and high-efficiency showerheads)
- Heat pumps, upgrades, and conversions

Cadmus evaluated the following measures using billing analysis:

- Attic, wall, and floor insulation
- Duct sealing

Further, Cadmus applied 100% realization rates to all measures not listed above (when combined, they contributed less than 2% of program savings). As shown in Table 23, UES realization rates for evaluated measures ranged from 9% for heat pump upgrades to 150% for kits.

Table 23. 2013–2014 Measurement Analysis and Unit Realization Rate Summary Table

Measure Category	Measure	Average UES (kWh/Unit)		UES Realization Rate*	UES Method
		Reported	Evaluated		
Appliance	Clothes Washer	170	172	101%	Engineering Review
	Light Fixture	48.9	27.6	56%	Engineering Review
HVAC	Duct Sealing and Insulation	3,224	2,864	89%	Billing Analysis
	Duct Sealing (Manufactured Homes)	1,344	1,285	96%	Billing Analysis
	Ductless Heat Pump	3,513	2,731	78%	Engineering Review
	Heat Pump	2,694	2,739	102%	Engineering Review
	Heat Pump System Conversion	10,738	6,247	58%	Engineering Review
	Heat Pump Upgrade	2,349	200	9%	Engineering Review
	Single-Head Ductless Heat Pump	3,697	2,724	74%	Engineering Review
Kits	***watt***smart Starter Kits	348	523	150%	Engineering Review
Lighting	CFL Bulbs	18.3	17.5	96%	Engineering Review
	LED Bulbs	30.3	23.5	78%	Engineering Review
	Light Fixtures	49.0	27.3	56%	Engineering Review
Weatherization	Attic Insulation**	0.8	0.7	96%	Billing Analysis
	Floor Insulation**	3.3	3.2	96%	Billing Analysis
	Wall Insulation**	2.2	2.2	96%	Billing Analysis

*The UES realization rate may not calculate exactly due to rounding reported and evaluated UES values.
**Attic, floor, and wall insulation units are kWh/square foot.

The following sections describe the methodology and results of measurement activities for each measure listed in Table 23.

CFL and LED Bulbs

During the 2013–2014 program years, Pacific Power awarded incentives for 582,242 CFLs and 48,805 LEDs through 20 different Washington retailers, representing 57 stores. Table 24 shows quantities and savings for the 14 different bulb types. Overall, upstream lighting represented 58% of total HES reported savings.

Table 24. 2013-2014 Incented CFL and LEDs Bulbs by Type

Lighting Type	Bulb Category	Bulb Type	Reported Quantity (Bulbs)	Reported Savings (kWh)
CFL	Standard	A-Lamp	7,780	117,783
		Spiral	421,143	7,148,595
	Specialty	3-Way	809	21,279
		Candelabra	2,080	34,607
		Daylight	85,359	1,968,809
		Dimmable	648	16,429
		Globe	6,304	111,455
		Outdoor	205	4,286
		Reflector	57,914	1,235,187
LED	Standard	A-Lamp	6,666	109,789
	Specialty	Candelabra	1,176	33,645
		Globe	6,913	197,781
	Downlight	Downlight	33,330	1,114,299
Total*			**630,327**	**12,113,944**

*Savings may not add exactly to totals due to rounding.

Cadmus estimated four parameters to calculate evaluated savings for LEDs and CFLs:

- Delta watts (ΔWatts)
- ISR
- Hours-of-use (HOU)
- Waste heat factor (WHF)

The following equation provided evaluated lighting savings:

$$Evaluated\ Per\ Unit\ Savings\ (kWh\ per\ unit) = \frac{\Delta Watts * ISR * HOU * 365 * WHF}{1{,}000}$$

Where:

ΔWatts = The difference in wattage between a baseline bulb and an evaluated efficient bulb

ISR = The percentage of incented units installed within the first year

HOU = The daily lighting operating hours

WHF = Accounts for interactive effects with a home's heating and cooling systems

To calculate the various CFL and LED lighting component inputs, Cadmus conducted the primary and secondary data collection and analysis activities shown in Table 25.

Table 25. CFL and LED Bulb Evaluated Savings Activities

Savings Variables	Activity
ΔWatts	Market baseline, grouped by lumen range and bulb type
ISR	General Population Survey (n=250)
HOU	RTF. ResLightingCFLandLEDLamps_v3_3.xlsm. Summary Tables tab.
WHF	RTF Space Interaction Calculator

Cadmus derived the annual savings algorithm from industry standard engineering practices, consistent with the methodology prescribed by the UMP for calculating residential lighting energy use and savings. Discussion follows addressing each equation component. (Though the upstream lighting and the non-lighting databases yielded total quantities in agreement with annual reports, two delivery channels were employed for light fixtures, which were first classified as a downstream measure before later being moved to an upstream measure.)

Delta Watts

Delta watts represents the wattage difference between a baseline bulb and an equivalent CFL or LED. Cadmus determined baseline wattages using the 2013–2014 upstream lighting tracking data, which included CFL and LED sales data by SKU numbers and bulb types for the 630,327 bulbs sold through the program.

The lumen equivalency method produces delta watts for a given lamp by first determining the lamp's lumen output and type. Each lamp type corresponds with a set of lumen bins, and each bin corresponds with an assumed baseline wattage. Delta watts equals the difference between this baseline wattage and the bulb's efficient wattage. Whenever possible, Cadmus estimated each lamp's lumens output and efficient wattage by mapping these to the ENERGY STAR® database. When this was not possible, Cadmus used the database values for lumens and/or efficient wattage. Finally, when even that could not be done, Cadmus interpolated lumen outputs from efficient wattages, based on a best-fit line derived from the ENERGY STAR database.

In the 2011–2012 HES program evaluation, Cadmus used the three lamp types defined by the UMP:

- Standard
- EISA-exempt
- Reflector

Updated in February 2015, the UMP now defines five lamp types:

- Standard
- Decorative
- Globe
- EISA-exempt (typically, three-way and certain globe lamps)
- Reflector

In evaluating delta watts, Cadmus used the latest methodology available in the UMP. Table 26 shows reported quantities for the five lamp categories.

Table 26. 2013 and 2014 CFL and LED Database Quantities by Bulb Types

Bulb Type	2013 Quantity	2013 Percentage	2014 Quantity	2014 Percentage	Overall Quantity	Overall Percentage
Standard	262,808	80.2%	259,177	85.6%	521,985	82.8%
Decorative	968	0.3%	2,076	0.7%	3,044	0.5%
Globe	3,968	1.2%	9,249	3.1%	13,217	2.1%
EISA-Exempt	569	0.2%	240	0.1%	809	0.1%
Reflectors	59,324	18.1%	31,948	10.6%	91,272	14.5%
Total	**327,637**	**100%**	**302,690**	**100%**	**630,327**	**100%**

Several federal baseline changes took effect in 2013 and 2014 due to the Energy Independence Security Act of 2007 (EISA). Table 27 presents baseline wattages and estimated efficient wattages, grouped by lumen bin for standard bulbs, as an example of changing baseline wattages. Starting in 2013, the standard 100-watt bulb baseline declined to 72 watts, and the 75-watt baseline declined to 53 watts. Similarly, starting in 2014, the 60-watt baseline declined to 43 watts, and the 40-watt baseline declined to 29 watts.

Table 27. Lumen Bins for Standard Lamps and Lamp Quantities

Lumen Bin	2012 Baseline Wattage*	2013 Baseline Wattage	2013 Reported Lamp Quantity	2014 Baseline Wattage	2014 Reported Lamp Quantity
0–309	25	25	0	25	0
310–449	25	25	0	25	0
450–799	40	40	10,223	29	11,864
800–1,099	60	60	140,601	43	168,642
1,100–1,599	75	53	50,200	53	16,970
1,600–1,999	100	72	61,783	72	61,700
2,000–2,600	100	72	1	72	1

*2012 baseline wattages, shown for comparison only, were not used in the evaluation.

Appendix B provides lumen bins and quantities for the remaining bulb types,[9] including a plot of baseline wattages versus lumen outputs for various bulb types. Overall, for a given lumen output, standard lamps possess a lower baseline wattage than reflectors, globes, or EISA-exempt lamps.

[9] Though the UMP provides lumen bins for standard, decorative, globe, and EISA-exempt lamps, it defers to EISA requirements for determination of lumen bins for reflector lamps. The Mid-Atlantic Technical Reference Manual (TRM) presents an analysis examining the requirements and defining lumen bins for six different reflector categories, depending on reflector types and diameters. Northwest Energy Efficiency Partnerships.

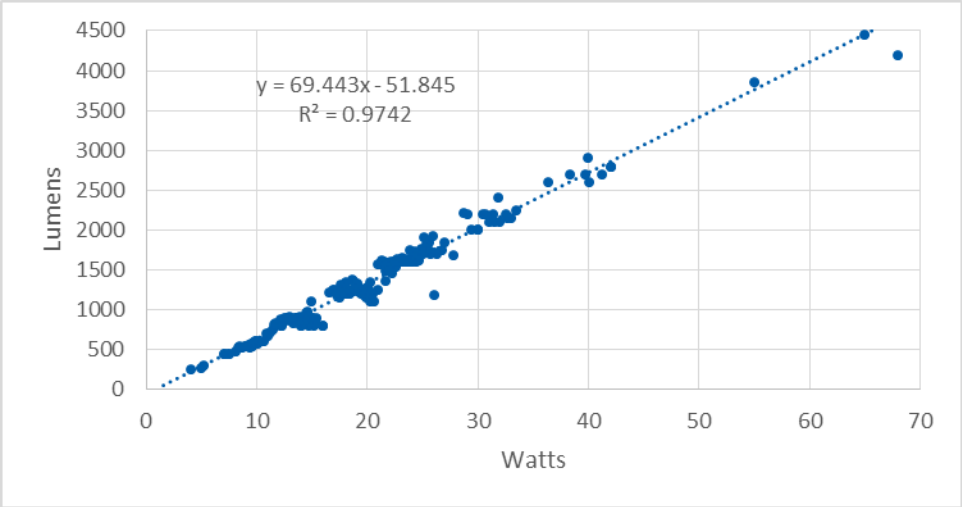
ENERGY STAR Qualified Product List Analysis

While all program bulbs were required to be ENERGY STAR certified, 8% of bulbs could not be matched to the compiled ENERGY STAR qualified product list used by Cadmus. To estimate the lumen outputs of these bulbs, Cadmus examined the entire ENERGY STAR qualified product list.

To determine a relationship between CFL and LED wattages and lumen outputs, Cadmus used the ENERGY STAR-qualified bulb product list updated on October 5, 2015.[10] The database consisted of approximately 7,900 CFL products and 11,500 LED products, along with their associated wattages and lumens. The lumen outputs for a given lamp wattage varied significantly; for example, 266 CFL products rated for 20 watts had lumen outputs ranging from 850 to 1,500.

Cadmus addressed these variations by using median lumens to create the relationship shown in Figure 2; the figure's calculated trend line shows a strong linear relationship between the CFL wattage and lumen output. Cadmus used this linear relationship to determine lumen outputs for CFL lamps without model numbers that matched the ENERGY STAR-qualified lamp product list.

Figure 2. Median Lumens vs. CFL Wattage for ENERGY STAR-Qualified Standard CFLs

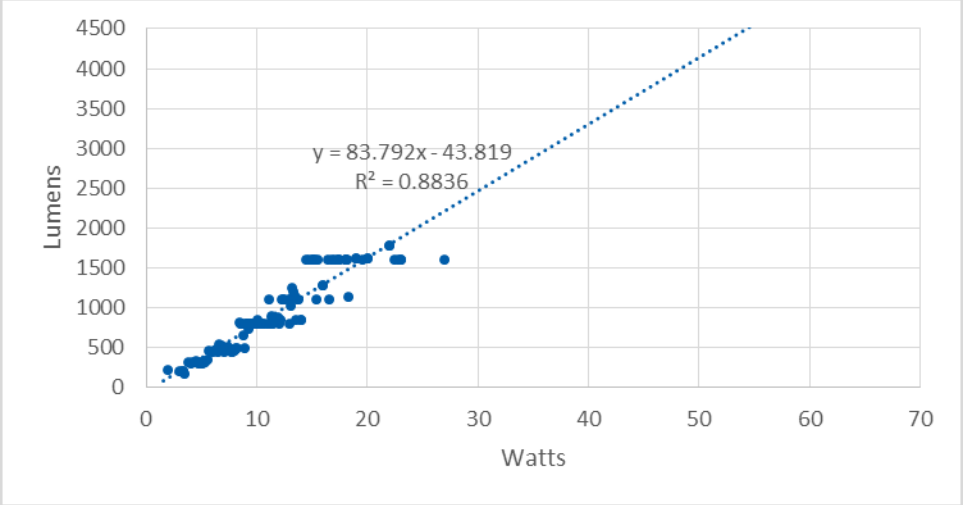


Mid-Atlantic Technical Reference Manual V5. June 2015. Available online: http://www.neep.org/mid-atlantic-technical-reference-manual-v5

[10] The most recent ENERGY STAR-qualified bulb list can be downloaded from ENERGY STAR's webpage. ENERGY STAR. "Find and Compare Products." Accessed May 2016: http://www.energystar.gov/productfinder/product/certified-light-bulbs/results.

Figure 3 shows the same chart for LED standard lamps.

Figure 3. Median Lumens vs. LED Wattage for ENERGY STAR-Qualified Standard LEDs



In total, the upstream lighting analysis employed six linear best-fit lines for LED and CFL standard, reflector, and specialty lamps, such as those shown in Figure 3. Generally, watts and lumens exhibited a stronger relationship for CFLs than for LEDs (as shown in both Figure 2 and Figure 3). Cadmus created two additional trend lines, drawn from the ENERGY STAR database for CFL and LED fixtures. Appendix B lists all trend lines employed.

Hours of Use (HOU)

For 2013–2014 lighting products, Cadmus used the HOU values shown in Table 28 (from version 3.3 of the RTF's guidance workbook for CFL and LED screw-in lamps).[11] In 2013 and 2014, all bulbs had a quantity-weighted average HOU value of 1.93 hours.

[11] Available online: http://rtf.nwcouncil.org/measures/res/archive/ResLightingCFLandLEDLamps_v3_3.xlsm. Summary Tables tab.

Table 28. HOU by Lamp Type and Lumen Range

Lamp Type	Lumen Range	HOU
Decorative and Mini-Base	250–664	1.792
	665–1,439	1.879
	1,440–2,600	1.631
General Purpose and Dimmable	250–664	1.747
	665–1,439	1.877
	1,440–2,600	1.992
Globe	250–664	1.385
	665–1,439	1.413
	1,440–2,600	1.878
Reflectors and Outdoor	250–664	1.951
	665–1,439	2.211
	1,440–2600	3.141
Three-Way	250–664	1.642
	665–1,439	1.901
	1,440–2,600	1.975

Waste Heat Factor

A WHF adjustment made to energy savings accounts for the effects of lighting measures on the operation of heating and cooling equipment. Lower-wattage bulbs produce less waste heat; consequently, their use requires more heating and less cooling to maintain a room's setpoint temperature.

For this evaluation, Cadmus used the Simplified Energy Enthalpy Model (SEEM),[12] with results from the most recent RTF residential CFL and LED savings workbook servings as a foundation for the analysis.[13]

Table 29 and Table 30 show RTF SEEM results and evaluation weightings. Saturation weightings for heating and cooling derived from the results of Pacific Power's surveys of its Washington residential customers in 2014; cooling zone weightings derive from typical meteorological year 3 (TMY3) weather data and census population data for Washington counties.

[12] SEEM is a building simulation model. The RTF calibrated the SEEM model for residential homes to determine the magnitude of interaction between lighting and HVAC systems. Additional SEEM background information can be found on the RTF website: *Regional Technical Forum*. "Simplified Energy Enthalpy Model (SEEM)." Accessed May 2016: http://rtf.nwcouncil.org/measures/support/seem/

[13] The RTF savings workbook for residential, screw-in, CFL and LED lamps: ResLighting_Bulbs_v4_0.xlsm

Table 29. WHF Heating Inputs Summary*

WHF Component	Heating System Type	SEEM Results (kWh/kWh Saved)**	Cadmus Saturation Weighting
Heating Impact	Electric Zonal	-0.440	13.5%
	Electric Forced Air	-0.479	16.5%
	Heat Pump	-0.258	22.6%
	Non-Electric	0.000	47.4%

*Percentages may not add to 100% due to rounding.

**RTF. "Simplified Energy Enthalpy Model (SEEM)." Accessed May 2016: http://rtf.nwcouncil.org/measures/support/seem/

Table 30. WHF Cooling Inputs Summary

WHF Component	System Type	SEEM Results (kWh/kWh Saved)	Cadmus Zone Weighting*	Cadmus Saturation Weighting
Cooling Impact	Cooling Zone 1	0.033	75.9%	**64.3%**
	Cooling Zone 2	0.053	6.8%	
	Cooling Zone 3	0.074	17.3%	

* Percentages may not add to 100% due to rounding.

Calculating the weighted averages of values presented in Table 29 and Table 30 provided the impacts from heating and cooling of a bulb installed in a conditioned space (shown in Table 31). Summing the heating and cooling impacts produced an estimated combined impact of -0.17 kWh per kWh of lighting savings.

Table 31. WHF Weighted Average Impact, Conditioned Space

Component	kWh/kWh Savings*
Heating	-0.197
Cooling	0.027
Combined	**-0.170**

*Table may not sum to total due to rounding.

Cadmus also considered bulb locations to determine the appropriate WHF to account for bulbs not installed in conditioned spaces. As shown in Table 32, Cadmus applied bulb allocations by space types, drawn from the 2013–2014 Pacific Power general population survey data, to thermal coupling factors from the RTF.

Table 32. Thermal Coupling by Space Type

Space Type	RTF Thermal Coupling Correction Factor	Bulb Allocation*
Basement	50%	2.6%
Main House	75%	90.7%
Outdoor	0%	6.8%
Weighted Average		**69.3%**

*Percentages may not add to 100% due to rounding.

Multiplying the combined impact from Table 31 with the weighted thermal coupling from Table 32 and adding 1 provided the final WHF, shown in Table 33.

Table 33. Washington CFL and LED Bulb WHF, Average Installation Location

Fuel	Value	Units
Electric	0.882*	kWh/kWh Saved

*Final WHF value does not compute exactly from reported variables due to rounding.

Cross-Sector Sales

During the intercept surveys, Cadmus collected data on the intended installation locations of efficient bulbs purchased at retailer stores. Recent data, collected in several jurisdictions around the country, revealed that many program bulbs have been installed in commercial settings. Bulbs installed in commercial spaces produce more first-year savings than bulbs installed in residential spaces because commercial locations typically have higher daily use than those in residential locations (i.e., higher HOU). Percentages of bulbs purchased from retail stores and installed in commercial buildings are called cross-sector sales.

Of all bulbs purchased at participating retailers (as estimated by the intercept surveys), Cadmus calculated that 3.9% of efficient bulbs ultimately would be installed in commercial applications. Cadmus did not include this adjustment in the evaluated savings calculation. Other jurisdictions around the country have increasingly accommodated cross-sector sales factors in calculating lighting savings; such an adjustment would require an update to savings calculations from those presented in this report. Appendix B contains further details regarding cross-sector sales methodologies and results.

CFL and LED Bulbs Total Savings

Table 34 shows reported savings inputs and input sources. Cadmus determined these inputs using assumptions provided by Pacific Power and information drawn from the tracking database. Reported savings for CFLs and LEDs in 2013 and 2014 were derived using various methods. For 2013 CFLs, various values for HOU, ISR, WHF and delta watts were used across various wattages of general and specialty bulbs. The displayed values in Table 34 for 2013 CFLs are therefore quantity-weighted averages. For 2013 LEDs, a single set of values for HOU, ISR, WHF, and delta watts was used to produce one savings value. For 2014 CFLs, two sets of RTF-derived values for HOU, ISR, WHF, and delta watts, from two different RTF workbooks, were used for general and specialty lamps. Therefore, the values presented in Table 34 for 2014 CFLs are quantity-weighted averages. For reported savings for 2014 LEDs, quantity-

weighted savings were derived from an RTF workbook across several lumen bin ranges for standard and specialty bulbs. The savings value for each of these lumen bins employs its own set of values for WHF, ISR, HOU, and delta watts. Therefore, Table 34 shows approximate weighted average values for these factors.

Table 34. 2013–2014 Reported CFL and LED Bulb Savings Inputs

Bulb Type	Reported Inputs	2013	2014	Source
CFLs	Quantity	307,677	274,565	Database/Annual Report
	Total Savings (kWh)	6,138,648	4,519,782	Database/Annual Report
	Average UES (kWh/bulb)	20.0	16.5	Database/Annual Report
	Average Delta Watts	48.0*	42.4*	2013: Back-calculated from final savings and other lighting factors, but originally derived from HES-Lighting-MASTER Source Workbook_2012-2016 v3.6.xlsx. 2014: Same.
	ISR	69.2%**	66.4%	2013: RTF. EStarLighting_SpecialtyFY10v1_0.xls and ResCFLLighting_v2_0.xlsm 2014: RTF. ResCFLLighting_v2_2.xlsm and ResSpecialtyCFL_v1_3.xlsm
	HOU	1.90**	1.86	2013: RTF. ResCFLLighting_v2_0.xlsm 2014: RTF. ResCFLLighting_v2_2.xlsm and ResSpecialtyCFL_v1_3.xlsm
	WHF	86.6%**	86.0%	2013: Cadmus Evaluation of PacifiCorp's HES Program in WA, 2009-2010 2014: RTF. ResCFLLighting_v2_2.xlsm and ResSpecialtyCFL_v1_3.xlsm
LEDs	Quantity	19,960	28,125	Database/Annual Report
	Total Savings (kWh)	720,556	734,959	Database/Annual Report
	Average UES (kWh)	36.1	26.1	Database/Annual Report
	Average Delta Watts	60.7	40.6†	2013: RTF. ResSpecialtyLighting v 1.1 2014: RTF. ResLEDLighting_v2.12.xlsm
	ISR	99.0%	100%†	2013: RTF. ResSpecialtyLighting v 1.1 2014: RTF. ResLEDLighting_v2.12.xlsm
	HOU	1.9	2.27†	2013: RTF. ResSpecialtyLighting v 1.1 2014: RTF. ResLEDLighting_v2.12.xlsm
	WHF	86.6%	88.4%†	2013: Cadmus PacifiCorp HES 2009 – 2010 Evaluation 2014: RTF. ResLEDLighting_v2.12.xlsm

*Reported ΔW values back-calculated from average reported unit savings and reported ISR, HOU, and WHF.
**Reported ISR, HOU, and WHF for CFLs in 2013 were different for general and specialty bulbs. These numbers represent quantity-weighted averages.
†Reported ISR, HOU, and WHF for LEDs in 2014 are approximate, derived from the range of values used across two bulb types, which were from the RTF's ResLightingLED_v2_12.xlsm.

Table 35 shows evaluated savings inputs and input sources. The preceding section described the sources for these inputs.

Table 35. 2013–2014 Evaluated CFL and LED Bulb Savings Inputs

Bulb Type	Evaluated Inputs	2013	2014	Source
CFLs	Quantity	307,677	274,565	Upstream Lighting Tracking Database
	Total Savings (kWh)	5,969,257	4,211,948	Calculated
	Average UES (kWh)	19.4	15.3	
	Average Delta Watts	44.2	34.9	Lumens equivalence method
	ISR	70.5%	70.5%	General Population Survey (n= 250)
	HOU	1.93*	1.92*	RTF. ResLightingCFLandLEDLamps_v3_3.xlsm. Summary Tables tab.
	WHF	0.882	0.882	RTF, updated for Washington weather
LEDs	Quantity	19,960	28,125	Upstream Lighting Tracking Database
	Total Savings (kWh)	553,866	571,756	Calculated
	Average UES (kWh)	27.7	20.3	
	Average Delta Watts	46.2	38.4	Lumens equivalence method
	ISR	84.8%	84.8%	General Population Survey (n= 250)
	HOU	2.18*	1.89*	RTF. ResLightingCFLandLEDLamps_v3_3.xlsm. Summary Tables tab.*
	WHF	0.882	0.882	RTF, updated for Washington weather

*Weighted average.

Figure 4 compares the impacts of reported and evaluated inputs on savings for CFLs, as shown in Table 34 and Table 35. Positive percentages indicate that an evaluated input was higher than a reported input (thus driving up the realization rate by that percentage due to that input). For example, the evaluated average delta watts value for CFLs in 2013 was 8% lower than the reported value. But, because the evaluated HOU, ISR, and WHF values were approximately 2% higher than the reported values, overall evaluated savings for 2013 CFLs actually were only 3% less than reported savings (i.e., realization rate = 97%).

Examining both 2013 and 2014, it can be seen that delta watts played the largest role in the difference between reported and evaluated savings. Differences in delta watts values stem from using slightly different lumen bins and baselines, and grouping many models together under single wattage-based measures, as opposed to evaluating every model individually as Cadmus did.

Figure 4. 2013–2014 CFL Impact of Calculation Parameters on Savings

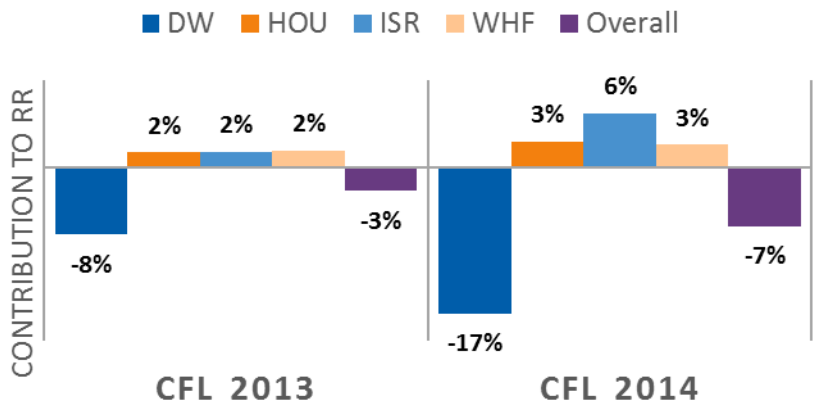
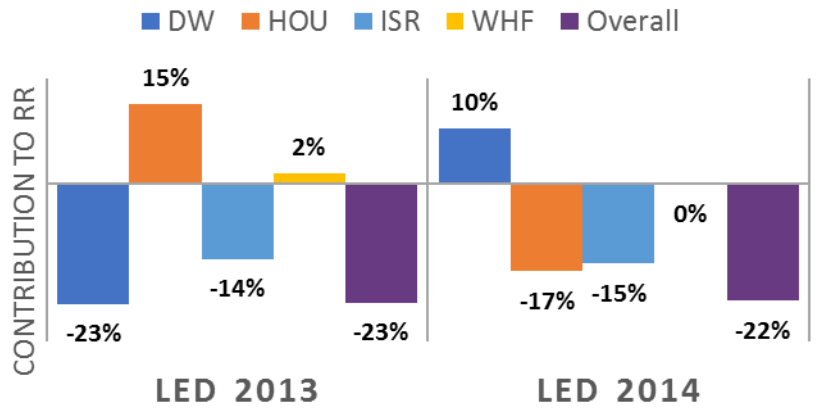


Figure 5. 2013–2014 LED Impact of Calculation Parameters on Savings



For 2013 LED reported savings, a single set of values for delta watts, HOU, ISR, and WHF was employed. These values came from an RTF workbook and often differ from the values Cadmus used, as seen in Figure 5. Delta watts, which assumed a 70.6 W baseline and a 10 W efficient bulb, is responsible for most of the difference. However, HOU and ISR made large contributions as well. For LEDs in 2014, average reported delta watts was slightly less than average evaluated delta watts. However, this is offset by larger contributions from approximate average HOU and ISR values calculated across the two RTF workbooks used to derive reported 2014 LED savings.

Table 36 provides evaluated CFL quantities, evaluated savings, and realization rates by bulb type. Generally, CFL realization rates were above 90% and LED realization rates were just below 80%. Overall, CFL and LED bulbs realized 93% of reported savings.

Table 36. 2013–2014 Evaluated and Reported HES Program CFL and LED Savings

Program Year	Technology	Quantity Purchased	Program Savings (kWh)		Average UES (kWh)		Realization Rate
			Reported	Evaluated	Reported	Evaluated	
2013	CFL	307,677	6,138,648	5,969,257	19.95	19.40	97%

	LED	19,960	720,556	556,992	36.10	27.75	77%
2014	CFL	274,565	4,519,782	4,211,948	16.46	15.34	93%
	LED	28,125	734,959	572,061	26.13	20.34	78%
2013–2014	CFL	582,242	10,658,429	10,181,205	18.31	17.49	96%
	LED	48,085	1,455,515	1,129,052	30.27	23.48	78%
Total		**630,327**	**12,113,944**	**11,310,257**	**19.22**	**17.94**	**93%**

Light Fixtures

During the 2013–2014 program period, Pacific Power provided incentives for 7,228 ENERGY STAR light fixtures, representing 1.7% of reported program savings. Light fixture participation ramped up during the 2013-2014 evaluation period. Because of this increased participation, Cadmus conducted a more granular evaluation of light fixtures in 2013-2014 than in the 2011-2012 program evaluation.

In the 2011–2012 evaluation period, Cadmus used weighted averages based on model lookups to determine mean values for the efficient wattages and number of bulbs per fixture, and applied a weighted average CFL baseline wattage to all fixtures. These mean values were then applied across all fixtures to calculate delta watts. For 2013–2014, Cadmus grouped and analyzed savings for fixtures within three categories:

- Downlight fixtures
- Fluorescent fixtures
- Miscellaneous fixtures

Downlight fixtures contributed 74.0%, fluorescent fixtures contributed 0.4%, and miscellaneous fixtures contributed 18.6% of program fixtures by quantity (with 7.0% unidentifiable). Generally, Cadmus used the same methodology to calculate fixture savings as employed for light bulbs, though the three fixture types required slight variations in their energy savings calculations. Again, the general equation for lighting evaluated saving evaluation follows:

$$Evaluated\ Per\ Unit\ Savings\ (kWh\ per\ unit) = \frac{\Delta Watts * ISR * HOU * 365 * WHF}{1{,}000}$$

To calculate the various light fixture component inputs, Cadmus conducted the primary and secondary data collection activities shown in Table 37.

Table 37. Light Fixture Evaluated Savings Activities and Results

Savings Variables	Activity	Mean Value
ΔWatts	Downlights and Miscellaneous: RTF Market Baseline Fluorescents: RTF	39.8*
ISR	Non-Lighting Participant Survey	1.0
HOU	RTF. ResLightingCFLandLEDLamps_v3_3.xlsm. Summary Tables tab.	1.904*
WHF	RTF Space Interaction Calculator	0.882

* Weighted average for all fixtures

Cadmus applied the same HOU and WHF used in the CFL and LED bulb analysis and generated an ISR (100%) from the non-lighting participant surveys. For delta watts, Cadmus conducted a lumens equivalence approach whenever possible (and when appropriate for the fixture type). A detailed discussion of the delta watts calculation follows for each fixture category.

Downlight Fixtures

Figure 6 provides an example of a downlight fixture. These fixtures are designed to be installed into recessed ceiling or "can" light receptacles (intended to accept reflector lamps). Therefore, this fixture type differs from other fixtures in that each purchase replaces a particular lamp, meriting the application of the lumens equivalence method to calculate delta watts.

Figure 6. Example of a Downlight Fixture

To calculate baseline wattages for LED downlights, investigators must determine the types of lamps typically replaced by LED downlight fixtures. Although recessed ceiling fixtures are typically designed to accommodate reflector lamps that point light down to maximize the light's output, other lamp types may be installed. Using data compiled from household lighting inventories conducted in four other jurisdictions across the United States, Cadmus calculated a weighted baseline wattage for LED downlight fixtures that accounts for the mix of bulb types typically installed in recessed ceiling receptacles.

To do so, Cadmus first calculated an average set of reflector lumen bins and baseline wattages that accounted for the six different types of reflector lamps. The lumen bins and baseline wattages for each reflector type were weighted by their quantities in the upstream lighting database, which provided the closest source of granular sales data available.

Cadmus then combined this set of average reflector baseline wattages and lumen bins with the lumen bins and baseline wattages for other lamp types, weighted by the saturation of bulb types typically installed in recessed ceiling receptacles, as determined by the four lighting inventories. The inventories collected data on bulb types installed in every fixture in over 200 homes. Using these data, Cadmus determined saturation levels of various lamp types typically installed in recessed ceiling receptacles.

Results, presented in Table 38, show that 85.6% of lamps installed in ceiling receptacles were reflector lamps and 13.5% were standard lamps, with other categories comprising the rest. Cadmus used these

saturation values to create an average set of lumen bins and baseline wattages for recessed ceiling receptacles in both 2013 and 2014. Appendix B provides plots of weighted reflector and final recessed can lumen bins and baseline wattages. As with reflector baseline wattages in general, recessed can baseline wattage values generally are higher than those for standard lamps.

Table 38. Lamp Type Saturation in Recessed Ceiling Receptacles

Lamp Type	Southwestern Utility	Central Utility	Midwest Utility	Mid-Atlantic Utility	Combined
Standard	11.70%	17.60%	13.20%	12.70%	13.52%
Globe	0.60%	0.50%	0.00%	0.90%	0.60%
Reflector	87.70%	81.90%	86.00%	86.00%	85.57%
Decorative	0.00%	0.00%	0.30%	0.40%	0.22%
EISA-Exempt	0.00%	0.00%	0.50%	0.00%	0.09%
Total Bulbs	**473**	**431**	**393**	**928**	**2,225**
Total Households	**38**	**46**	**68**	**65**	**217**

Fluorescent Fixtures

The UMP does not specify a lumens equivalence approach for fluorescent lamps (0.4% of fixtures), and EISA legislation does not provide discrete lumen bins or baseline wattages for these types of lamps. To calculate savings for these lamps, Cadmus applied a single delta watts value for all fluorescent lamps in the database. Although the database included some circline and other types of fluorescent lights, the majority (> 80%) of fluorescent lamps were two-lamp T8 fluorescents.

Cadmus applied the RTF's delta watts value for fluorescent fixtures. *The High-Performance T8 Lamps Workbook (Version 1.1)* provides a delta watts value of 42 watts for four-foot, two-lamp, T8 fixtures installed in kitchens and a 43-watts value for the same fixtures installed in garages.[14] Because the installation locations for these fixtures remained unknown, Cadmus applied a 42.5 delta watts value for all fluorescent lamp fixtures in the database. Cadmus also applied CFL values for HOU and WHF.

Miscellaneous Fixtures

Of fixtures sold, 18% could not be classified as downlights or fluorescent lights (e.g., single- and multi-bulb sconce lights, motion sensors, track lighting). Roughly one-third were single-lamp CFL fixtures, one-third were two-lamp CFL fixtures, and one-third were LED fixtures of various types. Cadmus applied the lumens equivalence approach to evaluate these fixtures.

Unknown Fixtures

The database included 7.0% of fixtures falling within unknown categories. Of these, 22% had no model numbers in the database. The remainder could not be matched to the ENERGY STAR database.

[14] Source. RTF Unit Energy Savings Measures. Lighting—High Performance 4-foot T8 Lamps. Version 1.1. Available at: http://rtf.nwcouncil.org/measures/measure.asp?id=205

Consequently, Cadmus applied the weighted average UES for the downlight, fluorescent, and miscellaneous fixture categories.

Lighting Fixture Findings

In 2013–2014, the HES program provided incentives for 7,228 light fixtures. Table 39 provides lamp quantities, savings, and realization rates by fixture type for 2013–2014.

Table 39. 2013–2014 Light Fixture Quantity and Evaluated Savings

Fixture Category	CFL/LED	Quantity	Reported Savings (kWh)	Evaluated Savings (kWh)	Evaluated UES (kWh/unit)	Realization Rate
Downlight	LED	5,346	261,704	139,626	26.1	53%
Fluorescent	N/A	32	1,567	868	27.1	55%
Miscellaneous	LED	671	32,878	11,391	17.0	35%
	CFL	676	33,045	32,591	48.2	99%
Unknown	N/A	503	24,682	12,782	25.4	52%
Total*		**7,228**	**353,875**	**197,258**	**27.3**	**56%**

*Savings may not sum exactly to totals due to rounding.

Most fixture types have realization rates near 50%, with overall realization rates of 56%. The reported UES for fixtures were 49.0 kWh for each fixture sold—a value based on HOU, ISR, and WHF values, similar to those for upstream CFL bulbs in 2013. In addition, baseline and efficient wattages of 57.8 W and 17.2 W were assumed, producing a delta watts value of 40.6—an amount not out of line with average evaluated delta watts of 39.8 W. It was assumed, however, that each fixture contained two bulbs—consequently doubling reported savings. This practice reflected RTF assumptions at the time of the savings calculation. However, the vast majority of fixtures are single-bulb fixtures, as reflected in the evaluation. This discrepancy produces the main source of low realization rates for fixtures.

wattsmart Starter Kits Pacific Power's HES program includes eight varieties of ***watt***smart Starter Kits, which contain unique combinations of 13-watt CFLs, 10-watt LEDs, kitchen aerators, bathroom aerators, and showerheads. Table 40 shows the components in each of the eight kits available in 2013 and 2014.

Table 40. Components in Each *watt*smart Starter Kit

Kit Name	Quantity per Kit				
	CFL	LED	Kitchen Aerator	Bathroom Aerator	Showerhead
Basic 1	4	0	1	1	1
Basic 2	4	0	1	2	2
Better 1	4	0	1	1	1
Better 2*	4	0	1	2	2
Best 1	0	4	1	1	1
Best 2	0	4	1	2	2
CFL Only	4	0	0	0	0
LED Only	0	4	0	0	0

*Better and basic kits 1 and 2 have the same quantities of measures, but differ in the type of showerhead provided: Better kits provide a handheld showerhead with the same flow rate as the fixed showerhead provided in the Basic kits.

Kit CFLs and LEDs

Cadmus estimated energy savings for CFLs and LEDs distributed through the ***watt***smart Starter Kit, using the following equation (outlined in the UMP's Residential Lighting Evaluation Protocol):[15]

$$\Delta kWh_{CFL/LED} = \left(\frac{Watts_{Base} - Watts_{CFL/LED}}{1{,}000}\right) \times ISR_{CFL/LED} \times HOURS_{CFL/LED} \times (WHF_E)$$

Table 41 defines the key variables in the above equation and provides values used in analysis and sources for these values.

[15] National Renewable Energy Laboratory. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*, Chapter 21: Residential Lighting Evaluation Protocol. December 2014. Available online: http://www.nrel.gov/extranet/ump/pdfs/ump-res-lighting-clean.pdf

Table 41. *watt*smart Starter Kit CFL and LED Key Variables and Assumptions

Parameter	Definition	Value	Unit	Source
$Watts_{Base}$	Baseline bulb wattage	43	W	Lumens equivalence method
$Watts_{CFL}$	Efficient bulb wattage	13	W	Program materials
$Watts_{LED}$	Efficient bulb wattage	10	W	Program materials
1000	W to kW conversion	1,000	$\frac{W}{kW}$	Constant
ISR_{CFL}	In-Service Rate	85	%	2014 kit participant telephone survey results n=62
ISR_{LED}	In-Service Rate	90	%	2014 kit participant telephone survey results n=53
$HOURS_{CFL}$	Annual HOU	686	$\frac{hours}{year}$	RTF Residential Lighting workbook v3.3 (HOU for general purpose, non-DI lamp, 655-1439 lms)
$HOURS_{LED}$	Annual HOU	686	$\frac{hours}{year}$	RTF Residential Lighting workbook v3.3 (HOU for general purpose, non-DI lamp, 655-1439 lms)
WHF_E	WHF	-0.118	–	2013-2014 HES Upstream Lighting WHF analysis
ΔkWh_{CFL}	**Energy Savings**	**15**	**$\frac{kWh}{year}$**	**Calculated**
ΔkWh_{LED}	**Energy Savings**	**18**	**$\frac{kWh}{year}$**	**Calculated**

Cadmus based the lighting ISRs on surveys of respondents receiving only CFLs or LEDs as part of kits (i.e., excluding respondents receiving CFLs or LEDs as a lighting fixture rebate), thus providing a value specific to the kit measure. Otherwise, the analysis remains consistent with the approach Cadmus used in evaluating upstream lighting. Cadmus conservatively assumed the baseline wattage of a standard efficiency bulb, i.e., a replacement-on-burnout, not a retrofit.

Cadmus determined measure-level *ex ante* savings for CFLs and LEDs by dividing total *ex ante* savings by the number of bulbs in the CFL or LED-only kits.[16] Table 42 shows *ex ante* and *ex post* savings for each bulb type, along with realization rates.

Table 42. Kit CFL and LED per Unit Reported and Evaluated *Ex Post* Savings

Bulb Type	Reported Savings Per Unit (kWh)	Evaluated *Ex Post* Savings Per Unit (kWh)	Realization Rate
CFL	15.0	15.4	102.5%
LED	15.8	17.9	113.2%

Kit Aerators

Cadmus evaluated faucet aerator electric savings using the following equation:

$$\Delta kWh = ISR \times (GPM_{Base} - GPM_{Low}) \times MPD \times \frac{PH}{FH} \times 8.3 \times (T_{Mix} - T_{In}) \times \frac{365}{RE \times 3{,}412} \times \%DHW_{elec}$$

[16] Cadmus did not receive the measure-level saving assumptions for the kit lighting measures.

Table 43 defines the equation's key variables and provides values used in the analysis, along with the sources for these values. The RTF does not provide any savings estimates for faucet aerators, thus savings are based on other sources.

Table 43. *watt*smart Starter Kit Aerator Key Variables and Assumptions

Parameter	Definition	Value	Unit	Source
ISR_K	Kitchen aerator ISR	63	%	2014 kit participant telephone survey results n=96
ISR_B	Bathroom aerator ISR	61	%	2014 kit participant telephone survey results n=87
GPM_{Base}	Baseline flow rate	2.20	GPM	Federal rated maximum flow rate for faucets (10CFR430.32 (p) (DOE 1998)
$GPM_{Low,K}$	Kitchen Efficient flow rate	1.5	GPM	Program Materials
$GPM_{Low,B}$	Bathroom Efficient flow rate	0.5	GPM	Program Materials
MPD_K	Average minutes of use per person per day (kitchen)	4.5	$\frac{min}{day}$	2013 Cadmus Study*
MPD_B	Average minutes of use per person per day (bathroom)	1.6	$\frac{min}{day}$	2013 Cadmus Study*
PH	Average people per household	2.37	$\frac{people}{household}$	2014 kit participant survey results n=99. Variable reflects average for only those receiving water saving measures.
FH_K	Average kitchen faucets per household	1	$\frac{faucets}{household}$	Assume 1 kitchen per household.
FH_B	Average bathroom faucets per household	2.43	$\frac{faucets}{household}$	2014 kit participant survey results n=80. Variable reflects average for only those receiving water saving measures.
$T_{Mix,K}$	Average temperature out of kitchen faucet	93	$°F$	2013 Cadmus Study*
$T_{Mix,B}$	Average temperature out of bathroom faucet	86	$°F$	2013 Cadmus Study*
T_{In}	Average temperature into water heater	56.95	$°F$	Calculated for Washington based on DOE Hot Water Scheduler workbook and 2013 U.S. Census Bureau Population.
RE	Recovery efficiency of electric hot water heater	98	%	NREL, "Building America Research Benchmark Definition"**
$\%DHW_{elec}$	Percent of households with electric hot water	98.0	%	2014 kit participant survey results n=102. Variable reflects average for only those receiving water saving measures.
ΔkWh_K	**Kitchen Aerator Energy Savings**	**149.7**	$\frac{kWh}{year}$	**Calculated**
ΔkWh_B	**Bathroom Aerator Energy Savings**	**49.3**	$\frac{kWh}{year}$	**Calculated**

*Cadmus and Opinion Dynamics. *Showerhead and Faucet Aerator Meter Study*. Prepared for Michigan Evaluation Working Group. 2013.

**National Renewable Energy Laboratory. *Building America Research Benchmark Definition*. December 2009. pg. 12. Available online: http://www.nrel.gov/docs/fy10osti/47246.pdf

Table 44 shows *ex ante* and *ex post* savings for each aerator type, along with realization rates.

Table 44. Kit Kitchen and Bathroom Aerator per Unit Reported and Evaluated *Ex Post* Savings

Kit Measure	Reported Savings Per Unit (kWh)	Evaluated *Ex Post* Savings Per Unit (kWh)	Realization Rate
Kitchen Aerator	11	150	1,354%
Bathroom Aerator	27	49	184%

The *ex ante* kit aerator savings are based on a 2013 potential study that provides per household savings assuming there are 2.12 bathroom aerators and one kitchen aerator per household.[17] The *ex ante* estimates assume that there is no difference in savings between an aerator installed in a kitchen and a bathroom. The kitchen aerator *ex ante* savings represent the average savings of 2.12 aerators installed in bathrooms and one aerator installed in a kitchen, all with flow rates of 1.5 GPM. The bathroom aerator *ex ante* savings represent the average savings of 2.16 aerators installed in bathrooms and one aerator installed in a kitchen, all with flow rates of 0.5 GPM. In both cases, the *ex ante* savings do not take into account the difference in operation between kitchen and bathroom faucets.

The ISR used to calculate *ex ante* savings (76%) is greater than the ISR used to calculate *ex post* savings (63% and 61% for kitchen and bathroom aerators respectively). The *ex ante* ISR is based on the RTF showerhead savings workbook from 2011.[18]

The *ex post* kit aerator savings are superior to the *ex ante* estimates because they are specific to the end use and equipment flow rate. The *ex post* kitchen aerator savings are specific to a 1.5 GPM aerator installed in a kitchen, and the *ex post* bathroom aerator savings are specific to a 0.5 GPM aerator installed in a bathroom. Although the rated flow rate of the bathroom aerators is lower than that of the kitchen aerators, the expected daily use of the kitchen aerators is much greater than that of the bathroom aerators. For that reason, the kitchen aerators result in greater savings.

[17] Cadmus. Assessment of Long-Term, System-Wide Potential for Demand-Side and Other Supplemental Resources, 2013-20132 Volume I and II. Prepared for Pacificorp, March 2013. Available online: https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjp1JmsoNbPAhUKqFQKHcmTAtAQFggeMAA&url=http%3A%2F%2Fwww.pacificorp.com%2Fcontent%2Fdam%2Fpacificorp%2Fdoc%2FEnergy_Sources%2FDemand_Side_Management%2FDSM_Potential_Study%2FPacifiCorp_DSMPotential_FINAL_Vol%2520I.pdf&usg=AFQjCNGWykZoZQk4JArl71ZelvYV0eoDzw&sig2=vBMmVteS8SecO0o6FShbUw&cad=rja and https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwjp1JmsoNbPAhUKqFQKHcmTAtAQFggjMAE&url=http%3A%2F%2Fwww.pacificorp.com%2Fcontent%2Fdam%2Fpacificorp%2Fdoc%2FEnergy_Sources%2FDemand_Side_Management%2FDSM_Potential_Study%2FPacifiCorp_DSMPotential_Vol-II_Mar2013.pdf&usg=AFQjCNFQVYe3-f5HtQDVU7caujZopw_rZQ&sig2=PNmxnYHKDOGBoro_0ObmYA&cad=rja

[18] Regional Technical Forum. "Residential: DHW – Showerheads." ResShowerheads_v2_1.xlsx. July 12, 2011. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=126#

The ***watt***smart Starter Kit Participant survey asked respondents who received water-saving measures (aerators and showerheads) about their water heating fuel types, and 98% of respondents reported using electric water heaters. The program strives to provide kits with water-saving measures only to customers with an electric water heater by including a question on the online kit ordering portal; this disqualifies customers from receiving water-saving measures if they report using a water heater fueled by natural gas or another fuel type. Cadmus assigned electric savings to the 98% of participants who reported using an electric water heater.

Kit Showerheads

Cadmus evaluated showerhead electric savings using the following equation:

$$\Delta kWh = (GPM_{Base} - GPM_{EE}) \times ISR \times MPS \times N_S \times Qty \times PH \times \frac{(T_{Mix} - T_{in})}{RE} \times \%DHW_{elec} \times \frac{365 \times 8.33}{3412}$$

Table 45 defines the equation's key variables, and provides values used in the analysis along with the sources for these values. Cadmus based showerhead ISRs on surveys of respondents receiving a kit during 2014.

Table 45. *watt*smart Starter Kit Showerhead Key Variables and Assumptions

Parameter	Definition	Value	Unit	Source
ISR	In-service rate	63	%	2014 kit participant telephone survey results n=97
$\%DHW_{elec}$	Percent of households with electric hot water	98	%	2014 kit participant survey results n=102. Variable reflects average for only those receiving water-saving measures.
$GPM_{Base,act}$	Baseline flow rate (actual)*	2.3	GPM	RTF Residential Showerhead Calculator V2.2** (*in situ* measured flow rate)
$GPM_{EE,nom}$	Efficient flow rate (nominal)	1.5	GPM	Program Materials
$\%Flow_{EE}$	Percent of rated flow expected	90	%	RTF Residential Showerhead Calculator V2.2**
N_S	Average showers per showerhead per year	328	$\frac{showers}{year}$	RTF Residential Showerhead Calculator V2.2**
MPS	Average shower duration	8.1	$\frac{min}{shower}$	RTF Residential Showerhead Calculator V2.2**
$T_{out} - T_{in}$	Water temperature difference	75	$°F$	RTF Residential Showerhead Calculator V2.2**
$\%HW_{Base}$	Baseline percent of shower water from hot tap	73	%	RTF Residential Showerhead Calculator V2.2**
$\%HW_{EE}$	Efficient percent of shower water from hot tap	78	%	RTF Residential Showerhead Calculator V2.2**
WHE	Water heating energy	0.0024	$\frac{kWh}{gal\ °F}$	RTF Residential Showerhead Calculator V2.2**
kWh_{Base}	Baseline energy consumption	816	$\frac{kWh}{year}$	Calculated
kWh_{EE}	Efficient energy consumption	816	$\frac{kWh}{year}$	Calculated
ΔkWh	**Energy Savings**	**188**	**$\frac{kWh}{year}$**	**Calculated**

*The GPM_{Base} value derives from *in situ* measurements, and is not based on a rated nominal flow rate; therefore, a percent flow reduction is not needed.

**RTF. *Residential: DHW – Showerheads Measure Workbook*. Version 2.2. (11/12/2015). Available Online: http://rtf.nwcouncil.org/measures/measure.asp?id=126

Table 46 shows *ex ante* and *ex post* savings for kit showerheads, along with realization rates.

Table 46. Kit Showerhead per Unit Reported and Evaluated *Ex Post* Savings

Kit Component	Reported Savings Per Unit (kWh)	Evaluated *Ex Post* Savings Per Unit (kWh)	Realization Rate
Showerhead	170	188	110%

Ex ante kit showerhead savings derive from version 2.1 of the *Residential DHW Showerhead RTF Workbook*.[19] The RTF workbook *ex ante* value is specific to residential showerhead replacements on any shower (primary or secondary) received by a mail-in request to a home with electric water heating. *Ex post* kit showerhead savings are based on program- and state-specific information, along with a more recent version of the RTF.[20] The more recent version of the RTF uses a greater average shower length (8.1 minutes instead of 7.8 minutes), a lower number of showers per year (328 instead of 404), and a higher baseline flow rate (2.3 GPM instead of 2.2 GPM).

*watt*smart Starter Kit Summary

Using evaluated savings (shown above) for CFLs, LEDs, aerators, and showerheads, Cadmus calculated savings for each variety of kit. Table 47 shows the percentage of evaluated savings attributable to each kit component.

Table 47. Percent of Evaluated Savings Attributable to each Kit Component

Kit Name	Percent of Kit Evaluated Savings				
	CFL Bulbs	LED Bulbs	Kitchen Aerators	Bathroom Aerators	Showerheads
Basic 1	14%	0%	33%	11%	42%
Basic 2	9%	0%	22%	14%	55%
Better 1	14%	0%	33%	11%	42%
Better 2	9%	0%	22%	14%	55%
Best 1	0%	16%	33%	11%	41%
Best 2	0%	10%	22%	14%	54%
CFL Only	100%	0%	0%	0%	0%
LED Only	0%	100%	0%	0%	0%

For all kits including more than lighting, showerheads accounted for the greatest share of evaluated savings, followed by kitchen aerators.

For each of the eight ***watt***smart Starter Kit configurations, Table 48 shows quantities of each component making up the kit, quantities of kits installed in 2014, reported and evaluated savings per kit, and realization rates.

[19] RTF. "Residential: DHW – Showerheads." ResShowerheads_v2_1.xlsx. July 12, 2011. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=126

[20] RTF. *Residential: DHW – Showerheads Measure Workbook*. Version 2.2. (11/12/2015). Available Online: http://rtf.nwcouncil.org/measures/measure.asp?id=126

Table 48. Components in Each *watt*smart Starter Kit

Kit Name	Quantity per Kit					Kits Distributed	Reported kWh Savings per Kit	Evaluated kWh Savings per Kit	Realization Rate
	CFL	LED	Kitchen Aerator	Bathroom Aerator	Showerhead				
Basic 1	4	0	1	1	1	3,122	268	448	167%
Basic 2	4	0	1	2	2	6,424	465	685	147%
Better 1	4	0	1	1	1	100	268	448	167%
Better 2*	4	0	1	2	2	252	465	685	147%
Best 1	0	4	1	1	1	96	271	458	169%
Best 2	0	4	1	2	2	404	468	695	149%
CFL Only	4	0	0	0	0	1,856	60	62	103%
LED Only	0	4	0	0	0	103	63	72	113%
Total	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**12,357**	**4,298,641****	**6,465,955****	**150%**

*Better and basic kits 1 and 2 have the same quantities of measures, but differ in the type of showerheads provided. Better kits provide a handheld showerhead, but this has no impact on reported or evaluated savings per kit.

**Total savings from all installed kits: the sum-product of quantities installed and savings per kit.

Clothes Washers

Cadmus estimated clothes washer energy savings using version 4.3 of the RTF workbook for residential clothes washers.[21] Published on January 12, 2015, this was the last RTF workbook based on the federal standard, effective from January 2011 to March 2015. The RTF workbook compared energy consumption of efficient clothes washers to a current practice baseline. Expected savings were expressed relative to efficient unit performance (divided into four performance tiers) and whether dryers and water heaters were electric or non-electric (e.g., natural gas, propane). Cadmus adjusted the RTF savings to use program-specific results from participant surveys for the expected number of loads per year. Participant surveys indicated 293 average loads expected per year—14% greater than that predicted by the RTF (257). This number remained consistent with the 2011–2012 Pacific Power evaluation survey, which projected an average of 283 loads per year.

Cadmus estimated an average evaluated savings value of 172 kWh per unit, yielding a 101% realization rate for 2013–2014.

Cadmus estimated savings for each combination of domestic hot water (DHW) fuel and dryer fuel. If the DHW or dryer fuel was not electrically powered (e.g., natural gas or propane), Cadmus set those savings components—respectively, $kWh_{sav\ HW}$ and $kWh_{sav\ dryer}$—equal to zero.

[21] RTF. "Residential: Appliances – Clothes Washers." ResClothesWashersSF_v4.3.xlsm. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=118

Table 49 shows the quantity of units incented, reported and evaluated savings, realization rates, and percentages of reported savings for each combination of DHW and dryer fuel at each efficiency level during 2013 and 2014.

Table 49. Clothes Washer Savings by Performance Level and DWH/Dryer Fuel

Efficiency Level	MEF Low	MEF High	DHW Fuel	Dryer Fuel	Quantity		Reported UES		Evaluated UES		Realization Rate*		Percentage of Reported Savings*	
					2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Level 1**	2.0	2.19	Electric	Electric	1	0	321	n/a	130	n/a	41%	n/a	0%	0%
			Electric	Other	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
			Other	Electric	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
			Other	Other	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
Level 2	2.2	2.59	Electric	Electric	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
			Electric	Other	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
			Other	Electric	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
			Other	Other	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
Level 3	2.6	3.19	Electric	Electric	441	55	204	203	169	169	83%	83%	69%	29%
			Electric	Other	5	1	93	93	68	68	74%	74%	0%	0%
			Other	Electric	127	22	114	114	119	119	104%	104%	11%	7%
			Other	Other	11	0	4	n/a	18	n/a	456%	n/a	0%	0%
Level 4	3.2	N/A	Electric	Electric	100	127	203	153	235	235	116%	154%	16%	51%
			Electric	Other	3	4	93	54	92	92	99%	171%	0%	1%
			Other	Electric	36	45	114	107	169	169	148%	157%	3%	13%
			Other	Other	3	11	4	15	26	26	656%	176%	0%	0%
All Levels	2.0	N/A	Electric	Electric	542	182	204	168	181	215	89%	128%	13%	3%
			Electric	Other	8	5	93	62	77	88	83%	142%	0%	0%
			Other	Electric	163	67	114	109	130	152	114%	139%	2%	1%
			Other	Other	14	11	4	15	20	26	499%	176%	0%	0%
Weighted Average* **					**727**	**265**	**178**	**145**	**165**	**189**	**93%**	**130%**	**100%**	**100%**

*Realization rates may not calculate exactly due to rounding of evaluated UES values. Percentage of reported savings may not add to 100% due to rounding.

**One level 1 clothes washer application was approved in late 2012 and fell into the 2013–2014 program accounting period. In the 2013–2014 program period, clothes washers at level 1 (MEF 2.0-2.19) were not eligible.

***"Quantity" and "Percent of Report Savings" values are summations, not average values.

As shown in Table 49, a clothes washer, paired with a non-electric dryer and a non-electric water heater, offers lower savings than a unit paired with an electric dryer and/or water heater. In 2013 and 2014, the tracking database indicated that units combining natural gas dryers and water heaters accounted for 3% of all incented units. Despite low savings for units with non-electric dryers and water heaters, instituting fuel eligibility requirements could lead to logistical burdens and inaccurate self-reporting if customers understand that their eligibility depends upon an electric dryer and/or water heater.

Table 50 shows the percentage of units installed in homes with electrically heated DHW and dryers. The saturation of fuel types for DHW and dryers remained consistent between the 2011–2012 and 2013–2014 performance periods.

Table 50. Clothes Washer Percentage of Electric DHW and Dryer Fuel

Input Categories		2013–2014 Saturation of Fuel Types	2011–2012 Saturation of Fuel Types	Source
DHW Fuel	Electric	74%	76%	WA 2011–2012 and 2013–2014 Non-Lighting Tracking Databases
	Other	26%	24%	
Dryer Fuel	Electric	96%	96%	
	Other	4%	4%	

Heat Pumps

Pacific Power offers incentives for several heat pump-related measures. Cadmus evaluated savings for these measures using the relevant RTF workbooks.[22] Table 51 shows measures incented by Pacific Power and the RTF workbooks used in this evaluation.

[22] Cadmus did not evaluate all heat pump measures. For measures accounting for a very small percent of total heat pump savings (less than 1.5%), the evaluation assumed a 100% realization.

Table 51. Heat Pump Measure List and Evaluation Sources

Measure	Source
Heat Pump System Conversion—Single-Family	[1]
Heat Pump System Conversion—Manufactured Homes	[2]
Heat Pump Upgrade—Single-Family	[1]
Heat Pump Upgrade—Manufactured Homes	[2]
Ductless Heat Pump—Single-Family & Multifamily*	[1]
Ductless Heat Pump—Manufactured Homes	[3]
Heat Pump—PTCS Commissioning, Controls, and Sizing	[4]
Heat Pump Best Practice	Not Evaluated

*As the RTF does not offer a workbook for multifamily installations, Cadmus used the single-family savings value.

[1] RTF. "Residential: Heating/Cooling – Air Source Heat Pump Conversions SF." ResSFExisitngHVAC_v3.xlsx. May 12, 2015. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=131

[2] RTF. "Residential: Heating/Cooling – Air Source Heat Pump Conversions MH." ResMHExisitngHVAC_v3_2.xlsx. August 28, 2015. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=129

[3] RTF. "Residential: Heating/Cooling – Ductless Heat Pumps for Zonal Heat MH." ResMHExisitngZonalDHP_v1_1.xlsx. April 21, 2015. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=215

[4] RTF. "Residential: Heating/Cooling – Commissioning, Controls, & Sizing SF." ResHeatingCoolingCommissioningControlsSizingSF_v3_2.xlsx. June 1, 2015. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=136

Whenever possible, Cadmus refined the RTF model by incorporating program or Washington-specific data. Specifically, Cadmus used Washington participant surveys to more completely define the baseline condition, estimating: 34% of homes had central air conditioning prior to installation of heat pumps; 71% of homes used electric resistance zonal systems; and 29% used electric forced air furnaces.

The RTF provides unique savings values for distinct heating and cooling zones, defined by average annual HDDs and CDDs. Cadmus determined that all incented units were located in heating zone 1 and either cooling zone 2 or 3 (Yakima County: 56% of units and Walla Walla County: 44% of units respectively). Cadmus calculated savings as the weighted average for each of these climate zones.

For heat pump upgrades, the RTF assumes the efficient heat pump has a HSPF of 9.0; however, the program requires all installed units to have a HSPF equal to or greater than 9.5. Cadmus adjusted the savings values in the RTF to account for this higher efficiency threshold.

Table 52 shows the quantity of each heat pump measure incented in 2013 and 2014, reported and evaluated savings, and realization rates.

Table 52. 2013–2014 Reported and Evaluated Heat Pump Savings

Measure	Quantity 2013	Reported Per Unit Savings 2013	Evaluated Per Unit Savings 2013	Realization Rate 2013	Quantity 2014	Reported Per Unit Savings 2014	Evaluated Per Unit Savings 2014	Realization Rate 2014
Heat Pump System Conversion*	37	10,738	6,247	58%	72	5,320	6,201	117%
Ductless Heat Pump*	29	3,697	2,724	74%	106	3,513	2,731	78%
Heat Pump Upgrade*	32	2,349	200	9%	31	650	199	31%
PTCS Commissioning, Controls, and Sizing	0	n/a	n/a	n/a	79	1,152	630	55%
Heat Pump Best Practice	26	772	772	100%	2	772	772	100%
Weighted Average**	**124**	**4,837**	**2,715**	**56%**	**290**	**2,994**	**2,736**	**91%**

Italics indicate Cadmus did not evaluate the measure.

*Includes ductless heat pumps installed in single-family, multifamily, and manufactured homes.

**Quantity values are summations, not average values.

Reported savings are based on EnergyGuage USA modeling while the evaluated savings are based on RTF workbooks. Across all evaluated measures, the 2014 reported savings values are closer to the evaluated savings than they were in 2013. The overall realization rate increased from 56% in 2013 to 91% in 2014.

The measure with the lowest realization rate is the heat pump upgrade, which is the replacement of an old heat pump with a new and more efficient unit (HSPF greater than or equal to 9.5). The average reported savings was decreased significantly from 2,349 kWh in 2013 to 650 kWh in 2014. This resulted in an increase in the realization rate from 9% to 31%. Although this remains a very low realization rate, heat pump upgrades made up only 2% of heat pump related savings in 2014.

The average reported savings for heat pump conversions was also decreased significantly from 10,738 kWh in 2013 to 5,320 kWh in 2014. This resulted in an increase in the realization rate from 58% to 117%. In both years, this measure constituted a significant portion of total heat pump savings.

Attic, Wall, and Floor Insulation

Cadmus conducted a billing analysis to assess evaluated energy savings associated with insulation measure installations.[23] The analysis determined that the savings estimate using a pooled, conditional savings analysis (CSA) regression model, which involved two groups:

- 2013–2014 insulation participants (combined attic, wall, and floor insulation) for single-family and manufactured homes.
- Nonparticipant homes, serving as the comparison group

Cadmus used program participants, a control group, billing consumption, and Washington weather data to create a final database for conducting the billing analysis. This required matching participant program data with billing data and, using zip codes, mapping daily HDDs and CDDs to respective monthly read-date periods. The process defined the billing analysis pre-period as 2012 (before measure installations occurred) and the post-period as September 2014 through August 2015.[24]

To ensure the final model used complete pre- and post-participation and nonparticipant billing data, Cadmus applied several screening mechanisms (Appendix C provides further details).

Insulation Results

Cadmus estimated average insulation savings of 1,980 kWh per participant, translating to a 96% evaluated realization rate for insulation measures. This analysis resulted in evaluated savings as it

[23] Billing analysis performed for customers installing only attic, wall, or floor insulation measures.

[24] As participants installing measures in late 2014 had less than 10 months of post-period data, Cadmus removed them from the analysis. Similarly, Cadmus removed customers participating in 2013 that had measure installation dates before November 2012 as this produced less than 10 months of pre-period data.

compared participant usage trends to a nonparticipant group, accounting for market conditions outside of the program.

With an average participant pre-usage of 20,860 kWh, savings represented a 9% reduction in total energy usage from the insulation measures installed. Table 53 presents the overall evaluated savings estimate for wall, floor, and attic insulation.

Table 53. Insulation Realization Rates

Model	Billing Analysis Participants (n)	Reported kWh Savings per Premise	Evaluated kWh Savings per Premise	Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall*	**156**	**2,055**	**1,980**	**96%**	**±19%**	**78%–114%**
Electric Heat	120	2,613	2,477	95%	±16%	79%–110%
Electric Heat (HP)	64	3,328	3,034	91%	±18%	75%–107%
Electric Heat (Non-HP)	56	1,797	1,861	104%	±30%	72%–135%

*Overall model includes electric and gas heat, and could not split out gas heat due to the small sample size.

Cadmus only used overall model results (which included electric and gas heat) to determine measure-level evaluated savings, but also to provide detailed results for the electric space heating fuel, presence of heat pumps, and homes without heat pumps. Overall, electrically heated homes achieved insulation savings of 2,477 kWh per home. Average, electrically heated, expected insulation savings were 2,613 kWh, translating to a 95% realization rate. With average, electrically heated, participant pre-usage of 22,838 kWh, savings represented an 11% reduction in energy usage from insulation measures. Participants with heat-pumps achieved savings of 3,034 kWh (13%); those without heat pumps achieved 1,861 kWh (9%).

Separate results could not be estimated for gas heated homes due to the small sample size (n=36).

Duct Sealing and Insulation

Cadmus conducted a billing analysis to assess evaluated energy savings associated with duct sealing and duct insulation measure installations,[25] determining the savings estimate from a pooled, CSA regression model, which included the following groups:

- 2013–2014 ductwork participants (combined duct sealing and duct insulation)
- Nonparticipant homes, serving as the comparison group

Cadmus used program participants, a control group, billing consumption, and Washington weather data to create a final database for conducting the billing analysis. This required matching participant program data with billing data, and, using zip codes, mapping daily HDDs and CDDs to respective monthly read-

[25] Billing analysis performed for customers installing only duct sealing and/or duct insulation measures.

date periods. The process defined the billing analysis pre-period as 2012 (before measure installations occurred) and the post-period as September 2014 through August 2015.[26]

To ensure the final model used complete pre- and post-participation and nonparticipant billing data, Cadmus applied several screening mechanisms (with details provided in Appendix C).

Duct Sealing and Insulation Results

Cadmus estimated overall duct sealing and duct insulation savings of 2,183 kWh per home. Expected average duct sealing and duct insulation savings were 2,457 kWh, translating to an 89% evaluated realization rate for duct sealing and insulation measures.

With average participant pre-usage of 18,300 kWh, savings represented a 12% reduction in total energy usage from duct sealing and duct insulation measures installed. Table 54 presents the overall savings estimate for duct sealing and duct insulation.

Table 54. Ductwork Realization Rates

Model	Billing Analysis Participant (n)	Reported kWh Savings per Premise	Evaluated kWh Savings per Premise	Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall*	**143**	**2,457**	**2,183**	**89%**	**±13%**	**77%–101%**
Electric Heat	138	2,538	2,241	88%	±13%	77%–100%
Electric Heat (HP)	42	4,737	4,039	85%	±13%	74%–96%
Electric Heat (Non-HP)	96	1,576	1,456	92%	±23%	71%–114%

*Overall model includes electric and gas heat; gas heat could not be split out due to the small sample size.

Though Cadmus only used overall Washington model results, results included electric heat, heat pump, and non-heat pump participants.

Overall, electrically heated homes achieved duct sealing and duct insulation savings of 2,241 kWh per home. Expected average, electrically heated, duct sealing and duct insulation savings were 2,538 kWh, translating to an 88% evaluated realization rate. With average, electrically heated, participant pre-usage of 18,579 kWh, savings represented a 12% reduction in energy usage from duct sealing and duct insulation measures. Electrically heated participants' homes with heat-pumps achieved savings of 4,039 kWh (18%); those without heat pumps achieved 1,456 kWh (9%).

[26] Because participants who installed measures in late 2014 had less than 10 months of post-period data, Cadmus removed them from the analysis. Similarly, Cadmus removed customers participating in 2013 with measure installation dates before November 2012 as this produced less than 10 months of pre-period data.

Cadmus could not obtain a separate savings estimate for gas heated homes due to small sample sizes (n=5).

Lighting Leakage Study

Cadmus conducted intercept surveys at stores in Utah, Idaho, and Washington, designing the surveys to determine how many light bulbs purchased within PacifiCorp's territory had been installed outside of its territory—an effect generally called leakage.[27] Cadmus also conducted intercept surveys at stores outside of PacifiCorp's territory to determine the percentage of light bulbs purchased and installed within PacifiCorp's territory.

The leakage study sought to test scores from PacifiCorp's RSAT, developed to determine the best stores for cost-effectively offering discounted energy-efficient light bulbs. The Retailer Allocation Review in Appendix G describes the RSAT. This section also discusses the leakage study's methodology and results.

Overall, Cadmus found the RSAT predicted well across the three states. In Washington, RSAT scores did not fall within Cadmus' estimated range of leakage scores (calculated from intercept survey responses). Cadmus found lighting leakage rates in the territory of 8.1% with a confidence level of 90% and precision of ±3.3%. Over the five participating stores, the RSAT predicted an average leakage rate of 0.7%, which suggests an underestimate of 7.4% compared to the survey results. However, it is important to note that the available population of stores in the Washington territory was very limited, and there was a lack of any available stores within the territory with a low RSAT score for comparison.

Methodology

Cadmus targeted 20 Washington stores for intercept surveys—15 in Pacific Power's service territory and five outside of its territory. Among the 15 stores within the service territory, Cadmus established targets of eight stores with RSAT scores greater than or equal to 96% and seven stores with RSAT scores less than 96%. Cadmus' roster of contacts consisted of 21 stores in Pacific Power's territory and 36 stores outside its territory. As Cadmus experienced difficulty in gaining cooperation (as discussed later in this report), it amended the target to 15 stores in Idaho and Washington (combined).

The program administrator provided Cadmus with store rosters for each state; these included retailer addresses, phone numbers, RSAT scores, and each store's location in Pacific Power's service territory. Cadmus also created rosters of stores outside of the service territory in each state. Cadmus used Pacific Power's and Rocky Mountain Power's service area maps to identify areas adjacent to the service territories.[28] Cadmus then used Google Maps to locate all relevant retailers in the specified areas, supplemented by phone calls to verify stores were outside of the service territory.

---

[27] This study did not review Internet lighting purchases, only those made at brick and mortar stores.

[28] Pacific Power. Map of service territories and facilities. Accessed May 2016: https://www.rockymountainpower.net/content/dam/pacificorp/doc/About_Us/Company_Overview/PC-10k-ServiceAreaMap-2015-v2.pdf

To set up store visits, CLEAResult contacted store managers to inform them of the study. A Cadmus representative then called a targeted store and asked for the contact provided by CLEAResult. If that contact proved unavailable, Cadmus asked for a manager or another employee in charge of daily operations. The representative followed a script that explained the study's purpose and Cadmus' intentions for conducting intercept surveys at the store. By calling ahead, Cadmus sought to ensure that store visits by Cadmus field technicians would be welcomed as well as authorized. From late October to early December 2015, the Cadmus representative attempted to contact each store's manager or owner until he or she could confirm if the store manager would participate. Consequently, Cadmus contacted most stores more than once. For each store granting authorization, Cadmus scheduled two-day visits—typically a week or more in advance—and Cadmus field technicians followed up with each store in advance of the visit to remind the store manager (or the employee in charge of daily operations) of the appointments.

Cadmus achieved more success in scheduling visits with independent retailers and independently owned franchises than with big-box home and hardware stores. Managers of large retail chains (e.g., Home Depot, Lowe's, Bed Bath & Beyond, Walmart, Target, Albertson's, Dollar Tree) frequently redirected Cadmus to their corporate offices, which most commonly resulted in rejections or nonresponses to contact attempts. The Leakage Survey Results by Store Size section of this report explores this further.

The difficulty in achieving the cooperation of big-box stores (i.e., which drew extensive foot traffic), limited the possible number of surveys Cadmus could complete. Cadmus also acknowledged that the rate at which stores agreed to participate—about one in eight—would likely prevent them from achieving the original targets.

Table 55 lists stores, states and territories, numbers and percentages of contacts, and numbers and percentages of stores visited.

Table 55. Store Contact Summary

State	Stores on Roster	Stores Contacted*	Stores Visited	
			Rocky Mountain Power/Pacific Power	Non- Rocky Mountain Power/Pacific Power
Washington	57 (21 in, 36 out)	57 (100%)	5/21 (24%)	5/36 (14%)
Idaho	50 (19 in, 31 out)	50 (100%)	5/19 (26%)	1/31 (3%)
Utah	345 (295 in, 50 out)	244 (71%)	19/194 (10%)	8/50 (16%)
Total	**452 (335 in, 117 out)**	**351 (78%)**	**29/234 (12%)**	**14/117 (12%)**

*Cadmus did not further contact stores by phone if corporate offices rejected solicitation in all stores.

Using all valid survey responses, Cadmus calculated leakage rates for each store and state (with a valid survey for leakage calculations defined as one in which respondents identified the utility serving the location where their bulbs would be installed). Interviewers asked respondents who did not wish to complete the entire survey if they would at least identify the utility.

Thus, some respondents answered the key question determining leakage, while not providing data about bulbs they purchased. For respondents with a determined leakage status but no light bulb counts recorded, Cadmus used the mean number of light bulbs for all survey respondents (i.e., five light bulbs). The following equation calculated leakage scores:

$$Leakage\ Rate = \frac{\#\ Bulbs\ Installed\ Outside\ Utility\ Territory}{Total\ Bulbs\ Purchased\ within\ Utility\ Territory}$$

Summary of Stores Visited in Washington

Cadmus visited 10 stores in southern Washington, and field technicians completed 175 surveys with customers purchasing light bulbs, as shown in Table 56. [29]

Table 56. Washington Summary

Territory	Stores Visited	Surveys Administered
Pacific Power	5	112 completed, 3 refused
Other Utility Territory	5*	63 completed, 0 refused
Total	**10**	**175 completed, 3 refused**

*Includes one store in which Cadmus gained access but did not administer surveys.

Table 57 shows the distribution of RSAT scores among the 21 stores within Pacific Power's Washington territory. Seventeen of the 21 Pacific Power stores in Washington that Cadmus contacted had RSAT scores of 99% or higher. Ultimately, Cadmus visited five Pacific Power stores, all with RSAT scores of 98.6% or higher.

Table 57. Distribution of RSAT Scores for Pacific Power Washington Stores

RSAT Score Range	Number of Stores	Percentage
0% up to 99%	4	19%
99% up to 100%	5	24%
100%	12	57%
Total	**21**	**100%**

Leakage Survey Results

Table 58 shows lighting leakage survey results for the five participating stores and the four stores outside of Pacific Power territory.[30]

[29] Leakage calculations used 174 valid surveys from Washington, but the evaluation completed 175 surveys. This difference resulted from some respondents identifying their utility without completing the survey (valid for leakage calculations, but not considered a completed survey), and some respondents completed the survey without identifying their utility (completed survey, but not considered valid for leakage calculations).

[30] The limited population of stores prevents definitive comparison to the RSAT tool, because no participating stores with low RSAT scores were surveyed in Washington.

Table 58. Washington Leakage Results Summary

Stores	Valid Surveys for Leakage Calculation	Total Bulbs Purchased by Respondents	Intercept Leakage	Precision at 90% Confidence*	RSAT Based Leakage	Difference Between Intercept and RSAT**
Total for Participating Pacific Power Stores	**114**	**558**	**8.1%**	**±3.3%**	**Average 0.7%**	**-7.4 points**
Participating store #1	17	159	0.0%	-	0%	0 points
Participating store #2	57	235	2.6%	±1.9%	0.9%	-1.7 points
Participating store #3	10	24	37.5%	±19.8%	1.4%	-36.1 points
Participating store #4	25	112	10.7%	±6.6%	0%	-10.7 points
Participating store #5	5	28	64.3%	±33.9%	1.0%	-63.3 points
Total for Stores Not in Pacific Power Territory	**60**	**217**	**0.9%**	**±0.8%**	**N/A**	**N/A**
Non-Pacific Power store #1	6	11	0.0%	-	N/A	N/A
Non-Pacific Power store #2	16	73	2.7%	±2.4%	N/A	N/A
Non-Pacific Power store #3	26	82	0.0%	-	N/A	N/A
Non-Pacific Power store #4	12	51	0.0%	-	N/A	N/A

*Precision cannot be calculated for stores with 0% or 100% leakage due to a zero variance.

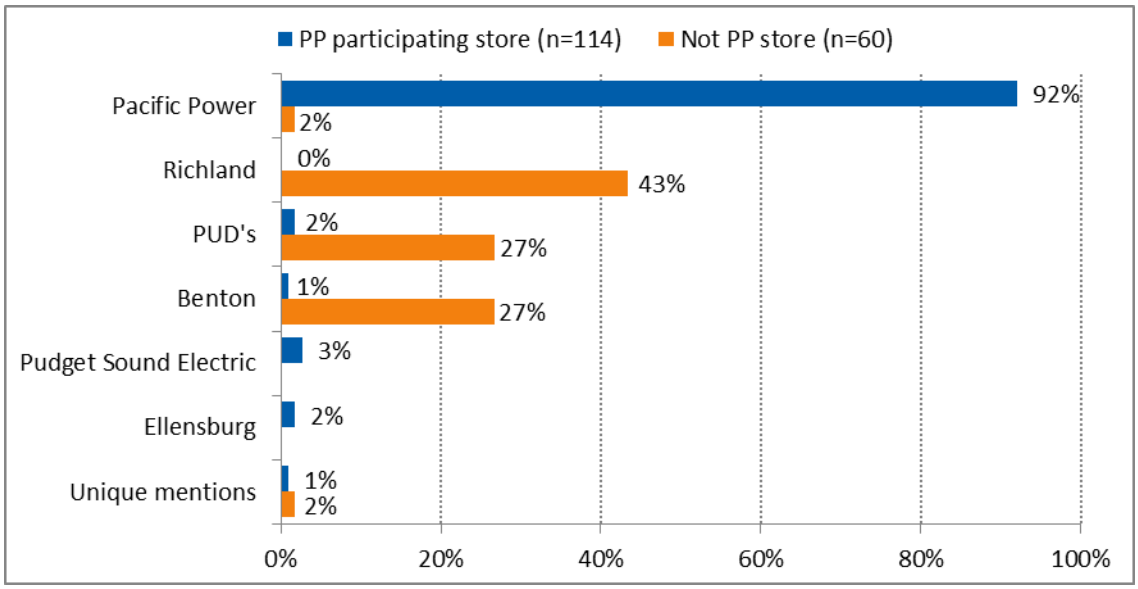
**The calculation used: (RSAT Based Leakage) - (Intercept Leakage). A negative difference between RSAT-based leakage and intercept leakage means the RSAT underestimates leakage.

One of the five participating stores surveyed had an RSAT score of 100% and an equivalent leakage rate of 0%, while another store also had an RSAT score of 100%, but had a leakage rate of 10.7%. The other three participating stores had RSAT scores between 98.6% and 99.1%, and leakage rates ranging from 2.6% to 64.3%; the two stores with the highest leakage rates also sold the fewest light bulbs (and measurements from these stores had the lowest precision). Combining results for all stores produced an overall leakage rate of 8.1% of bulbs sold in participating stores.

Cadmus surveyed four stores outside of Pacific Power's territory in Washington, where 60 respondents purchased a total of 217 light bulbs. These stores exhibited a 0% leakage rate, with the fourth store reporting a 2.7% leakage rate. Overall, surveyed stores outside of Pacific Power's territory reported a 0.9% leakage rate.

The distribution of utilities served by store customers provides a key component in computing leakage rates. Figure 7 shows that 92% of surveyed customers intercepted in participating Washington stores intended to install bulbs they purchased within Pacific Power's territory; only 2% of those surveyed outside of Pacific Power territory intended to install their bulbs inside of Pacific Power's territory.

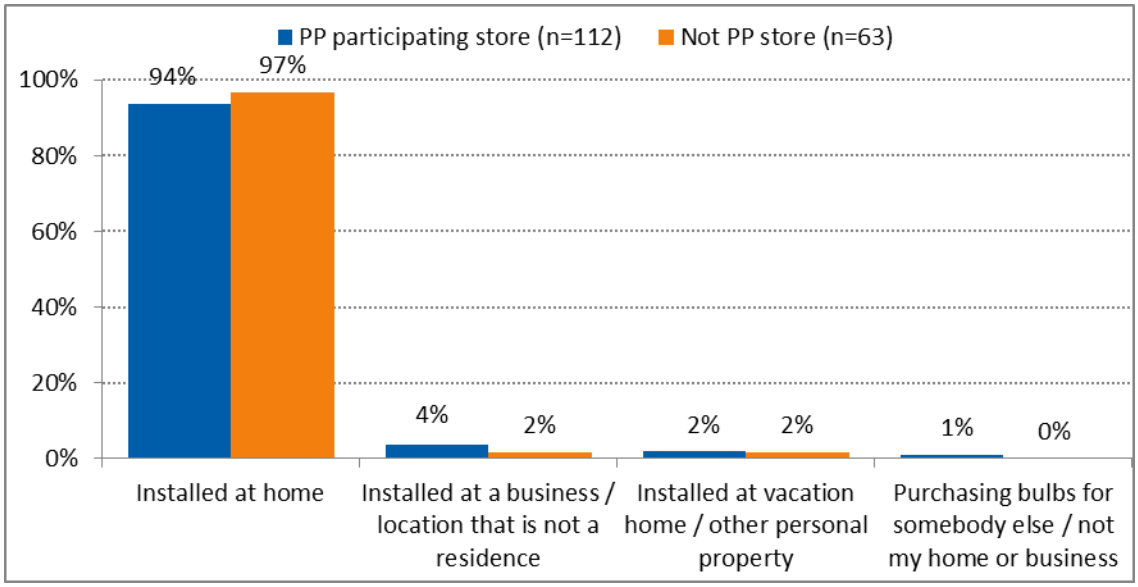
Figure 7. Respondent's Electric Utility by Store Type in Washington



Installation Location

Survey respondents confirmed where they intended to install the bulbs purchased. Figure 8 indicates the overwhelming majority of respondents purchased light bulbs for their homes, while business locations accounted for 4% of purchases in participating stores. Two percent of Washington respondents reported purchasing light bulbs for vacation homes, and only 1% made purchases for other people.

Figure 8. Installation Location for Bulbs Purchased in Washington

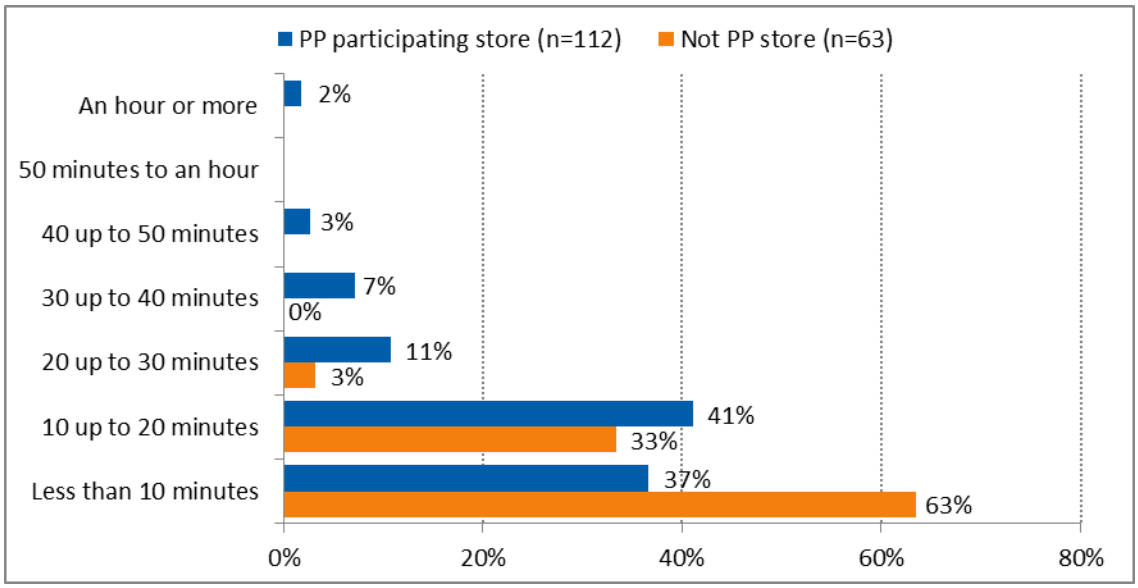


Distance Traveled

Because travel distances serve as a key component in calculating RSAT scores, surveys asked respondents to indicate how far away their intended installation location was from the store where they purchased their bulbs.

Figure 9 shows more than three-quarters of respondents in participating stores (78%) and almost everyone surveyed in stores outside of the territory (97%)[31] intended to install their light bulbs within a 20-minute drive of the store where they purchased them.

Figure 9. Distance from Store to Installation Location in Washington



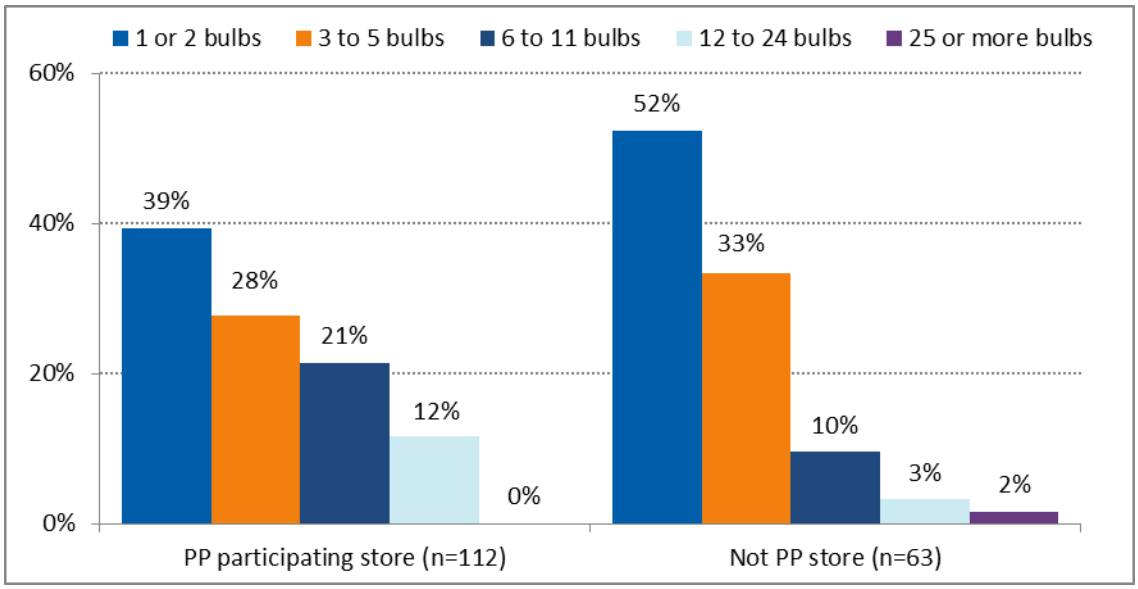
Purchase Quantities

Figure 10 shows the distribution of total bulbs purchased by survey respondents. Customers in participating stores tended to make larger purchases, with 33% buying at least six bulbs, a mean of 4.9 purchased, and a median of four bulbs purchased. At stores outside of Pacific Power's territory, only 14%[32] of customers purchased at least six bulbs, with a mean number of 3.6 purchased, and a median of two bulbs purchased.

[31] The 97% score is higher than Figure 9's 96% (33% + 63%) due to rounding.

[32] The score of 14% is lower than Figure 10's 15% (10% + 3% +2%) due to rounding.

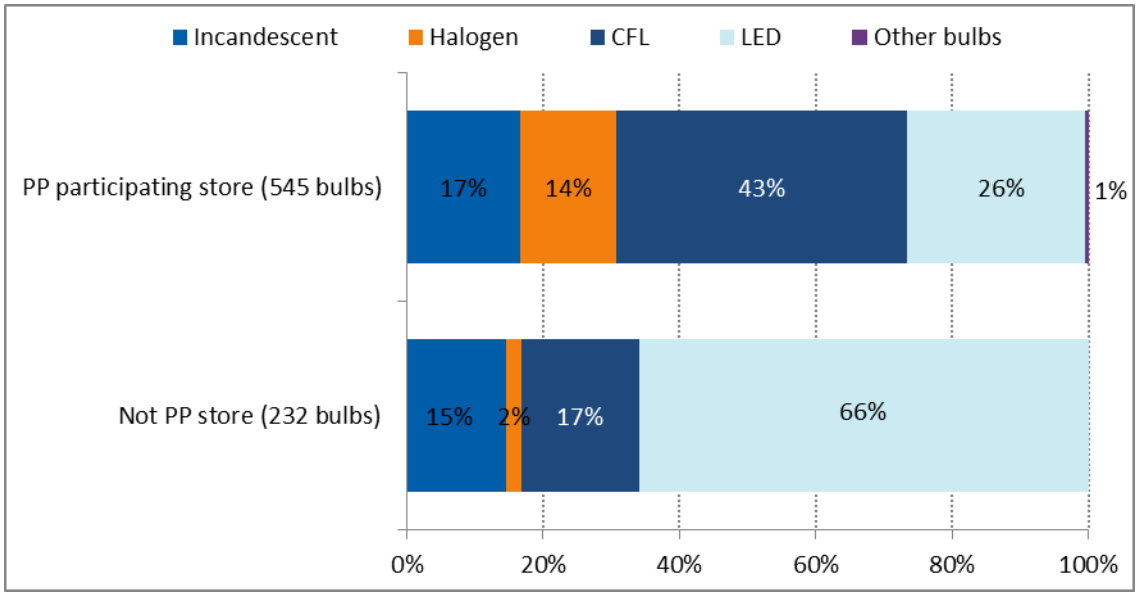
Figure 10. Total Bulbs Purchased in Washington



Bulb Type

Regarding light bulbs purchased, participating stores most commonly sold CFLs (43% of bulbs purchased), followed by LEDs (26%), with less-efficient incandescents (17%) and halogens (14%) combining for a little less than one-third of bulbs sold. In nonparticipating stores, customers mostly purchased LEDs (66%), with only one out of six bulbs purchased not efficient (i.e., 15% incandescent and 2% halogen). Figure 11 shows the percentage of bulb types purchased by respondents intercepted in Washington stores.

Figure 11. Types of Bulbs Being Purchased in Washington: Distribution of Bulbs



Purchasing Decisions

Table 59 lists respondents' reasons for purchasing energy efficient and standard light bulbs. Respondents most often cited energy efficiency (70% for participating stores, 65% for nonparticipating stores), while fewer than 25% of respondents bought standard bulbs for this reason. Respondents purchasing efficient bulbs also more likely cited the environment (16% to 22%, compared to 0% of respondents buying standard bulbs). Respondents purchasing standard bulbs more likely said they purchased the kind of bulb they always bought or bought bulbs as they needed them right away—the two most frequently mentioned reasons for customers buying standard bulbs in participating stores.

Table 59. Reasons for Purchasing Bulbs in Washington

Reason	Participating Store		Nonparticipating Store	
	Purchasing Energy Efficient Bulbs (n=70)*	Purchasing Standard Bulbs (n=29)*	Purchasing Energy Efficient Bulbs (n=49)*	Purchasing Standard Bulbs (n=8)*
Energy efficiency/saving energy	70%**	14%	65%	25%
Low bulb price/reduced price/on sale	37%	17%	29%	50%
Bulb color/light quality	23%	17%	27%	0%
Environment/"green" reasons	16%	0%	22%	0%
Bulbs I always buy/I am used to	4%	24%	2%	38%
Needed bulbs right away	4%	31%	0%	13%
Hard-to-find bulbs for unique fixture	4%	7%	8%	0%
Information in the store/store display or advertising	3%	3%	6%	0%
Someone made a recommendation	7%	0%	0%	0%
Appearance/looks good in my fixtures	0%	7%	2%	13%
Stocking up/spare bulbs	0%	7%	0%	13%
Advertising	0%	0%	4%	0%

*Indicates number of respondents answering the question.

**Respondents were allowed to provide multiple reasons; therefore, the results do not add up to 100%.

Leakage Survey Results for Idaho, Washington, and Utah Combined

Table 60 shows leakage rates for all three PacifiCorp states, separately and combined. Overall, stores surveyed in PacifiCorp's territory exhibited 6.1% leakage, with leakage at 34.3% in stores surveyed outside of the territory. The only nonparticipating stores surveyed inside PacifiCorp's territory were in Utah; so no results were combined across states.

Table 60. Leakage Results Summary for All States

States	Valid Surveys for Leakage Calculation	Total Bulbs Purchased by Respondents	Intercept Leakage	Precision at 90% Confidence	RSAT Based Leakage	Difference Between Intercept and RSAT*
Total for Participating PacifiCorp Stores**	**423**	**2,043**	**6.1%**	**±4.2%**	**0.8%*** **	**-5.3 points**
Washington	114	558	8.1%	±3.3%	0.7%	-7.4 points
Idaho	36	157	2.5%	±2.0%	0%	-2.5 points
Utah	273	1,328	6.2%	±5.3%	1.1%	-5.1 points
Total for Nonparticipating Stores in PacifiCorp Territory	**23**	**252**	**29.0%**	**±12.7%**	**20.4%**	**-8.6 points**
Utah	23	252	29.0%	±12.7%	20.4%	-8.6 points
Total for Stores Not in PacifiCorp Territory	**155**	**708**	**34.3%**	**±6.0%**	**Not applicable**	**Not applicable**
Washington	60	217	0.9%	±0.8%	N/A	N/A
Idaho	6	13	23.1%	±16.6%	N/A	N/A
Utah	89	478	49.8%	±8.6%	N/A	N/A

*Calculation used: (RSAT Based Leakage) - (Intercept Leakage). A negative difference between RSAT Based Leakage and Intercept Leakage meant the RSAT underestimated leakage.

**For combined participating stores in Utah and the overall total across states, intercept leakage and precision were weighted by sample stratification, resulting in two strata: stores with RSAT scores greater than 96%; and stores with RSAT scores of 96% or less. Survey samples for other groups of stores were not stratified, and intercept leakage was not weighted.

***Because of the variables input into the RSAT score (described in Appendix G), averaging RSAT-based leakage scores did not provide a statistically significant result. This simple average of RSAT-based leakage scores did not include sampling weights representing retail customer drive times, retailer locations, retailer trade areas, customer purchasing power, or retail sales allocations. Therefore, the average was a qualitative estimate. The variance, however, of RSAT scores for the sampled stores was low; so a simple average likely provided a reasonable approximation of the weighted RSAT-based leakage.

In aggregate, RSAT scores slightly underestimated leakage observed in the survey results, with a 99.2% average RSAT score for all surveyed participating scores, implying 0.8% leakage. Survey results calculated a 6.1% leakage rate for these stores—a difference of 5.3 points on the RSAT scale. Nonparticipating Utah stores produced an average RSAT score of 79.6%, implying 20.4% leakage, while survey results produced a 29% leakage rate—a difference of 8.6 points on the RSAT scale.

Leakage Survey Results by Store Size

Cadmus categorized stores as "big box stores" or "other stores,"[33] enabling leakage result comparisons between the two types. Only one big box store operates in PacifiCorp's Idaho territory (which Cadmus was not allowed to visit); all big box stores in Washington were participating stores within PacifiCorp's

[33] "Big box stores" are large retail chains (e.g., Home Depot, Lowe's, Walmart, Target, Sutherland's, Big Lots).

territory. All Utah big box stores also were participating stores in PacifiCorp's territory, but Cadmus surveyed both store types among those outside PacifiCorp's territory and among participating stores within the territory. Overall, Cadmus interviewed 57% (n=601) of survey respondents in big box stores, with these surveys accounting for 56% (n=3,003) of the total bulbs purchased by all respondents. Table 61 shows big box stores usually exhibited leakage rates slightly higher than other stores, though comparisons within states were not statistically significant.

Table 61. Leakage Results by Size of Store

States	Big Box Stores*			Other Stores**		
	Valid Surveys for Leakage Calculation	Total Bulbs Purchased	Intercept Leakage	Valid Surveys for Leakage Calculation	Total Bulbs Purchased	Intercept Leakage
Total for Participating PacifiCorp Stores* **	**291**	**1,447**	**7.7%**	**132**	**596**	**3.2%**
Washington	72	287	11.5%	42	271	4.4%
Idaho	0	0	N/A	36	157	2.5%
Utah	219	1,160	6.6%	54	168	3.9%
Total for Nonparticipating Stores in PacifiCorp Territory	**0**	**0**	N/A	**23**	**252**	**29.0%**
Utah	0	0	N/A	23	252	29.0%
Total for Stores Not in PacifiCorp Territory	**51**	**247**	**52.2%**	**104**	**461**	**24.7%**
Washington	0	0	N/A	60	217	0.9%
Idaho	0	0	N/A	6	13	23.1%
Utah	51	247	52.2%	38	231	47.2%

*12 big box stores total: 9 in Utah, 3 in Washington, 0 in Idaho.

**27 other stores total: 15 in Utah, 6 in Washington, 6 in Idaho.

***For combined participating stores in Utah and the overall total across states, intercept leakage and precision were weighted by sample stratification. The two strata were stores with RSAT scores greater than 96% and stores with RSAT scores of 96% or less. Survey samples for other groups of stores were not stratified, and intercept leakage was not weighted.

Process Evaluation

This section describes the detailed findings of Cadmus' process evaluation of the HES program. These findings are based on analysis of data collected through program staff interviews, the general population survey, two participant surveys, and secondary research. In conducting the evaluation, Cadmus focused on assessing the following:

- Effectiveness of the delivery structure, implementation strategy, and communication channels
- Marketing approaches and materials review
- Customer satisfaction and drivers for participation

Cadmus focused the research activities on the key research topics identified during the evaluation kick-off and on topics of interest identified by program stakeholders. Table 62 lists Cadmus' primary research questions.

Table 62. Research Areas

Research Areas	Researchable Questions and Topics
Program status	How did the program perform in 2013–2014, and what opportunities and challenges do program staff foresee for future program years?
Awareness	Are customers aware of the Pacific Power programs? If so, how did they learn about the programs?
Satisfaction	How satisfied are customers with their CFLs/LEDs, ***watt***smart Starter Kits, or incented non-lighting measures? Why?
Motivations	What actions have customers taken to save energy, and what motivated them to purchase a rebated CFL/LED, ***watt***smart Starter Kit, or non-lighting measure?
Demographics	How do awareness/activities/behaviors vary by demographic characteristics?

Methodology

Cadmus conducted the following process evaluation research:

- Program and marketing materials review
- Utility and administrator staff interviews
- General population survey
- Non-lighting participant survey
- ***watt***smart Starter Kit participant survey

Program Materials Review

The program materials review concentrated on critical program documents, including past evaluation reports, the program logic model, and program marketing and communications materials developed to promote HES program participation and to educate target audiences in Washington about program

offerings. Cadmus also discussed marketing effectiveness with program stakeholders and considered their insights when analyzing participant survey findings and industry best practices:

- In assessing program progress and analyzing trends across program years, Cadmus considered the findings and conclusions from the *Pacific Power 2011–2012 Washington Residential Home Energy Savings Evaluation* and the *Pacific Power 2009–2010 Washington Residential Home Energy Savings Evaluation*.
- Cadmus reviewed the HES program logic model and updated to reflect the 2013–2014 program processes (see Appendix I).
- Cadmus reviewed Pacific Power's marketing plans and online materials, and compared its messages to the challenges and motivations described by customers; Cadmus also sought to assess whether the program's marketing had been appropriately targeted, and reviewed the HES program marketing strategy, executional plans, and online (website) and social media elements.

Utility and Administrator Staff Interviews

Cadmus developed stakeholder interview guides and collected information about key topics from program management staff. The evaluation involved two interviews: one with program staff at PacifiCorp, and one with program staff at CLEAResult (the program administrator), which oversees the HES program in five PacifiCorp service territory states. The interviews covered the following topics:

- Program status and delivery processes
- Program design and implementation changes
- Marketing and outreach tactics
- Barriers and areas for improvement

Cadmus conducted the interviews by telephone and contacted the interviewees via e-mail with follow-up questions or clarification requests.

Participant Surveys

Cadmus conducted telephone surveys with non-lighting and ***watt***smart Starter Kit participating customers, designing the survey instruments to collect data about the following process topics:

- ***Program process***. Details to inform the following performance indicators:
  - Effectiveness of the program processes
  - Program awareness
  - Participation motivations and barriers
  - Customer satisfaction
  - Program strengths and/or areas for improvement
- ***Customer information***. Demographic information and household statistics.

General Population Survey

Cadmus conducted a telephone survey with customers regarding lighting purchases, designing the survey instrument to collect data regarding the following process topics:

- ***Program process***. Details to inform the following performance indicators:
  - Upstream lighting rebate awareness
  - Lighting purchase decisions and barriers to purchasing energy-efficient lighting
  - Customer satisfaction with products purchased
- ***Customer information***. Demographic information and household statistics

Program Implementation and Delivery

Drawing on stakeholder interviews and participant survey data, this section discusses HES program implementation and delivery.

Program Overview

Through the HES program, Pacific Power provided cash incentives to residential customers, and in some cases contractors, toward the purchase of energy-efficient products, home improvements, and heating and cooling equipment and services. Through the program, customers could install multiple measures to lower their utility bills. Pacific Power encouraged all of its residential customers, including non-homeowners and owners of multifamily buildings and manufactured homes, to participate in the program.

During the evaluation period, Pacific Power offered energy efficiency measures in three primary categories, based on the program's three delivery channels: lighting, non-lighting, and ***watt***smart Starter Kits. (Note that only internal program staff referred to these three categories; the company did not market the program this way to customers.) The lighting component used an upstream incentive mechanism that may not have been apparent to customers, whereas the non-lighting component operated using a mail-in or online (for select measures) incentive approach, which required participants' awareness and action. All non-lighting component incentives were prescriptive.

The third delivery channel consisted of ***watt***smart Starter Kits, added in 2014 to reach Washington's rural population. As rural customers can be a considerable distance from stores or qualified retailers that meet program requirements, the program designed the kits to be ordered through Pacific Power's website and delivered by mail. Pacific Power created eight kit types that contained a mix of measures, depending on the participant's lighting preferences (CFLs or LEDs) and whether the participant had an electric water heater.

The base package—including four standard CFLs—was delivered at no cost to customers. If customers reported having an electric water heater, they qualified for water-savings measures such (e.g., bath and kitchen faucet aerators and a high-efficiency showerhead). The program began offering a kit upgrade option from CFLs to LEDs (for $19.99) as staff observed that customizable options could improve

installation rates, and LEDs tended to have much higher installation rates than CFLs (as confirmed by the impact analysis).

Tariff Changes

Each year, if program changes occur, Pacific Power files program modifications (i.e., tariff changes) with the Washington Utilities and Public Transportation Commission. Pacific Power filed several program changes during the evaluation period, such as adding air sealing and heat pumps, and realigning incentives for comprehensive whole-home upgrades. Most significantly, Pacific Power added ***watt***smart Starter Kits in 2014, and changed the delivery method for CFL and LED fixtures and room air conditioners to a hybrid model; so downstream and upstream rebates became available through different channels.

Delivery Structure and Processes

In 2014, adding the ***watt***smart Starter Kit offering presented a significant change in the HES program's delivery structure. Program staff described challenges in reaching rural markets with existing lighting and home energy upgrade rebates, particularly in Washington where rural customers reside considerable distances from stores or qualified retailers. The ***watt***smart Starter Kit offered a method to reach these rural markets.

Other than the addition of the ***watt***smart Starter Kits, program staff reported that the HES program saw minimal changes to its customer delivery method since 2009. Program staff coordinated with participating distributors, retailers, and trade allies to deliver the program's different components. For most program-qualifying measures, customers received cash-back incentives. For qualifying light bulbs, the program paid incentives directly to manufacturers that provided high-efficiency bulbs to retailers at a discount. Retailers, sales associates, and trade allies supported the program by encouraging customers to purchase higher-efficiency equipment that qualified for an incentive.

Data Tracking

Program Data

CLEAResult, the program administrator, reported that the data tracking systems met (and in some cases exceeded) the company's needs, allowing meaningful use of data. The program administrator reported entering program data into the program's Key What You See (KWYS) system, a Microsoft Access-based tool, then transferring some KWYS data into a Salesforce database. Weekly aggregation of participant databases allowed the program administrator to monitor incentives paid and goals achieved, and each month the program administrator provided Pacific Power with a report that enabled program staff to evaluate any program activity changes and adjust program delivery, if necessary.

Although Pacific Power and the program administrator reported that the upstream lighting data tracking effectively met their needs and expectations, Cadmus experienced some challenges when using data for evaluation purposes. Specifically, significant issues emerged when Cadmus tried to match the lighting tracking data (in a system called Sprocket) to price scheduling data for evaluating the impacts of bulb prices and incentives on lighting products sold.

Emerging data issues included the following:

- Inconsistent bulb types for each SKU
- Inconsistent use of SKUs or model numbers to track products
- Inconsistent use of "posted," "reconciled," and "posted-reconciled" tags to track the final quantities of bulbs sold through the program
- Very limited tracking of product merchandising and promotional events

Most of the issues generated from 2013 tracking data had been resolved in 2014 data, except for product merchandising and promotional events tracking.

Rebate Data

In 2013, the program administrator began transferring rebate data entry to a new third-party vendor, National Business Systems (NBS), as the program administrator reported dissatisfaction with the previous vendor. The transition began with the program administrator providing NBS access to one measure at a time, until NBS proved it could operate under all program rules. The program administrator reported the transition as a success.

The program processed upstream lighting invoices using Sprocket: the program administrator received invoices from the manufacturer, verified the information's accuracy, and entered data into Sprocket.

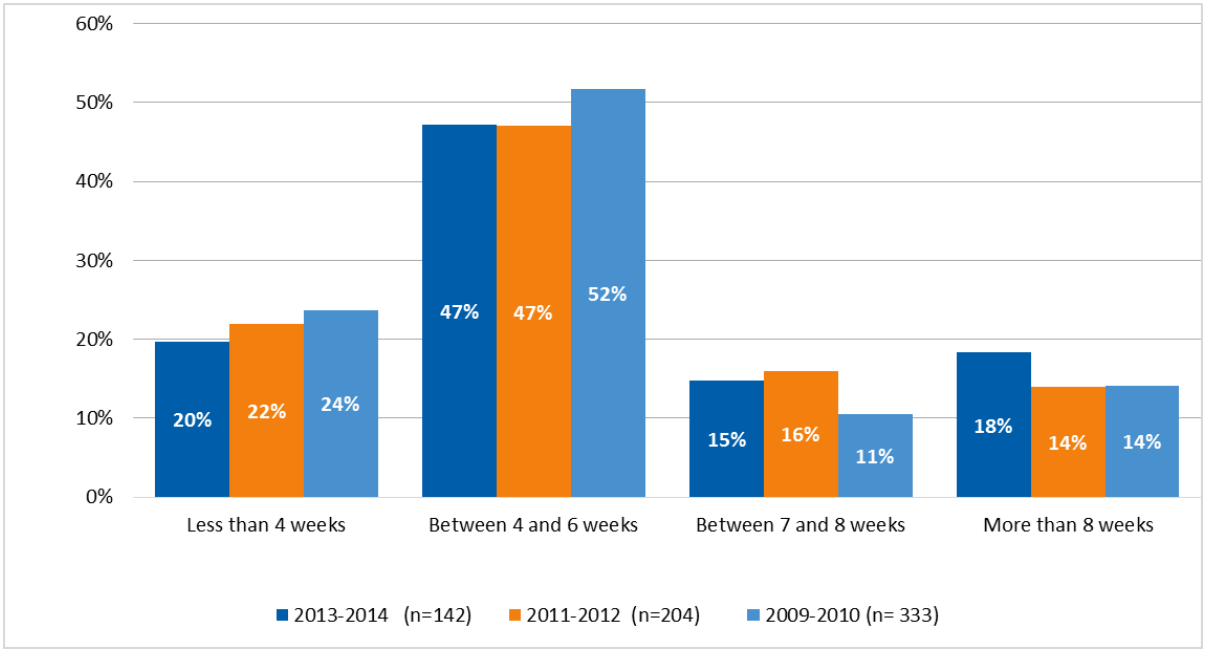
Application Processing

Application processing largely remained unchanged during the 2013–2014 program years, with online applications covering most qualifying products. As discussed above, the program did contract with NBS to process data, measure by measure.

The program administrator reported that, in 2013, that program sought to revise the customer application to make it more efficient for customers and trade allies to complete. For example, in 2013, the application included every measure type; in 2014, the program administrator developed an application for each measure type. The program administrator reported that this change resulted in fewer errors and less missing information on applications.

As shown in Figure 12, the time between non-lighting customer's application submission and incentive receipt closely matched the time reported in 2011-2012. Twenty percent of non-lighting customers reported receiving incentives in less than four weeks from 2013–2014, and 47% reported it took four to six weeks to receive their incentive. Fifteen percent said it took seven to eight weeks to receive their incentive and 18% of respondents said it took more than eight weeks to receive their incentive; while an increase from 2009-2010, these changes are not significant. Notably, this question gauged participants' perceptions of the time required to receive the rebate, and their responses probably included the time required to resubmit applications with information missing or incorrect.

Figure 12. Time Between Non-lighting Application Submission and Incentive Receipt (2009–2014)



Source: Pacific Power Washington HES Residential Non-Lighting Survey (Appendix A). Don't know, refused, and have not received the incentive yet responses removed.

Regarding the time required to receive the incentive, 87% of non-lighting customers expressed satisfaction. Among 13% of customers expressing dissatisfaction (19 total customers), five reported they had to resubmit the incentive application.

Overall, 63% of non-lighting customers expressed high satisfaction rates (i.e., very satisfied) with the application process, and 33% said they were somewhat satisfied. The 4% who said they were not very satisfied offered the following reasons:

- "I had applied for the rebate for my duplexes with separate applications but only one rebate was given for one of the homes."
- "It took too long to pay us."
- "It took so long to apply because of…not being able to answer some of the questions…and resending it in. Plus the amount of time it took to receive the incentive."
- "It shouldn't have been that complicated [or] time consuming."

Retailers and Trade Allies

The program administrator continued using the tiered account management system, developed in earlier program years, to streamline the process of working with trade allies and retailers. For internal tracking purposes, the program administrator divided trade allies into two tiers, and estimated Tier 1 trade allies accounted for 80% of program savings, conducting the most work with customers and having more projects per year than Tier 2 trade allies.

The program administrator regularly (i.e., at least three times per year) offered training to distributors, retailers, and their associates, and found regular training necessary for the following reasons:

- Addressing rapid turnover in the industry
- Keeping trade allies abreast of program changes
- Working toward the program administrator's goal of educating trade allies to reduce the number of applications containing errors

For example, the program administrator contacted retailer account managers at the beginning of the heating season to discuss products in demand at that time. For the upstream lighting component, the program administrator focused on training The Home Depot and Lowe's to educate each sales associate about the program and to provide information on how to sell energy-efficient products. According to the program administrator, training increased retailer participation between 2013 and 2014, especially during the summer cooling season.

Marketing

Approach

According to the 2014 Marketing Plan, the program shifted resources toward targeted marketing and away from mass marketing. In doing so, the program administrator used bill inserts, social media, sell sheets, and website features that employed tailored messages.

Five key strategies emerged for 2014:

- Focus on priority measures during key seasonal selling windows (e.g., heating season, cooling season, and lighting season)
- Shift the marketing mix to include more cost-effective, flexible, and measureable delivery
- Simplify and enhance the customer experience to increase participation
- Streamline basic program processes, take advantage of opportunities, and track results to reduce marketing costs
- Strategically support unplanned opportunities

Effectiveness

The program administrator tracked marketing effectiveness on a limited basis, with its marketing team tracking click-through statistics for the program website and, at the end of the evaluation period, tracking time spent on the website, how customers reached the website, and materials they viewed. The program administrator could not provide information related to these tracking efforts as they had been in effect for a short time.

The program administrator also noted that the guerrilla tool kit (i.e., marketing in an unconventional way), developed for lighting and appliances, and effectively engaged retailers. The tool kit provided talking points that educated retail employees about the business case for energy efficiency and its

contribution to retailer profits. The program administrator also noted that program mailings proved more effective for low- to mid-income and older customers.

Program Challenges and Successes

Program staff reported that communicating tariff changes to trade allies was the program's primary challenge in 2013 and 2014. For example, when the Washington tariff changed, trade allies had difficulty understanding the tariff, how it had changed, and the way it was written. The program administrator mitigated confusion over future tariff changes by providing trade allies with education and training opportunities when a tariff changed.

In 2013, the higher program standards for clothes washers and refrigerators from the U.S. Department of Energy and ENERGY STAR eliminated the majority of program-qualifying models. Program staff reported this change stressed its relationships with retailers, but it also offered an opportunity to contact and open a dialogue with these retail partners.

In 2013 and 2014, participation of contractors who had not yet become a part of the program's trade ally network caused some confusion and frustration for customers. The program requires that customers use an eligible contractor to qualify for rebates, and some customers expressed frustration when some applications were rejected and some upgrades did not qualify because customers did not use eligible contractors. To mitigate this, program staff began contacting and encouraging these contractors to enroll with the program within 90 days of a customer submitting a rebate application, allowing the application to be processed.

The Washington market's rural customer population also presented significant challenges. As rural Pacific Power customers do not visit participating retailers often enough to encounter program advertisements or purchase HES program products, program staff began rethinking its marketing and outreach approach with these customers. This ultimately led to development of the ***watt***smart Starter Kits, introduced in 2014.

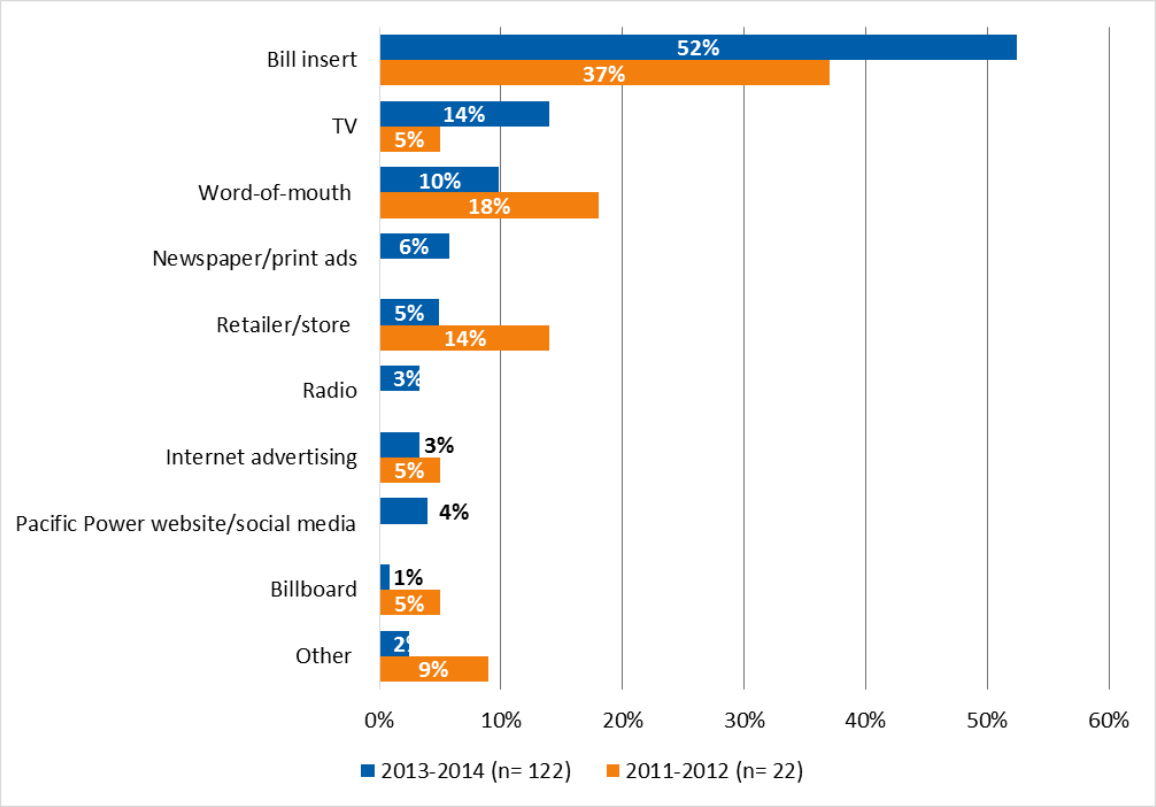
Customer Response

Awareness

The general population of Pacific Power's Washington customers learned of the ***watt***smart HES program through a variety of means, most frequently reporting bill inserts as the most frequently reported awareness source during the 2013–2014 and 2011–2012 program periods. Similar to 2011–2012, respondents mentioned TV (14%) and word-of-mouth (10%) as awareness sources. "Other" responses included participating in the See Ya Later Refrigerator Program, participating in a similar program in another state, and learning about the program when building their homes.

Figure 13 presents awareness sources from 2011 to 2014.

Figure 13. General Population Source of *watt*smart Awareness

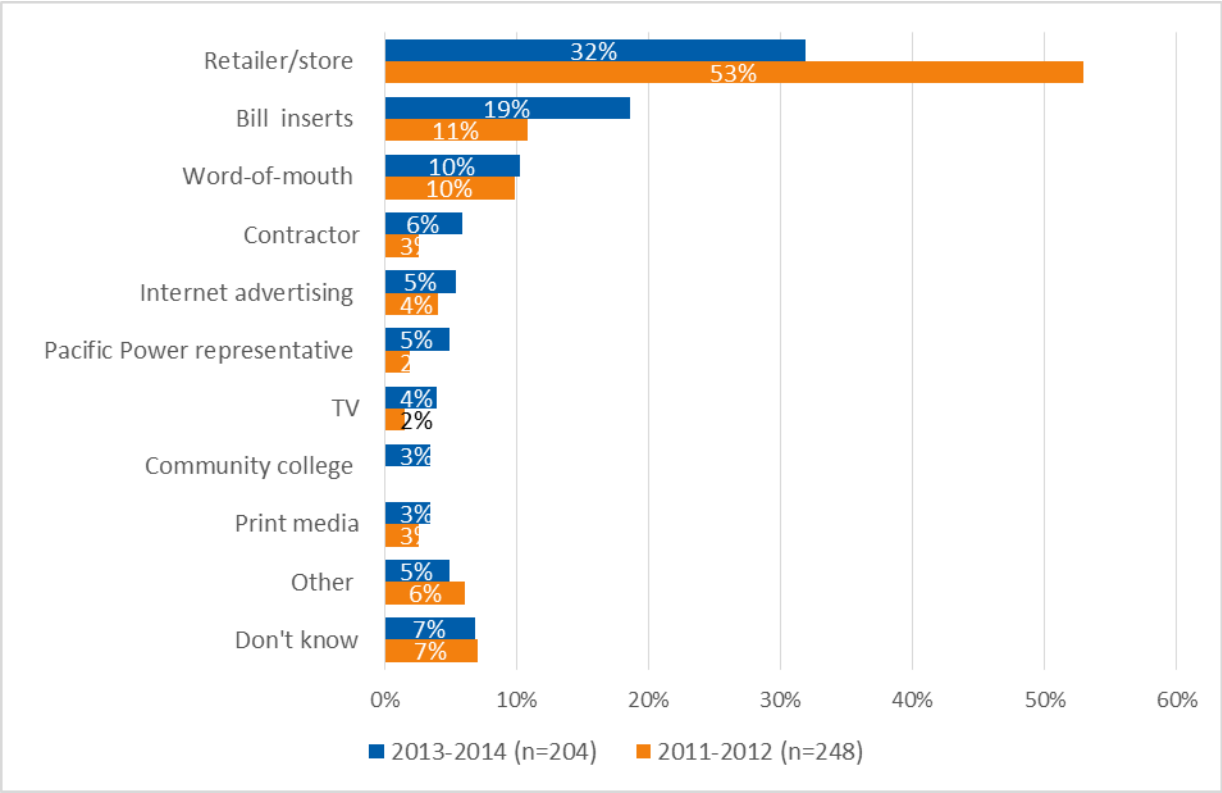


Source: Pacific Power Washington HES Residential General Population Survey (Appendix A). Don't know and refused responses removed.

As shown in Figure 14, 32% of non-lighting participants reported learning about the program through a retailer—a significant decrease since the 2011–2012 program period.[34] Customers also reported learning about the program through bill inserts (19%) and word-of-mouth sources (10%). "Other" responses included a community college class on sustainable living. Figure 14 shows how participants learned about the program.

[34] Statistically significant change (p-value <0.10).

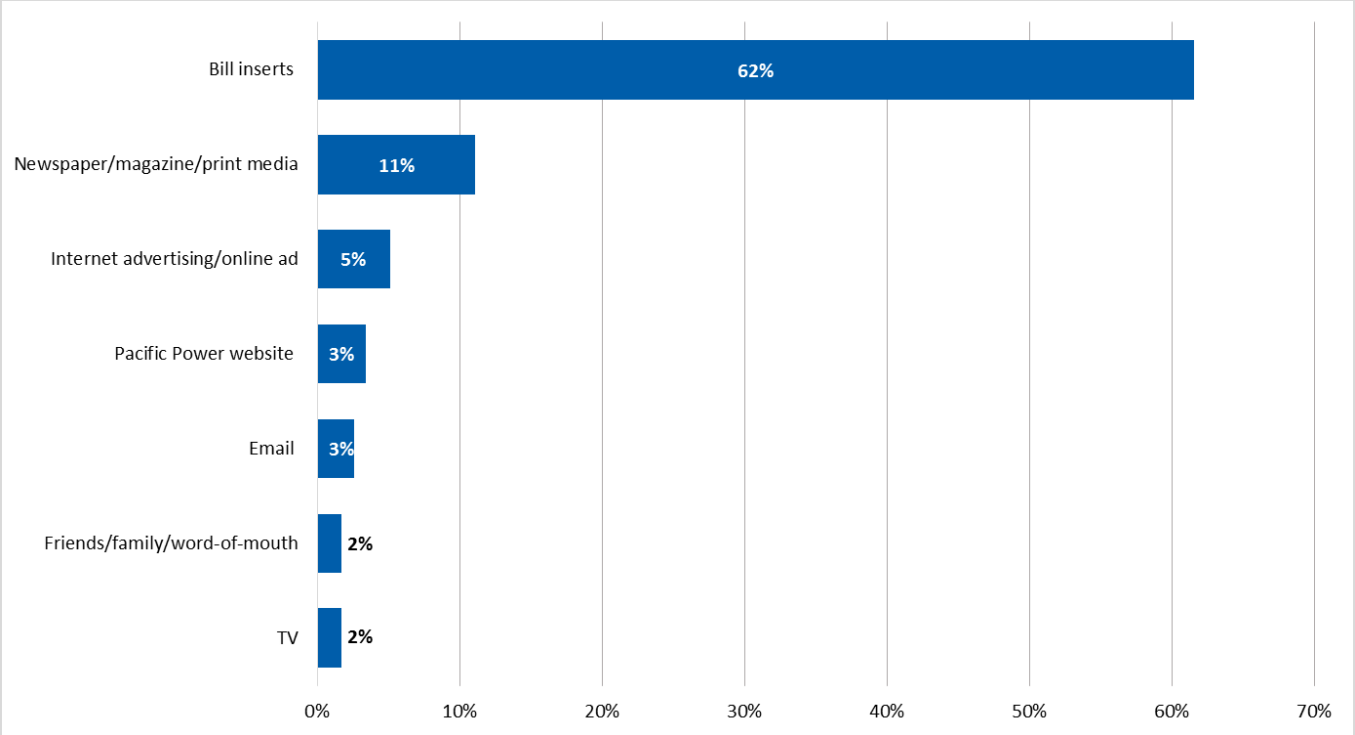
Figure 14. Non-Lighting Participant Source of Awareness



Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A)

Of kit customers, 62% reported learning about the program through bill inserts, and 11% cited newspapers, magazines, or print media. Figure 15 shows how participants learned about the ***watt***smart Starter Kits.

Figure 15. Sources of Awareness (*watt*smart Starter Kits)

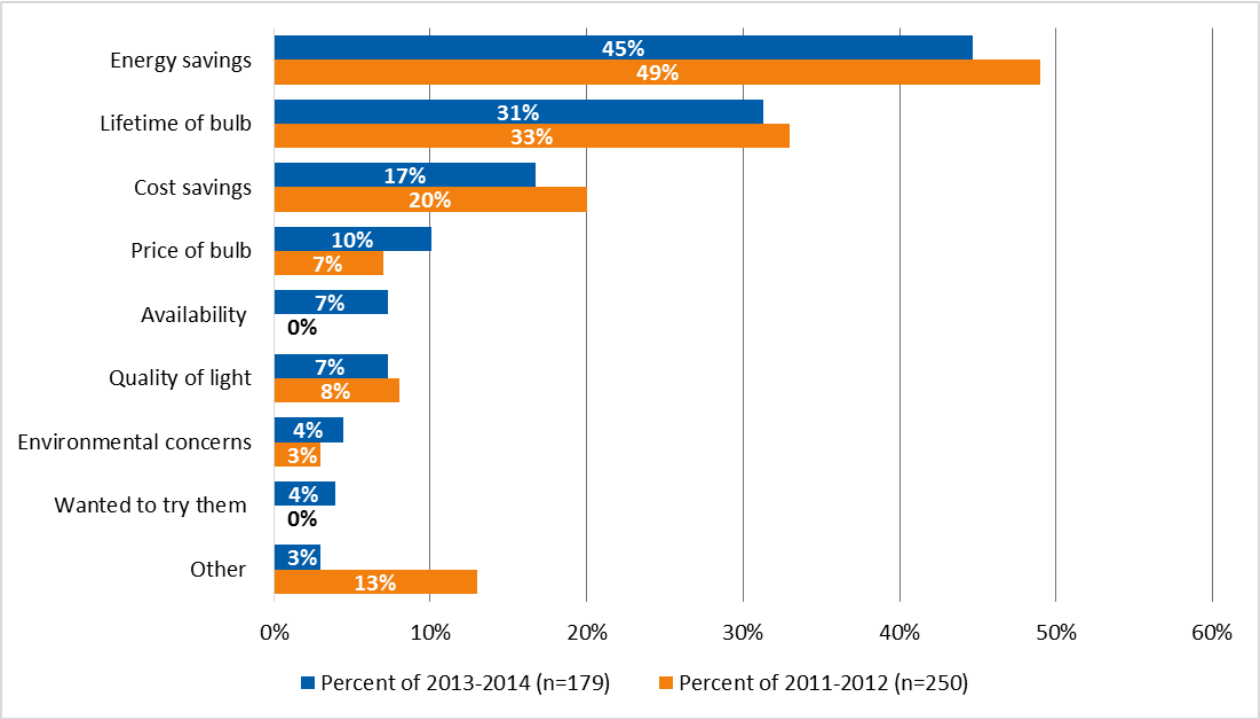


Source: Pacific Power Washington HES Kit Survey (Appendix A) (n=113). Don't know and refused responses removed.

Lighting Purchasing Decisions

In the general population survey, Pacific Power's Washington customers expressed a variety of reasons for purchasing energy-efficient bulbs (i.e., CFLs or LEDs). Customers most commonly cited energy savings (45%) and the bulb's lifetime (31%) as the main reasons for purchasing CFLs over other bulb types. As shown in Figure 16, these reasons remained consistent with 2011–2012 findings, except for one key difference: 7% of customers cited availability of bulbs as a motivating factor in 2013–2014, while none cited this in 2011–2012. Other responses included temperature of the bulb and environmental concerns.

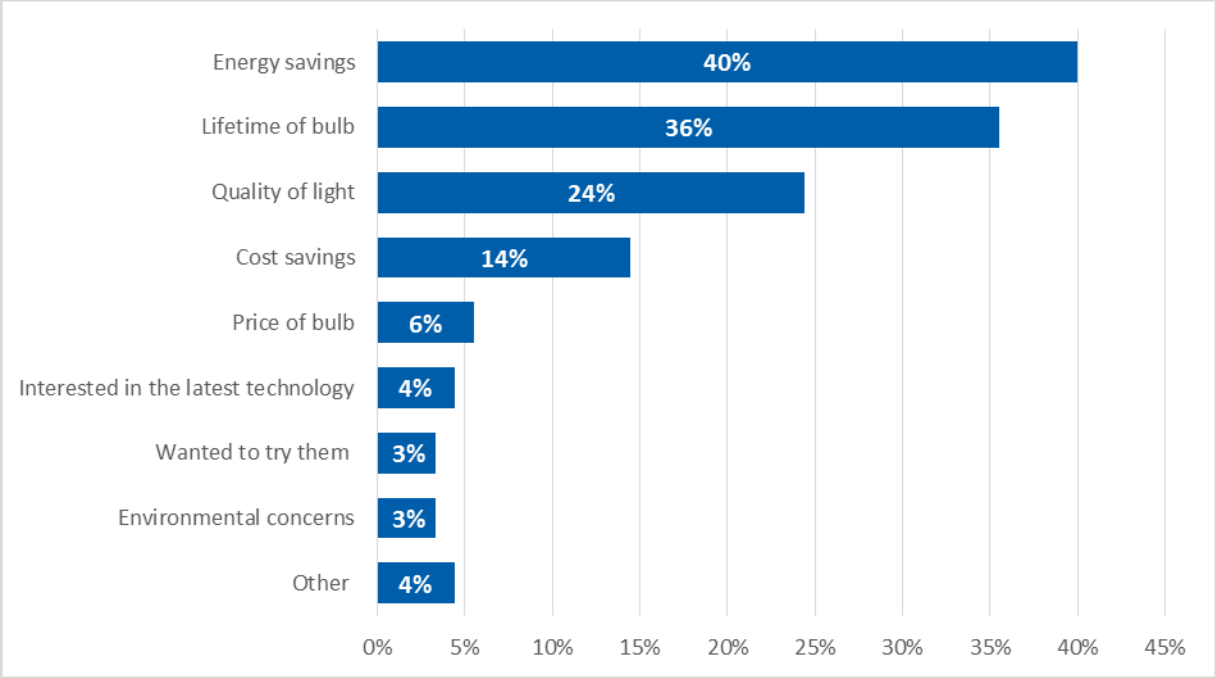
Figure 16. General Population Reasons for Choosing to Buy CFLs



Source: Pacific Power Washington HES Residential General Population Survey (Appendix A). Refused responses removed. Multiple responses allowed.

In addition, LED purchasers most commonly cited energy savings (40%), bulb lifetimes (36%), and the quality of light (24%) as reasons they purchased the bulbs. Other responses included CFL disposal concerns, availability, and temperature. Figure 17 shows why customers purchased LEDs over other bulbs.

Figure 17. General Populations Reasons for Choosing to Buy LEDs



Source: Pacific Power Washington HES Residential General Population Survey (Appendix A) (n=101). Don't know and refused responses removed. Multiple responses allowed.

Customers exhibited limited awareness that bulbs they purchased were part of a sponsored sale; only 9% of CFL purchasers and 15% of LED purchasers cited bulbs purchased as part of a utility-sponsored sale. However, the majority of those aware of utility sponsorship found discounts highly influential in their decisions to purchase bulbs.

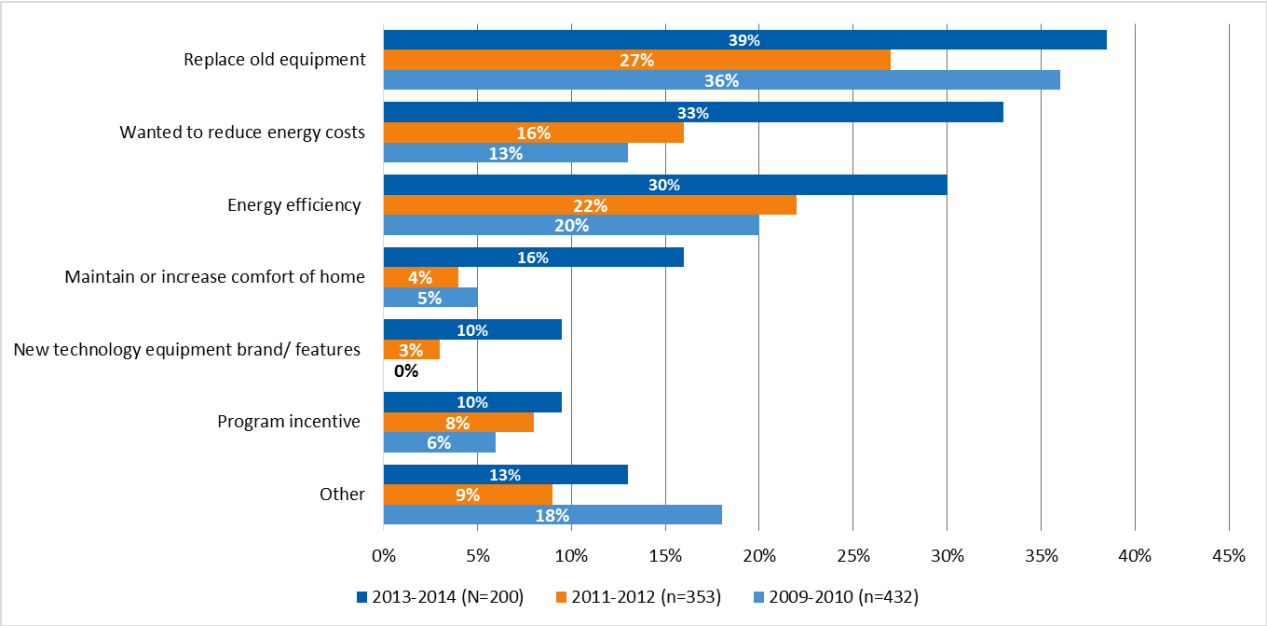
Non-Lighting Participation Decisions

Pacific Power non-lighting participants described a number of different factors influencing their decisions to participate in the HES program, as shown in Figure 18. Most commonly, participants cited an interest in replacing old equipment (39%), wanting to reduce energy costs (33%), and energy efficiency 30%), and maintain or increase comfort of the home, all of which increased from 2011–2012.[35]

The "Other" responses included home remodel, availability, health or environmental concerns, recommendation, and price.

[35] Statistically significant change (p-value <0.10).

Figure 18. Reasons for Participation (Non-lighting)

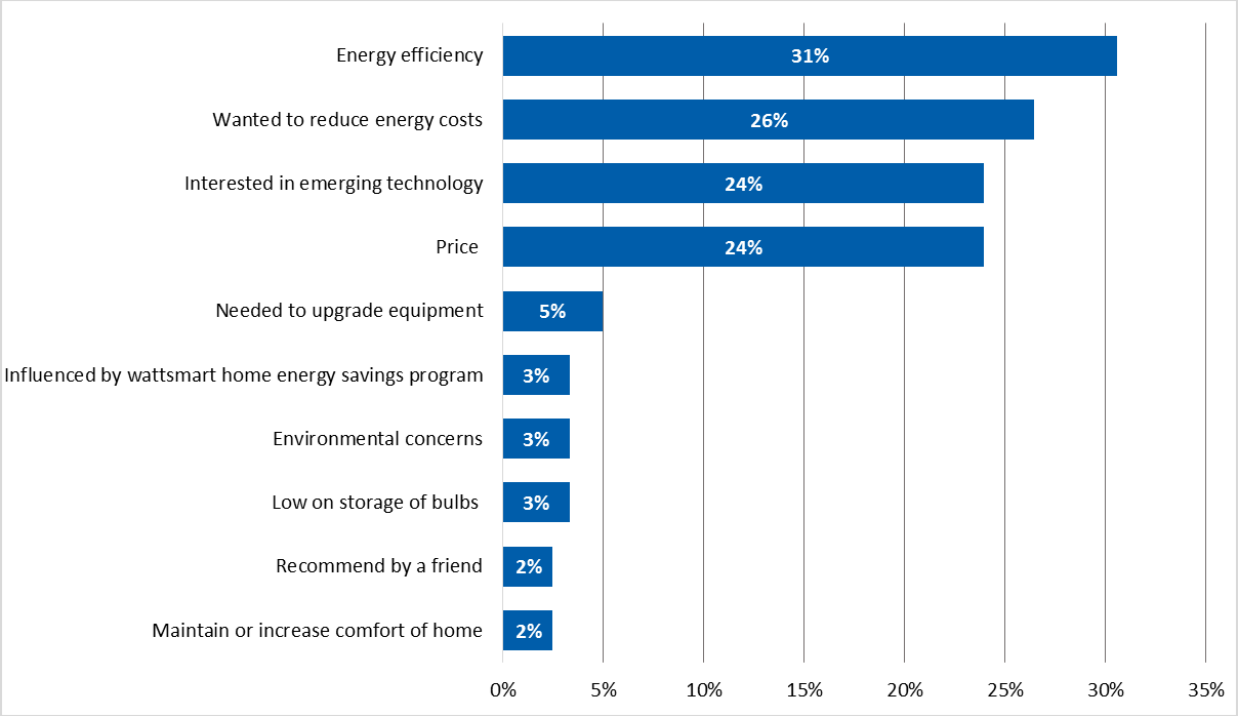


Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A) (n=109).
Don't know and refused responses removed. Multiple responses allowed in each reporting year.

Kit Purchasing Decisions

Pacific Power customers expressed a variety of reasons for applying for the ***watt***smart Starter Kit and, among those choosing the option, for upgrading to LEDs. Customers most commonly cited energy efficiency (31%) and wanting to reduce energy costs (26%) as their main reasons. Many customers also were motivated to apply kits due to price (24%) and their interest in emerging technology (24%). Figure 19 illustrates why customers were motivated to request kits.

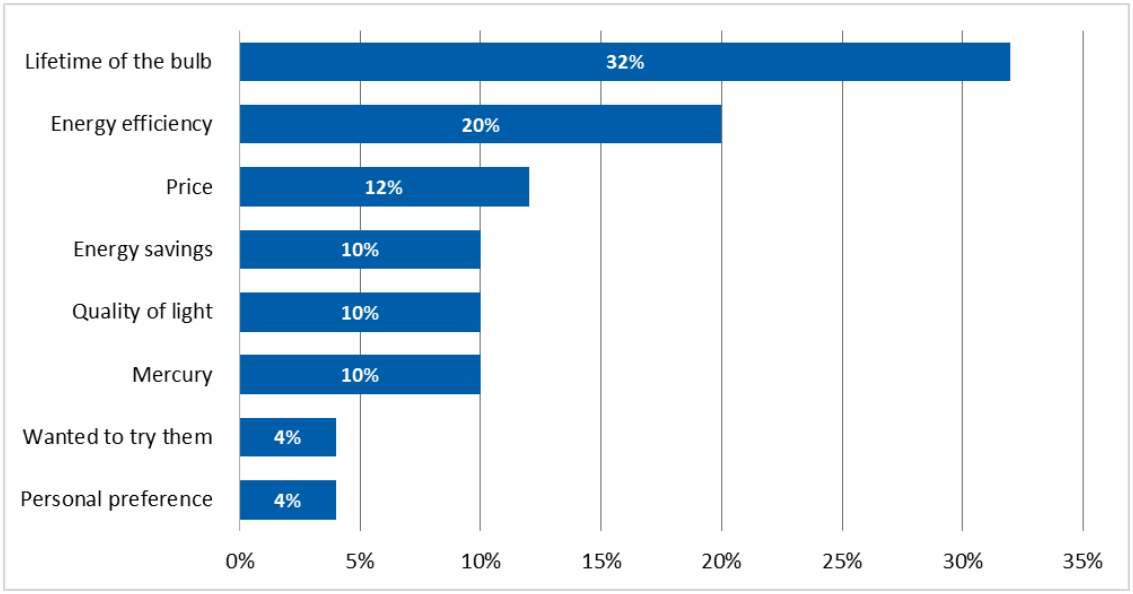
Figure 19. Reasons for Requesting a *watt*smart Starter Kit



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (n=124).

During the application process, customers could upgrade their kits from CFLs to LEDs for $19.99. Of 50 customers paying to upgrade their kits, top motivating factors included lifetime of the bulb (32%), energy efficiency (20%), and price (12%). Customers also noted quality of light and the lack of mercury in LED bulbs as motivating factors to upgrade their kits. Figure 20 shows reasons that customers upgraded their kits to include LEDs rather than CFLs.

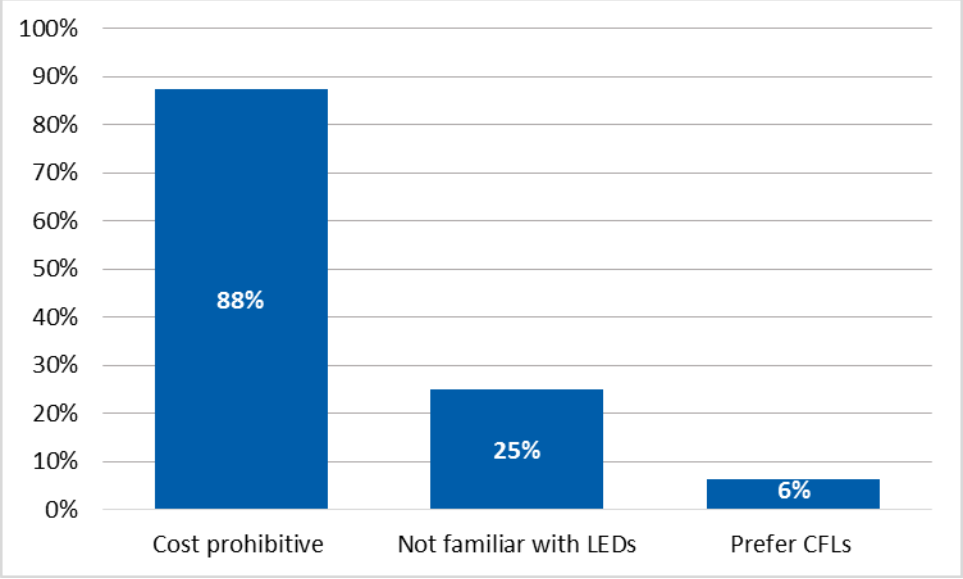
Figure 20. Reasons for LED Upgrade



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (n=54).

Cadmus asked customers selecting CFL kits why they chose not to upgrade their kits to include LEDs. Of 28 customers responding to this question, 88% said upgrading the kit proved cost-prohibitive, and 25% were not familiar with LEDs, as shown in Figure 21. An additional 6% expressed preferences for CFL bulbs.

Figure 21. Reasons for Not Upgrading to LEDs



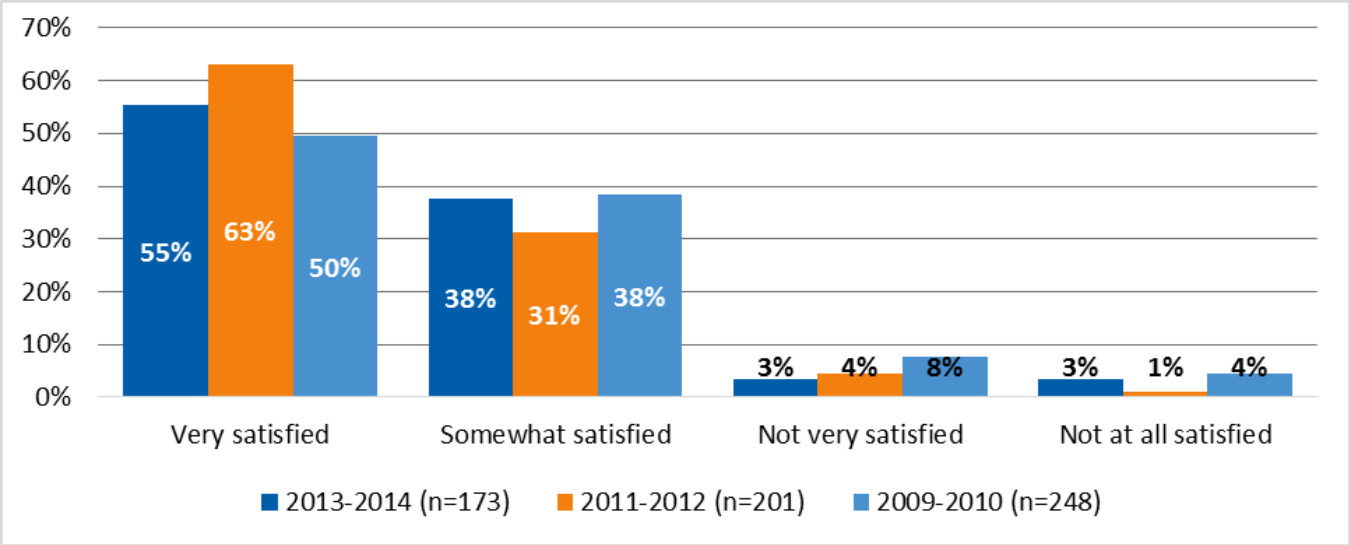
Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (n=28). Multiple responses allowed

Satisfaction

Lighting

Customers differed somewhat regarding their satisfaction levels with products they purchased, depending on whether they purchased CFLs or LEDs: 55% of CFL customers were very satisfied, 38% were somewhat satisfied, 3% were not too satisfied, and 3% were not at all satisfied with products purchased, as shown in Figure 22.

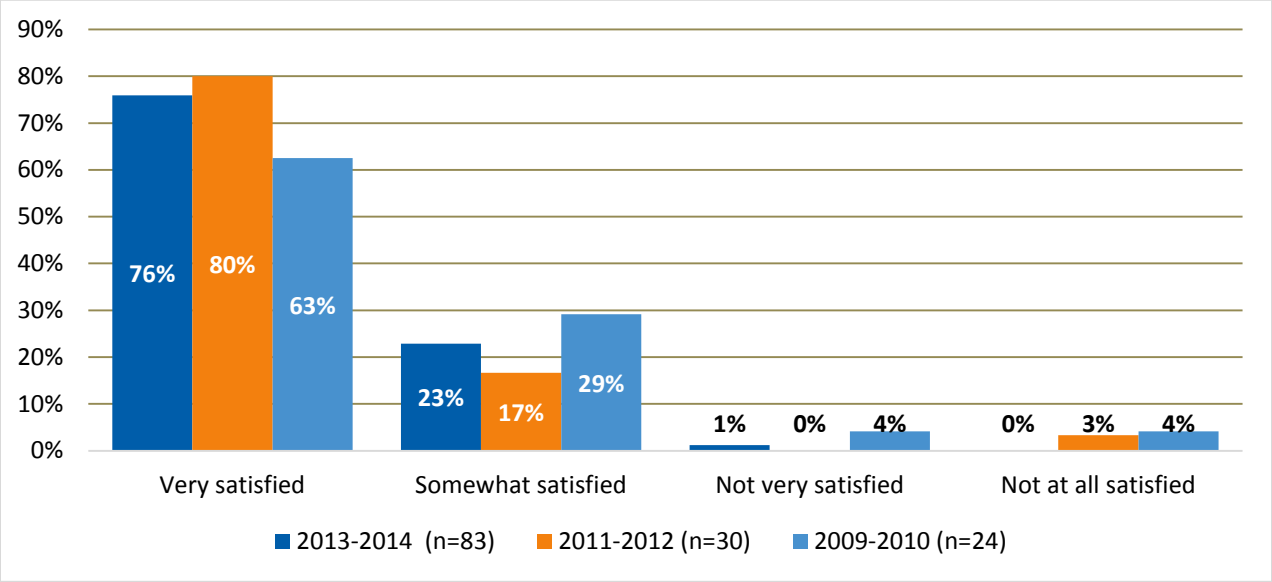
Figure 22. General Population CFL Satisfaction



Source: Pacific Power Washington HES Residential Upstream Lighting Survey (Appendix A). Don't know and refused responses removed.

As shown in Figure 23, customers purchasing LEDs expressed higher satisfaction levels, with 76% very satisfied and 23% somewhat satisfied with products purchased.

Figure 23. General Population LED Satisfaction



Source: Pacific Power Washington HES Residential General Population Survey (Appendix A). Don't know and refused responses removed.

Non-lighting

Non-lighting customers overwhelmingly expressed satisfaction with the HES program, with 96% of participants reporting they were very satisfied or somewhat satisfied with the program. Participants provided the following reasons for their satisfaction levels:

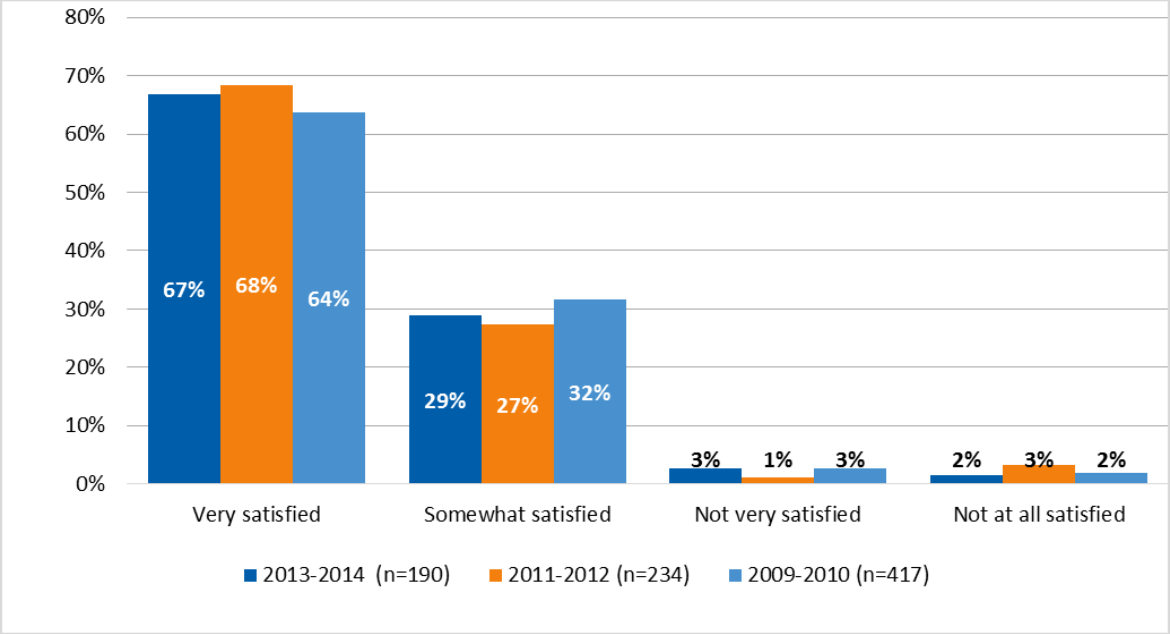
- "My home is more comfortable now."
- "I don't have any complaints."
- "It was a good deal for the heat pump."
- "Because of the application process and that contractors are willing to do this."
- "You guys gave me a reason to spend less and fix my home."

Dissatisfied customers provided a variety of reasons for their responses, with their comments including the following:

- "They don't really explain the criteria well for receiving the rebates."
- "I'd be much happier with an intelligent grid than a home energy savings program."
- "It wasn't worth the effort, and it was difficult to get all the information for the application."
- "There should be more incentives during the year, not just seasonal."

Satisfaction levels have remained consistent since 2009: Figure 24 illustrates trends year over year.

Figure 24. Non-lighting Satisfaction with HES Program

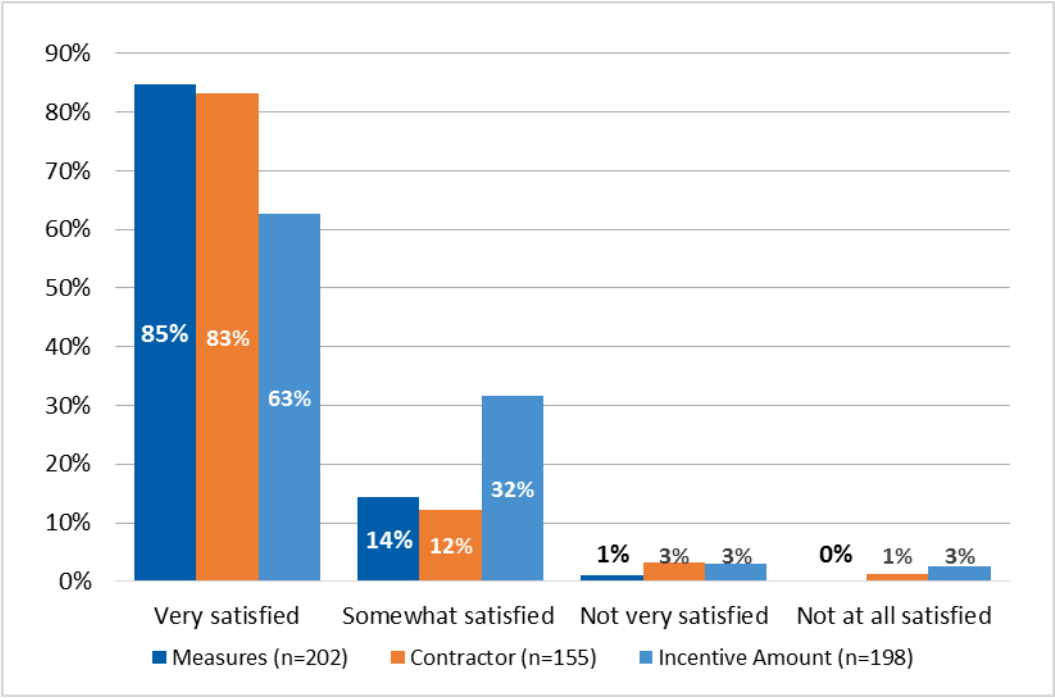


Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A)

Program participation program appears to have positive or neutral effects on most customers' perceptions of Pacific Power. When asked whether their participation in the HES program caused their satisfaction with Pacific Power to change, 38% said participation increased their satisfaction, 55% said their satisfaction stayed the same, and 7% said their satisfaction decreased.

In addition to overall satisfaction levels with the HES program, non-lighting customers expressed high satisfaction levels with measures they installed, their contractors, and incentive amounts they received. As shown in Figure 25, 85% of non-lighting customers said they were very satisfied with measures installed, and 14% said they were somewhat satisfied.

Figure 25. Non-Lighting Satisfaction with Measures, Contractors, Incentive Amounts



Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A). Don't know and refused responses removed.

About three-quarters of participants hired contractors to install measures for which they received program incentives; 83% of these participants reported being very satisfied with their contractors; 12% were somewhat satisfied. Participant satisfaction with incentive amounts received were not quite as strong, with 63% reporting they were very satisfied with incentive amounts. An additional 32% said they were somewhat satisfied, and just 6% said they were not very or not at all satisfied.

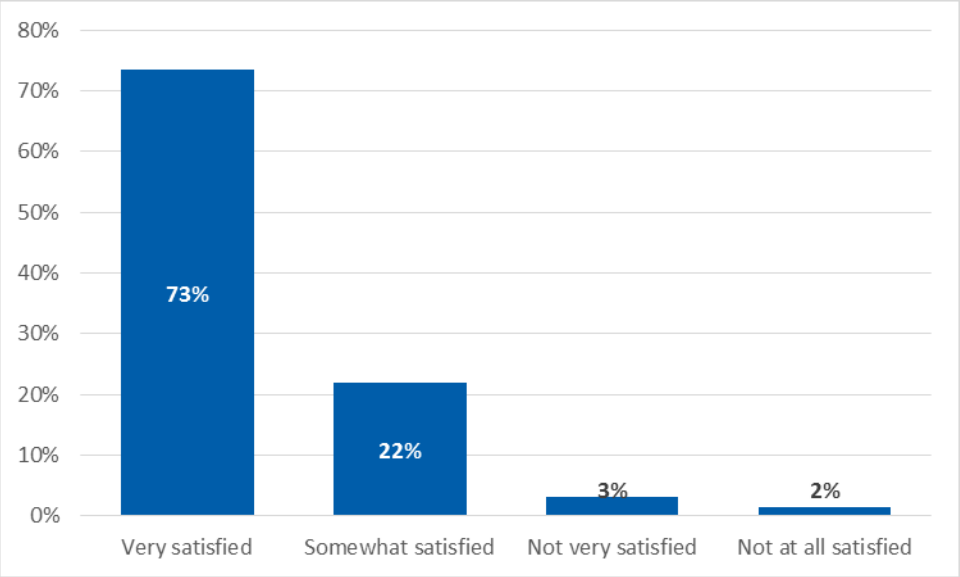
Non-lighting customers found the HES program incentive application easy to fill out, with 66% of respondents reporting it very easy to fill out and 27% reporting it somewhat easy. Participants who reported experiencing difficulties with filling out the application (6%) cited the following challenges:

- "Hard to figure out the square footage."
- "I thought it had a lot of questions that didn't pertain."
- "It asked for information I had to ask a contractor [for]."
- "The amount of time me and the contractor had to spend on the application process. The constant back and forth between us was like reapplying a few times."

wattsmart Starter Kits Program Satisfaction

Nearly all kit recipients expressed satisfaction with the HES program, as shown in Figure 26, with 95% of participants reporting they were very or somewhat satisfied with the program.

Figure 26. *watt*smart Starter Kit Satisfaction with the HES Program

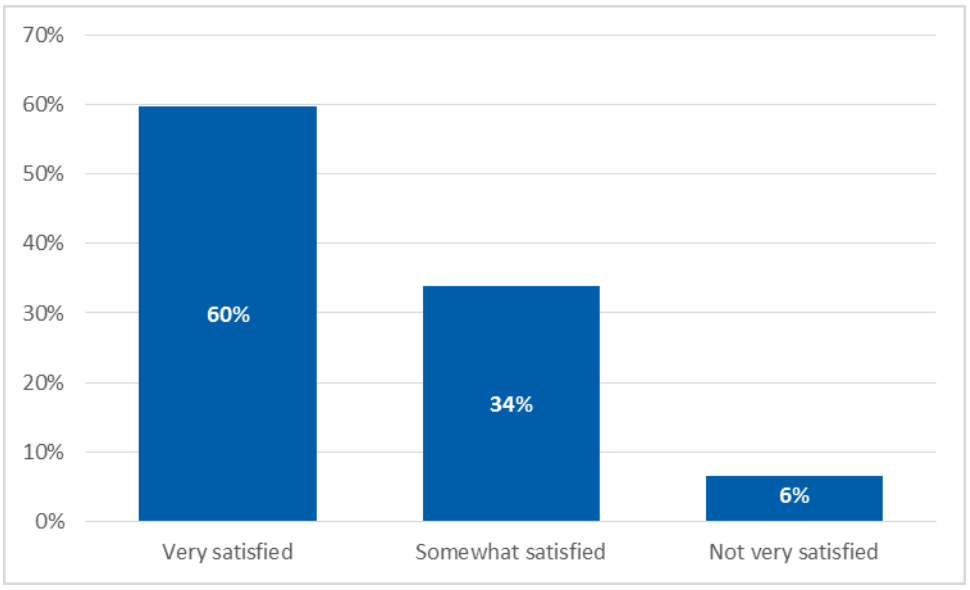


Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (n=128). Don't know responses were removed.

Satisfaction with Kit Measures

Kit recipients also reported high satisfaction levels with kit components. As Pacific Power offered eight kit variations, with either CFLs or LEDs and water measures (depending on whether the customer had electric water hearing), survey respondents answered questions that pertained only to their specific kit's contents. Still, 60% of CFL kit respondents were very satisfied with CFLs they received, 34% said they were somewhat satisfied, and 6% were not very satisfied, as shown in Figure 27.

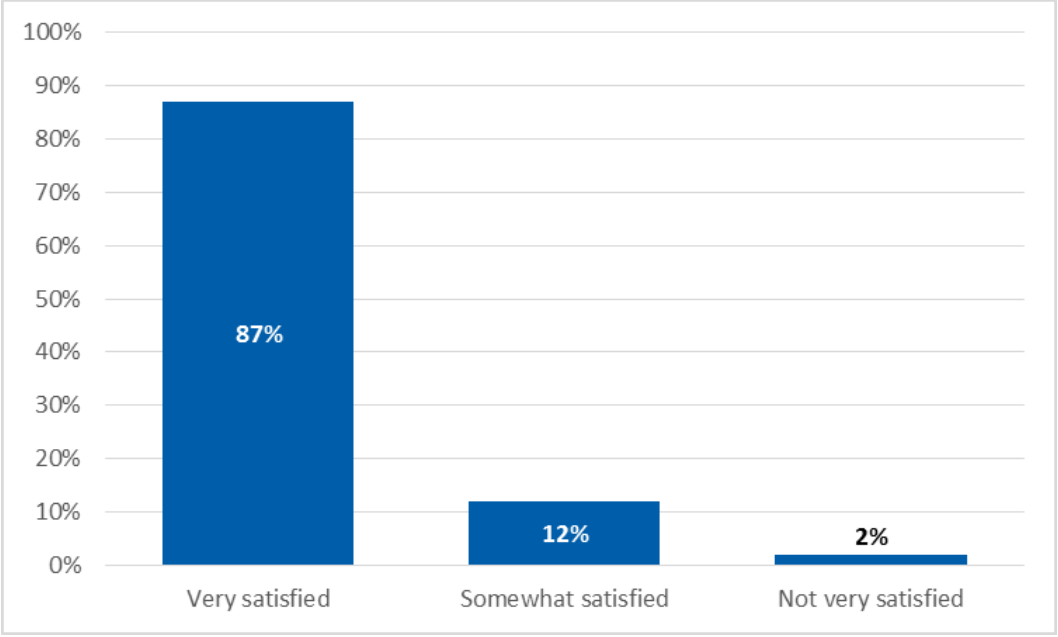
Figure 27. Satisfaction with CFLs in *watt*smart Starter Kit



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (n=62)

Customers also expressed high satisfaction levels with LEDs in their kits: 87% were very satisfied, 12% were somewhat satisfied, and 2% were not very satisfied, as shown in Figure 28.

Figure 28. Satisfaction with LEDs in *watt*smart Starter Kit

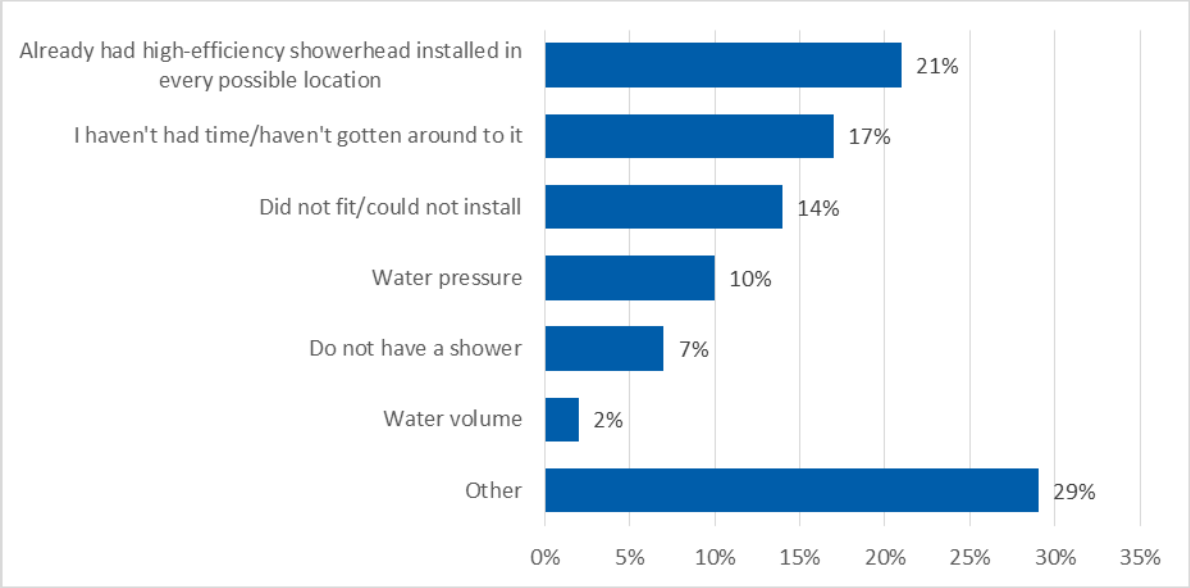


Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (n=52)

Kit participants expressed satisfaction with the number of CFL and LED bulbs provided: 70% of customers who received a CFL kit and 70% of customers who received an LED kit said they were very satisfied with the number of bulbs in the kit.

Regarding high-efficiency showerheads provided, 60% of customers chose to install all units. Of customers saying they did not install all units provided, 21% already had a high-efficiency showerhead, 17% had not yet installed it, and 14% said it did not fit or they could not install it. Figure 29 shows the results. The majority (77%) of these customers put unused showerheads in storage.

Figure 29. Reasons for Not Installing Both High-Efficiency Showerheads



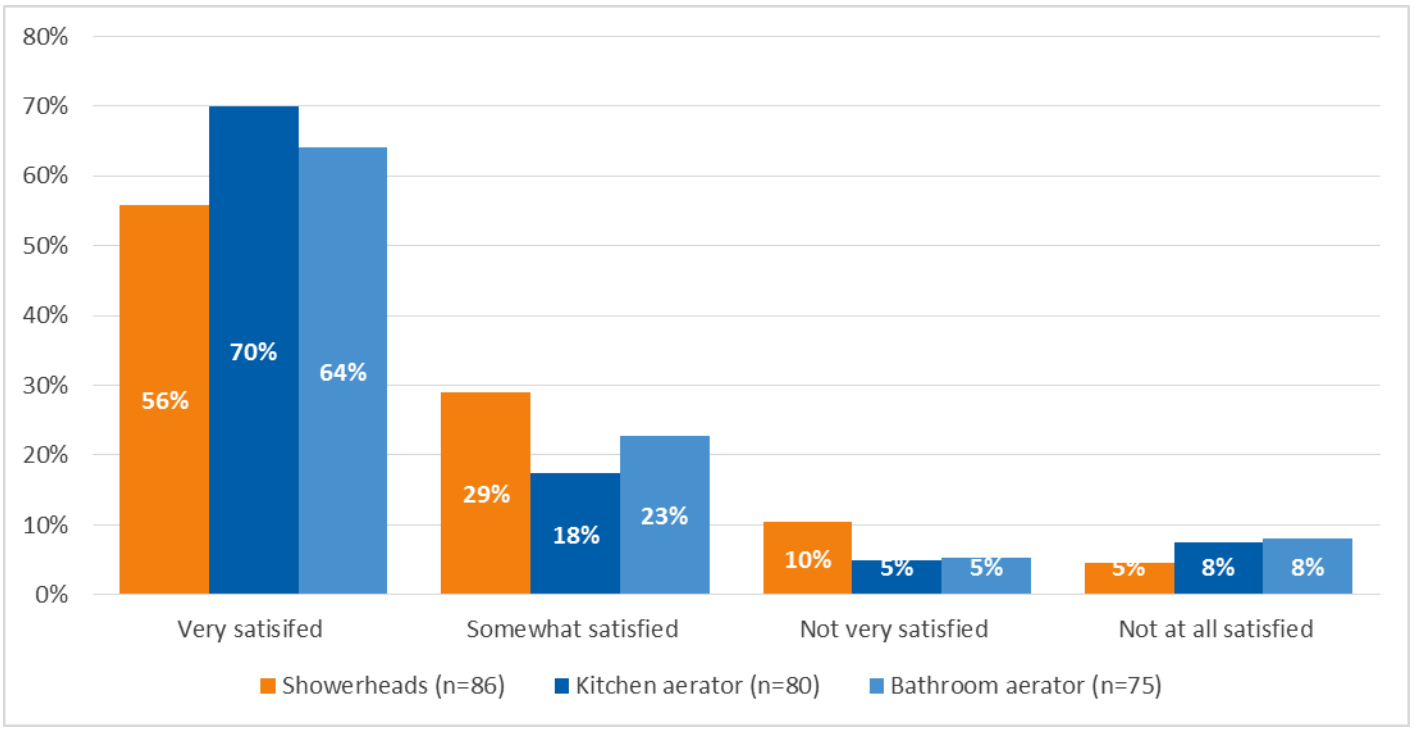
Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (n=42)

Despite low installation rates, customers expressed satisfaction with showerheads received: 56% percent of respondents said they were very satisfied with the showerhead, and 29% said they were somewhat satisfied; 76% also noted found it very easy to install the showerheads.

Customers reported lower installation rates for kitchen and bathroom faucet aerators than CFLs or LEDs. Only 63% of respondents installed the kitchen faucet aerator in their home. Over one-third (35%) of respondents who did not install the measure reported the kitchen faucet aerators did not fit; 36% also cited this reason not installing bathroom faucet aerators. Twenty-six percent said they simply had not yet installed the kitchen aerator, and 26% said they already had installed faucet aerators in every possible location. Eighty-one percent of respondents not installing the kitchen aerator, 81% said it was in storage.

Kit recipients expressed similar satisfaction levels with aerators as with showerheads: 70% of respondents were very satisfied with the measure, and 18% were somewhat satisfied. Figure 30 shows satisfaction levels with each water measure.

Figure 30. Water Measure Satisfaction



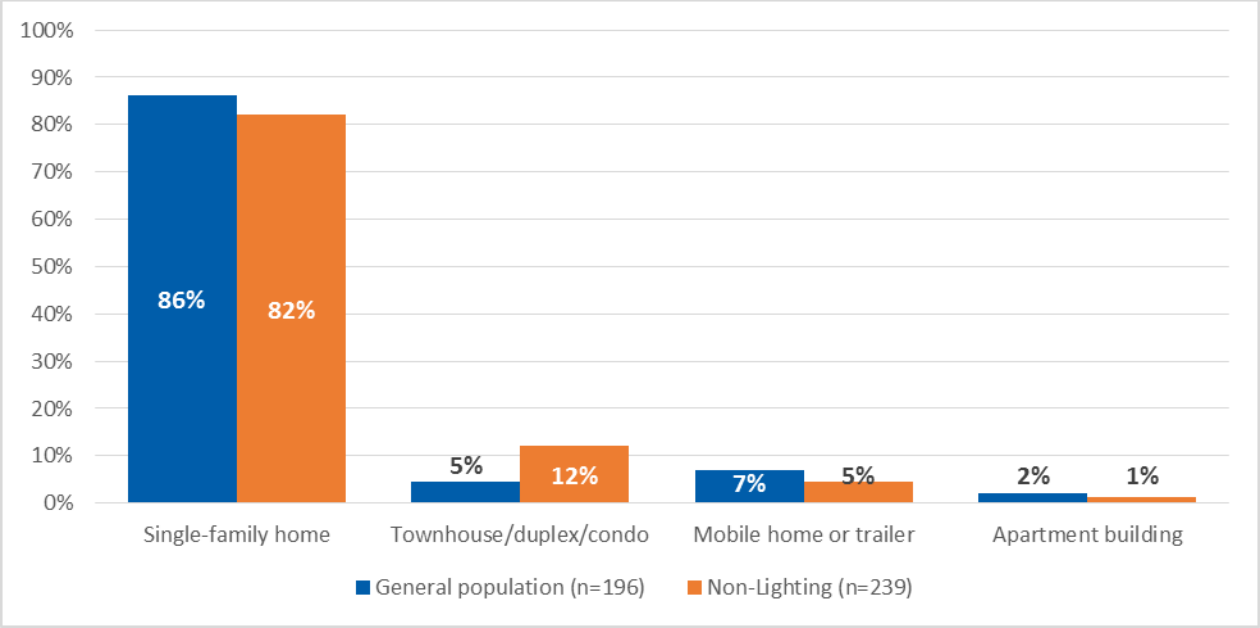
Source: Pacific Power Washington HES Residential Kit Survey (Appendix A)

Customers found the application easy to fill out, with 79% of respondents reporting it very easy to fill out and 15% reporting it somewhat easy.

Customer Demographics

As shown in Figure 31, most general population and non-lighting participants surveyed lived in single-family homes, with a small percentage of customers residing in condominiums, townhomes, apartments, or mobile homes.

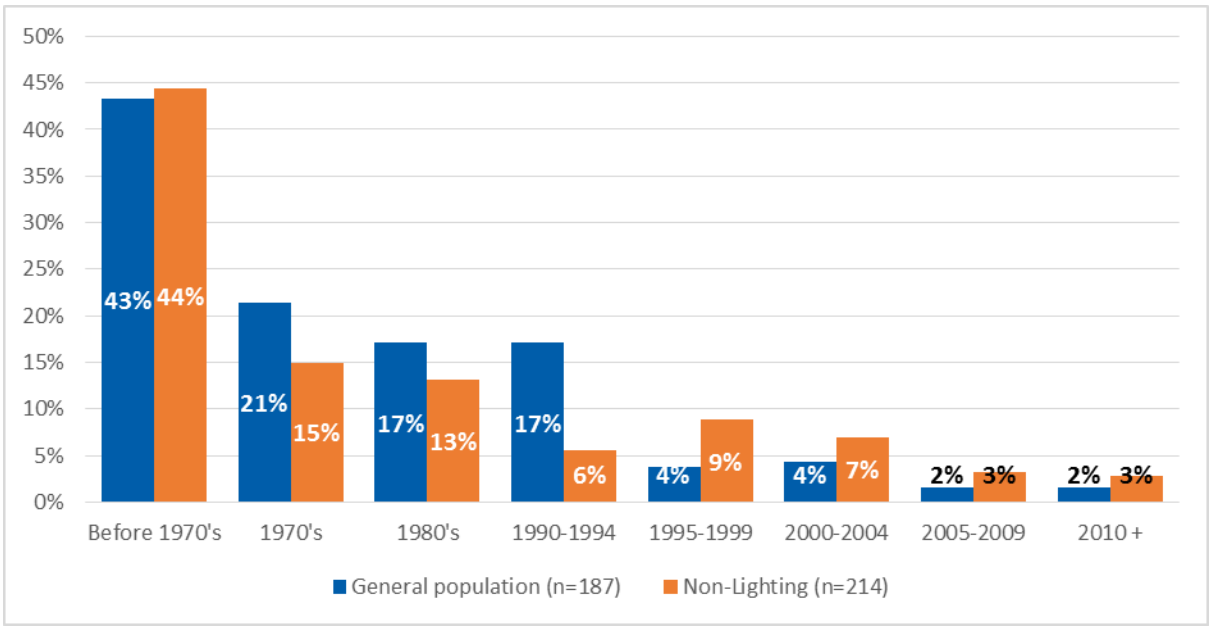
Figure 31. General Population and Non-Lighting Residence Types



Source: Pacific Power Washington HES Residential General Population and Non-lighting Surveys (Appendix A). Don't know and refused responses removed.

Eighty-two percent of the general population surveyed and 96% of non-lighting participants surveyed reported owning their own homes. Figure 32 shows survey respondents in both groups reported similar home vintages.

Figure 32. General Population and Non-Lighting Home Age



Source: Pacific Power Washington HES Residential General Population and Non-lighting Surveys (Appendix A). Don't know and refused responses removed.

Cost-Effectiveness

In assessing HES program cost-effectiveness, Cadmus analyzed program benefits and costs from five different perspectives, using Cadmus' DSM Portfolio Pro model.[36] The California Standard Practice Manual for assessing demand-side management (DSM) program cost-effectiveness describes the benefit-cost ratios Cadmus used for the following five tests:

- **PacifiCorp Total Resource Cost (PTRC) Test:** This test examined program benefits and costs from Pacific Power's and Pacific Power customers' perspectives (combined). On the benefit side, it included avoided energy costs, capacity costs, and line losses, plus a 10% adder to reflect non-quantified benefits. On the cost side, it included costs incurred by both the utility and participants.
- **Total Resource Cost (TRC) Test:** This test also examined program benefits and costs from Pacific Power's and Pacific Power customers' perspectives (combined). On the benefit side, it included avoided energy costs, capacity costs, and line losses. On the cost side, it included costs incurred by both the utility and participants.
- **Utility Cost Test (UCT):** This test examined program benefits and costs solely from Pacific Power's perspective. The benefits included avoided energy, capacity costs, and line losses. Costs included program administration, implementation, and incentive costs associated with program funding.
- **Ratepayer Impact Measure (RIM) Test:** All ratepayers (participants and nonparticipants) may experience rate increases designed to recover lost revenues. The benefits included avoided energy costs, capacity costs, and line losses. Costs included all Pacific Power program costs and lost revenues.
- **Participant Cost Test (PCT):** From this perspective, program benefits included bill reductions and incentives received. Costs included a measure's incremental cost (compared to the baseline measures), plus installation costs incurred by the customer.

Table 63 summarizes the five tests' components.

[36] DSM Portfolio Pro has been independently reviewed by various utilities, their consultants, and a number of regulatory bodies, including the Iowa Utility Board, the Public Service Commission of New York, the Colorado Public Utilities Commission, and the Nevada Public Utilities Commission.

Table 63. Benefits and Costs Included in Various Cost-Effectiveness Tests

Test	Benefits	Costs
PTRC	Present value of avoided energy and capacity costs,* with a 10% adder for non-quantified benefits	Program administrative and marketing costs, and costs incurred by participants
TRC	Present value of avoided energy and capacity costs*	Program administrative and marketing costs, and costs incurred by participants
UCT	Present value of avoided energy and capacity costs*	Program administrative, marketing, and incentive costs
RIM	Present value of avoided energy and capacity costs*	Program administrative, marketing, and incentive costs, plus the present value of lost revenues
PCT	Present value of bill savings and incentives received	Incremental measure and installation costs

*Includes avoided line losses.

Table 64 provides selected cost analysis inputs for each year, including evaluated energy savings, the discount rate, line loss, the inflation rates, and total program costs. Pacific Power provided all of these values, except for energy savings and the discount rate, which Cadmus derived from Pacific Power's 2013 *Integrated Resource Plan*.

Table 64. Selected Cost Analysis Inputs

Input Description	2013	2014	Total
Evaluated Energy Savings (kWh/year)*	7,744,422	14,106,187	21,850,609
Discount Rate	6.88%	6.88%	N/A
Line Loss	9.67%	9.67%	N/A
Inflation Rate**	1.9%	1.9%	N/A
Total Program Costs	**$1,353,196**	**$2,243,020**	**$3,596,216**

*Savings are realized at the meter, while benefits account for line loss.

**Future retail rates determined using a 1.9% annual escalator.

HES program benefits included energy savings and their associated avoided costs. For the cost-effectiveness analysis, Cadmus used this study's evaluated energy savings and measure lives from sources such as the RTF.[37] For all analyses, Cadmus used avoided costs associated with Pacific Power's 2013 *IRP Westside Class 2 DSM Decrement Values*.[38]

Cadmus analyzed HES program cost-effectiveness for evaluated savings.

[37] See Appendix H for detailed cost-effectiveness inputs and results at the measure category level.

[38] Appendix N of PacifiCorp's *2013 Integrated Resource Plan, Volume II—Appendices* details the IRP decrements. April 20, 2013. Available online: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2013IRP/PacifiCorp-2013IRP_Vol2-Appendices_4-30-13.pdf

Table 65 provides the annual program non-energy benefits (NEBs) from the appliance measure category.

Table 65. HES Annual Non-Energy Benefits

Measure	Annual Value	Perspective Adjusted	NEBs	Source
Clothes Washer—2013	$58,906	PTRC, TRC, PCT	Water, Detergent, and Sewer	Sixth Northwest Conservation and Electric Power Plan
Dishwasher—2013	$77	PTRC, TRC, PCT	Water and Sewer	Sixth Northwest Conservation and Electric Power Plan
Clothes Washer—2014	$21,384	PTRC, TRC, PCT	Water, Detergent, and Sewer	Sixth Northwest Conservation and Electric Power Plan
Dishwasher—2014	$13	PTRC, TRC, PCT	Water and Sewer	Sixth Northwest Conservation and Electric Power Plan

Table 66 presents the 2013–2014 program cost-effectiveness analysis results, accounting for non-energy benefits. For this scenario, the HES program proved cost-effective from all perspectives, except the RIM test. The primary criterion for assessing cost-effectiveness in Washington is the PTRC with non-energy benefits, which achieved a 1.81 benefit-cost ratio for the combined years' evaluated savings.

The RIM test measures program impacts on customer rates. Many programs do not pass the RIM test because, while energy efficiency programs reduce costs, they also reduce energy sales. As a result, the average rate per unit of energy may increase in the short term. A passing RIM test indicates that rates, as well as costs, will decrease in the short term due to the program. Typically, this only happens for demand-response programs or programs targeted to the highest marginal cost hours (when marginal costs are greater than rates).

Table 66. HES Program Cost-Effectiveness Summary for 2013–2014 (Including Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.047	$7,354,151	$13,335,771	$5,981,620	1.81
TRC No Adder	$0.047	$7,354,151	$12,191,039	$4,836,888	1.66
UCT	$0.022	$3,451,791	$11,447,329	$7,995,538	3.32
RIM		$17,165,165	$11,447,329	($5,717,836)	0.67
PCT		$6,091,657	$16,646,380	$10,554,724	2.73
Lifecycle Revenue Impacts ($/kWh)	$0.000098312				
Discounted Participant Payback (years)	2.71				

Table 67 presents the 2013 program cost-effectiveness analysis results, accounting for non-energy benefits. For this scenario, the HES program proved cost-effective from all perspectives except for RIM.

Table 67. HES Program Cost-Effectiveness Summary for 2013 (Including Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.075	$3,615,534	$4,344,625	$729,092	1.20
TRC No Adder	$0.075	$3,615,534	$4,000,137	$384,603	1.11
UCT	$0.028	$1,353,196	$3,444,883	$2,091,687	2.55
RIM		$5,515,817	$3,444,883	($2,070,934)	0.62
PCT		$3,072,116	$5,527,653	$2,455,538	1.80
Lifecycle Revenue Impacts ($/kWh)					$0.000035607
Discounted Participant Payback (years)					3.55

Table 68 presents the 2014 program cost-effectiveness analysis results, accounting for non-energy benefits. For this scenario, again, the HES program proved cost-effective from all perspectives except the RIM test.

Table 68. HES Program Cost-Effectiveness Summary for 2014 (Including Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.034	$3,995,909	$9,609,917	$5,614,008	2.40
TRC No Adder	$0.034	$3,995,909	$8,754,599	$4,758,690	2.19
UCT	$0.019	$2,243,020	$8,553,174	$6,310,153	3.81
RIM		$12,451,055	$8,553,174	($3,897,882)	0.69
PCT		$3,227,346	$11,883,918	$8,656,572	3.68
Lifecycle Revenue Impacts ($/kWh)					$0.000067361
Discounted Participant Payback (years)					1.41

Table 69 presents the 2013–2014 program cost-effectiveness analysis results, not accounting for non-energy benefits (except those represented by the 10% conservation adder included in the PTRC). For this scenario, the HES program proved cost-effective from all perspectives, except the RIM test, and achieved a 1.71 benefit-cost ratio for the combined years' evaluated savings.

Table 69. HES Program Cost-Effectiveness Summary for 2013–2014 (Excluding Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.047	$7,354,151	$12,592,061	$5,237,911	1.71
TRC No Adder	$0.047	$7,354,151	$11,447,329	$4,093,178	1.56
UCT	$0.022	$3,451,791	$11,447,329	$7,995,538	3.32
RIM		$17,165,165	$11,447,329	($5,717,836)	0.67
PCT		$6,091,657	$15,902,671	$9,811,014	2.61
Lifecycle Revenue Impacts ($/kWh)	$0.000098312				
Discounted Participant Payback (years)	2.82				

Table 70 presents the 2013 program cost-effectiveness analysis results, not accounting for non-energy benefits (except those represented by the 10% conservation adder included in the PTRC). For this scenario, the HES program proved cost-effective from the PTRC, UCT, and PCT perspectives.

Table 70. HES Program Cost-Effectiveness Summary for 2013 (Excluding Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.075	$3,615,534	$3,789,371	$173,838	1.05
TRC No Adder	$0.075	$3,615,534	$3,444,883	($170,651)	0.95
UCT	$0.028	$1,353,196	$3,444,883	$2,091,687	2.55
RIM		$5,515,817	$3,444,883	($2,070,934)	0.62
PCT		$3,072,116	$4,972,399	$1,900,284	1.62
Lifecycle Revenue Impacts ($/kWh)	$0.000035607				
Discounted Participant Payback (years)	3.55				

Table 71 presents the 2014 program cost-effectiveness analysis results, not accounting for non-energy benefits (except those represented by the 10% conservation adder included in the PTRC). For this scenario, the HES program proved cost-effective from all perspectives except the RIM test.

Table 71. HES Program Cost-Effectiveness Summary for 2014 (Excluding Non-Energy Benefits)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.034	$3,995,909	$9,408,491	$5,412,582	2.35
TRC No Adder	$0.034	$3,995,909	$8,553,174	$4,557,265	2.14
UCT	$0.019	$2,243,020	$8,553,174	$6,310,153	3.81
RIM		$12,451,055	$8,553,174	($3,897,882)	0.69
PCT		$3,227,346	$11,682,492	$8,455,147	3.62
Lifecycle Revenue Impacts ($/kWh)	$0.000067361				
Discounted Participant Payback (years)	1.43				

Conclusions and Recommendations

Based on findings previously presented, Cadmus offers the following conclusions and recommendations.

Measure Categorization

Some measure categories were assigned based on delivery channels rather than end uses (e.g., light fixtures were assigned as appliances in the downstream delivery channel, and evaporative coolers were assigned as both appliances and HVAC equipment). For cost-effectiveness purposes, measure categories should be allocated by end use to ensure applications of the most appropriate load shapes.

Recommendation

Assign measure categories by end use to ensure use of the most appropriate cost-effectiveness results. Ensure consistent applications of measure categories in all data tracking and reporting efforts (including annual reports, evaluations, and participant databases).

Upstream Lighting Tracking Database

Although Cadmus could match quantities and savings in the lighting tracking database to annual reports, using the data proved challenging for evaluation purposes. Specifically, Cadmus encountered difficulties in mapping the lighting tracking database to the price scheduling database.

The tracking database contained several inconsistences. For example, bulb types were inconsistently defined for each SKU, SKUs and model numbers were used interchangeably, and reconciled quantities were inconsistently labeled. The program administrator also could not provide detailed tracking information on product merchandising or promotional events. Data tracking, however, improved significantly between 2013 and 2014.

Many inconsistencies arose from changes as manufacturers updated descriptions between price schedules (i.e., the negotiated period for which prices and incentives are agreed upon between manufacturers/retailers and the program implementer). The 2014 tracking data included the schedule name in pricing data and in sales data, which improved accuracy in matching prices to sales (rather than relying on inconsistent secondary descriptions). If the data continue to be collected in 2015–2016 as they were in 2014, the data will facilitate more accurate reporting and analysis.

Recommendation

Track all data in a consistent manner across each program period. This specifically includes the following:

- Provide consistently defined bulb types for each SKU
- Provide consistent SKUs or model numbers
- Provide tracking data with final and reconciled quantities
- Track all product merchandising and promotional events (these were not tracked in 2013 or 2014)

Lighting Cross-Sector Sales

Cadmus estimated 3.9% of efficient bulbs purchased at retail stores would ultimately be installed in commercial applications—a result similar to findings in other jurisdictions that implement upstream lighting programs. Bulbs installed in commercial spaces produce greater first-year savings than bulbs installed in residential spaces as commercial locations typically experience higher daily use of bulbs than residential locations (i.e., higher HOU). Currently, Pacific Power does not account for cross-sector sales from upstream lighting incentives.

Recommendation

Increasingly, other jurisdictions around the country have accommodated cross-sector sales factors in calculating reported lighting savings. Cadmus recommends that Pacific Power explore accounting for commercial installations of upstream bulbs in the reported savings.

Accounting for these installations can be complex due to the split between residential and nonresidential programs in the ***watt***smart portfolio. One option would be to calculate savings values for each bulb, accounting for different HOUs of residential and nonresidential installations, weighted by the cross-sector sales factor. This option would require calculating a lower measure life to account for commercial bulbs burning out faster. Pacific Power would then need to decide whether all lighting savings from the program would fall under the residential ***watt***smart portfolio or if some savings would be transferred to the nonresidential side.

Customer Awareness

Retailers constituted the most commonly cited program awareness source for non-lighting participants, and bill inserts served as influential awareness sources for ***watt***smart Starter Kits.

Recommendation

Continue to pursue a multi-touch marketing strategy, using a mix of bill inserts and retailer training. Given the large percentage of customers learning of ***watt***smart offerings through bill inserts, examine the proportion of customers electing to receive online bills, and ensure these online channels advertise the programs. Convey messages that motivate customers to participate, such as recommendations for long-lasting products, saving energy, replacing equipment, and reducing costs.

Satisfaction with Program Experience

Participants in all program categories expressed high satisfaction levels with their program experiences, and non-lighting customers expressed high satisfaction with their contractors, measures installed, and incentive amounts. Cadmus could not verify the efficacy of the program administrator's efforts to reach non-registered contractors who worked with customers seeking a rebate. (The program accepts applications only from trade allies registered with the program.) Customers' reported satisfaction levels appear to support the program's efforts to lessen contractors' confusion about tariff changes.

Recommendation

Continue conducting regular training sessions with trade allies (e.g., distributors, retailers, sales associates, contractors), updating them on tariff changes and, where appropriate, supporting them with sales and marketing training.

wattsmart Starter Kits

The 2014 kit rollout proved successful, with over 12,000 kits distributed. Though participants generally expressed satisfaction with the ordering process and kit equipment, installations of water-saving measures were more limited than other measures. Many participants stored extra faucet aerators or showerheads as the measure did not fit, they had trouble installing the equipment, or they already had the equipment.

Recommendation

To reduce unnecessary program costs, consider offering an opt-out for water-saving measures if the customer does not have a shower or already has efficient showerheads or faucet aerators.

Appendices

A separate volume contains the following appendices:

Appendix A. Survey and Data Collection Forms

Appendix B. Lighting Impacts

Appendix C. Billing Analysis

Appendix D. Self-Report NTG Methodology

Appendix E. Self-Report NTG Findings

Appendix F. Nonparticipant Spillover

Appendix G. Lighting Retailer Allocation Review

Appendix H. Measure Category Cost-Effectiveness

Appendix I. Logic Model

Appendix A. Survey Instruments and Data Collection Tools

CADMUS

PacifiCorp HES Program PM Staff Interview Guide
PY 2013 - 2014

Name:

Title:

Interviewer:

Date of Interview:

Introduction

The purpose of the interview is to explore your experience with the HES Program. We use input from a variety of staff involved with the program to describe how the program worked during 2013 and 2014, what made it successful, and where there may be opportunities for improvement. Please feel free to let me know if there are questions that may not apply to your role so that we can focus on the areas with which you have worked most closely.

Program Overview, Management Roles and Responsibilities:

1. To start, please tell me about your role and associated responsibilities with the HES Program.

a. How long have you been involved?

b. Who are the other key PacifiCorp staff involved in the 2013 and 2014 program period and what are their roles?

Program Goal and Objectives:

2. How would you describe the main objective of the 2013 and 2014 HES Program?

3. What were the savings and participation goals of the program for 2013 and 2014? How did the program do with respect to those goals?

4. Did the program have any informal or internal goals/Key Performance Indicators for this year, such as level of trade ally engagement, participant satisfaction, participation in certain regions, etc.?

a. How or why were these goals developed?

b. How did the program perform in terms of reaching the internal goals (for each state)?

5. Please walk me through how the program worked from a customer perspective. For example, how would a customer hear about the program, how would participation be initiated, and what steps would I go through as a customer? (for all delivery channels – upstream, rebate and kits).

6. How did this customer experience differ among the five states?

7. [If not covered above] Please tell me about how the program worked with trade allies. What types of trade allies did you work with? What are their roles and responsibilities?

Program Design:

Thank you. Now I'd like to ask you about the program design.

8. [If not answered above] Who is your target market for this program?

9. How well did the current program design meet customer needs? (Probe: measures, incentive levels, documentation required, etc.)

10. Were any major changes made to the program since 2012? (incentives, program components (kits), etc) [Probe: Simple Steps, kits]?

a. What was the reason kits were introduce to ID, CA and WA? Are there plans to provide the kits in UT and WY too?

b. Are the kits a standard set of measures or can customers choose which components they want? How is this tracked? [Cadmus will request the specifications for each kit item during a follow-up data request]

c. Were any changes made to the rebate application forms (recommendation from last evaluation)?

d. Have there been any tariff changes since 2012?

11. What worked well in the 2013-2014 period?

12. Conversely, what was not working as well as anticipated?

13. What barriers or challenges did the program face in 2013-2014? What was done/what is planned to address them?

14. What changes are planned or now in place for the HES program (by state)?

15. What was the program's QA/QC process like in 2013-2014? Would you please describe that?

16. In your opinion, what other ways can the program design be improved? (Probe: What? Why?)

Program Marketing

17. [If not covered above] Please describe how the program was marketed (through the website, one-on-one outreach, through trade allies, etc.)?

18. Do you have a marketing plan from 2013-2014 you could share with me? What were the primary marketing activities during that time period?

a. Did all five states use the same marketing plan and tactics?

b. How did the messaging differ in the five states?

c. How much of the marketing is wattsmart vs program specific (HES)?

d. Who is the primary target audience for the program?

19. Did you track marketing effectiveness? What did you track?

a. What was the most effective marketing approach? (Why do you say this?)

Customer Experience:

20. Did you have a process by which you receive customer feedback about the program? (Probe: What is that process and how frequently does it happen, what happens to the information, if a response is required who does that?)

21. What feedback did you receive from customers about the program? What did they say? (Probe: incentive levels, timing for project approvals, incentive payments, satisfaction with studies, trade allies, etc.)

Trade Ally Experience:

22. How did the program recruit trade allies (contractors and retailers)?

23. Do you feel you had sufficient trade allies to support the program? Why or why not?

24. What barriers have the trade allies said they encounter with the program?

    a. What steps have been taken to address these?

    b. What remains to be done to remove these barriers?

25. What kind of training was required and/or offered for trade allies? How frequently and on what topics?

26. Did the program provide marketing resources or sales training to trade allies?

Data Tracking and Savings

27. Please tell us about program data tracking and reporting. How were rebate forms processed? (Probe: What systems did they use, how well did systems communicate, how did trade allies and other stakeholders submit information to the program?). Please describe for all delivery mechanisms (rebates, upstream, kits).

28. Did the data tracking systems in place meet your needs? Why or why not?

29. How were savings deemed for each program measure? How often were the unit energy savings values updated? [Cadmus will request unit energy saving calculators/assumptions during a follow-up data request]

Closing

30. Are there specific topics you are interested in learning more about from our evaluation this year?

31. For the purposes of our customer survey, what should we call the program? Will customers recognize Home Energy Savings, or should we use wattsmart/bewattsmart?

Thank you very much for your time today!

CADMUS

PacifiCorp Home Energy Savings Participant Survey

[UTILITY]

Washington: Pacific Power

Utah, Wyoming, and Idaho: Rocky Mountain Power

Audience: This survey is designed for PacifiCorp residential customers in Utah, Idaho, Washington, and Wyoming that applied for an incentive through the incentive application process in 2013 or 2014. The primary purpose of this survey is to collect information on measure installation, program awareness, motivations to participate, satisfaction, freeridership and spillover effects. This survey will be administered through telephone calls.

Quota: 204 completed surveys for each state (UT, ID, WA, and WY)

Topics	Researchable Questions	Survey Questions
Measure Verification	Did program measure(s) get installed in the household?	Section B
Program Awareness and Purchase Decisions	How did the customer learn about the program? Has the customer been to the wattsmart website (feedback)? Why did the customer purchase the program measure?	Section C
Measure Usage	How is the customer using certain common household appliances and equipment? What was replaced when the new measure was installed?	Section D
Satisfaction	How satisfied is the customer with the measure? With the contractor? With the incentive amount and time it took to receive it? With the overall application process? With the program overall?	Section E
Net-to-Gross	Self-reported freeridership and spillover batteries	Section F and G
Demographics	Customer household information for statistical purposes	Section H

- Interviewer instructions are in green.
- CATI programming instructions are in red.

[MEASURE]

["MEASURE TYPES" TO BE USED IN THE INTERVIEWER INSTRUCTIONS/SKIP PATTERN ARE INCLUDED IN GREEN FONT IN THE TABLE OF MEASURES]

Measure Name	Measure Type for Interviewer Instructions/ Skip Pattern
Air sealing	SEALING
Duct Sealing	SEALING
Duct Sealing and Insulation	SEALING
Ceiling Fan	OTHER
Central Air Conditioner	COOLING
Central Air Conditioner Best Practice Installation	SERVICE
Central Air Conditioner Proper Sizing	SERVICE
Clothes Washer	CLOTHES WASHER
Computer Monitor	OTHER
Desktop Computer	OTHER
Dishwasher	OTHER
Ductless Heat Pump	HEATING/COOLING
Evaporative Cooler	COOLING
Portable Evaporative Cooler	COOLING
Flat Panel TV	OTHER
Freezer	OTHER
Furnace	HEATING
Ground Source Heat Pump	HEATING/COOLING
Heat Pump	HEATING/COOLING
Heat Pump Service	SERVICE
Heat Pump Water Heater	OTHER
Light Fixture	LIGHTING
Refrigerator	OTHER
Room Air Conditioner	ROOM AC
Electric Water Heater	OTHER
Attic Insulation	INSULATION
Wall Insulation	INSULATION
Floor Insulation	INSULATION
Windows	WINDOWS

A. Introduction

A1. **[TO RESPONDENT]** Hello, I'm **[INSERT FIRST NAME]** I am calling from **[INSERT SURVEY FIRM]** on behalf of **[INSERT UTILITY].** We are exploring the impacts of energy efficiency programs offered in your area. I'm not selling anything; I just want to ask you some questions about your energy use and the impact of promotions that have been run by **[INSERT UTILITY]**.

Responses to Customer Questions [IF NEEDED]

(**Timing**: This survey should take about 15 minutes of your time. Is this a good time for us to speak with you?

(**Who are you with**: I'm with **[INSERT SURVEY FIRM]**, an independent research firm that has been hired by **[INSERT UTILITY]** to conduct this research. I am calling to learn about your experiences with the **[INSERT MEASURE]** that you received through **[INSERT UTILITY]**'s wattsmart Home Energy Savings program. [IF NEEDED] You may have received other equipment or benefits through **[INSERT UTILITY]**'s wattsmart Home Energy Savings program, however, we are interested in focusing on the **[INSERT MEASURE]** that you received.

(**Sales concern**: I am not selling anything; we would simply like to learn about your experience with the products you bought and received an incentive for through the program. Your responses will be kept confidential. If you would like to talk with someone from the wattsmart Home Energy Savings Program about this study, feel free to call 1-800-942-0266, or visit their website: http://www.homeenergysavings.net)

(**Who is doing this study: [INSERT UTILITY]**, your electric utility, is conducting evaluations of several of its efficiency programs, including the Home Energy Savings program.)

(**Why you are conducting this study:** Studies like this help **[INSERT UTILITY]** better understand customers' needs and interests in energy programs and services.)

A2. Our records show that in **[INSERT YEAR]** your household received an incentive from **[INSERT UTILITY]** for purchasing **[IF QUANTITY =1; "A OR AN"] [INSERT MEASURE NAME]** through the wattsmart Home Energy Savings program. We're talking with customers about their experiences with the incentive program. Are you the best person to talk with about this?

1. Yes
2. No, not available **[SCHEDULE CALLBACK]**
3. No, no such person **[THANK AND TERMINATE]**

98. Don't Know **[TRY TO REACH RIGHT PERSON; OTHERWISE TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

A3. Were you the primary decision-maker when deciding to purchase the **[INSERT MEASURE](S)]**?

1. Yes
2. No **[REQUEST TO SPEAK TO THE PRIMARY DECISION MAKER, IF AVAILABLE START OVER, IF NOT, SCHEDULE TIME TO CALL BACK]**
98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

A4. Have you, or anyone in your household, ever been employed by with **[INSERT UTILITY]** or any of its affiliates?

1. Yes **[THANK AND TERMINATE]**
2. No **[CONTINUE]**
98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

B. Measure Verification

Now I have a few questions to verify my records are correct.

[FOR SECTION B "MEASURE VERIFICATION, FOLLOW THE RULES BELOW TO DETERMINE WHICH QUESTIONS TO ASK BEFORE CONTINUING TO SECTION C:
IF MEASURE TYPE = SEALING OR SERVICE SKIP TO B7 AND ASK QUESTIONS B7 TO B8;
IF MEASURE TYPE = INSULATION OR WINDOWS SKIP TO B9 AND ASK QUESTIONS B9 TO B14;
ALL REMAINING MEASURE TYPES, CONTINUE TO B1 AND ASK QUESTIONS B1 TO B6]

B1. **[INSERT UTILITY]** records show that you applied for an incentive for **[IF MEASURE QUANTITY = 1 SAY "A"] [IF MEASURE QUANTITY >1 INSERT MEASURE QUANTITY] [INSERT MEASURE](S)** in **[YEAR OF PARTICIPATION]**. Is that correct? **[DO NOT READ RESPONSES]**

[IF NEEDED SAY: "WE KNOW YOU MAY HAVE APPLIED FOR OTHER INCENTIVES, BUT FOR THIS SURVEY, WE'D LIKE TO FOCUS ON JUST THIS ONE TYPE OF EQUIPMENT."]

1. Yes **[SKIP TO B4]**
2. No, quantity is incorrect **[CONTINUE TO B2]**
3. No, measure is incorrect **[SKIP TO B3]**
4. No, both quantity and measure are incorrect **[SKIP TO B3]**
98. Don't Know **[SKIP TO B3]**
99. Refused **[TERMINATE]**

B2. **[ASK IF B1 = 2]** For how many **[INSERT MEASURE](S)** did you apply for an incentive? **[NUMERIC OPEN ENDED. DOCUMENT AND USE AS QUANTITY FOR REMAINDER OF SURVEY]**

1. **[RECORD] [SKIP TO B4]**
98. Don't Know **[SKIP TO B4]**
99. Refused **[SKIP TO B4]**

B3. **[ASK IF B1 = 3 OR 4 OR 98]** Please tell me for what type of equipment you applied for an incentive? **[PROBE FOR MEASURE AND QUANTITY THEN SAY: "Thanks for your time, but unfortunately you do not qualify for this survey." THEN THANK AND TERMINATE]**

1. **[RECORD VERBATIM] [IF RESPONSE = SAME MEASURE, GO BACK TO B1]**
98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

B4. Did **[IF MEASURE QUANTITY >1 SAY "ALL OF"]** the **[INSERT MEASURE](S)** get installed in your home? **[DO NOT READ RESPONSES]**

1. Yes **[SKIP TO C1]**
2. No **[CONTINUE TO B5]**
98. Don't know **[SKIP TO C1]**
99. Refused **[SKIP TO C1]**

[ASK B5 IF B4 = 2 AND MEASURE QUANTITY > 1 OTHERWISE SKIP TO B6]

B5. How many **[INSERT MEASURE](S)** were installed?

1. **[RECORD # 1-100] [CONTINUE TO B6]**
98. Don't Know **[CONTINUE TO B6]**
99. Refused **[CONTINUE TO B6]**

B6. **[ASK IF B4 = 2]** Why haven't you installed the **[INSERT MEASURE](S)** **[MULTIPLE RESPONSE UP TO 3; DO NOT READ, THEN SKIP TO C1]**

1. Failed or broken unit **[SKIP TO C1]**
2. Removed because did not like it **[SKIP TO C1]**
3. Have not had time to install it yet **[SKIP TO C1]**
4. In-storage **[SKIP TO C1]**
5. Back up equipment to install when other equipment fails **[SKIP TO C1]**
6. Have not hired a contractor to install it yet **[SKIP TO C1]**
7. Purchased more than was needed **[SKIP TO C1]**
8. Other **[RECORD]** **[SKIP TO C1]**

98. Don't Know **[SKIP TO C1]**
99. Refused **[SKIP TO C1]**

B7. **[INSERT UTILITY]** records show that you applied for an incentive for **[INSERT MEASURE]** in **[YEAR OF PARTICIPATION]**. Is that correct? **[DO NOT READ RESPONSES]**

[IF NEEDED SAY: "WE KNOW YOU MAY HAVE APPLIED FOR OTHER INCENTIVES, BUT FOR THIS SURVEY, WE'D LIKE TO FOCUS ON JUST THIS ONE TYPE OF EQUIPMENT."]

1. Yes **[SKIP TO C1]**
2. No, measure is incorrect **[SKIP TO B8]**

98. Don't Know **[SKIP TO B8]**
99. Refused **[TERMINATE]**

B8. **[ASK IF B7 = 2 OR 98]** Please tell me for what type of equipment you applied for an incentive? **[PROBE FOR MEASURE AND QUANTITY THEN SAY: "Thanks for your time, but unfortunately you do not qualify for this survey." THEN THANK AND TERMINATE]**

1. **[RECORD VERBATIM]** **[IF RESPONSE =SAME MEASURE, GO BACK TO B7]**

98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

B9. **[INSERT UTILITY]** records show that you applied for an incentive for **[INSERT MEASURE QUANTITY]** square feet of **[INSERT MEASURE](S)** in **[YEAR OF PARTICIPATION]**. Is that correct? **[DO NOT READ RESPONSES; IF CORRECTED YEAR IS NOT 2013 OR 2014, THANK AND TERMINATE,]**

[IF NEEDED SAY: "WE KNOW YOU MAY HAVE APPLIED FOR OTHER INCENTIVES, BUT FOR THIS SURVEY, WE'D LIKE TO FOCUS ON JUST THIS ONE TYPE OF EQUIPMENT."]

1. Yes **[SKIP TO B12]**
2. No, quantity is incorrect **[CONTINUE TO B10]**
3. No, measure is incorrect **[SKIP TO B11]**
4. No, both quantity and measure are incorrect **[SKIP TO B11]**

98. Don't Know **[SKIP TO B11]**
99. Refused **[TERMINATE]**

B10. **[ASK IF B9 = 2]** How many square feet of **[INSERT MEASURE](S)** did you apply for an incentive? **[NUMERIC OPEN ENDED. DOCUMENT AND USE AS QUANTITY FOR REMAINDER OF SURVEY]**

1. **[RECORD] [SKIP TO B12]**

98. Don't Know **[SKIP TO B12]**
99. Refused **[SKIP TO B12]**

B11. **[ASK IF B9 = 3 OR 4 OR 98]** Please tell me for what type of equipment you applied for an incentive? **[PROBE FOR MEASURE AND QUANTITY THEN SAY: "Thanks for your time, but unfortunately you do not qualify for this survey." THEN THANK AND TERMINATE]**

1. **[RECORD VERBATIM] [IF RESPONSE = SAME MEASURE, GO BACK TO B9]**

98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

B12. Did all of the **[INSERT MEASURE QUANTITY]** square feet of **[INSERT MEASURE](S)** get installed in your home? **[DO NOT READ RESPONSES]**

1. Yes **[SKIP TO C1]**
2. No **[CONTINUE TO B13]**

98. Don't know **[SKIP TO C1]**
99. Refused **[SKIP TO C1]**

B13. What percentage of the **[INSERT MEASURE](S)** was installed?

1. **[RECORD 0-100%] [CONTINUE TO B14]**

98. Don't Know **[CONTINUE TO B14]**
99. Refused **[CONTINUE TO B14]**

B14. Why haven't you had a chance to install all **[INSERT MEASURE QUANTITY]** square feet of **[INSERT MEASURE] (S)**? **[MULTIPLE RESPONSE UP TO 3; DO NOT READ, THEN SKIP TO C1]**

1. Failed or broken unit **[SKIP TO C1]**
2. Removed because did not like it **[SKIP TO C1]**
3. Have not had time to install it yet **[SKIP TO C1]**
4. In-storage **[SKIP TO C1]**
5. Back up equipment to install when other equipment fails **[SKIP TO C1]**
6. Have not hired a contractor to install it yet **[SKIP TO C1]**
7. Purchased more than was needed **[SKIP TO C1]**
8. Other **[RECORD]** **[SKIP TO C1]**

98. Don't Know **[SKIP TO C1]**
99. Refused **[SKIP TO C1]**

C. Program Awareness & Purchase Decisions

C1. How did you first hear about **[INSERT UTILITY]**'s wattsmart Home Energy Savings program? **[DO NOT PROMPT. RECORD ONLY THE FIRST WAY HEARD ABOUT THE PROGRAM.]**

1. Bill Inserts
2. Billboard/outdoor ad
3. Family/friends/word-of-mouth
4. Home Energy Reports
5. Home Shows/Trade Shows (Home and Garden Shows)
6. Internet Advertising/Online Ad
7. Newspaper/Magazine/Print Media
8. Northwest Energy Efficiency Alliance (NEEA)
9. Other website
10. Radio
11. Retailer/Store
12. Rocky Mountain Power/Pacific Power Representative
13. Rocky Mountain Power/Pacific Power website
14. Social Media
15. Sporting event
16. TV
17. wattsmart Home Energy Savings website
18. Other **[RECORD VERBATIM]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C2. **[ASK IF C1 <> 13 0R 17, OTHERWISE SKIP TO C3]** Have you been to the **[INSERT UTILITY]** wattsmart Home Energy Savings program website? **[DO NOT READ RESPONSES]**

1. Yes
2. No

C3. **[ASK IF C1 = 13 OR 17, OR IF C2 = 1, OTHERWISE SKIP TO C5]** Was the website… **[READ]**

1. Very helpful **[SKIP TO C5]**
2. Somewhat helpful
3. Somewhat unhelpful
4. Very unhelpful
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C4. **[ASK IF C3= 2, 3, OR 4. OTHERWISE SKIP TO C5]** What would make the website more helpful for you? **[DO NOT READ RESPONSES, MARK ALL THAT APPLY]**

1. Nothing, it is already very helpful for me.
2. Make the website easier to navigate or more user-friendly (clear hierarchy)
3. Make program information more clear and concise
4. Incorporate more visual information (charts, graphs, images) and less text
5. Provide easier access to customer service or FAQs
6. Other **[RECORD]**

C5. Please think back to the time when you were deciding to buy the energy saving **[INSERT MEASURE](S)**. What factors motivated you to purchase the **[INSERT MEASURE](S)? [DO NOT READ. INDICATE ALL THAT APPLY. ONCE THEY RESPONDENT HAS FINISHED, SAY: "ARE THERE ANY OTHER FACTORS?"]**

1. Old equipment didn't work
2. Old equipment working poorly
3. The program incentive
4. A program affiliated contractor
5. Wanted to save energy
6. Wanted to reduce energy costs
7. Environmental concerns
8. Recommendation from other utility **[PROBE: "WHAT UTILITY?" RECORD]**
9. Recommendation of dealer/retailer **[PROBE: "FROM WHICH STORE?" RECORD]**
10. Recommendation from friend, family member, or colleague
11. Recommendation from a contractor
12. Advertisement in newspaper **[PROBE: "FOR WHAT PROGRAM?" RECORD]**
13. Radio advertisement **[PROBE: "FOR WHAT PROGRAM?" RECORD]**
14. Health or medical reasons
15. Maintain or increase comfort of home
16. Interested in new/updated technology
17. Other **[RECORD]**
98. Don't Know
99. Refused

D. Measure Usage

[SAY "I HAVE SOME QUESTIONS ABOUT YOUR GENERAL HOUSEHOLD ENERGY USE AND COMMON HOUSEHOLD APPLIANCES"]

D1. **[IF MEASURE TYPE = CLOTHES WASHER, SKIP TO D2]** Do you have a clothes washer installed in your home?

1. Yes
2. No **[SKIP TO D9]**
98. Don't Know **[SKIP TO D9]**
99. Refused **[SKIP TO D9]**

D2. Approximately how many loads of clothes does your household wash in a typical week?

1. **[RECORD]**
98. Don't Know
99. Refused

D3. **[ASK IF MEASURE TYPE = CLOTHES WASHER, OTHERWISE SKIP TO D5]** How does the number of wash loads you do now compare to the number that you did with your old clothes washer? **[DO NOT READ RESPONSES]**

1. Same **[SKIP TO D5]**
2. Different **[CONTINUE TO D4]**
98. Don't Know **[SKIP TO D5]**
99. Refused **[SKIP TO D5]**

D4. **[ASK IF D3 = 2]**Do you do more or fewer loads now than you did before? Could you estimate a percentage?

1. More loads now, Record percentage **[MUST BE GREATER THAN 100%, EG 125% FOR 25% MORE]**
2. Fewer loads now, Record percentage **[MUST BE LESS THAN 100%, EG 75% FOR 25% LESS THAN BEFORE]**
98. Don't Know
99. Refused

D5. On what percentage of loads do you use a high-speed spin cycle? **[IF NEEDED: HIGH-SPEED SPIN CYCLES REMOVE MORE WATER FROM THE LOAD, RESULTING IN SHORTER DRYING TIMES]**

1. Never
2. LESS THAN 25%
3. 25-50%
4. 50-75%
5. 75-99%
6. Always or 100% **[SKIP TO D7]**
98. **[DO NOT READ]** Don't know **[SKIP TO D7]**
99. **[DO NOT READ]** Refused **[SKIP TO D7]**

D6. **[ASK IF D5 = 1-5]** When you do not use the high spin cycle, what is your reason? **[DO NOT READ. INDICATE ALL THAT APPLY]**

1. Noise/vibration
2. Impact on clothing
3. Always use high spin
4. Other **[RECORD]**
98. **[DO NOT READ]**Don't know
99. **[DO NOT READ]** Refused

D7. What percentage of your loads do you dry using a clothes dryer? **[READ CATEGORIES IF NEEDED]**

1. Never **[SKIP TO D9]**
2. LESS THAN 25%
3. 25-50%
4. 50-75%
5. 75- 99%
6. Always or 100%
98. Don't know **[SKIP TO D9]**
99. Refused **[SKIP TO D9]**

D8. When you dry your clothes do you… **[READ]**

1. Use a timer to determine drying times.
2. Use the dryer's moisture sensor to determine when the load is dry.
3. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't know
99. **[DO NOT READ]** Refused

D9. How many times a week do you use a dishwasher?

1. **[RECORD]**
2. Don't have a dishwasher
98. Don't Know
99. Refused

[IF MEASURE TYPE= HEATING SKIP TO D13 OR HEATING/COOLING SKIP TO D20]

D10. What type of heating system do you primarily use… **[READ]**

1. Furnace
2. Boiler
3. Air Source Heat Pump
4. Ground Source Heat Pump
5. Ductless Heat Pump
6. Stove
7. Baseboard
8. No heating system **[SKIP TO D13]**
9. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D11. How many years old is the heating system?

1. **[RECORD]**
98. Don't Know
99. Refused

D12. What type of fuel does the heating system use… **[READ]**

1. Gas
2. Electric
3. Oil
4. Propane
5. Coal
6. Wood
7. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D13. **[IF MEASURE TYPE= COOLING SKIP TO D23]** What type of cooling system do you primarily use **[IF MEASURE TYPE = ROOM AC THEN SAY "BESIDES THE ROOM AIR CONDITIONER"]**? A… **[READ, MULTIPLE CHOICES ALLOWED]**

1. Central Air Conditioner
2. Evaporative Cooler
3. Air Source Heat Pump
4. Ground Source Heat Pump
5. Ductless heat pump
6. Whole house fan
7. No central cooling system **[SKIP TO D15]**
8. Other **[SPECIFY]**

98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D14. How many years old is your current cooling system?

1. **[RECORD]**

98. Don't Know
99. Refused

D15. **[ASK IF MEASURE TYPE = LIGHTING]** in which room(S) [is/are] the lighting fixture(s) installed? **[MULTIPLE RESPONSES ALLOWED]**

1. Living/family room
2. Bedroom
3. Unoccupied bedroom
4. Bathroom
5. Kitchen
6. Garage
7. Office
8. Attic
9. Closet/storage
10. Hallway
11. Exterior

98. Don't Know
99. Refused

[FOR QUESTIONS D16 - D24 USE THE FOLLOWING SKIP PATTERN
FOR MEASURE TYPES OTHER, CLOTHES WASHER, ROOM AC, AND LIGHTING: READ QUESTIONS D16 TO D17 THEN SKIP TO E1;
FOR MEASURE TYPE WINDOWS: READ QUESTIONS D18 AND D19 THEN SKIP TO E1;

FOR MEASURE TYPE HEATING: READ QUESTIONS D20 TO D22 THEN SKIP TO E1
FOR MEASURE TYPE COOLING: READ QUESTIONS D23 TO D24 THEN SKIP TO E1;
FOR MEASURE TYPE HEATING/COOLING: READ QUESTIONS D20 TO D24 THEN SKIP TO E1;
FOR MEASURE TYPES SEALING, INSULATION AND SERVICE: SKIP TO E1]

D16. Was the purchase of your new **[INSERT MEASURE](S)** intended to replace **[AN]** old **[INSERT MEASURE TYPE]**?

1. Yes **[CONTINUE TO D17]**
2. No **[SKIP TO E1]**
98. Don't Know **[SKIP TO E1]**
99. Refused **[SKIP TO E1]**

D17. **[ASK IF D16 = 1]** What did you do with the old **[INSERT MEASURE TYPE]** after you got your new **[INSERT MEASURE](S)**? **[READ CATEGORIES IF NEEDED]**

1. Sold or given away **[SKIP TO E1]**
2. Recycled **[SKIP TO E1]**
3. Installed in another location in the home **[SKIP TO E1]**
4. Still in home but permanently removed [stored in garage, etc.] **[SKIP TO E1]**
5. Thrown away **[SKIP TO E1]**
98. **[DO NOT READ]** Don't Know **[SKIP TO E1]**
99. **[DO NOT READ]** Refused **[SKIP TO E1]**

D18. **[ASK IF MEASURE TYPE= WINDOWS AND (B9 = 1 OR B13.1>0%). OTHERWISE SKIP TO E1]** What type of windows did you have before the new windows were installed?

1. Single pane **[OLDER WINDOWS]**
2. Double Pane **[NEWER WINDOWS]**
3. Triple Pane **[RARE]**
98. Don't Know
99. Refused

D19. **[ASK IF MEASURE = WINDOWS AND (B9= 1 OR B13.1>0%), OTHERWISE SKIP TO E1]** What type of window frames (not window trim, which is almost always wood) did you have before the new windows were installed?

1. Wood
2. Vinyl
3. Metal
98. Don't Know
99. Refused

[ASK D20 TO D22 IF MEASURE TYPE = HEATING OR HEATING/COOLING. OTHERWISE SKIP TO E1]

D20. What type of heating system did you have before the new **[INSERT MEASURE]** was installed?

1. Furnace
2. Boiler
3. Air Source Heat Pump
4. Ground Source Heat Pump
5. Ductless Heat Pump
6. Stove
7. Baseboard
8. No heating system before **[SKIP TO E1]**
9. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D21. How many years old was the previous heating system?

1. **[RECORD]**
98. Don't Know
99. Refused

D22. What type of fuel does the new heating system use**… [READ]**

1. Gas
2. Electric
3. Oil
4. Propane
5. Coal
6. Wood
7. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. [do not read] Refused

[ASK D23 TO D24 IF MEASURE TYPE = COOLING OR HEATING/COOLING]

D23. What type of cooling system did you have before the new **[INSERT MEASURE]** was installed? **[READ]**

1. Central Air Conditioner
2. Room Air Conditioner
3. Evaporative Cooler
4. Air Source Heat Pump
5. Ground Source Heat Pump
6. Ductless Heat Pump
7. Whole house fan
8. No cooling system before **[SKIP TO E1]**
9. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D24. How many years old was the previous cooling system?

1. **[RECORD]**
98. Don't Know
99. Refused

E. Satisfaction

E1. Overall, how satisfied are you with your **[INSERT MEASURE](S)** Would you say you are…? **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied
4. Not At All Satisfied
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E2. Did a contractor install the **[INSERT MEASURE](S)** for you?

1. Yes
2. No
98. Don't Know
99. Refused

E3. **[ASK IF E2=1]** How satisfied were you with the contractor that installed the **[INSERT MEASURE](S)** for you? **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied
4. Not At All Satisfied
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E4. **[IF E3 = 3 OR 4]** Why were you not satisfied with the contractor that installed the **[INSERT MEASURE](S)**?

1. **[RECORD]**
98. Don't know
99. Refused

E5. How easy did you find filling out the wattsmart Home Energy Savings Program incentive application? **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Easy
2. Somewhat Easy
3. Not Very Easy **[PROBE FOR REASON AND RECORD]**
4. Not At All Easy **[PROBE FOR REASON AND RECORD]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E6. How satisfied were you with the amount of the incentive you received for the **[INSERT MEASURE](S)?**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
98. Don't Know
99. Refused

E7. After you submitted the incentive application for the **[INSERT MEASURE](S)**, how long did it take to receive the incentive check from **[INSERT UTILITY]**? Was it… **[READ CATEGORIES IF NEEDED, RECORD ONLY FIRST RESPONSE]**

1. Less than 4 weeks
2. Between 4 and 6 weeks
3. Between 7 and 8 weeks
4. More than 8 weeks
5. Have not received the incentive yet
98. **[DO NOT READ]** Don't Know **[SKIP TO E9]**
99. **[DO NOT READ]** Refused **[SKIP TO E9]**

E8. **[ASK IF E7<> 5]** Were you satisfied with how long it took to receive the incentive?

1. Yes
2. No **[PROBE FOR REASON AND RECORD]**
98. Don't Know
99. Refused

E9. How satisfied were you with the entire application process?

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**

E10. Overall, how satisfied are you with the wattsmart Home Energy Savings program? **[READ CATEGORIES; RECORD ONLY FIRST RESPONSE]**

1. Very Satisfied **[PROBE FOR REASON AND RECORD]**
2. Somewhat Satisfied **[PROBE FOR REASON AND RECORD]**
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E11. Did your participation in **[INSERT UTILITY]**'s wattsmart Home Energy Savings Program cause your satisfaction with **[INSERT UTILITY]** to…

1. Increase
2. Stay the same
3. Decrease
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

F. Freeridership

Now I'd like to talk with you a little more about the **[INSERT MEASURE](S)** you purchased.

F1. When you first heard about the incentive from **[INSERT UTILITY]**, had you already been planning to purchase the **[INSERT MEASURE](S)**?

1. Yes
2. No **[SKIP TO F4]**
98. Don't Know **[SKIP TO F4]**
99. Refused **[SKIP TO F4]**

F2. Ok. Had you already purchased or installed the new **[INSERT MEASURE](S)** before you learned about the incentive from the wattsmart Program?

1. Yes
2. No **[SKIP TO F4]**
98. Don't Know **[SKIP TO F4]**
99. Refused **[SKIP TO F4]**

F3. Just to confirm, you learned about the **[INSERT UTILITY]** rebate program after you had already purchased or installed the **[INSERT MEASURE](S)** ?

1. Yes **[SKIP TO F13]**
2. No
98. Don't Know
99. Refused

[IF F3= 1 SKIP TO F13]

F4. Would you have purchased the same **[INSERT MEASURE](S)** without the incentive from the wattsmart Home Energy Savings program?

1. Yes **[SKIP TO F6]**
2. No
98. Don't Know
99. Refused

[IF F4 = 1 THEN SKIP TO F6]

F5. **[ASK IF F4 = 2, -98 OR -99]** Help me understand, would you have purchased something without the wattsmart Home Energy Savings program incentive? **[DO NOT READ RESPONSES]**

1. Yes, I would have purchased something
2. No, I would not have purchased anything **[SKIP TO F9]**
98. Don't Know **[SKIP TO F13]**
99. Refused **[SKIP TO F13]**

[IF F5 = 2 SKIP TO F9. IF F5 = -98 OR -99 SKIP TO F13]

F6. **[ASK IF F4= 1 OR F5 = 1]** Let me make sure I understand. When you say you would have purchased **[A] [MEASURE](S)** without the program incentive, would you have purchased **[A] [INSERT MEASURE](S)] THAT [WAS/WERE] JUST AS ENERGY EFFICIENT"**?

1. Yes
2. No
98. Don't Know
99. Refused

F7. **[ASK IF F4= 1 OR F5 = 1 AND MEASURE QUANTITY >1]** Without the program incentive would you have purchased the same amount of **[INSERT MEASURE](S)**?

1. Yes, I would have purchased the same amount
2. No, I would have purchased less
98. Don't Know
99. Refused

F8. **[ASK IF F4= 1 OR F5 = 1]** Without the program incentive would you have purchased the **[INSERT MEASURE](S)… [READ]**

1. At the same time
2. Within one year?
3. In more than one year?
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

[SKIP TO F13]

F9. **[ASK IF F5=2]** To confirm, when you say you would not have purchased the same **[INSERT MEASURE](S)** without the program incentive**,** do you mean you would not have purchased the **[INSERT MEASURE](S)** <u>at all</u>?

1. Yes
2. No
98. Don't Know
99. Refused

[IF F9 = 1 SKIP TO F13]

F10. **[ASK IF F9 = 2, -98, -99]** Again, help me understand. Without the program incentive, would you have purchased the same type of **[INSERT MEASURE](S)** but **[A] [[INSERT MEASURE](S)] THAT [WAS/WERE] NOT AS ENERGY EFFICIENT?**

1. Yes
2. No
98. Don't Know
99. Refused

F11. **[ASK IF F9= 2, -98, -99 AND QTY MEASURE>1]** Without the program incentive would you have purchased the same amount of **[INSERT MEASURE](S)**?

1. Yes, I would purchase the same amount
2. No, I would have purchased less
98. Don't Know
99. Refused

F12. **[ASK IF F9 = 2, -98, -99]**And, would you have purchased the **[INSERT MEASURE](S)… [READ]**

1. At the same time
2. Within one years?
3. In more than one year?
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

F13. In your own words, please tell me the influence the Home Energy Saving incentive had on your decision to purchase **[INSERT MEASURE](S)?**

1. _____ **[RECORD RESPONSE]**

G. Spillover

G1. Since participating in the program, have you added any other energy efficient equipment or services in your home that were not incentivized through the wattsmart Home Energy Savings Program?

1. Yes
2. No
98. Don't Know
99. Refused

[IF G1 = 2, -98 OR -99 SKIP TO H1]

G2. What high-efficiency energy-saving equipment or services have you purchased since applying for the incentive, not including the **[INSERT MEASURE]** that we have been discussing today? **[LIST OF OTHER ELIGIBLE APPLIANCES AND MEASURES OTHER THAN THOSE LISTED IN PROGRAM RECORDS. PROMPT IF NEEDED]**

1. Clothes Washer **[RECORD QUANTITY]**
2. Refrigerator **[RECORD QUANTITY]**
3. Dishwasher **[RECORD QUANTITY]**
4. Windows **[RECORD QUANTITY IN SQ FT]**
5. Fixtures **[RECORD QUANTITY]**
6. Heat Pump **[RECORD QUANTITY]**
7. Central Air Conditioner **[RECORD QUANTITY]**
8. Room Air Conditioner **[RECORD QUANTITY]**
9. Ceiling Fans **[RECORD QUANTITY]**
10. Electric Storage Water Heater **[RECORD QUANTITY]**
11. Electric Heat Pump Water Heater **[RECORD QUANTITY]**
12. CFLs **[RECORD QUANTITY]**
13. LEDs **[RECORD QUANTITY]**
14. Insulation **[RECORD QUANTITY IN SQ FT]**
15. Air Sealing **[RECORD QUANTITY IN CFM REDUCTION]**
16. Duct Sealing **[RECORD QUANTITY IN CFM REDUCTION]**
17. Programmable thermostat **[RECORD QUANTITY]**
18. Other **[RECORD]** **[RECORD QUANTITY]**
19. None
98. Don't Know
99. Refused

[IF G2 = 12 (ONLY), -98 OR -99 SKIP TO H1. REPEAT G3 THROUGH G5 FOR ALL RESPONSES TO G2]

G3. In what year did you purchase **[INSERT MEASURE TYPE FROM G2]**?

1. 2013
2. 2014
3. Other **[RECORD YEAR]**
98. Don't Know
99. Refused

G4. Did you receive an incentive for **[INSERT MEASURE TYPE FROM G2]?**

1. Yes **[PROBE AND RECORD]**
2. No
98. Don't Know
99. Refused

G5. How influential would you say the wattsmart Home Energy Savings program was in your decision to add the **[INSERT MEASURE FROM G2]** to your home? Was it… **[REPEAT FOR EACH MEASURE LISTED IN G2]**

1. Highly Influential
2. Somewhat Influential
3. Not very influential
4. Not at all influential
98. Don't Know
99. Refused

H. Demographics

I have just a few more questions about your household. Again, all your answers will be strictly confidential.

H1. Which of the following best describes your house? **[READ LIST]:**

1. Single-family home
2. Townhouse or duplex
3. Mobile home or trailer
4. Apartment building with 4 or more units
5. Other **[RECORD]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** refused

H2. Do you rent or own your home?

1. Own
2. Rent
3. Other **[RECORD]**
98. Don't Know
99. Refused

H3. Including yourself and any children, how many people currently live in your home?

1. **[RECORD]**
98. Don't Know
99. Refused

H4. About when was this building first built? **[READ LIST IF NEEDED]**

1. Before 1970's
2. 1970's
3. 1980's
4. 1990-94
5. 1995-99
6. 2000-2004
7. 2005-2009
8. 2010 +
9. OTHER **[RECORD]**
98. **[DO NOT READ]** don't know
99. **[DO NOT READ]** refused

H5. What type of foundation does your home have? **[READ LIST IF NEEDED]**

1. Full finished basement
2. Unfinished Basement
3. Crawlspace
4. Slab on Grade
5. OTHER **[RECORD]**
98. **[DO NOT READ]** don't know
99. **[DO NOT READ]** refused

H6. Approximately how many square feet is the home in which the **[INSERT MEASURE](S)** was installed or purchased for? **[READ LIST IF NEEDED]**

1. Under 1,000 square feet
2. 1,000 – 1,500 square feet
3. 1,501 – 2,000 square feet
4. 2,001 – 2,500 square feet
5. Over 2,500 square feet
98. **[DO NOT READ]** don't know
99. **[DO NOT READ]** refused

H7. **[SKIP IF MEASURE = ELECTRIC WATER HEATER OR HEAT PUMP WATER HEATER]** What is the fuel used by your primary water heater?

1. Electricity
2. Natural gas
3. Fuel oil
4. Other **[RECORD]**
98. Don't know
99. refused

I. Conclusion

I1. That concludes the survey. Do you have any additional feedback or comments?

1. Yes **[RECORD VERBATIM]**
2. No
98. Don't know
99. refused

Thank you very much for your time and feedback. Have a great day.

CADMUS

PacifiCorp HES Upstream Lighting Survey

Audience: This survey is designed for PacifiCorp residential customers in Utah, Idaho, Washington, Wyoming and California (pending). The primary purpose of this survey is to collect information on awareness, satisfaction, installation of energy efficient lighting and energy efficient equipment purchases and motivations. This survey will be administered through telephone calls.

Quota: 250 completed surveys for each state (UT, ID, WA, WY and CA [pending])

Topics	Researchable Questions	Survey Questions
Awareness	Are respondents aware of CFL and LED lighting products?	B1, B2, C1
Installation	What percent of CFLs and LEDs purchased in the past 12 months were installed in the home? Where were the purchased CFLs and LEDs installed (room)?	B4, B9, C3, C8
Disposal and Storage	What percent of CFLs/LEDs purchased in the past 12 months were removed and why? What percent of CFLs/LEDs purchased in the past 12 months are in storage for future use?	**Error! Reference source not found.**-B12, C9-C11
Satisfaction with CFLs and LEDs	How satisfied are residents with their CFLs and LEDs? What do they like or dislike about them?	B8, B15, B16, C7, C14, C15
PacifiCorp Programs	Are respondents aware of the PacifiCorp programs? How did they hear about them? Have respondents visited the Home Energy Savings Website?	Section D
Participant Decisions	What actions are residents taking to save energy? Did they receive a rebate from PacifiCorp during the 2013-2014 program period? How influential were the PacifiCorp programs in their decision to install the equipment?	Section E
Demographics	How do awareness /activities/behaviors vary by demographic characteristics?	Section F

- Interviewer instructions are in green.
- CATI programming instructions are in red.

[UTILITY]

Washington and California: Pacific Power

Utah, Wyoming, and Idaho: Rocky Mountain Power

A. Introduction

A1. **[TO RESPONDENT]** Hello, I'm **[INSERT FIRST NAME]**, calling from **[INSERT SURVEY FIRM],** on behalf of **[UTILITY]**. May I please speak with **[INSERT NAME]**?

Hello, we are conducting a survey about household lighting and home energy use and would like to ask you some questions about your household's lighting and energy use. We would greatly appreciate your opinions.

[IF NOT AVAILABLE, ASK FOR AN ADULT IN THE HOUSEHOLD WHO IS RESPONSIBLE FOR PURCHASING THE LIGHT BULBS. IF NO ONE APPROPRIATE IS AVAILABLE, TRY TO RESCHEDULE AND THEN TERMINATE. IF TRANSFERRED TO ANOTHER PERSON, REPEAT INTRO AND THEN CONTINUE.]

Responses to Customer Questions [IF NEEDED]

(**Timing:** This survey should take about 10 to 15 minutes of your time. Is this a good time for us to speak with you?)

(**Who are you with**: I'm with **[INSERT SURVEY FIRM]**, an independent research firm that has been hired by **[UTILITY]** to conduct this research. I am calling to learn about your household lighting and home energy use)

(**Sales concern:** I am not selling anything; we would simply like to learn about your household lighting and home energy use. Your responses will be kept confidential. If you would like to talk with someone from the Home Energy Savings Program about this study, feel free to call 1-800-942-0266, or visit their website: http://www.homeenergysavings.net/.)

(**Who is doing this study: [INSERT UTILITY]**, your electric utility, is conducting evaluations of several of its efficiency programs.)

(**Why are you conducting this study:** Studies like this help **[INSERT UTILITY]** better understand customers' need and interest in energy programs and services.)

A2. This call may be monitored for quality assurance. First, are you the person who usually purchases light bulbs for your household?

1. Yes
2. No, but person who does can come to phone **[START OVER AT INTRO SCREEN WITH NEW RESPONDENT]**
3. No, and the person who does is not available **[SCHEDULE CALLBACK]**

98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

A3. Have you, or anyone in your household, ever been employed by or affiliated with **[INSERT UTILITY]** or any of its affiliates?

1. Yes **[THANK AND TERMINATE]**
2. No **[CONTINUE]**
98. Don't Know **[CONTINUE]**
99. Refused **[THANK AND TERMINATE]**

B. CFL Awareness and Purchases

B1. Before this call today, had you ever heard of a type of energy-efficient light bulb called a "compact fluorescent light bulb", or CFL, for short?

1. Yes **[SKIP TO B3]**
2. No

B2. CFLs usually do not look like traditional incandescent light bulbs. The most common type of CFL has a spiral shape, resembling soft-serve ice cream, and it fits in a regular light bulb socket. Before today, had you heard of CFLs?

1. Yes
2. No **[SKIP TO C1]**

B3. I have some questions about your lighting purchases during the last twelve months. Did you purchase any CFLs in the last twelve months?

1. Yes
2. No **[SKIP TO C1]**
98. Don't Know **[SKIP TO C1]**
99. Refused **[SKIP TO C1]**

B4. During the last twelve months, how many *CFLs* did you or your household purchase? Please try to estimate the total number of *individual CFL bulbs*, as opposed to packages. **[IF "DON'T KNOW," PROBE: "IS IT LESS THAN OR MORE THAN FIVE BULBS?" WORK FROM THERE TO GET AN ESTIMATE]**

1. **[RECORD # OF CFLS: NUMERIC OPEN END] [IF QUANTITY=0, SKIP TO C1]**
98. Don't Know **[PROBE: "IS IT LESS THAN OR MORE THAN FIVE BULBS?" WORK FROM THERE TO GET AN ESTIMATE] [IF UNABLE TO GET AN ANSWER, SKIP TO C1]**
99. Refused **[SKIP TO C1]**

B5. Where did you purchased the **[B4.1]** CFLs? **[PROBE FOR RETAIL CHAINS OR ONLINE] [DO NOT READ, MULTIPLE REPSONSES ALLOWED]**

1. Ace Hardware **[CITY, STATE, # PURCHASED]**
2. Broulim's Fresh Foods **[CITY, STATE, # PURCHASED]**
3. Barrett's Foodtown **[CITY, STATE, # PURCHASED]**
4. Batteries Plus **[CITY, STATE, # PURCHASED]**
5. Bi-Mart **[CITY, STATE, # PURCHASED]**
6. Big Lots **[CITY, STATE, # PURCHASED]**
7. Corner Grocery & Hardware **[CITY, STATE, # PURCHASED]**
8. Costco **[CITY, STATE, # PURCHASED]**
9. Delta Jubilee Foods **[CITY, STATE, # PURCHASED]**
10. Do It Best **[CITY, STATE, # PURCHASED]**
11. Dollar Tree **[CITY, STATE, # PURCHASED]**
12. Family Dollar **[CITY, STATE, # PURCHASED]**
13. Fresh Markets **[CITY, STATE, # PURCHASED]**
14. Kamas Foodtown **[CITY, STATE, # PURCHASED]**
15. Kroger – Fred Meyer **[CITY, STATE, # PURCHASED]**
16. Griffith Foodtown **[CITY, STATE, # PURCHASED]**
17. Gunnison Market **[CITY, STATE, # PURCHASED]**
18. Hess Lumber Co **[CITY, STATE, # PURCHASED]**
19. Habitat for Humanity **[CITY, STATE, # PURCHASED]**
20. Harmons **[CITY, STATE, # PURCHASED]**
21. Lowe's **[CITY, STATE, # PURCHASED]**
22. Menards **[CITY, STATE, # PURCHASED]**
23. Petersons Fresh Market **[CITY, STATE, # PURCHASED]**
24. Rancho Markets **[CITY, STATE, # PURCHASED]**
25. Ream's Foods **[CITY, STATE, # PURCHASED]**
26. Ridley's **[CITY, STATE, # PURCHASED]**
27. Safeway **[CITY, STATE, # PURCHASED]**
28. Sam's Club **[CITY, STATE, # PURCHASED]**
29. Smith's **[CITY, STATE, # PURCHASED]**
30. Stokes Market Place **[CITY, STATE, # PURCHASED]**
31. Sutherlands **[CITY, STATE, # PURCHASED]**
32. Thomas Market **[CITY, STATE, # PURCHASED]**
33. Target **[CITY, STATE, # PURCHASED]**
34. Home Depot **[CITY, STATE, # PURCHASED]**
35. The Market **[CITY, STATE, # PURCHASED]**
36. True Value Hardware **[CITY, STATE, # PURCHASED]**
37. Walgreens **[CITY, STATE, # PURCHASED]**
38. Walmart **[CITY, STATE, # PURCHASED]**

39. Winegar's Supermarkets **[CITY, STATE, # PURCHASED]**
40. Online **[WEBSITE, # PURCHASED]**
98. Other **[RECORD STORE NAME, CITY, STATE, # PURCHASED]**
98. Don't Know
99. Refused

B6. Do you recall if any of the **[B4.1]** CFLs you purchased part of a **[INSERT UTILTY]** sponsored sale?

1. Yes
2. No
98. Don't Know
99. Refused

B7. **[ASK IF B6 = 1, OTHERWISE SKIP TO B8]** Did the **[INSERT UTILTY]** discount influence your decision to purchase CFLs over another type of bulb?

1. Yes
2. No
98. Don't Know
99. Refused

B8. What **[IF B7=1 SAY "OTHER"]** factors were important for your decision to buy CFLs over other types of bulbs? **[DO NOT READ. MULTIPLE RESPONSES ALLOWED]**

1. Energy savings
2. Cost savings on electricity bill
3. Price of bulb
4. Environmental concerns
5. Quality of light
6. Lifetime of bulb
7. Other **[RECORD]**
98. Don't Know
99. Refused

B9. Now I'd like to ask you a few questions about the **[B4.1]** CFLs you purchased in the last twelve months. How many did you install in your home since you purchased them?

1. **[RECORD # OF CFLS]**
2. None **[SKIP TO B12]**
98. Don't Know **[SKIP TO B15]**
99. Refused **[SKIP TO B15]**

B10. Have you since removed any of those CFL bulbs from the sockets?

1. Yes **[ASK "HOW MANY DID YOU REMOVE?" RECORD # OF CFLS]**
2. No **[SKIP TO B12]**
98. Don't Know
99. Refused

B11. What were the reasons you removed the **[B10.1]** purchased CFLs from the sockets? **[QUANTITIES SHOULD ADD TO B10.1, IF NOT, ASK "WHAT ABOUT THE REMAINING BULBS YOU REMOVED?] [DO NOT READ, MULTIPLE RESPONSES ALLOWED]**

1. Bulb burned out **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
2. Bulbs were too bright **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
3. Bulbs were not bright enough **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
4. Delay in light coming on **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
5. Did not work with dimmer/3-way switch **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
6. Didn't fit properly **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
7. Stuck out of fixture **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
8. Light color **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
9. Concerned about mercury **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
10. Replaced with LEDs for better efficiency **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
11. Other **[RECORD VERBATIM] [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
98. Don't Know
99. Refused

B12. Are any of the **[B4.1]** CFLs you purchased in the last twelve months currently in storage for later use?

1. Yes **[ASK: "HOW MANY ARE NOW IN STORAGE?" RECORD # OF CFLS]**
2. No
98. Don't Know
99. Refused

B13. **[SKIP TO C1 IF B9= 2, 98 OR 99]** Of the **[B9.1]** bulbs that you installed in your home that were purchased during the last twelve months, can you tell me how many CFLs were installed in each room in your house?

1. Bedroom **[RECORD]**
2. Bedroom (unoccupied) **[RECORD]**
3. Basement **[RECORD]**
4. Bathroom **[RECORD]**
5. Closet **[RECORD]**
6. Dining **[RECORD]**
7. Foyer **[RECORD]**
8. Garage **[RECORD]**
9. Hallway **[RECORD]**
10. Kitchen **[RECORD]**
11. Office/Den **[RECORD]**
12. Living Space **[RECORD]**
13. Storage **[RECORD]**
14. Outdoor **[RECORD]**
15. Utility **[RECORD]**
16. Other **[RECORD VERBATIM]**

98. Don't Know
99. Refused

B14. **[ASK ONLY IF TOTAL BULBS IN B13 <QUANTITY FROM B9.1 (IF TOTAL NUMBER OF BULBS LISTED IN EACH ROOM DOES NOT MATCH THE NUMBER OF BULBS INSTALLED STATED IN B9.1, OTHERWISE SKIP TO B15]** Thanks, that accounts for **[TOTAL BULBS IN B13]** of the total quantity that were installed in your home. Can you tell me where the **[B9.1 MINUS TOTAL BULBS IN B13]** other bulbs were installed?

1. **[RECORD VERBATIM]**

98. Don't Know
99. Refused

B15. How satisfied are you with the compact fluorescent light bulb(s) that you purchased during the last twelve months? Would you say you are… **[READ]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied
4. Not At All Satisfied

98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

B16. **[ASK ONLY IF B15 = 3 OR 4]** Why would you say you are **[INSERT ANSWER FROM B15]** with CFLs? **[DO NOT READ LIST AND RECORD ALL THAT APPLY]**

1. Bulb burned out
2. Bulbs are too bright
3. Bulbs are not bright enough
4. Delay in light coming on
5. Did not work with dimmer/3-way switch
6. Didn't fit properly
7. Stuck out of fixture
8. Light color
9. Too expensive
10. Concerned about mercury
11. Replaced with LEDs for better efficiency
12. Other **[RECORD VERBATIM]**
98. Don't Know
99. Refused

C. LED Awareness and Purchases

C1. Another type of light bulb that is used in homes is called a light emitting diode or L-E-D **[SAY THE LETTERS L-E-D]**. These bulbs have regular screw bases that fit into most household sockets. **[IF NEEDED: LEDS HAVE HISTORICALLY BEEN USED FOR NIGHTLIGHTS, FLASHLIGHTS, AND HOLIDAY LIGHTS. HOWEVER, WE ARE NOT ASKING ABOUT THESE TYPES OF LEDS.]**. Before today, had you heard of LEDs that can be used in regular, screw based light sockets?

1. Yes
2. No **[IF ALSO B2= 2 THANK AND TERMINATE, OTHERWISE CONTINUE]**

C2. Did you purchase any LEDs in the last twelve months?

1. Yes
2. No **[THANK AND TERMINATE IF B2= 2, B3=2, OR B4.1 = 0, OTHERWISE SKIP TO SECTION D]**
98. Don't Know **[THANK AND TERMINATE IF B2= 2, B3=2, OR B4.1 = 0, OTHERWISE SKIP TO SECTION D]**
99. Refused **[THANK AND TERMINATE IF B2= 2, B3=2, OR B4.1 = 0, OTHERWISE SKIP TO SECTION D]**

C3. In the last 12 months, how many screw base *LEDs* did you or your household purchase? Please try to estimate the total number of *individual LED bulbs*, as opposed to packages. **[IF "DON'T KNOW," PROBE: "IS IT LESS THAN OR MORE THAN FIVE BULBS?" WORK FROM THERE TO GET AN ESTIMATE]**

[NUMERIC OPEN END: RECORD NUMBER OF LEDS, NOT A RANGE.] [IF QUANTITY=0 AND (IF B2= 2, B3=2, OR B4.1 = 0) THANK AND TERMINATE, OTHERWISE IF QUANTITY = 0 SKIP TO SECTION D]

1. **[RECORD # OF LEDS]**
98. Don't Know **[PROBE FOR ESTIMATES; IF UNABLE TO GET AN ANSWER, SKIP TO D1]**
99. Refused **[SKIP TO D1]**

C4. Where did you purchased the **[C3.1]** LEDs? **[PROBE FOR RETAIL CHAINS OR ONLINE] [DO NOT READ, MULTIPLE REPSONSES ALLOWED]**

1. Ace Hardware **[CITY, STATE, # PURCHASED]**
2. Broulim's Fresh Foods **[CITY, STATE, # PURCHASED]**
3. Barrett's Foodtown **[CITY, STATE, # PURCHASED]**
4. Batteries Plus **[CITY, STATE, # PURCHASED]**
5. Bi-Mart **[CITY, STATE, # PURCHASED]**
6. Big Lots **[CITY, STATE, # PURCHASED]**
7. Corner Grocery & Hardware **[CITY, STATE, # PURCHASED]**
8. Costco **[CITY, STATE, # PURCHASED]**
9. Delta Jubilee Foods **[CITY, STATE, # PURCHASED]**
10. Do It Best **[CITY, STATE, # PURCHASED]**
11. Dollar Tree **[CITY, STATE, # PURCHASED]**
12. Family Dollar **[CITY, STATE, # PURCHASED]**
13. Fresh Markets **[CITY, STATE, # PURCHASED]**
14. Kamas Foodtown **[CITY, STATE, # PURCHASED]**
15. Kroger – Fred Meyer **[CITY, STATE, # PURCHASED]**
16. Griffith Foodtown **[CITY, STATE, # PURCHASED]**
17. Gunnison Market **[CITY, STATE, # PURCHASED]**
18. Hess Lumber Co **[CITY, STATE, # PURCHASED]**
19. Habitat for Humanity **[CITY, STATE, # PURCHASED]**
20. Harmons **[CITY, STATE, # PURCHASED]**
21. Lowe's **[CITY, STATE, # PURCHASED]**
22. Menards **[CITY, STATE, # PURCHASED]**
23. Petersons Fresh Market **[CITY, STATE, # PURCHASED]**
24. Rancho Markets **[CITY, STATE, # PURCHASED]**
25. Ream's Foods **[CITY, STATE, # PURCHASED]**
26. Ridley's **[CITY, STATE, # PURCHASED]**
27. Safeway **[CITY, STATE, # PURCHASED]**
28. Sam's Club **[CITY, STATE, # PURCHASED]**
29. Smith's **[CITY, STATE, # PURCHASED]**
30. Stokes Market Place **[CITY, STATE, # PURCHASED]**
31. Sutherlands **[CITY, STATE, # PURCHASED]**
32. Thomas Market **[CITY, STATE, # PURCHASED]**
33. Target **[CITY, STATE, # PURCHASED]**
34. Home Depot **[CITY, STATE, # PURCHASED]**
35. The Market **[CITY, STATE, # PURCHASED]**
36. True Value Hardware **[CITY, STATE, # PURCHASED]**
37. Walgreens **[CITY, STATE, # PURCHASED]**
38. Walmart **[CITY, STATE, # PURCHASED]**

39. Winegar's Supermarkets **[CITY, STATE, # PURCHASED]**
40. Online **[WEBSITE, # PURCHASED]**
98. Other **[RECORD STORE NAME, CITY, STATE, # PURCHASED]**
98. Don't Know

C5. RefusedWere any of the **[C3.1]** LEDs you purchased part of a **[INSERT UTILTY]** sponsored sale?

1. Yes
2. No
98. Don't Know
99. Refused

C6. **[ASK IF C5 = 1, OTHERWISE SKIP TO C7]** Did the **[INSERT UTILTY]** discount influence your decision to purchase LEDs over another type of bulb?

1. Yes
2. No
98. Don't Know
99. Refused

C7. What **[IF C6=1 SAY "OTHER"]** factors were important for your decision to buy LEDs over other types of bulbs? **[DO NOT READ. MULTIPLE RESPONSES ALLOWED]**

1. Energy savings
2. Cost savings on electricity bill
3. Price of bulb
4. Environmental concerns
5. CFL disposal concerns
6. Quality of light
7. Lifetime of bulb
8. Interested in the latest technology
9. Other **[RECORD]**
98. Don't Know
99. Refused

C8. Now I'd like to ask you a few questions about the **[C3.1]** LED(s) you acquired in the last twelve months. How many did you install in your home since you purchased them?

1. **[RECORD # OF LEDS]**
2. None **[SKIP TO C11]**
98. Don't Know **[SKIP TO D1]**
99. Refused **[SKIP TO D1]**

C9. Have you since removed any of those LED bulbs from the sockets?

1. **YES [ASK "HOW MANY DID YOU REMOVED?" RECORD # OF LEDS]**
2. No **[SKIP TO C11]**
98. Don't Know **[SKIP TO C11]**
99. Refused **[SKIP TO C11]**

C10. What were the reasons you removed the **[C9.1]** purchased LEDs from the sockets? **[QUANTITIES SHOULD ADD TO B10.1, IF NOT, ASK "WHAT ABOUT THE REMAINING BULBS YOU REMOVED?] [DO NOT READ, MULTIPLE RESPONSES ALLOWED]**

1. Bulb burned out **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
2. Bulbs were too bright **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
3. Bulbs were not bright enough **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
4. Delay in light coming on **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
5. Did not work with dimmer/3-way switch **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
6. Didn't fit properly **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
7. Stuck out of fixture **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
8. Light color **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
9. Light is too pointed/narrow **[RECORD VERBATIM] [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
10. Other **[RECORD VERBATIM] [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
98. Don't Know
99. Refused

C11. Are any of the **[C3.1]** LEDs you purchased in the last twelve months currently in storage for later use?

1. Yes **[ASK: "HOW MANY ARE NOW IN STORAGE?" RECORD # OF LEDS]**
2. No
98. Don't Know
99. Refused

C12. **[SKIP TO C14 IF C8= 2, 99, OR 98]** Of the **[C8.1]** bulbs that are currently installed in your home that were purchased during the last twelve months, can you tell me how many LEDs are installed in each room in your house?

1. Bedroom **[RECORD]**
2. Bedroom (unoccupied) **[RECORD]**
3. Basement **[RECORD]**
4. Bathroom **[RECORD]**
5. Closet **[RECORD]**
6. Dining **[RECORD]**
7. Foyer **[RECORD]**
8. Garage **[RECORD]**
9. Hallway **[RECORD]**
10. Kitchen **[RECORD]**
11. Office/Den **[RECORD]**
12. Living Space **[RECORD]**
13. Storage **[RECORD]**
14. Outdoor **[RECORD]**
15. Utility **[RECORD]**
16. Other **[RECORD VERBATIM]**
98. Don't Know
99. Refused

C13. **[ASK ONLY IF TOTAL BULBS IN C12<C8.1 (IF TOTAL NUMBER OF BULBS LISTED IN EACH ROOM DOES NOT MATCH THE NUMBER OF BULBS INSTALLED STATED IN C8.1)OTHERWISE SKIP TO C13]** Thanks, that accounts for **[TOTAL BULBS IN C12]** of the total quantity that were installed in your home. Can you tell me where the **[C8.1 MINUS TOTAL BULBS IN C12]** other bulbs were installed?

1. **[RECORD VERBATIM]**
98. Don't Know
99. Refused

C14. How satisfied are you with the LEDs that you purchased during the last twelve months? Would you say you are… **[READ]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied
4. Not At All Satisfied
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C15. **[ASK ONLY IF C14= 3 OR 4]** Why would you say you are **[INSERT ANSWER FROM C14]** with LEDs? **[DO NOT READ LIST AND RECORD ALL THAT APPLY]**

1. Light is too pointed/narrow
2. Too expensive
3. Bulbs are too bright
4. Bulbs are not bright enough
5. Delay in light coming on
6. Did not work with dimmer/3-way switch
7. Didn't fit properly
8. Stuck out of fixture
9. Light color
10. Other **[RECORD VERBATIM]**

98. Don't Know
99. Refused

D. Program Awareness

D1. Before this call, were you aware that **[INSERT UTILITY]** offers energy-efficiency programs that provide monetary incentives to customers for installing equipment that will reduce their utility bills?

1. Yes
2. No

98. Don't Know
99. Refused

D2. One of these **[INSERT UTILITY]** programs is the "Wattsmart Home Energy Savings Program" and it provides discounts on CFLs, LEDs light fixtures and room air conditioners at participating retailers in your area as well as incentives for high-efficiency home equipment and upgrades such as appliances and insulation. Before today, were you aware of this program?

1. Yes
2. No **[SKIP TO SECTION E]**

98. Don't Know **[SKIP TO SECTION E]**
99. Refused **[SKIP TO SECTION E]**

D3. How did you first hear about **[INSERT UTILITY]'s** Wattsmart Home Energy Savings program**? [DO NOT READ LIST. RECORD FIRST RESPONSE. ONE ANSWER ONLY]**

1. Newspaper/Magazine/Print Media
2. Bill Inserts
3. Rocky Mountain Power/Pacific Power website
4. Wattsmart Home Energy Savings website
5. Other website
6. Internet Advertising/Online Ad
7. Family/friends/word-of-mouth
8. Rocky Mountain Power/Pacific Power Representative
9. Radio
10. TV
11. Billboard/outdoor ad
12. Retailer/Store
13. Sporting event
14. Home Shows/Trade Shows (Home and Garden Shows)
15. Social Media
16. Home Energy Reports (OPower)
17. Other **[RECORD VERBATIM]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D4. **[ASK ONLY IF D3<>3 OR 4]** Have you ever visited the Wattsmart Home Energy Savings Website?

1. Yes
2. No

D5. **[ASK ONLY IF D4 = 1 OR D3=3 OR 4, OTHERWISE SKIP TO SECTION E]** Was the website… **[READ]**

1. Very helpful
2. Somewhat helpful
3. Somewhat unhelpful
4. Very unhelpful
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D6. What would make the website more helpful for you? **[DO NOT READ RESPONSES. MARK ALL THAT APPLY]**

1. Nothing, it is already very helpful for me.
2. Make the website easier to navigate or more user-friendly (clear hierarchy)
3. Make program information more clear and concise
4. Incorporate more visual information (charts, graphs, images) and less text
5. Provide easier access to customer service or FAQs
6. Other **[RECORD]**

98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E. Nonparticipant Spillover

E1. **[INSERT UTILITY]'s** Home Energy Reporting (HER) program is designed to generate energy savings by providing residential customers with sets of information about the specific energy use and related energy conservation suggestions and tips. Were you participating in this program in 2013 or 2014?

1. Yes
2. No **[SKIP TO SECTION F]**

98. Don't Know
99. Refused

[ASK SECTION E ONLY IF D1 = 1, OTHERWISE SKIP TO F1] Now, I have a few questions about energy efficient improvements that you made or energy efficient equipment you installed specifically in either 2013 or 2014 that might affect your home's energy use.

Number	Measure	**E1.1** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.1=1]** **E2.1** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.1** How many did you install? **[RECORD QTY]**
1	High-efficiency Boiler (a)		N/A	
2	High-efficiency Water Heater (b)			
3	High-efficiency heat pump water heater (c)			
4	High-efficiency Furnace (d)			

Number	Measure	**E1.2** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.2=1]** **E2.2** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.2** How many did you install? **[RECORD QTY]**
5	High-efficiency Air Source Heat Pump (e)			
6	High-efficiency Ground Source Heat Pump (f)			
7	High-efficiency Ductless Heat Pump (g)			
8	High-efficiency Central Air Conditioner *(h)*			
9	High-efficiency Evaporative Cooler (i)			

Number	Measure	**E1.3** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.3=1]** **E2.3** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.3** How many did you install? **[RECORD QTY]**
10	ENEGY STAR Room Air Conditioner (j)			
11	ENERGY STAR Clothes Washer (k)			
12	ENERGY STAR Dishwasher (l)			
13	ENERGY STAR Freezer (m)			
14	ENERGY STAR Refrigerator (n)			

Number	Measure	**E1.4** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.4=1]** **E2.4** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.4** How many square feet did you install? **[RECORD QTY IN SQUARE FEET]**
15	Attic insulation (0)			
16	Wall insulation (p)			
17	Duct insulation (q)			
18	Duct sealing (r)			
19	Windows (s)			

Number	Measure	**E1.5** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.5=1]** **E2.5** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.5** How many did you install? **[RECORD QTY]**
20	High-Efficiency Showerhead (t)			
21	High-Efficiency Faucet aerator (u)			
22	Any other energy-efficient products? [SPECIFY] (v)			
23	Did not install anything (w)		N/A	N/A
24	Don't know (x)		N/A	N/A
25	Refused (y)		N/A	N/A

[ASK E5 SERIES FOR EACH MEASURE WITH E1 FLAGGED IN TABLES ABOVE (E1.1; E1.2; E1.3; E1.4; E1.5]

E5. On a 1 to 4 scale, with 1 meaning "not at all important", to 4, meaning the item was "very important", how important were each of the following on your decision to install energy efficient equipment or make energy-efficiency improvements?

How important was **[INSERT STATEMENT FROM TABLE BELOW]** on your decision to purchase the **[INSERT MEASURE NAME FROM E1.X]**? **[REPEAT SCALE AS NEEDED; REPEAT FOR ALL STATEMENTS AND ALL MEASURES]**

Statement	Not at all important	Not very important	Somewhat Important	Very Important	Don't know	Not applicable
	1	2	4	5	98	96
a. General information about energy efficiency provided by **[INSERT UTILITY]**.						
b. Information from friends or family members who installed energy efficient equipment and received a rebate from **[INSERT UTILITY].**						
c. Your experience with a past **[INSERT UTILITY]** energy efficiency program.						

E6. **[ASK IF E2.1-5 = 2 OTHERWISE SKIP TO SECTION 98]** What are the reasons you did not apply for a rebate from **[INSERT UTILITY]** for these energy efficiency improvements? **[DO NOT READ LIST; RECORD ALL THAT APPLY]**

1. Didn't know/wasn't aware
2. Was going to apply but forgot
3. Not interested
4. Too busy/didn't have time
5. Dollar rebate for rebate was not high enough
6. Application too difficult to fill out
7. Did apply but never received rebate
8. Other **[SPECIFY]**

98. Don't Know
99. Refused

F. Demographics

F1. Next are a few questions for statistical purposes only. Which of the following best describes your house? **[READ LIST]**

1. Single-family home
2. Townhouse or duplex
3. Mobile home or trailer
4. Apartment building with 4 or more units
5. Other **[RECORD]**

98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

F2. Do you or members of your household own this home or do you rent?

1. Own
2. Rent
3. Other **[RECORD]**

98. Don't Know
99. Refused

F3. About when was this building first built? **[READ LIST IF NEEDED]**

1. Before 1970's
2. 1970's
3. 1980's
4. 1990-94
5. 1995-99
6. 2000-2004
7. 2005-2009
8. 2010 +
9. OTHER **[RECORD]**

98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

F4. What is the primary heating source for your home? **[READ LIST IF NEEDED]**

1. Forced air natural gas furnace
2. Forced air propane furnace
3. Air Source Heat Pump **[FUEL SOURCE]**
4. Ground Source Heat Pump **[FUEL SOURCE]**
5. Electric baseboard heat
6. Gas fired boiler/radiant heat
7. Oil fired boiler/radiant heat
8. Passive Solar
9. Pellet stove
10. Wood stove
11. Other **[RECORD]**

98. Don't Know
99. Refused

F5. How old is the primary heating system? **[RECORD RESPONSE IN YEARS]**

1. **[RECORD 1-100]**

98. Don't Know
99. Refused

F6. What type of air conditioning system, if any, do you use in your home? **[INDICATE ALL THAT APPLY]**

1. Central Air Conditioner
2. Room Air Conditioner
3. Evaporative Cooler
4. Air Source Heat Pump
5. Ground Source Heat Pump
6. Whole house fan
7. No cooling system
8. Other **[SPECIFY]**

98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

F7. **[SKIP IF F6= 7,98 OR 99]** How many years old is your primary cooling system? **[RECORD RESPONSE IN YEARS]**

1. **[RECORD]**

98. Don't Know
99. Refused

F8. What type of fuel is the primary source for your water heating? **[INDICATE ALL THAT APPLY]**

1. Electricity
2. Natural Gas
3. Propane
4. Other [RECORD]
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

F9. Including yourself and any children, how many people currently live in your home?

1. **[RECORD]**
98. Don't Know
99. Refused

F10. **[ASK ONLY IF F9> 1]** Are any of the people living in your home dependent children under the age of 18?

1. Yes
2. No
98. Don't Know
99. Refused

G. Conclusion

G1. Do you have any additional feedback or comments regarding your household lighting?

1. Yes **[RECORD VERBATIM]**
2. No
98. Don't Know
99. Refused

G2. **[SEX; DO NOT READ]**

1. Female
2. Male
98. Don't Know

That concludes the survey. Thank you very much for your time and feedback.

Appendix A: Lighting Leakage Survey

A1 Hello, my name is _____, and we're doing a survey about light bulbs today. This is a short survey that will only take about five minutes to complete, and we will give you a $10 gift card that you can use in this store today for your time. You will remain completely anonymous. Do you have five minutes to answer some questions today?

- ❍ 1. (Yes) (1)
- ❍ 99. (No/Refused) (2)

If 1. (Yes) Is Selected, Then Skip To A3

If 99. (No/Refused) Is Selected

A2 OK, thanks for your consideration. Though if you don't mind answering one question for me, could you please tell me which utility provides electric service to your home? [SHOW UTILITY LOGOS IF NEEDED. THANK THE CUSTOMER AND END SURVEY AFTER THIS QUESTION]

- ❍ 1. Pacific Power (1)
- ❍ 2. Rocky Mountain Power (2)
- ❍ 91. Any other utility (specify) (3) _____
- ❍ 98. Don't know (4)
- ❍ 99. Refused (5)

Then Skip To E1 short

A3 Which utility provides electric service to your home? [SHOW UTILITY LOGOS IF NEEDED]

- ❍ 1. Pacific Power (1)
- ❍ 2. Rocky Mountain Power (2)
- ❍ 91. Any other utility (specify) (3) _____
- ❍ 98. Don't know (4)
- ❍ 99. Refused (5)

A4 Which zip code do you live in?

- ❍ Record response if given (1) _____
- ❍ 98. Don't know (2)
- ❍ 99. Refused (3)

B1 Do you plan to install the bulbs you're purchasing today in your home, at a business, or someplace else? [CHECK ALL THAT APPLY – ONLY CHECK ONE IF ALL BULBS ARE BEING INSTALLED AT THE SAME ADDRESS]

- ❑ 1. (bulbs will be installed at my home) (1)
- ❑ 2. (bulbs will be installed at my vacation home (or other personal property) (2)
- ❑ 3. (bulbs will be installed at a business / location that is not a residence, including non-profits) (3)
- ❑ 4. (purchasing bulbs for somebody else / not my home or business) (4)
- ❑ 98. (Don't know) (5)
- ❑ 99. (Refused) (6)

If (bulbs will be installed at a business / location that is not a residence, including non-profits) Is Selected

B1a What kind of business is this (what do they do)?

- ❍ A: AGRICULTURE, FORESTRY AND FISHING (VETERINARY, CROPS, HUNTING) (1)
- ❍ B: MINING (GRAVEL, COAL, OIL, METAL, CHEMICAL, NONMETALLIC MINERALS) (2)
- ❍ C: CONTRACT CONSTRUCTION (PLUMBING, PAINTING, ELECTRICAL, ROOFING) (3)
- ❍ D: MANUFACTURING (TEXTILES, FURNITURE, FABRICATED METAL, PRODUCTS) (4)
- ❍ E: TRANSPORTATION, COMMUNICATION, ELECTRIC (FREIGHT, COURIER, CABLE) (5)
- ❍ F: WHOLESALE TRADE (GROCERY SUPPLIERS, RAW MATERIALS, APPAREL) (6)
- ❍ G: RETAIL TRADE (MARKETS, CLOTHING STORES, RESTAURANTS, CAR DEALERS) (7)
- ❍ H: FINANCE, INSURANCE AND REAL ESTATE (BANKS, MORTGAGE BROKERS) (8)
- ❍ I: SERVICES (BEAUTY QUALITY) (9)
- ❍ K: NONCLASSIFIABLE ESTABLISHMENTS (OTHERS) [RECORD RESPONSE] (10) _____
- ❍ (98. don't know) (11)
- ❍ (99. refused) (12)

If (bulbs will be installed at a business / location that is not a residence, including non-profits) Is Selected

B1b What zip code or city is this business located in? [RECORD ZIP CODE IF KNOWN]

- ❍ (RECORD RESPONSE IF GIVEN) (1) _____
- ❍ (98. don't know) (2)
- ❍ (99. refused) (3)

If (bulbs will be installed at a business / location that is not a residence, including non-profits) Is Selected

B1c Do you know which utility provides power for this business? [RECORD NAME OF UTILITY IF KNOWN]

- ❍ (1. Pacific Power) (1)
- ❍ (2. Rocky Mountain Power) (2)
- ❍ (3. Any other utility - SPECIFY) (3) _____
- ❍ (98. don't know) (4)
- ❍ (99. refused) (5)

If (purchasing bulbs for somebody else / not my home or business) Is Selected

B1d Do you know where these bulbs that you are purchasing for somebody else will be installed? (Do you know the zip code or city?) [RECORD RESPONSE – ZIP CODE IS IDEAL, OR CITY AND STATE, OR JUST A VERBAL DESCRIPTION IF ADDRESS IS NOT KNOWN – for example “my mother-in-law’s house”]

- ❍ (1. RECORD RESPONSE IF GIVEN) (1) _____
- ❍ (98. don't know) (2)
- ❍ (99. refused) (3)

B2 How many minutes does it take to drive to this store from the place where you intend to install these bulbs?

- ❍ (Less than 10 minutes) (1)
- ❍ (10 up to 20 minutes) (2)
- ❍ (20 up to 30 minutes) (3)
- ❍ (30 up to 40 minutes) (4)
- ❍ (40 up to 50 minutes) (5)
- ❍ (50 minutes up to an hour) (6)
- ❍ (An hour or more) (7)
- ❍ (Other response or multiple locations - record details below) (8) _____
- ❍ (98. don't know) (9)
- ❍ (99. refused) (10)

B3 What kind of light bulbs are you purchasing today? [GO OVER THE LIGHT BULBS IN THE CUSTOMER'S CART AND RECORD HOW MANY OF EACH TYPE – ONLY CONTINUE IF THERE IS AT LEAST ONE LIGHT BULB IN THEIR CART.]

- ❑ (Enter quantity of INCANDESCENT bulbs) (1) _____
- ❑ (Enter quantity of HALOGEN bulbs) (2) _____
- ❑ (Enter quantity of CFL bulbs) (3) _____
- ❑ (Enter quantity of LED bulbs) (4) _____
- ❑ (Enter quantity AND TYPE of OTHER bulbs) (5) _____

B3scan [SCAN THE BARCODES FOR THE LIGHT BULBS IN THEIR CART AND COPY-PASTE THE NUMBERS INTO THE FIELDS BELOW - ONLY NEED TO SCAN ONE PACKAGE OF EACH TYPE OR WATTAGE; DO NOT SCAN MULTIPLE PACKS OF EXACTLY THE SAME BULBS.]

- ❑ First light bulb type (1) _____
- ❑ Second light bulb type (2) _____
- ❑ Third light bulb type (3) _____
- ❑ Fourth light bulb type (4) _____
- ❑ Fifth light bulb type (5) _____
- ❑ Sixth light bulb type (6) _____
- ❑ Seventh light bulb type (7) _____
- ❑ Eighth light bulb type (8) _____

If (Enter quantity of INCANDESCENT bulbs) Is Greater Than or Equal to 1

B3i What type and wattage of light bulb will you replace with the INCANDESCENT bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity of HALOGEN bulbs) Is Greater Than or Equal to 1

B3h What type and wattage of light bulb will you replace with the HALOGEN bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity of CFL bulbs) Is Greater Than or Equal to 1

B3c What type and wattage of light bulb will you replace with the CFL bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity of LED bulbs) Is Greater Than or Equal to 1

B3l What type and wattage of light bulb will you replace with the LED bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity AND TYPE of OTHER bulbs) Is Selected

B3o What type and wattage of light bulb will you replace with the ${q://QID7/ChoiceTextEntryValue/5} you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

B4 Do you know if any of these bulbs are being sold at a discounted price?

- ❍ (Yes, some are discounted) (1)
- ❍ (None are discounted) (2)
- ❍ (98. don't know) (3)
- ❍ (99. refused) (4)

C1 Were you planning to purchase all of these bulbs before you arrived at this store?

- ❍ (All bulbs in their cart are planned purchases) (1)
- ❍ (Some bulbs in their cart are planned purchases, and some are not) (2)
- ❍ (Customer had planned to purchase more bulbs than are in their cart) (3)
- ❍ (Had not been intending to purchase any bulbs before arriving at the store) (4)
- ❍ (98. don't know) (5)
- ❍ (99. refused) (6)

If (Some bulbs in their cart are planned purchases, and some are not) Is Selected Or (Had not been intending to purchase any bulbs before arriving at the store) Is Selected

C2 What made you decide to purchase these bulbs after you got to the store? [CHECK ALL THAT APPLY]

- ❑ (did not know this type of bulb was available / have not seen these bulbs before) (1)
- ❑ (better value of buying in bulk / buying a larger package size) (2)
- ❑ (regular prices were lower than expected – but not "on sale") (3)
- ❑ (in-store promotional price / these bulbs are "on sale") (4)
- ❑ (in-store advertising / displays) (5)
- ❑ (in-store coupon) (6)
- ❑ (rebate offer) (7)
- ❑ (recommendation of store employee) (8)
- ❑ (other reason given) [RECORD RESPONSE] (9) _____
- ❑ (98. don't know) (10)
- ❑ (99. refused) (11)

If (Customer had planned to purchase more bulbs than are in their cart) Is Selected

C3 What kind of bulbs had you been planning to purchase before you got to the store, but then decided not to purchase? [CHECK ALL THAT APPLY - INCLUDING BULBS THAT THEY ARE PURCHASING IF THEY HAD BEEN INTENDING TO PURCHASE MORE OF THAT TYPE THAN THEY DID]

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (98. don't know) (6)
- ❑ (99. refused) (7)

If (Customer had planned to purchase more bulbs than are in their cart) Is Selected

C4 How many of these bulbs that you were planning to purchase before you got to the store did you end up not purchasing? [CHECK ALL THAT APPLY - INCLUDING BULBS THAT THEY ARE PURCHASING IF THEY HAD BEEN INTENDING TO PURCHASE MORE OF THAT TYPE THAN THEY DID]

If (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (1. Incandescent bulbs) RECORD QUANTITY (1) _____

If (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (2. Halogen bulbs) RECORD QUANTITY (2) _____

If (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (3. CFL bulbs) RECORD QUANTITY (3) _____

If (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (4. LED bulbs) RECORD QUANTITY (4) _____

If (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN Is Selected

- ❑ (5. other type of bulbs) RECORD TYPE AND QUANTITY (5) _____

❑ (98. don't know) (6)

❑ (99. refused) (7)

If (Customer had planned to purchase more bulbs than are in their cart) Is Selected

C5 Why didn’t you purchase these bulbs that you had been planning to buy? [CHECK ALL THAT APPLY]

❑ (the type of bulb was not available / could not find them) (1)

❑ (found a better value) (2)

❑ (saw the deal on the program bulbs) (3)

❑ (saw a deal with different bulbs) (4)

❑ (prices were higher than expected) (5)

❑ (found bulbs that were a better deal) (6)

❑ (found bulbs that were better suited for my purpose) (7)

❑ (decided to go with more efficient bulbs) (8)

❑ (in-store coupon for other bulbs) (9)

❑ (rebate offer for other bulbs) (10)

❑ (recommendation of store employee) (11)

❑ (other) [RECORD RESPONSE] (12) _____

❑ (98. don't know) (13)

❑ (99. refused) (14)

C6 What factors led you to purchase these light bulbs? [CHECK ALL THAT APPLY]

- ❑ 1. (low bulb price / reduced price / on sale) (1)
- ❑ 2. (information in the store / store display or advertising) (2)
- ❑ 3. (information from a utility) (3)
- ❑ 4. (advertising, online or elsewhere) - SPECIFY SOURCE OF AD (radio, TV, online, etc.) (4) _____
- ❑ 5. (someone made a recommendation) - SPECIFY WHO RECOMMENDED (5) _____
- ❑ 6. (energy efficiency / saving energy) (6)
- ❑ 7. (saving money on utility bills) (7)
- ❑ 8. (good for the environment / "green" reasons) (8)
- ❑ 9. (bulb color / light quality) (9)
- ❑ 10. (appearance of the bulb / looks good in my fixtures) (10)
- ❑ 11. (hard to find bulb for a unique fixture) (11)
- ❑ 12. (these are the bulbs I always buy / I am used to) (12)
- ❑ 13. (I needed bulbs right away) (13)
- ❑ 14. (just stocking up / these are spare bulbs) (14)
- ❑ 15. (other reasons given) [RECORD RESPONSE] (15) _____
- ❑ 98. (Don't know) (16)
- ❑ 99. (Refused) (17)

D1 Are you going to purchase any other energy-saving items such as power strips, low-flow showerheads, or any Energy Star products while you are at this store today? [INCLUDING ITEMS THEY INTEND TO PURCHASE WHICH ARE NOT IN THEIR CART YET]

- ❍ (Yes) (1)
- ❍ (No) (2)
- ❍ (98. Don't know) (3)
- ❍ (99. Refused) (4)

If “Are you going to purchase any other energy-saving items such as power strips, low-flow showerheads, or any Energy Star products while you are at this store today?” [INCLUDING ITEMS THEY INTEND... (Yes) Is Selected

D1b What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY (showerhead, insulation, thermostat, etc.)]

- ❑ Record name of first item (1) _____
- ❑ Record name of second item (2) _____
- ❑ Record name of third item (3) _____
- ❑ Record name of fourth item (4) _____
- ❑ Record name of fifth item (5) _____
- ❑ Record name of sixth item (6) _____
- ❑ (99. Refused) (7)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of first item Selected

D1b1 How much/many of [D1b] do you plan to use/install right away?

- ❍ (All of it will be installed/used right away) (1)
- ❍ (Some of it will be installed/used right away) - RECORD QUANTITY THAT WILL BE USED RIGHT AWAY (2) _____
- ❍ (None of it will be installed/used right away) (3)
- ❍ (98. Don’t know) (4)
- ❍ (99. Refused) (5)

If What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” … Record name of first item Is Selected

D2.1 Do you have any rebates or coupons for [D1b]?

- ❍ (Yes) - SPECIFY WHO IS OFFERING REBATE OR COUPON BELOW (1) _____
- ❍ (No) (2)
- ❍ (98. Don’t know) (3)
- ❍ (99. Refused) (4)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of second item Is Selected

D1b2 How much/many of [D1b] do you plan to use/install right away?

- ❍ (All of it will be installed/used right away) (1)
- ❍ (Some of it will be installed/used right away) - RECORD QUANTITY THAT WILL BE USED RIGHT AWAY (2) _____
- ❍ (None of it will be installed/used right away) (3)
- ❍ (98. Don’t know) (4)
- ❍ (99. Refused) (5)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of second item Is Selected

D2.2 Do you have any rebates or coupons for [DB1]?

- ❍ (Yes) - SPECIFY WHO IS OFFERING REBATE OR COUPON BELOW (1) _____
- ❍ (No) (2)
- ❍ (98. Don’t know) (3)
- ❍ (99. Refused) (4)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of second item Is Selected

D1b3 How much/many of [DB1] do you plan to use/install right away?

- ❍ (All of it will be installed/used right away) (1)
- ❍ (Some of it will be installed/used right away) - RECORD QUANTITY THAT WILL BE USED RIGHT AWAY (2) _____
- ❍ (None of it will be installed/used right away) (3)
- ❍ (98. Don’t know) (4)
- ❍ (99. Refused) (5)

[REPEAT FOR UP TO SIX ITEMS]

If What energy-saving items are you going to purchase today? Is Selected

D3.1 Please tell me how important your experience purchasing efficient light bulbs was in your decision to purchase [db1] Would you say it was . . .

- ❍ Very important (1)
- ❍ Somewhat important (2)
- ❍ Not very important, or (3)
- ❍ Not important at all? (4)
- ❍ 98. (Don't know) (5)
- ❍ 99. (Refused) (6)

[REPEAT FOR UP TO SIX ITEMS]

E1 Thank you for your time and feedback today! [GIVE CUSTOMER THE GIFT CARD]

- ❍ ENTER YOUR INITIALS AND CLICK NEXT TO CONFIRM SURVEY COMPLETED _____

E1short Thank you for your time! [DO NOT GIVE CUSTOMER A GIFT CARD]

- ❍ ENTER YOUR INITIALS AND CLICK NEXT TO CONFIRM SURVEY COMPLETED _____

CADMUS

PacifiCorp Home Energy Savings wattsmart Starter Kit Survey

Audience: This survey is designed for PacifiCorp residential customers in Idaho and Washington. The primary purpose of this survey is to collect information on receipt of the kit, installation and satisfaction of kit items, wattsmart/Homes Energy Savings Program awareness and satisfaction. This survey will be administered through telephone calls.

Quota: 70 completed surveys for CFLs and 60 for LEDs for each state (ID and WA) (260 total)

Topics	Researchable Questions	Survey Questions
Receipt of kit	Did the customer receive (or recall receiving) the wattsmart Home Energy Savings starter kit?	A3-A6
Installation of kit measures	How many of each kit item did the customer install? How many items were removed? How many items remain in storage?	B1, B2, B5, B15, B16, B19, C1, C3, C5, D1, D4, D10,D13
Reasons for removal or non-installation	Why were items removed? Why were items never installed? Where are the items now?	B3-B5,B17-B19, C2-C3,D3, D4
Satisfaction with kit items	How satisfied are customers with the kit items and overall kit? How easy was it to install the water items? How easy was it to fill out online request form? Why did the customer request the kit?	B6, B7, B20-B22, C4-C5,D5-D6,E1-E4,E10
Program awareness	How did the customer hear about the wattsmart Home Energy Savings Starter Kit? Are kit recipients familiar with Home Energy Savings program (Home Energy Savings)? Have they received other incentives from wattsmart?	E5, E6, E7
NTG	What is the freeridership and spillover associated with this program.	B8-B14, B23-B26, C6-C8, D7-D9, D16-D18, Section F
Household Characteristics	What are some general household characteristics (used to inform engineering review)?	Section G

- Interviewer instructions are in green.
- CATI programming instructions are in red.

[UTILITY]

Washington: Pacific Power

Idaho: Rocky Mountain Power

[KIT TYPE]

Kit Name	Kit Type	Quantity CFLs	Quantity LEDs	Quantity Kitchen Aerators	Quantity Bath Aerators	Quantity Showerheads
Basic 1	1	4	0	1	1	1
Basic 2	2	4	0	1	2	2
Better 1	3	4	0	1	1	1
Better 2	4	4	0	1	2	2
Best 1	5	0	4	1	1	1
Best 2	6	0	4	1	2	2
CFL Only	7	4	0	0	0	0
LED Only	8	0	4	0	0	0

A. Introduction

A1. **[TO RESPONDENT]** Hello, I'm **[INSERT FIRST NAME]**, calling from **[INSERT SURVEY FIRM],** on behalf of **[INSERT UTILITY]**. May I please speak with **[INSERT NAME]**?

1. Yes
2. No, the person is not available **[SCHEDULE CALLBACK]**
98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

A2. **[INSERT UTILITY]** is sponsoring additional research about their energy efficiency programs. Our records indicate that you requested a free wattsmart Home Energy Savings starter kit online. Would you be willing to participate in a very quick 5 to 10 minute survey to talk about the kit?

1. Yes
2. No **[THANK AND TERMINATE]**
98. Don't know **["IS THERE SOMEONE ELSE THAT WOULD BE ABLE TO ANSWER?" IF YES, START AGAIN, IF NO, THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

Responses to Customer Questions [IF NEEDED]

(Timing: This survey should take about 5-10 minutes of your time. Is this a good time for us to speak with you?)

(**Who are you with**: I'm with **[INSERT SURVEY FIRM],** an independent research firm that has been hired by **[INSERT UTILITY]** to conduct this research. I am calling to learn about the wattsmart Home Energy Savings starter kit that you received from **[INSERT UTILITY]**)

(Sales concern: I am not selling anything; we would simply like to learn about the wattsmart Home Energy Savings starter kit you received and hear your feedback on the items included. Your responses

will be kept confidential. If you would like to talk with someone from the Home Energy Savings Program about this study, feel free to call 1-800-942-0266, or visit their website: http://www.homeenergysavings.net/.)

(Who is doing this study: **[INSERT UTILITY],** your electric utility, is conducting evaluations of several of its efficiency programs.)

(Why are you conducting this study: Studies like this help **[INSERT UTILITY]** better understand customers' need and interest in energy programs and services?)

A1. Have you, or anyone in your household, ever been employed by or affiliated with **[INSERT UTILITY]** or any of its affiliates?

1. Yes **[THANK AND TERMINATE]**
2. No **[CONTINUE]**
98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

A2. Thank you. To confirm, did you receive a kit containing energy-saving items from **[INSERT UTILITY]** by mail?

1. Yes **[SKIP TO A5]**
2. No **[CONTINUE TO A3]**
98. Don't know **["THE WATTSMART HOME ENERGY SAVINGS STARTER KIT WAS A BOX THAT CONTAINED ENERGY EFFICIENT HOUSEHOLD ITEMS THAT WAS MAILED TO YOU BY [INSERT UTILITY]. IT CONTAINED FOUR CFLS OR LED LIGHT BULBS AND ALSO MAY HAVE CONTAINED FAUCET AERATORS AND HIGH-EFFICIENT SHOWERHEADS. DO YOU RECALL WHETHER YOUR HOUSEHOLD RECEIVED ONE OR MORE OF THESE KITS?" IF YES, ADJUST RESPONSE AND SKIP TO A5, IF NO, SKIP TO A4]**

A3. Did you or a member of your household request a wattsmart Home Energy Savings Starter Kit?

1. Yes **["WE APPOLOGIZE THAT YOU DID NOT RECEIVE YOUR REQUESTED KIT. WOULD YOU LIKE US TO NOTIFY [INSERT UTILITY] ON YOUR BEHALF?" IF YES, ASK FOR NAME AND PHONE NUMBER, THANK AND TERMINATE]**
2. No **[THANK AND TERMINATE]**
98. Don't know **[THANK AND TERMINATE]**

A4. Is there anyone else in your household who would recall if you received a wattsmart Home Energy Savings starter kit from **[INSERT UTILITY]**?

1. Yes **[ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN, IF UNAVAILBLE, UPDATE SAMPLE LIST WITH NEW CONTACT AND CALL BACK ANOTHER TIME]**
2. No **[THANK AND TERMINATE]**
98. Don't know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

A5. **[ASK ONLY IF KIT TYPE = 7 OR 8, OTHERWISE SKIP TO A6]** My records show that you received a wattsmart Home Energy Savings Starter Kit that contained **[IF KIT TYPE = 7, "FOUR CFL LIGHT BULBS", IF KIT TYPE = 8, "FOUR LED LIGHT BULBS"],** is that correct?

1. Yes
2. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**

   A5a. (Specify_____) **[ADJUST QUANTITY OF MEASURES AND KIT TYPE AS APPROPRIATE]**

98. Don't know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

A6. **[ASK ONLY IF KIT TYPE = 1-6]** My records show that you received a wattsmart Home Energy Savings Starter Kit that contained several items such as energy efficient light bulbs, faucet aerators and showerheads. I'd like to confirm the number of each item that you received in your kit. I will read the quantity of each item, please confirm if they are correct. My records show that you received **[READ A-D AND USE RESPONSE OPTIONS BELOW FOR EACH]**:

A6a. **[IF KIT TYPE = 1-4, "FOUR CFL LIGHT BULBS", IF KIT TYPE = 5 OR 6, "FOUR LED LIGHT BULBS"]**

1. Yes
2. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**

98. Don't Know
99. Refused

A6b. One kitchen faucet aerator

1. Yes
2. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**

98. Don't Know
99. Refused

A6c. **[BATHROOM FAUCET AERATOR QUANTITY]** bathroom faucet aerator(s)

1. Yes
2. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**

98. Don't Know
99. Refused

A6d. **[SHOWERHEAD QUANTITY]** showerhead (s)

1. Yes
2. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**

   A6b. (Specify_____) **[ADJUST QUANTITY OF MEASURES AS APPROPRIATE]**

98. Don't know
99. Refused **[THANK AND TERMINATE]**

A7. **[THANK AND TERMINATE IF PARTICIPANT ANSWERS "DON'T KNOW" OR "REFUSED" TO ALL QUESTIONS A6. A-D]**

B. Light Bulbs

[ASK B1 TO B14 IF KIT TYPE = 1 --4 OR 7, OTHERWISE SKIP TO B15]

[IF A6.A6A = 98 OR 99, OR IF A6.A6A = 2 AND THE CORRECTED QUANTITY IS ZERO THEN SKIP TO SECTION C]

B1. Of the four CFL bulbs you received in the kit, how many are currently installed in your home?

1. _____ **[RECORD # OF BULBS FROM 0-4 RANGE] [IF=4 SKIP TO B6]**
98. (Don't know) **[SKIP TO B6]**

B2. Of the **[4-B1.1]** CFL bulb(s) that is/are not currently installed, "was this"/"were any of these" bulb(s) ever installed in your home and then removed?

1. Yes _____ **["HOW MANY WERE REMOVED?" RECORD # OF BULBS]**
2. No **[SKIP TO B4]**
98. (Don't know) **[SKIP TO B5]**

B3. And why were the **[INSERT B2.1 QUANTITY]** CFL bulb(s) removed? **[DO NOT READ, MULTIPLE RESPONSE ALLOWED]**

1. Burned out
2. Quality of light
3. Mercury content
4. Requires special disposal/must be recycled
5. Fire hazard
6. Replaced with new technology (LEDs)
7. Other **[OPEN ENDED, WRITE RESPONSE]**
98. (Don't know)

[SKIP TO B5, UNLESS 4-B1.1– B2.1>0 (CONTINUE)]

B4. Why wasn't/weren't the **[QUANTITY NEVER INSTALLED: 4-B1.1– B2.1]** CFL bulb(s) ever installed? **[DO NOT READ, MULTIPLE RESPONSE ALLOWED]**

1. Quality of light
2. Mercury content
3. Requires special disposal/must be recycled
4. Fire hazard
5. Already had CFL bulbs (or LEDs) installed in every possible location
6. Waiting for a bulb to burn out
7. I haven't had time/ haven't gotten around to it
8. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

B5. What did you do with the bulbs that are not currently installed in your home? **[DO NOT READ, MULTIPLE RESPONSES ALLOWED]**

1. Put into storage
2. Gave Away
3. Sold it
4. Threw it away in trash
5. Recycled it

6. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

B6. Overall, how satisfied are you with the CFLs you received in the kit? Please choose from one of these options: **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

B7. And how satisfied were you with the number of CFLs you received in the wattsmart Home Energy Savings Starter Kit? **[IF NEEDED: PLEASE CHOOSE FROM ONE OF THESE OPTIONS (READ RESPONSES)]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. Don't Know
99. Refused

B8. Before you signed up for the kit, did you already have CFLs installed in your home?

1. (Yes)
2. (No)
98. (DON'T KNOW)
99. (REFUSED)

B9. **[ASK IF B8 = 1]** How many CFLs were you using in your home at the time you signed up for the kit?

1. (# of Bulbs): _____
98. (DON'T KNOW)
99. (REFUSED)

B10. At the time you signed up for the kit, were you already planning to purchase CFLs?

1. (Yes)
2. (No)
3. (No, I already had them installed in all available sockets)
98. (DON'T KNOW)
99. (REFUSED)

B11. **[ASK IF B10 = 1]** In terms of timing, when would you have purchased the CFLs?

1. (Around the same time I received the kit)
2. (Later but within the same year)
3. (In one year or more)
98. (Don't know)
99. (REFUSED)

B12. Were you aware of the option to upgrade your kit from CFLs to LED bulbs for $19.99?

1. (Yes) **[CONTINUE TO B13]**
2. (No) **[SKIP TO B14]**
98. Don't Know **[SKIP TO B14]**
99. Refused **[SKIP TO B14]**

B13. **[ASK IF B12 = 1]** Why did you decide not to upgrade to LEDs? [do not read, multiple responses allowed]

1. The cost/too expensive **[SKIP TO C1]**
2. Not familiar with LEDs **[SKIP TO C1]**
3. Prefer CFLs **[SKIP TO C1]**
4. Other **[RECORD]** **[SKIP TO C1]**
98. Don't Know **[SKIP TO C1]**
99. Refused **[SKIP TO C1]**

B14. **[ASK IF B12 = 2, 98, OR 99]** If you knew about the option to upgrade from CFLs to LEDs at a cost of $19.99, would you have upgraded to the LED kit?

1. (Yes) **[SKIP TO C1]**
2. (No) **[SKIP TO C1]**
98. Don't Know **[SKIP TO C1]**
99. Refused **[SKIP TO C1]**

[ASK B15 THROUGH B26 IF KIT TYPE = 5, 6 OR 8, OTHERWISE SKIP TO SECTION ERROR! REFERENCE SOURCE NOT FOUND.**]**

B15. Of the four LED bulbs you received in the kit, how many are currently installed in your home?

1. _____ **[RECORD # OF BULBS FROM 0-4 RANGE]** **[IF=4 SKIP TO B20]**
98. Don't know **[SKIP TO B20]**

B16. Of the **[4-B15.1]** **[OR IF A6.A6A = 2, USE THE REVISED NUMBER OF BULBS - B15.1]** LED bulb(s) that is/are not currently installed, "was this"/"were any of these" bulb(s) ever installed in your home and then removed?

1. Yes _____ **["HOW MANY WERE REMOVED?" RECORD # OF BULBS]**
2. No **[SKIP TO B18]**

98. (Don't know) **[SKIP TO B19]**

B17. And why was/were the **[INSERT B16.1 QUANTITY]** LED bulb(s) removed? **[DO NOT READ, MULTIPLE RESPONSE ALLOWED]**

1. Burned out
2. Quality of light
3. Requires special disposal/must be recycled
4. Other **[OPEN ENDED, WRITE RESPONSE]**

98. Don't know)

[SKIP TO B19 UNLESS 4 - B15.1- B16 >0 (CONTINUE)]

B18. Why wasn't/weren't the **[QUANTITY NEVER INSTALLED: 4 - B15.1-B16.1] [OR IF A6.A6A = 2, USE THE REVISED NUMBER OF BULBS - B15.1 - B16.1]** LED bulb(s) ever installed? **[DO NOT READ, MULTIPLE RESPONSE ALLOWED]**

1. Quality of light
2. Requires special disposal/must be recycled
3. Fire hazard
4. Already had LEDs bulbs (or CFLs) installed in every possible location
5. Waiting for a bulb to burn out
6. I haven't had time/ haven't gotten around to it
7. Other **[OPEN ENDED, WRITE RESPONSE]**

98. Don't know

B19. What did you do with the bulbs that are not currently installed in your home? **[DO NOT READ, MULTIPLE RESPONSES ALLOWED]**

1. Put into storage
2. Gave Away
3. Sold it
4. Threw it away in trash
5. Recycled it
6. Other **[OPEN ENDED, WRITE RESPONSE]**

98. Don't know

B20. Why did you choose to spend the extra $19.99 to have LEDs included in your kit instead of CFLs?

1. _____ **[OPEN RESPONSE, RECORD VERBATIM]**

98. **[DO NOT READ]** Don't Know

99. **[DO NOT READ]** Refused

B21. Overall, how satisfied are you with your LEDs? Please choose from one of these options: **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

B22. How satisfied were you with the number of LEDs you received in the kit? **[IF NEEDED: PLEASE CHOOSE FROM ONE OF THESE OPTIONS (READ RESPONSES)]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. Don't Know
99. Refused

B23. Before you signed up for the kit, did you already have LEDs installed in your home?

1. (Yes)
2. (No)
3. (DK/NS)

B24. **[ASK IF B23 = 1]** How many LEDs were you using in your home at the time you signed up for the kit?

1. (# of Bulbs): _____
2. (DK/NS)

B25. At the time you signed up for the kit and agreed to pay the additional $19.99 for the 4 LEDs, were you already planning on buying the same kind of LEDs you received in the kit? **[IF NEEDED: WERE YOU PLANNING ON BUYING THE SAME WATTAGE OF LED BULB?]**

1. (Yes)
2. (No)
3. (No, already had them installed in all available sockets)
4. (DK/NS)

B26. **[ASK IF B25 = 1]** In terms of timing, when would you have purchased the LEDs on your own if they were not offered through the kit?

1. (Around the same time I received the kit)
2. (Later but within the same year)
3. (In one year or more)

98. (Don't know)
99. (Refused)

[ASK SECTION ERROR! REFERENCE SOURCE NOT FOUND. **AND D IF KIT TYPE = 1-6, OTHERWISE SKIP TO SECTION E]**

C. *High-Efficiency Showerheads*

[IF A6DA6B = 98 OR 99, OR IF A6D = 2 AND THE CORRECTED QUANTITY IS ZERO THEN SKIP TO SECTION D]

C1. **HOW MANY OF THE** [SHOWERHEAD QUANTITY] **HIGH-EFFICIENCY SHOWERHEAD(S) YOU RECEIVED ARE CURRENTLY INSTALLED IN YOUR HOME?**

1. Record _____ **[IF RESPONSE = SHOWERHEAD QUANTITY, SKIP TO C4]**
98. Don't know **[SKIP TO C5]**

C2. **[IF KIT TYPE = 2, 4 OR 6 AND C1.1C1 = 0 SAY "WHY ARE THE HIGH-EFFICIENCY SHOWERHEADS NOT CURRENTLY IN USE"; IF KIT TYPE = 2, 4 OR 6 AND C1.1 = 1 SAY "WHY IS ONE OF THE HIGH-EFFICIENCY SHOWERHEADS NOT CURRENTLY IN USE"; IF KIT TYPE = 1, 3 OR 5 AND C1.1 C1 = 0 SAY "WHY IS THE HIGH-EFFICIENCY SHOWERHEAD NOT CURRENTLY IN USE"]**? **[DO NOT READ, MULTIPLE RESPONSE ALLOWED]**

1. Water volume
2. Water temperature
3. Water pressure
4. Did not like the design/look of it
5. Did not fit/could not install
6. Already had high-efficiency showerhead installed in every possible location
7. Do not have a shower
8. I haven't had time/ haven't gotten around to it
9. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

C3. What did you do with the high-efficiency showerhead(s) that is/are not installed? **[DO NOT READ, SINGLE RESPONSE]**

1. Put into storage
2. Gave Away
3. Sold it
4. Threw it away in trash
5. Recycled it
6. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

C4. Overall, how satisfied are you with the high-efficiency showerhead(s) you received in the kit? Please choose from one of these options: **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C5. **[IF C1.1 = 0 OR C1 = 98 SAY "IF YOU ATTEMPTED TO INSTALL IT,"]**How easy was it to install your high-efficiency showerhead(s)? Please choose from one of these options: **[READ]**

1. Very Easy
2. Somewhat Easy
3. Somewhat Difficult **[PROBE FOR REASON AND RECORD]**
4. Very Difficult **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
6. **[DO NOT READ]** Did not attempt to install it
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C6. Did you have any **other** high-efficiency showerheads installed in your home at the time you signed up the kit?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

C7. At the time you signed up for the kit, were you already planning on buying a high-efficiency showerhead for your home?

1. (Yes)
2. (No)
3. (No, I already have them installed in all showers)
4. (Maybe)
98. (Don't know)
99. (Refused)

C8. **[ASK IF C7=1]** In terms of timing, when would you have purchased the showerhead?

1. (Around the same time I received the kit)

2. (Later but within the same year)
3. (In one year or more)
98. (Don't know)
99. (Refused)

D. Faucet Aerators

D1. **[IF A6B = 98 OR 99, OR IF A6B = 2 AND THE CORRECTED QUANTITY IS ZERO THEN SKIP TO D11]**

D2. Is the kitchen faucet aerator you received in the kit currently installed in your home?

1. Yes **[SKIP TO D5]**
2. No **[CONTINUE]**
98. Don't know **[SKIP TO D6]**

D3. Why is the kitchen faucet aerator not currently in use? **[DO NOT READ, MULTIPLE RESPONSE ALLOWED]**

1. Water volume
2. Water temperature
3. Water pressure
4. Did not like the design/look of it
5. Did not fit/could not install
6. Already had faucet aerators installed in every possible location
7. I haven't had time/ haven't gotten around to it
8. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

D4. What did you do with the kitchen faucet aerator that is not installed? **[DO NOT READ, SINGLE RESPONSE]**

1. Put into storage
2. Gave Away
3. Sold it
4. Threw it away in trash
5. Recycled it
6. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

D5. Overall, how satisfied are you with the kitchen faucet aerator you received in the kit? Please choose from one of these options: **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D6. **[IF D1= 2 OR 98 SAY "IF YOU ATTEMPTED TO INSTALL IT,"]**How easy was it to install the kitchen faucet aerator? please choose from one of these options: **[READ]**

1. Very Easy
2. Somewhat Easy
3. Somewhat Difficult **[PROBE FOR REASON AND RECORD]**
4. Very Difficult **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
6. **[DO NOT READ]** Did not attempt to install it
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D7. Did you have any **other** high-efficiency kitchen faucet aerators installed in your home before you signed up for the kit?

3. (Yes)
4. (No)
98. (Don't know)
99. (Refused)

D8. At the time you signed up for the kit, were you already planning on buying a high-efficiency kitchen faucet aerator for your home?

1. (Yes)
2. (No)
3. (No, I already have them installed on all faucets)
4. (Maybe)
98. (Don't know)
99. (Refused)

D9. **[ASK IF D8 = 1 OR 4]** In terms of timing, when would you have purchased the kitchen faucet aerators?

1. (Around the same time I received the kit)
2. (Later but within the same year)
3. (In one year or more)
98. (Don't know)
99. (Refused)

D10. **[IF A6C = 98 OR 99, OR IF A6C = 2 AND THE CORRECTED QUANTITY IS ZERO THEN SKIP TO SECTION E**

D11. How many of the [BATHROOM FAUCET AERATOR QUANTITY] **BATHROOM FAUCET AERATOR**(s) you received are currently installed in your home?

1. Record_____
98. Don't know **[SKIP TO D15]**

D12. **[IF KIT TYPE = 2, 4 OR 6 AND D11.1 = 0 SAY "WHY ARE THE BATHROOM FAUCET AERATORS NOT CURRENTLY IN USE"; IF KIT TYPE = 2, 4, OR 6 AND D11.1 = 1 SAY "WHY IS ONE OF THE BATHROOM FAUCET AERATORS NOT CURRENTLY IN USE"; IF KIT TYPE = 1, 3 OR 5 AND D11.1 = 0 SAY "WHY IS THE BATHROOM FAUCET AERATOR NOT CURRENTLY IN USE"]**? **[DO NOT READ, MULTIPLE RESPONSE ALLOWED]?**

1. Water volume
2. Water temperature
3. Water pressure
4. Did not like the design/look of it
5. Did not fit/could not install
6. Already had faucet aerators installed in every possible location
7. I haven't had time/ haven't gotten around to it
8. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

D13. What did you do with the bathroom faucet aerator(s) not installed? **[DO NOT READ, SINGLE RESPONSE]**

1. Put into storage
2. Gave Away
3. Sold it
4. Threw it away in trash
5. Recycled it
6. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know

D14. Overall, how satisfied are you with the bathroom faucet aerator(s) you received in the kit? **[IF NEEDED: PLEASE CHOOSE FROM ONE OF THESE OPTIONS (READ RESPONSES)] [RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE FOR REASON AND RECORD]**
4. Not At All Satisfied **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D15. **[IF D11.1 = 0 OR D10 = 98 SAY "IF YOU ATTEMPTED TO INSTALL IT,"]**How easy was it to install the faucet aerator? **[IF NEEDED: PLEASE CHOOSE FROM ONE OF THESE OPTIONS (READ RESPONSES)]**

1. Very Easy
2. Somewhat Easy
3. Somewhat Difficult **[PROBE FOR REASON AND RECORD]**
4. Very Difficult **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
6. **[DO NOT READ]** Did not attempt to install it
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D16. Did you have any **other** high-efficiency bathroom faucet aerators installed in your home before you signed up for the kit?

5. (Yes)
6. (No)
98. (Don't know)
99. (Refused)

D17. At the time you signed up for the kit, were you already planning on buying a high-efficiency bathroom faucet aerator for your home?

1. (Yes)
2. (No)
3. (No, I already have them installed on all faucets)
4. (Maybe)
98. (Don't know)
99. (Refused)

D18. **[ASK IF D17 = 1 OR 4]** In terms of timing, when would you have purchased the bathroom faucet aerators?

1. (Around the same time I received the kit)
2. (Later but within the same year)
3. (In one year or more)
98. (Don't know)
99. (Refused)

E. Satisfaction and Program Awareness

E1. How easy was it to fill out the online request for the wattsmart Home Energy Savings Starter Kit? **[IF NEEDED: PLEASE CHOOSE FROM ONE OF THESE OPTIONS (READ RESPONSES)] [RECORD FIRST RESPONSE ONLY]**

1. Very Easy
2. Somewhat Easy
3. Not Very Easy **[PROBE FOR REASON AND RECORD]**
4. Not At All Easy **[PROBE FOR REASON AND RECORD]**
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E2. After you submitted the request for the wattsmart Home Energy Savings Starter Kit how long did it take to receive the kit from **[INSERT UTILITY]**? Please choose from one of these options: **[READ CATEGORIES IF NEEDED, RECORD ONLY FIRST RESPONSE]**

1. Less than 4 weeks
2. Between 4 and 8 weeks
3. More than 8 weeks
98. **[DO NOT READ]** Don't Know **[SKIP TO E4]**
99. **[DO NOT READ]** Refused **[SKIP TO E4]**

E3. Were you satisfied with how long it took to receive the wattsmart Home Energy Savings Starter Kit?

1. Yes
2. No **[PROBE FOR REASON AND RECORD]**
98. Don't Know
99. Refused

E4. Overall, how satisfied are you with your wattsmart Home Energy Savings Starter Kit? **[IF NEEDED: PLEASE CHOOSE FROM ONE OF THESE OPTIONS (READ RESPONSES)] [READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied
4. Not At All Satisfied
5. **[OPEN RESPONSE IF PARTICIPANT DOES NOT PROVIDE DIRECT ANSWER]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E5. How did you first hear about **[INSERT UTILITY]**'s wattsmart Home Energy Savings Starter Kits? **[DO NOT PROMPT. RECORD ONLY THE FIRST WAY HEARD ABOUT THE PROGRAM]**

1. Newspaper/Magazine/Print Media
2. Bill Inserts
3. Rocky Mountain Power/Pacific Power website
4. Home Energy Savings website
5. Other website
6. Internet Advertising/Online Ad
7. Family/friends/word-of-mouth
8. Rocky Mountain Power/Pacific Power Representative
9. Radio
10. TV
11. Billboard/outdoor ad
12. Retailer/Store
13. Sporting event
14. Home Shows/Trade Shows (Home and Garden Shows)
15. Social Media
16. Northwest Energy Efficiency Alliance (NEEA)
17. Other **[RECORD VERBATIM]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E6. **[INSERT UTILITY]** also provides incentives for high-efficiency home equipment and upgrades such as appliances and insulation through the wattsmart Home Energy Savings program. Before today, were you aware of these offerings?

1. Yes
2. No **[SKIP TO E8]**
98. Don't Know **[SKIP TO E8]**
99. Refused **[SKIP TO E8]**

E7. Have you ever received an incentive from **[INSERT UTILITY]**'s wattsmart Home Energy Savings program?

1. Yes **["WHAT DID YOU RECEIVE AN INCENTIVE FOR?" RECORD]**
2. No
98. Don't Know
99. Refused

E8. **[INSERT UTILITY]** also provides a Home Energy Reports Web portal to provide you with detailed information about your home's energy use and help you discover ways to save money. Before today, were you aware of this offering?

1. Yes
2. No **[SKIP TO E10]**
98. Don't Know **[SKIP TO E10]**
99. Refused **[SKIP TO E10]**

E9. Have you ever participated in the Home Energy Reports web portal?

1. Yes
2. No
98. Don't Know
99. Refused

E10. Please think back to the time when you were deciding to apply for the wattsmart Home Energy Savings Starter Kit. What were the reasons why you decided to request the kit? **[DO NOT READ. INDICATE ALL THAT APPLY. ONCE THEY RESPONDENT HAS FINISHED, SAY: "ARE THERE ANY OTHER FACTORS?"]**

1. Household bulbs had burned out
2. Low on storage of household bulbs
3. Did not have any CFLs or LEDs in my home prior
4. Was interested in emerging technology
5. The kit was free
6. Wanted to save energy
7. Wanted to reduce energy costs
8. Environmental concerns
9. Recommendation from friend, family member, or colleague
10. Advertisement in newspaper **[PROBE: "FOR WHAT PROGRAM?" RECORD]**
11. Radio advertisement **[PROBE: "FOR WHAT PROGRAM?" RECORD]**
12. Health or medical reasons
13. Maintain or increase comfort of home
14. Influenced by the Home Energy Reports the customer receives
15. Influenced by the wattsmart Home Energy Savings Program
16. Other **[RECORD]**
98. Don't Know
99. Refused

F. Spillover

F1. Since receiving the wattsmart Home Energy Savings Starter Kit have you added any other energy efficient equipment or services in your home that were not incentivized through the wattsmart Home Energy Savings Program?

1. Yes
2. No
98. Don't Know
99. Refused

[IF F1 = 2, -98 OR -99 SKIP TO G1]

F2. What high-efficiency energy-saving equipment or services have you purchased since applying for the incentive, not including the **[INSERT MEASURE]** that we have been discussing today? **[LIST OF OTHER ELIGIBLE APPLIANCES AND MEASURES OTHER THAN THOSE LISTED IN PROGRAM RECORDS. PROMPT IF NEEDED]**

1. Clothes Washer **[RECORD QUANTITY]**
2. Refrigerator **[RECORD QUANTITY]**
3. Dishwasher **[RECORD QUANTITY]**
4. Windows **[RECORD QUANTITY IN SQ FT]**
5. Fixtures **[RECORD QUANTITY]**
6. Heat Pump **[RECORD QUANTITY]**
7. Central Air Conditioner **[RECORD QUANTITY]**
8. Room Air Conditioner **[RECORD QUANTITY]**
9. Ceiling Fans **[RECORD QUANTITY]**
10. Electric Storage Water Heater **[RECORD QUANTITY]**
11. Electric Heat Pump Water Heater **[RECORD QUANTITY]**
12. CFLs **[RECORD QUANTITY]**
13. LEDs **[RECORD QUANTITY]**
14. Insulation **[RECORD QUANTITY IN SQ FT]**
15. Air Sealing **[RECORD QUANTITY IN CFM REDUCTION]**
16. Duct Sealing **[RECORD QUANTITY IN CFM REDUCTION]**
17. Programmable thermostat **[RECORD QUANTITY]**
18. Other **[RECORD]** **[RECORD QUANTITY]**
19. None
98. Don't Know
99. Refused

[IF F2 = 12 (ONLY), -98 OR -99 SKIP TO G1. REPEAT F3 THROUGH F5 FOR ALL RESPONSES TO F2]

F3. In what year did you purchase **[INSERT MEASURE TYPE FROM F2]**?

1. 2013
2. 2014
3. Other **[RECORD YEAR]**
98. Don't Know
99. Refused

F4. Did you receive an incentive for **[INSERT MEASURE TYPE FROM F2]?**

1. Yes **[PROBE AND RECORD]**
2. No
98. Don't Know
99. Refused

F5. How influential would you say the wattsmart Home Energy Savings program was in your decision to add the **[INSERT MEASURE FROM F2]** to your home? Please choose from one of these options: **[REPEAT FOR EACH MEASURE LISTED IN F2]**

1. Highly Influential
2. Somewhat Influential
3. Not very influential
4. Not at all influential
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

G. Household Characteristics

Before we conclude the survey, I have a few more questions regarding some information about your household. Please be advised that responses to these questions will be kept strictly confidential and you may opt to refuse to answer any proceeding question.

G1. What is the fuel used by your primary water heater?

1. Electric
2. Natural Gas
3. Fuel oil
4. Other **[OPEN ENDED, WRITE RESPONSE]**
98. Don't know
99. Refused

G2. Approximately how many square feet is your home? **[READ LIST IF NEEDED]**

1. Under 1,000 square feet
2. 1,000 – 1,500 square feet
3. 1,501 – 2,000 square feet
4. 2,001 – 2,500 square feet
5. Over 2,500 square feet
98. **[DO NOT READ]** don't know
99. **[DO NOT READ]** refused

G3. How many showers are in your home?

1. _____ **[RECORD]**
98. (Don't know)
99. (Refused)

G4. How many bathroom sinks are in your home?

1. _____ **[RECORD]**
98. (Don't know)
99. (Refused)

G5. Including yourself and any children, how many people currently live in your home?

1. _____ **[RECORD]**
98. Don't Know
99. Refused

G6. **[ASK ONLY IF G5.1> 1]** Are any of the people living in your home dependent children under the age of 18?

1. Yes
2. No
98. Don't Know
99. Refused

H. Conclusion

H1. That concludes the survey. Do you have any additional feedback or comments?

1. Yes **[RECORD VERBATIM]**
2. No
98. Don't know
99. refused

Thank you very much for your time and feedback. Have a great day.

CADMUS

Appendix B. Lighting Impacts

This appendix contains further details on the following lighting topics that are introduced in the main body of the report:

1. Delta Watts
2. Cross-Sector Sales
3. Demand Elasticity Modeling

Where applicable, Cadmus followed the Uniform Methods Protocol for lighting impact evaluations.[1]

Delta Watts Lumen Bins

Table B1 through Table B9 provide lumen bins by lamp types applied in the evaluated lighting evaluation (CFLs, LEDs, and light fixtures). The tables include evaluated baseline wattages by year and total lamp quantities sold in 2013–2014.

Table B1. Lumen Bins and Quantities for Standard Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Estimated CFL Efficient Wattage	Estimated LED Efficient Wattage	Lamp Quantity
0–309	25	25	1–5	1-4	0
310–449	25	25	6–7	5-6	0
450–799	40	29	8–12	7-10	22,087
800–1,099	60	43	13–17	11-14	309,243
1,100–1,599	53	53	18–24	15-20	67,170
1,600–1,999	72	72	25–30	21-24	123,483
2,000–2,600	72	72	31–38	25-32	2

Table B2. Lumen Bins and Quantities for Globe Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity*
250–349	25	25	38
350–499	40	29	591
500–574	60	43	8,166
575–649	53	53	1,261
650–1099	72	72	3,161
1100–1300	72	72	0

*Cadmus was unable to evaluate 150 globe lamps with less than 250 lumens

[1] Available online at: http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf

Table B3. Lumen Bins and Quantities for Decorative Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
70–89	10	10	0
90–149	15	15	3
150–299	25	25	47
300–499	40	29	2,994
500–699	60	43	0

Table B4. Lumen Bins and Quantities for EISA-Exempt Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
310–449	25	25	0
450–799	40	40	0
800–1099	60	60	0
1100–1599	75	75	5
1600–1999	100	100	509
2000–2600	150	150	295

Table B5. Lumen Bins and Quantities for D > 20 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
200–299	20	20	1
300–639	30	30	1,001
640–739	40	40	8,141
740–849	45	45	4,579
850–1179	50	50	3,900
1180–1419	65	65	5,402
1420–1789	75	75	3
1790–2049	90	90	0
2050–2579	100	100	0
2580–3429	120	120	0

Table B6. Lumen Bins and Quantities for BR30, BR40, ER40 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
300–399	30	30	0
400–449	40	40	0
450–499	45	45	0
500–649	50	50	5
650–1179	65	65	65,851
1180–1419	65	65	0
1420–1789	75	75	0
1790–2049	90	90	0
2050–2579	100	100	0
2580–3429	120	120	0

Table B7. Lumen Bins and Quantities 20 ≥ D > 18 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
300–539	20	20	4
540–629	30	30	0
630–719	40	40	0
720–999	45	45	0
1000–1199	50	50	0
1200–1519	65	65	0
1520–1729	75	75	0
1730–2189	90	90	0
2190–2899	100	100	0

Table B8. Lumen Bins and Quantities for R20 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
300–399	30	30	0
400–449	40	40	44
450–719	45	45	2,214
720–999	50	50	0
1000–1199	65	65	0
1200–1519	75	75	0
1520–1729	90	90	0
1730–2189	100	100	0
2190–2899	120	120	0

Table B9. Lumen Bins and Quantities for 18 ≥ D Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
200-299	20	20	0
300-399	30	30	0
400-449	40	40	0
450-499	45	45	0
500-649	50	50	0
650-1199	65	65	0

Figure B1 displays 2014 baseline wattage plotted as a function of lumen output for standard, globe, decorative, and EISA-exempt lamps, as well as the three most common reflector types. This figure shows this correlation up to 2000 lumens (only 0.03% of lamps had lumen output greater than 2000 lm).

Figure B1: Plot of 2014 Baseline Wattage vs. Lamp Lumens for Various Lamp Types

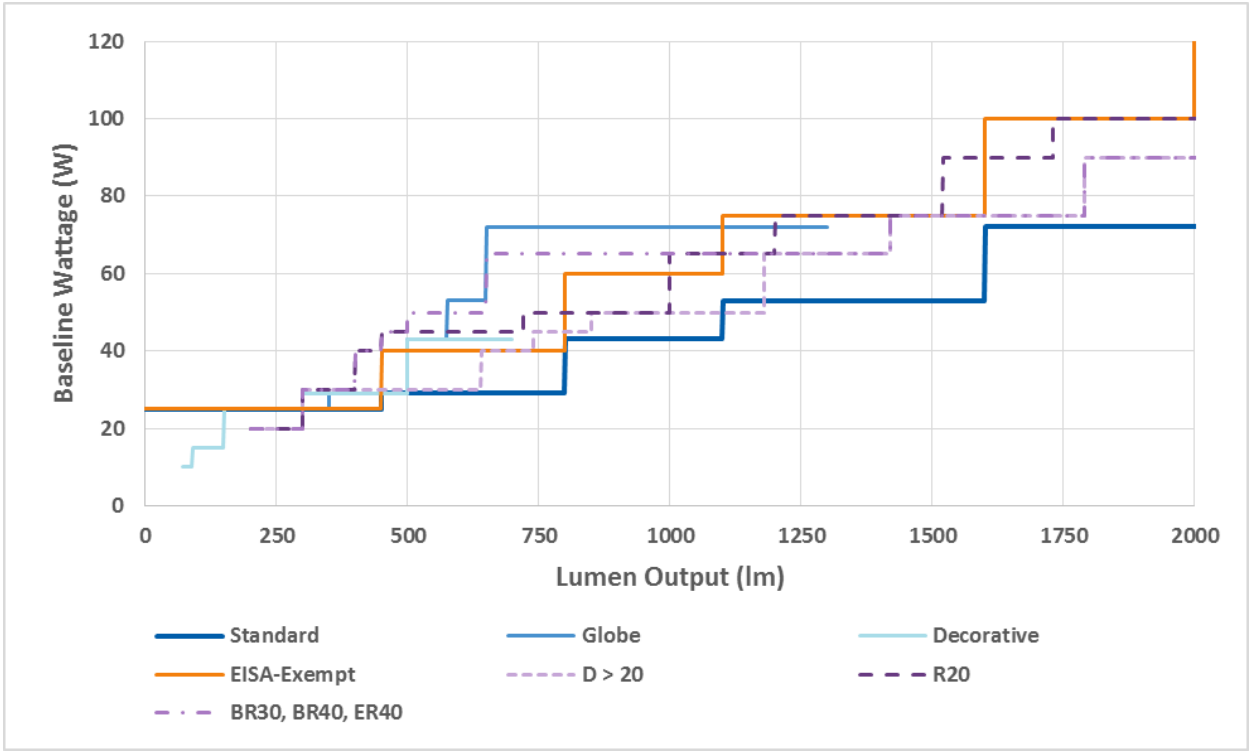
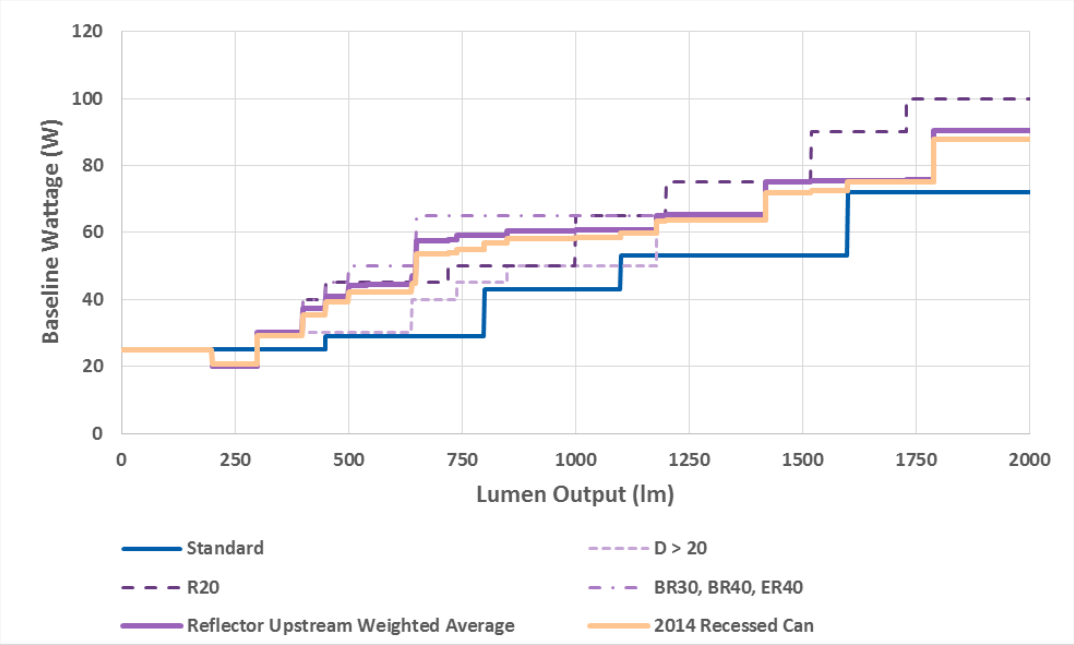


Figure B2 also displays lumen bins and baseline wattages for standard bulbs and the three most common reflector types. It also displays the average combined reflector lumen bins, weighted by quantities, and the average recessed can lumen bins, weighted by bulb type saturation in recessed can receptacles. Standard and recessed can baseline wattages reflect 2014 values.

Figure B2: Plot of Cadmus-created Weighted Reflector and 2014 Recessed Can Baseline Wattages



Watts vs. Lumen ENERGY STAR Linear Fits

Figure B3 through Figure B10 show watts versus lumens from the ENERGY STAR database for eight different lamp categories. Standard, reflector, and specialty LED and CFL lamps are represented. When lumens could not be determined for a particular model of bulb, these linear fits were used to obtain that bulb's lumen output.

Figure B3: Median Lumens vs. Wattage for ENERGY STAR-Qualified Standard CFLs

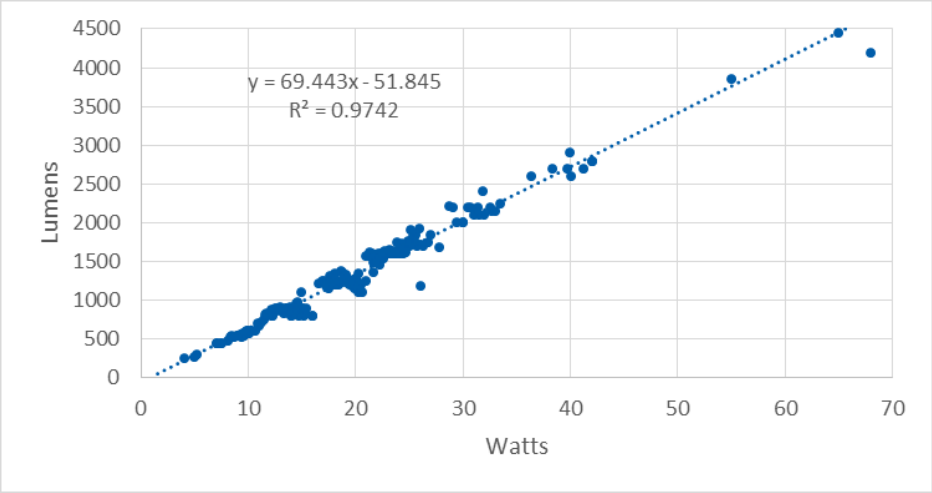


Figure B4: Median Lumens vs. Wattage for ENERGY STAR-Qualified Reflector CFLs

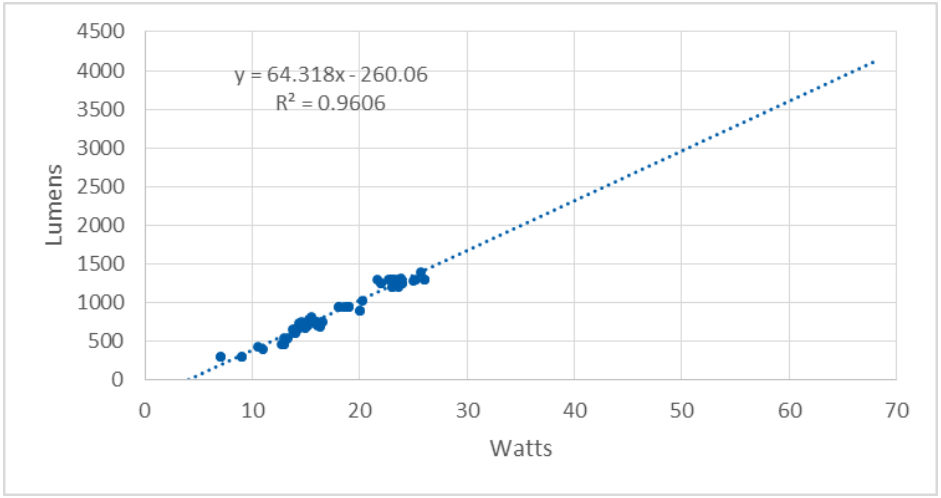


Figure B5: Median Lumens vs. Wattage for ENERGY STAR-Qualified Specialty CFLs

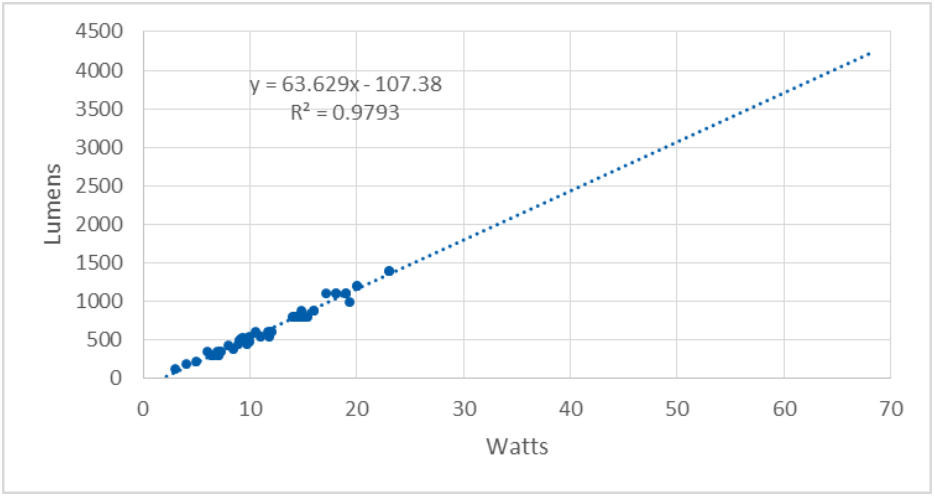


Figure B6: Median Lumens vs. Wattage for ENERGY STAR-Qualified CFL Fixtures

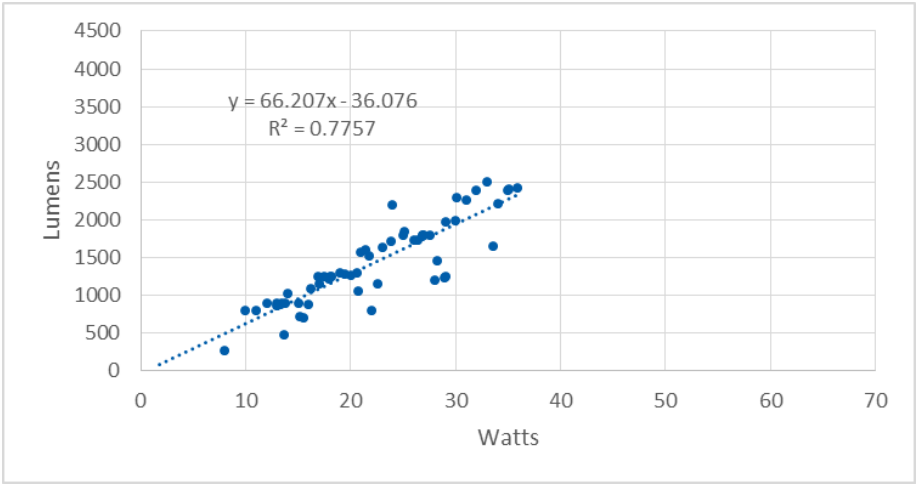


Figure B7: Median Lumens vs. Wattage for ENERGY STAR-Qualified Standard LEDs

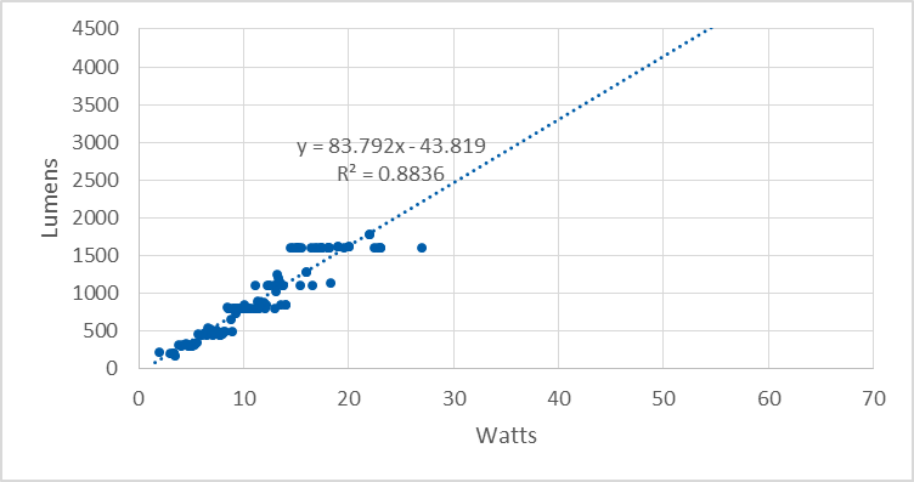


Figure B8: Median Lumens vs. Wattage for ENERGY STAR-Qualified Reflector LEDs

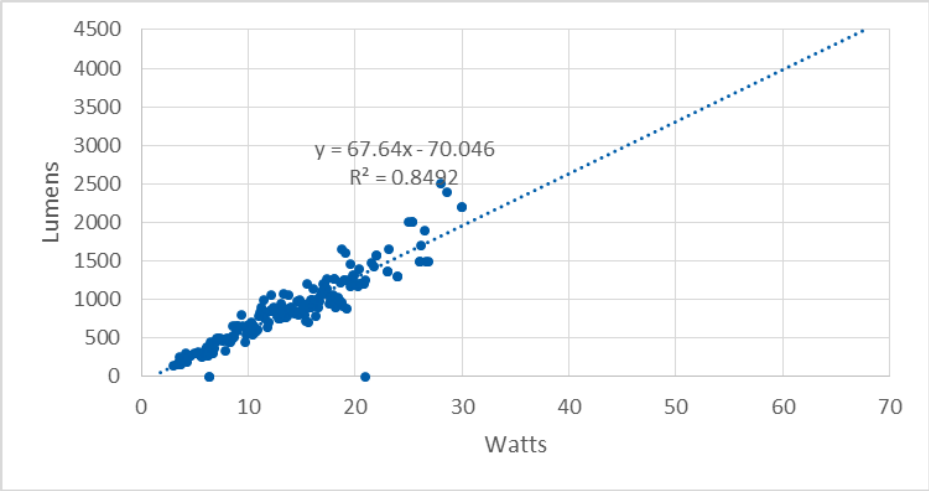


Figure B9: Median Lumens vs. Wattage for ENERGY STAR-Qualified Specialty LEDs

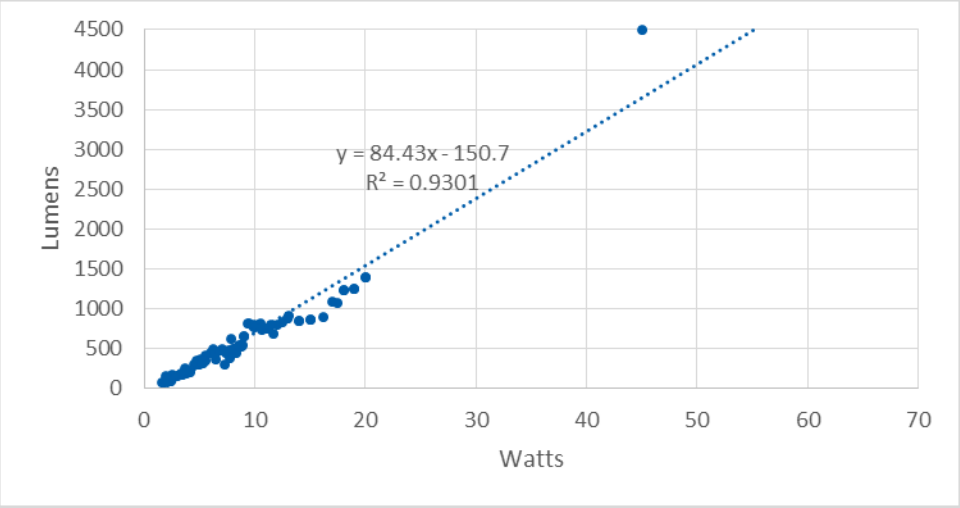
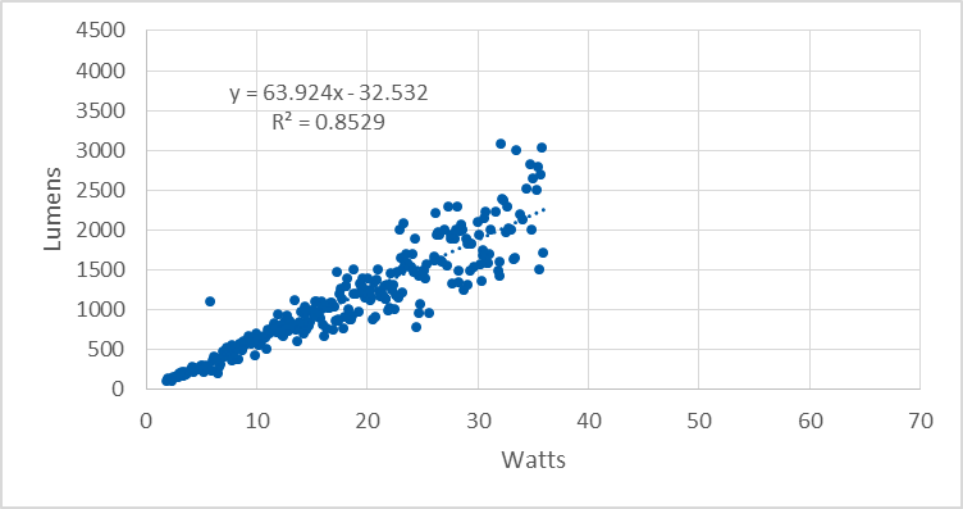


Figure B10: Median Lumens vs. Wattage for ENERGY STAR-Qualified LED Fixtures



Cross-Sector Lighting Sales

Cadmus performed intercept surveys in Utah, Washington, and Idaho to collect information from customers about efficient bulb purchases and whether they intended to install these bulbs in residential or commercial applications, then using these data to calculate a cross-sector sales percentage. Cadmus combined the data from the three states to maximize the confidence and precision around the estimate. The estimated cross-sector lighting sales factor not applied to the evaluated savings analysis for this evaluation.

During these surveys, field staff intercepted customers as they left stores if they purchased lighting products from a participating retail; staff asked customers questions addressing their efficient bulb purchases. For cross-sector sales purposes, staff asked customers about their intentions to install the purchased bulbs in residential or commercial applications. Table B10 summarizes respondent results. In total, Cadmus completed 630 surveys, and 363 of the respondents purchased one or more efficient bulbs. Of all respondents, 347 said they intended to install their bulbs in residential applications and 16 intended to install them in commercial applications.

Table B10. Cross-Sector Respondent Counts

Respondent Count	Application	
	Residential	Commercial
CFL	125	10
LED	227	6
CFL or LED	347	16
Total Respondents*		**363**

*Results aggregated across three states: interviews were conducted in Utah, Washington, and Idaho, but only one respondent intended to install bulbs in commercial applications in Washington and Idaho.

Table B11 summarizes the quantity of bulbs purchased by respondents. In total, respondents intended to install 1,536 CFLs and LEDs in residential applications and 62 in commercial applications.

Table B11. Cross-Sector Bulb Counts

Bulb Count	Application	
	Residential	Commercial
CFLs	632	50
LEDs	904	12
Total Bulbs	**1,536**	**62**

Cadmus used the bulb quantities shown in Table B11 to calculate a cross-sector sales percentage of 3.9% using the following equation:

$$\frac{Commercial\ CFLs\ \&\ LEDs}{All\ CFLs\ \&\ LEDs} = \frac{62}{1{,}598} = 3.9\%$$

The denominator in the equation represents the total number of efficient bulbs installed in residential and commercial facilities (1,536 + 62 = 1,598). Cadmus determined a 90% confidence interval of 2.2%–5.5% for the cross-sector sales percentage of 3.9%.

Demand Elasticity Modeling

As lighting products incur price changes and promotion over the program period, they provide valuable information regarding the correlation between sales and prices. Cadmus developed a demand elasticity model to estimate freeridership for the upstream markdown channel in 2014. A description follows detailing the methodology and analysis results.

Demand Elasticity Methodology

Demand elasticity modeling draws upon the same economic principle that drives program design: changes in price and promotion generate changes in quantities sold (i.e., the upstream buy-down approach). Demand elasticity modeling uses sales and promotion information to achieve the following:

- Quantify the relationship of price and promotion to sales;
- Determine likely sales levels without the program's intervention (baseline sales); and
- Estimate freeridership by comparing modeled baseline sales with predicted program sales.

After estimating variable coefficients, Cadmus used the resulting model to predict the following:

- Sales that would occur *without* the program's price impact; and
- Sales that would occur *with* the program (and should be close to actual sales with a representative model).

Once the model predicted sales that would occur with and without the program, Cadmus multiplied predicted bulb sales with evaluated savings values, calculated as part of this evaluation to estimate program savings and savings without the program's price impact.

Input Data

As the demand elasticity approach relies exclusively on program data, a model's robustness depends on data quality. Cadmus previously identified issues in the 2013 sales data as part of Cadmus' evaluation of Pacific Power programs.

The issues identified with the 2013 data were:

1. Inconsistent model numbers between 2013 and 2014.
2. Lack of schedule ID number in 2013 data.
3. Inconsistent bulb type designations within each model number (e.g., spiral and candelabra, reflector and general purpose spiral/a-line).

Mapping the correct price to sales within a given time period is the most critical task for this analysis since price is the primary driver of lighting sales. Because the 2014 sales data contained the pricing schedule ID, Cadmus was able to map the prices to the sales data. The 2013 sales that were provided did not include the price schedule ID. Due to limited budget for Pacific Power Washington and the difficulty in mapping sales to prices without the price schedule ID in the 2013 sales data, Cadmus used only the 2014 sales for the elasticity model.

To deal with inconsistent model numbers and bulb type designations, Cadmus had to make the most reasonable assumptions possible when preparing the data to support the analysis (e.g., assessing whether two model numbers with different formats and detail levels were the same).

Price Variation

Price and sales variation was measured across all bulbs within a given retail location and bulb type category by taking the sales-weighted average price per bulb for all products within the retail location and bulb category and the sum of the sales with the retailer/bulb category designations. For example, all standard CFLs within a specific Wal-Mart storefront location were combined into one category regardless of manufacturer or pack size. Each monthly observation in the data reflected the average price per-bulb for standard CFLs and the total standard CFL bulb sales within that specific location.

Defining cross sections for the model this way increases the observed level of variation in price and sales by capturing not only changes in a product's own price (for a given bulb model number) but also changes in the average price of a bulb due to changes in pack size (e.g., if a three-pack is introduced and displaces sales of a single pack bulb) or the introduction of a new comparable product to the program.

Promotional Displays

The program administrator, did not collect and could not provide detailed data on product merchandising (e.g., clip strips, end caps, pallet displays). Therefore, the model may not have captured all program impacts.[2]

Evaluations in other jurisdictions have found that product merchandising can generate sales lift between 60% and 120%. Capturing and providing this level of detail ensures that the program is credited for all activities. Cadmus recommends this data be collected and provided for future evaluations.

LEDs

To control for the introduction of LEDs and CFL sales being displaced by LEDs, Cadmus added a variable indicating when LED sales were being reported in each retail location. LEDs were a newer, more novel product in 2014, have a much longer useful life, and typically produce higher quality light than CFLs so some customers may switch from CLFs to LEDs as the price of LEDs decreases.

Other reasons for CFLs sales to decline, other than price, could be retailers shifting shelf space from CFLs to LEDs, which could lead to decreased visibility of CFL bulbs and decrease sales regardless of price.

Cadmus found that CFL sales decreased by an average of 97% when comparable LEDs were introduced.

Seasonality Adjustment

In economic analysis, it proves critical to separate data variations resulting from seasonality from those resulting from relevant external factors. For example, suppose prices had been reduced on umbrellas at the beginning of the rainy season. Any estimate of this price shift's impact would be skewed if the analysis did not account for the natural seasonality of umbrella sales.

To adjust for seasonal variations in sales, Cadmus used a monthly seasonal trend provided by an evaluation partner. This represented national sales from a major lighting products manufacturer. Ideally, a trend would derive from historical data on aggregate sales of lighting products (e.g., inefficient and efficient, program and non-program). Such data would represent overall trends in lighting product sales and would not suffer from potential confounding with programmatic activity to the same degree as CFL sales.[3] The trend, however, indicated aggregated, nationwide CFL sales for a specific manufacturer.

Presumably, the trend included some activity from programs across the nation, which could affect the sales trend, potentially leading to underestimated program impacts. Cadmus assumed, however, that

---

[2] To the degree that product merchandising and prices co-vary, elasticity estimates may capture some sales lift generated by merchandising. However, as data were not available to incorporate into the model, it impossible to estimate separate impacts.

[3] This assumes aggregate lighting sales did not change due to promotions; that is, customers simply substituted an efficient product for an inefficient one. While bulb stockpiling could occur during programmatic periods, this should smooth out over time, as the program would not affect the number of sockets in the home.

program activity would be somewhat random across all programs that could be included in the sales data used to develop the trend. In that case, program activity would be spread through the year, and the variation between months would be driven primarily by non-program factors.

Nevertheless, not controlling for seasonal variations could lead to program impacts overestimated by falsely attributing seasonal trends to price impacts (to the degree that they co-varied) or vice versa.

For example, sales in July tend to be lower (presumably due to longer daylight hours); so if program activity increased sales in July, not controlling for seasonal variation would underestimate the program's impact. October, on the other hand, sees higher sales, and no control for seasonality would likely overestimate program activity impacts occurring in that month.

The trend, given the national aggregation level, covered non-program products and areas without programs, therefore limiting the degree that the trend correlated with program activity. Absent primary seasonal data from Washington's territory, Cadmus estimated model and subsequent freeridership ratios using the CFL trend.

Model Specification

Cadmus modeled bulb, pricing, and promotional data using an econometric model, addressing these data as a panel, with a cross-section of program package quantities modeled over time as a function of prices, promotional events, and retail channels. This involved testing a variety of specifications to ascertain price impacts—the main instrument affected by the program—on bulb demand. Cadmus estimated the following equation for the model (for bulb model *i*, in month *t*):

$$\ln(Q_{it}) = \sum_{\pi}(\beta_{\pi} ID_{\pi,\mathrm{i}}) + \sum_{\theta}\left(\beta_{\theta 1}\left[ln(P_{it}) * (Retail\ Channel_{\theta,\mathrm{i}})\right]\right) + \sum_{\theta}\left(\beta_{\theta 2}\left[ln(P_{it}) * (Bulb\ Category_{\theta,\mathrm{i}})\right]\right) + CFL * LED\ Month + \alpha Seasonal\ Trend_t + \varepsilon_i$$

Where:

ln	=	Natural log
Q	=	Quantity of bulb packs sold during the month
P	=	Sales-weighted retail price per-bulb (after markdown) in month *t*
Retail Channel	=	Retail category (Club or non-Club store)
Bulb Category	=	Bulb category (reflector, standard, globe, candelabra)
LED Month	=	Dummy variable indicating LED bulbs were added to the program in month *t*; 0 otherwise
CFL	=	Dummy variable indicating a given cross section was CFL bulbs; 0 otherwise

ID = Dummy variable equaling 1 for each unique retail channel, bulb technology, and bulb category; 0 otherwise

Seasonal Trend = Quantitative trend representing the impact of secular trends not related to the program[4]

ε_{it} = Cross-sectional random-error term

The model specification assumed a negative binomial distribution, which served as the best fit of the plausible distributions (e.g., lognormal, poisson, negative binomial, and gamma). The negative binomial distribution provided accurate predictions for a small number of high-volume sale bulbs, while the other distributions under predicted sales for those bulbs.

Using the following criteria, Cadmus ran numerous model scenarios to identify the one with the best parsimony and explanatory power:

- Model coefficient p-values (keeping values less than <0.1);[5]
- Explanatory variable cross-correlation (minimizing where possible);
- Model Akaike's Information Criteria (AIC) (minimizing between models);[6]
- Minimizing multicollinearity; and
- Optimizing model fit.

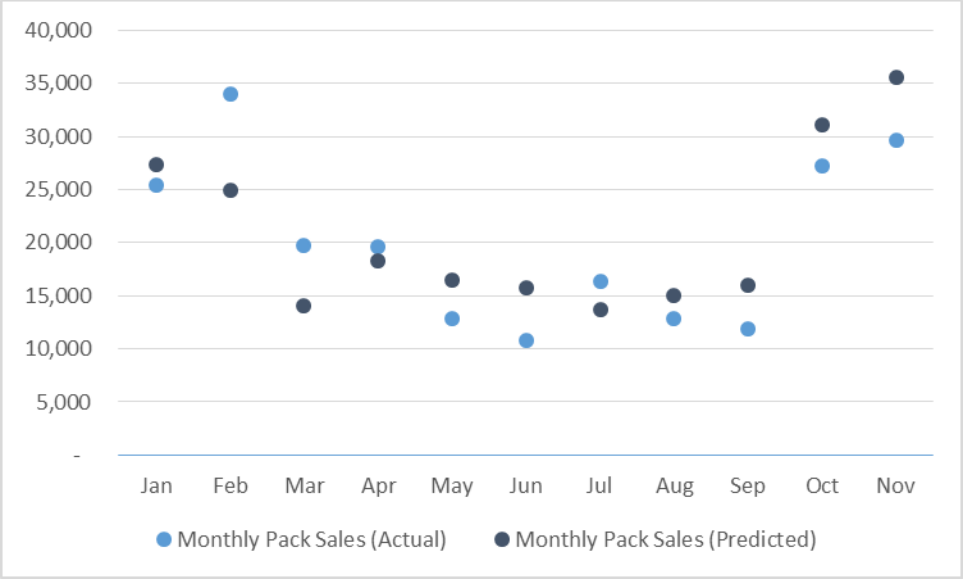
The model's fit can be examined by comparing model-predicted sales with actual sales. As shown in Figure B11, the model-predicted sales matches closely with actual sales. The model under predicted a couple of months, but it also over predicted a couple of months without persistent bias in a single direction (over- or under-predicting), indicating the model fit the data well. Overall, the model fell within 3.6% of actual sales.

[4] The time trend for this analysis represented shifts in sales due to non-program-related seasonality.

[5] Where a qualitative variable had many states (such as bulb types), Cadmus did not omit variables if one state's was insignificant; rather, the analysis considered the joint significance of all states.

[6] The Team used AIC to assess model fit, as nonlinear models do not define the R-square statistic. AIC also offers a desirable property in that it penalizes overly complex models, similarly to the adjusted R-square.

Figure B11. Predicted and Actual Sales



Findings

Cadmus estimated a combined CFL and LED freeridership of 23%. Table B12 shows the estimated freeridership ratio by bulb type. LEDs have higher freeridership than CFLs.

Table B12. Modeling Results by Bulb Type

Bulb Type	Freeridership	NTG*
CFLs	23%	77%
LEDs	38%	62%
All Bulbs	**23%**	**77%**

Table B13 shows the incentive as a share of the original retail price and the estimated freeridership ratio by bulb type. Typically, the proportional price reduction and the net of freeridership trend correlate: the higher the incentive, the lower the freeridership. This is particularly apparent in this case. The average markdown for LED bulbs was only 43% which results in an estimated freeridership ratio of 38%. Because of the lower markdown for LEDs, the program generated a net sales lift of 62% for LEDs compared to 77% for CFLs, which were marked down 63% of the original price.

Table B13. Modeling Results by Bulb Type

Bulb Type	Final Price per Bulb	Original Price per Bulb	Markdown %	Freeridership
CFL	$0.65	$1.75	63%	23%
LED	$3.73	$6.50	43%	38%

Elasticities

The net of freeridership ratios derived from the estimate of a price elasticity of demand. Price elasticity of demand measures the percent change in the quantity demanded, given a percent change in price. Due to the model's logarithmic functional form, these simply represented the coefficients for each price variable. In previous, similar analyses, elasticities typically range from -1 to -3 for CFLs, meaning a 10% drop in price led to a 10% to 30% increase in the quantity sold. As shown in Table B14, DIY and Mass Market store elasticity estimates fell a bit below the expected ranges, with some estimates less than one. Elasticities at grocery stores and hard-to-reach retailers were considerably higher and standard bulbs at club stores had the highest observed elasticity of 3.24, which is greater than the typical range.

The greater elasticity for standard lamps at club stores suggests that customers are much more sensitive to price changes for standard, general purpose bulbs than for specialty bulbs. For a given markdown, standard lamps would be expected to have lower freeridership because of the greater elasticity.

Table B14. Elasticity Estimates by Retail Channel and Bulb Type

Retail Channel	Bulb Type	Elasticity
Club Store	Globe	-1.28
	Reflector	-1.65
	Standard	-3.24
DIY Store	Standard	-0.65
Grocery	Standard	-1.96
Hard to Reach	Standard	-1.77
Mass Market	Standard	-0.81

Net of Freeridership Comparisons

Table B15 compares CFL net of freeridership estimates from several recent evaluations using the elasticity model approach. The table also shows the average, sales-weighted, original retail price of program bulbs and the incentive as a share of the original price, as the percent of markdown serves as a large driver to freeridership estimates.

Though the net of freeridership estimates for Pacific Power fell within the range of those observed in other programs, they decreased since the 2011–2012 modeling effort, though markdown levels were down to 53%, from 63% in the prior evaluation cycle. Another potential factor in the decline may be from the maturation of the efficient lighting market. As CFLs become a more familiar and accepted technology, demand may become less elastic—that is, for consumers willing to substitute CFLs for less-efficient bulbs, their willingness to buy CFLs will become less variable. For those less inclined to substitute CFLs, their decision may remain the same, regardless of price changes.

A lack of merchandising data could present another potential factor. Without data to explicitly control for sales lift due to merchandising, price elasticity estimates may absorb some impacts of product

merchandising to a degree that merchandising and price changes co-vary. This could lead to larger elasticity estimates when merchandising and prices positively correlate or lower elasticity estimates when they negatively correlate.

Table B15. Comparisons of CFL Net of Freeridership and Incentive Levels

Utility	Bulb Type	Original Price per bulb	Markdown per bulb	Markdown %	Freeridership
Pacific Power Washington 2014	**Standard**	**$2.27**	**$1.43**	**63%**	**23%**
Mid-Atlantic Utility 1 (2012-2013)	Standard	$1.97	$1.41	72%	27%
Mid-Atlantic Utility 3 (2012-2013)	Standard	$2.10	$1.59	76%	27%
New England (2011)	Standard	$2.11	$1.00	47%	32%
Mid-Atlantic Utility 2 (2012-2013)	Standard	$2.14	$1.43	67%	35%
Mid-Atlantic Utility 4 (2012-2013)	Standard	$2.22	$1.46	66%	35%
Midwest Utility (2014)	Standard	$1.82	$1.13	62%	43%
Southeast (2013)	Standard	$2.15	$1.09	51%	48%

The freeridership estimates for Pacific Power are within the range of those observed in other programs and on the low end of observed estimates.

Table B16 shows LED freeridership estimates for four other recent evaluations. The freeridership estimate for Pacific Power Washington's program is in the mid-range of those observed in other utilities. Additional details for markdown levels and prices are not provided because the retail and product mix varies considerably between evaluations, a major factor in the per-bulb prices.

Table B16. Comparison of LED Freeridership

Utility	Freeridership
Wisconsin (2015)	29%
Midwest (2014)	30%
South (2015)	48%
Mid-Atlantic (2014-2015)	48%
Pacific Power Washington (2013-2014)	**38%**

CADMUS

Appendix C. HES Billing Analysis

Cadmus conducted two billing analyses to estimate evaluated savings for the following measures:

- Insulation (attic, wall, or floor)
- Ductwork (duct sealing and/or duct insulation)

The following sections outline the methodology and results for each effort.

Insulation Billing Analysis

Cadmus conducted billing analysis to assess evaluated energy savings associated with insulation measure installations.[1] Cadmus determined the savings estimate using a pooled, conditional savings analysis (CSA) regression model, which included the following groups:

- 2013–2014 insulation participants (combined attic, wall, and floor insulation); and
- Nonparticipant homes, serving as the comparison group.

The billing analysis resulted in a 96% evaluated realization rate for insulation measures.

Insulation Program Data and Billing Analysis Methodology

Cadmus used the following sources to create the final database for conducting the billing analysis:

- ***Participant program data,*** collected and provided by the program administrator (including account numbers, measure types, installation dates, square footage of insulation installed, heat sources, and expected savings for the entire participant population).
- ***Control group data,*** which Cadmus collected from a census of approximately 76,000 nonparticipating customers in Washington. Cadmus matched energy use for the control group to quartiles of the participants' pre-participation energy use to ensure comparability of the two groups. To ensure adequate coverage of the nonparticipating population, Cadmus included four times the number of nonparticipants as participants.
- ***Billing data***, provided by Pacific Power, which included all Washington residential accounts. Cadmus matched the 2013–2014 participant program data to the census of Washington's billing data for participants installing only insulation measures (i.e., did not install other measures through HES). Billing data included meter-read dates and kWh consumption from January 2012 through August 2015. The final sample used in the billing analysis consisted of 156 participants and 624 control customers.
- ***Washington weather data***, including daily average temperatures from January 2012 to August 2015 for three weather stations, corresponding with HES participant locations.

[1] Billing analysis performed for customers installing only attic, wall, or floor insulation measures.

Cadmus matched participant program data with billing data, mapping daily heating degree days (HDDs) and cooling degree days (CDDs) to respective monthly read date periods using zip codes. Cadmus defined the billing analysis pre-period as 2012, before measure installations occurred. This meant defining the post-period as September 2014 through August 2015.[2]

Data Screening

To ensure the final model used complete pre- and post-participation and nonparticipant billing data, Cadmus selected accounts with the following:

1. Participant addresses matching to the billing data provided.
2. A minimum of 300 days in each of the pre- and post-periods (i.e., before the earliest installation, and after the latest reported installation).
3. More than 4,301 kWh per year or less than 48,718 kWh per year (the lowest and highest participant usage to remove very low- or high-usage nonparticipants).
4. Accounts showing a consumption change of less than 50% of pre-program usage, ensuring a better match between participants and the control group.
5. Expected savings under 70% of household consumption (i.e., accounts with a mismatch between participant database and billing data or with pre-period vacancies).

Cadmus also examined individual monthly billing data to check for vacancies, outliers, and seasonal usage changes. If the usage patterns remained inconsistent between pre- and post-periods, the analysis dropped accounts.

Table C1 shows participant and nonparticipant screening criteria used for the insulation billing analysis.

[2] As participants installing measures in late 2014 had less than 10 months of post-period data, the analysis excluded them. Similarly, the analysis excluded customers participating in 2013 with measure installation dates before November 2012 had less than 10 months of pre-period data.

Table C1. Screen for Inclusion in Billing Analysis

Screen	Attrition		Remaining	
	Nonparticipant	Participant	Nonparticipant	Participant
Original measures database (insulation installations only) and nonparticipant population	N/A	N/A	76,308	358
Matched billing data sample (reduced to nonparticipant, single-family residential accounts in participant zip codes; participant accounts that could be matched to the billing data addresses).	21,300	100	55,008	258
Reject accounts with less than 300 days in pre- or post-period	12,758	79	42,250	179
Reject accounts with less than 4,301 kWh or more than 48,718 kWh in pre- or post-period	1,400	-	40,850	179
Reject accounts with consumption changing by more than 50%	1,072	3	39,778	176
Reject accounts with expected savings over 70% of pre-period consumption	-	3	39,778	173
Reject accounts with billing data outliers, vacancies, and seasonal usage	285	17	39,493	156
Nonparticipant sample selection (random sample of nonparticipants to match participant pre-period usage by quartile; four times more than participants)	38,869	-	624	156
Final Sample			**624**	**156**

Regression Model

After screening and matching accounts, the final analysis group consisted of 156 participants and 624 nonparticipants.

Of the final sample, 87% of participant homes installed attic insulation, 22% installed wall insulation, and 19% installed of the participant homes installed floor insulation. As determining separate wall or floor insulation savings proved impossible, Cadmus estimated a combined realization rate for all insulation measures.

Cadmus used the following CSA regression specification to estimate HES Program insulation savings:

$$ADC_{it} = \alpha_i + \beta_1 HDD_{it} + \beta_2 CDD_{it} + \beta_3 POST_t + \beta_4 PARTPOST_{it} + \varepsilon_{it}$$

Where for customer (i) and month (t):

ADC_{it}	=	Average daily kWh consumption
HDD_{it}	=	Average daily HDDs (base 65)
CDD_{it}	=	Average daily CDDs (base 65)
$POST_t$	=	Indicator variable of 1 in the post-period for participants and nonparticipants, 0 otherwise
$PARTPOST_{it}$	=	Indicator variable of 1 in the post-period for participants, 0 otherwise

β_4 served as the key coefficient determining average insulation savings. The coefficient averaged daily insulation savings per program participant, after accounting for nonparticipant trends. Cadmus included individual customer intercepts (α_i) as part of a fixed-effects model specification to ensure no participants or nonparticipants exerted an undue influence over the final savings estimate; this resulted in a more robust model.[3]

Insulation Results

Cadmus estimated overall insulation savings of 1,980 kWh per participant. Average insulation had expected savings of 2,055 kWh, translating to a 96% evaluated realization rate for insulation measures. With average participant pre-usage of 20,860 kWh, savings represented a 9% reduction in total energy usage from insulation measures installed. Table C2 presents the overall evaluated savings estimate for wall, floor, and attic insulation.

Table C2. Insulation Evaluated Realization Rates

Model	Billing Analysis Participants (n)	Reported kWh Savings per Premise	Evaluated kWh Savings per Premise	Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall *	**156**	**2,055**	**1,980**	**96%**	**±19%**	**78%–114%**
Electric Heat	120	2,613	2,477	95%	±16%	79%–110%
Electric Heat (HP)	64	3,328	3,034	91%	±18%	75%–107%
Electric Heat (Non-HP)	56	1,797	1,861	104%	±30%	72%–135%

* Overall model includes both electric and gas heat – could not split out gas heat due to small sample size.

Cadmus only used overall Washington model results to determine measure-level evaluated savings, but provided results by for electric heat, heat pump and non-heat pump participants.

[3] Due to the complexity of estimating the model with separate intercepts, Cadmus estimated a difference model, subtracting out the customer-specific averages for both the dependent and independent variables. This method produced results identical to the fixed effects models with separate intercepts; however, using a difference model proved simpler in estimating savings and presenting final model outputs.

Overall, electrically heated homes achieved insulation savings of 2,477 kWh per home. Average electrically heated expected insulation savings were 2,613 kWh, translating to a 95% realization rate. With average electrically heated participant pre-usage of 22,838 kWh, savings represented an 11% reduction in energy usage from insulation measures. Participants with heat-pumps achieved savings of 3,034 kWh (13%), and those without heat pumps achieved 1,861 kWh (9%).

Because of small sample size (n=36) Cadmus was not able to obtain reliable estimates of savings for gas heated homes.

Table C3, Table C4, Table C5, and Table C6 summarize model outputs for the regression models Cadmus used to determine the insulation realization rates.

Table C3. Insulation Regression Model for Washington (Overall Model)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	3,796,365	949,091	3408.38	<.0001
Error	18,658	5,195,474	278.45824		
Corrected Total	18,662	8,991,839			
Root MSE		16.68707	R-Square		0.4222
Dependent Mean		-1.83E-17	Adj. R-Square		0.4221
Coefficient of Variation		-9.13E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	-0.9340	0.27371	-3.41	.0006
PartPost	**1**	**-5.4234**	**0.61253**	**-8.85**	**<.0001**
AvgHdd	1	1.6162	0.01419	113.93	<.0001
AvgCdd	1	2.2803	0.03709	61.48	<.0001

Table C4. Insulation Regression Model for Washington (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	3,909,446	977,362	3525.72	<.0001
Error	17,798	4,933,764	277.2089		
Corrected Total	17,802	8,843,211			
Root MSE		16.64959	R-Square		0.4421
Dependent Mean		-1.92E-17	Adj. R-Square		0.4420
Coefficient of Variation		-8.69E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	-0.8584	0.27313	-3.14	.0002
PartPost	**1**	**-6.7869**	**0.68084**	**-9.97**	**<.0001**
AvgHdd	1	1.6675	0.01447	115.23	<.0001
AvgCdd	1	2.2687	0.03796	59.76	<.0001

Table C5. Insulation Regression Model for Washington (Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	3,395,695	848,924	3137.38	<.0001
Error	16,462	4,454,347	270.58357		
Corrected Total	16,466	7,860,042			
Root MSE		16.44942	R-Square		0.4326
Dependent Mean		-2.42E-16	Adj. R-Square		0.4324
Coefficient of Variation		-6.81E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	-0.9183	0.26881	-3.40	.0007
PartPost	**1**	**-8.3128**	**0.88722**	**-9.37**	**<.0001**
AvgHdd	1	1.6270	0.01490	109.20	<.0001
AvgCdd	1	2.2812	0.03921	58.17	<.0001

Table C6. Insulation Regression Model for Washington (Electric Heat Non-Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	3,331,358	832,839	3081.85	<.0001
Error	16,283	4,400,314	270.23976		
Corrected Total	16,287	7,731,672			
Root MSE		16.43897	R-Square		0.4309
Dependent Mean		-0.00117	Adj. R-Square		0.4307
Coefficient of Variation		-1409576			
Source	**Parameter Estimates**				
	DF	Parameter Estimates	Standard Error	t value	Prob. t
Post	1	-0.9268	0.26974	-3.44	.0006
PartPost	**1**	**-5.0983**	**0.93882**	**-5.43**	**<.0001**
AvgHdd	1	1.6209	0.01494	108.51	<.0001
AvgCdd	1	2.2747	0.03935	57.81	<.0001

Ductwork Billing Analysis

Cadmus conducted a billing analysis to assess evaluated energy savings associated with duct sealing and duct insulation measure installations,[4] determining the savings estimate from a pooled, CSA regression model, which included the following groups:

- 2013–2014 ductwork participants (combined duct sealing and duct insulation); and
- Nonparticipant homes, serving as the comparison group.

The billing analysis resulted in an 89% evaluated realization rate for duct sealing and duct insulation measures. This produced an evaluated result as it compared participant usage trends to a nonparticipant group, accounting for market conditions outside of the program.

Ductwork Program Data and Billing Analysis Methodology

Cadmus used the following sources to create the final database for conducting the billing analysis:

- ***Participant program data,*** collected and provided by the program administrator (including account numbers, measure types, installation dates, square footage of insulation installed, heat source, and expected savings for the entire participant population).
- ***Control group data,*** which Cadmus collected from a census of approximately 76,000 nonparticipating customers in Washington. This included matching energy use for the control group to quartiles of the participants' pre-participation energy use to ensure comparability of

[4] Billing analysis performed for customers installing only duct sealing and/or duct insulation measures.

the two groups. To ensure adequate coverage of the nonparticipating population, Cadmus included four times the number of nonparticipants than participants.

- ***Billing data***, provided by Pacific Power, included all Washington residential accounts. Cadmus matched the 2013–2014 participant program data to the census of billing data for the state (only for participants installing duct sealing and/or duct insulation measures).The data included meter-read dates and kWh consumption from January 2012 through August 2015. The final sample used in the billing analysis consisted of 143 participants and 572 control customers.
- ***Washington weather data***, including daily average temperatures from January 2012 to August 2015 for 3 weather stations, corresponding with HES participants' locations.

Cadmus matched participant program data with billing data and mapped daily heating and CDDs to respective monthly read date periods using zip codes. Cadmus defined the pre-period for the billing analysis as 2012, before any measure installations occurred, and defined the post-period as September 2014 through August 2015.[5]

Data Screening

To ensure the final model used complete pre- and post-participation and nonparticipation billing data, Cadmus selected accounts with the following:

1. Participant addresses matching to the billing data provided.
2. A minimum of 300 days in each of the pre- and post-periods (i.e., before the earliest installation and after the latest reported installation).
3. More than 4,971 kWh per year or less than 48,944 kWh per year (the lowest and highest participant usages to remove very low or high usage nonparticipants).
4. Accounts showing a consumption change of less than 50% of pre-program usage, ensuring a better match between participants and the control group.
5. Expected savings under 70% of household consumption (accounts for either a mismatch between participant database and billing data or pre-period vacancies).

Further, Cadmus examined the individual monthly billing data to check for vacancies, outliers, and seasonal usage changes. If usage patterns proved inconsistent between the pre- and post-periods, the analysis dropped the accounts. Table C7 shows participant and nonparticipant screening criteria used in the billing analysis.

[5] As participants installing measures in late 2014 had less than 10 months of post-period data, Cadmus removed them from the analysis. Similarly, customers who participated in 2013 with measure installation dates before November 2012 had less than 10 months of pre-period data and were removed from the analysis.

Table C7. Screen for Inclusion in Billing Analysis

Screen	Attrition		Remaining	
	Nonparticipant	Participant	Nonparticipant	Participant
Original measures database (duct work installations only) and nonparticipant population	N/A	N/A	76,308	215
Matched billing data sample (reduced to nonparticipant, single-family/manufactured home residential accounts in participant zip codes; participant accounts that could be matched to the billing data addresses)	31,326	43	44,982	172
Reject accounts with less than 300 days in pre- or post-period	9,314	20	35,668	152
Reject accounts with less than 4,971 kWh or more than 48,944 kWh in pre- or post-period	5,587	-	30,081	152
Reject accounts with consumption changing by more than 50%	1,252	-	28,829	152
Reject accounts with expected savings over 70% of pre-period consumption	-	1	28,829	151
Reject accounts with billing data outliers, vacancies, and seasonal usage	148	8	28,681	143
Nonparticipant sample selection (random sample of nonparticipants to match participant pre-period usage by quartile: four times more than participants)	28,109	-	572	143
Final Sample			**572**	**143**

Regression Model

After screening and matching accounts, the final analysis group consisted of 143 participants and 572 nonparticipants.

Cadmus used the following CSA regression specification to estimate duct sealing and duct insulation savings from the HES Program:

$$ADC_{it} = \alpha_i + \beta_1 HDD_{it} + \beta_2 CDD_{it} + \beta_3 POST_t + \beta_4 PARTPOST_{it} + \varepsilon_{it}$$

Where for customer (i) and month (t):

ADC_{it} = Average daily kWh consumption

HDD_{it} = Average daily HDDs (base 65)

CDD_{it} = Average daily CDDs (base 65)

$POST_t$ = Indicator variable of 1 in the post-period for participants and nonparticipants, 0 otherwise

$PARTPOST_{it}$ = Indicator variable of 1 in the post-period for participants, 0 otherwise

β_4 served as the key coefficient that determined average duct sealing and duct insulation savings. This coefficient averaged daily duct sealing and duct insulation savings per program participant, after accounting for nonparticipant trends. Cadmus included individual customer intercepts (α_i) as part of a fixed-effects model specification to ensure no participants or nonparticipants had an undue influence over the final savings estimate, resulting in a more robust model.[6]

Ductwork Results

Cadmus estimated overall duct sealing and duct insulation savings of 2,183 kWh per home. Expected average duct sealing and duct insulation savings were 2,457 kWh, translating to an 89% evaluated realization rate for duct sealing and insulation measures. With average participant pre-usage of 18,300 kWh, savings represented a 12% reduction in total energy usage from duct sealing and duct insulation measures installed. **Error! Reference source not found.** presents the overall savings estimate for duct sealing and duct insulation.

Table C8. Overall Ductwork Evaluated Realization Rates

Model	Billing Analysis Participant (n)	Reported kWh Savings per Premise	Evaluated kWh Savings per Premise	Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall*	**143**	**2,457**	**2,183**	**89%**	**±13%**	**77%–101%**
Electric Heat	138	2,538	2,241	88%	±13%	77%–100%
Electric Heat (HP)	42	4,737	4,039	85%	±13%	74%–96%
Electric Heat (Non-HP)	96	1,576	1,456	92%	±23%	71%–114%

* Overall model includes both electric and gas heat – could not split out gas heat due to small sample size.

Cadmus only used overall Washington model results, but provided results for electric heat, heat pump and non-heat pump participants.

Overall, electrically heated homes achieved duct sealing and duct insulation savings of 2,241 kWh per home. Expected average electrically heated duct sealing and duct insulation savings were 2,538 kWh, translating to an 88% evaluated realization rate. With average electrically heated participant pre-usage

[6] Due to the complexity of estimating the model with separate intercepts, Cadmus estimated a difference model, which, for both the dependent variable and the independent variables, subtracted out customer-specific averages. This method produced identical results to the fixed-effects models with separate intercepts; however, using a difference model proved simpler to estimate savings and present final model outputs.

of 18,579 kWh, savings represented a 12% reduction in energy usage from duct sealing and duct insulation measures. Electrically heated participants with heat-pumps achieved savings of 4,039 kWh (18%), and those without heat pumps achieved 1,456 kWh (9%).

It was not possible to obtain a separate savings estimate for gas heated homes because of small sample sizes (n=5).

Furthermore Cadmus also estimated separate duct sealing and insulation savings and realization rates estimates for only manufactured homes (that was used to determine the manufactured homes realization rates for Idaho and Wyoming). Cadmus estimated overall duct sealing and duct insulation savings of 1,825 kWh per manufactured home. Expected average duct sealing and duct insulation savings were 1,910 kWh, translating to a 96% evaluated realization rate for manufactured home duct sealing and insulation measures. With average participant pre-usage of 17,671 kWh, savings represented a 10% reduction in total energy usage from duct sealing and duct insulation measures installed. Table C9 summarizes the results of for manufactured homes.

Table C9. Manufactured Home Ductwork Evaluated Realization Rates

Model	Billing Analysis Participant (n)	Reported kWh Savings per Premise	Evaluated kWh Savings per Premise	Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall	**118**	**1,910**	**1,825**	**96%**	**±16%**	**80%–111%**
Electric Heat	118	1,910	1,825	96%	±16%	80%–111%
Electric Heat (HP)	24	3,214	3,000	93%	±20%	74%-112%
Electric Heat (Non-HP)	94	1,577	1,524	97%	±21%	76%-117%

Cadmus only used overall Washington manufactured home model results, but provided results for heat pump and non-heat pump participants. Electrically heated participants with heat-pumps achieved savings of 3,000 kWh (15%), and those without heat pumps achieved 1,525 kWh (9%).

Table C1, Table C15, Table C16, and Table C13 summarize model outputs for the regression models Cadmus used to determine the Washington overall duct sealing and duct insulation realization rates.

Table C10. Overall Ductwork Regression Model for Washington (Overall)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,782,237	1,195,559	7,404	<.0001
Error	17,124	2,765,070	161.47336		
Corrected Total	17,128	7,547,307			
Root MSE		12.70722	R-Square		0.6336
Dependent Mean		3.52E-16	Adj. R-Square		0.6335
Coefficient of Variation		3.61E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	**1**	0.1255	0.21859	0.57	0.5661
PartPost	**1**	**-5.9803**	**0.48638**	**-12.30**	**<.0001**
AvgHdd	1	1.7802	0.01123	158.59	<.0001
AvgCdd	1	1.8434	0.02777	66.39	<.0001

Table C11. Overall Ductwork Regression Model for Washington (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,809,614	1,202,403	7,499	<.0001
Error	17,004	2,726,392	160.3383		
Corrected Total	17,008	7,536,006			
Root MSE		11.55503	R-Square		0.6382
Dependent Mean		2.86E-16	Adj. R-Square		0.6381
Coefficient of Variation		4.05E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	**1**	0.1518	0.21783	0.70	0.4858
PartPost	**1**	**-6.1404**	**0.49168**	**-12.49**	**<.0001**
AvgHdd	1	1.7889	0.01122	159.43	<.0001
AvgCdd	1	1.8424	0.02776	66.36	<.0001

Table C12. Overall Ductwork Regression Model for Washington (Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,059,334	1,014,833	5,990	<.0001
Error	14,709	2,492,208	169.43421		
Corrected Total	14,713	6,551,542			
Root MSE		13.01669	R-Square		0.6196
Dependent Mean		3.52E-16	Adj. R-Square		0.6195
Coefficient of Variation		3.69E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.0467	0.22413	0.21	0.835
PartPost	**1**	**-11.0655**	**0.85445**	**-12.95**	**<.0001**
AvgHdd	1	1.7593	0.01229	143.14	<.0001
AvgCdd	1	1.8776	0.03078	61.00	<.0001

Table C13 Overall Ductwork Regression Model for Washington (Non-Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,425,724	1,106,431	6,859	<.0001
Error	16,008	2,544,982	158.98188		
Corrected Total	16,012	6,970,706			
Root MSE		12.6088	R-Square		0.6349
Dependent Mean		2.67E-16	Adj. R-Square		0.6348
Coefficient of Variation		4.72E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.1080	0.21700	0.50	.6187
PartPost	**1**	**-3.9902**	**0.56882**	**-7.01**	**<.0001**
AvgHdd	1	1.7709	0.0115	154.00	<.0001
AvgCdd	1	1.8216	0.0285	63.92	<.0001

Table C14, Table C155, Table C166 summarize model outputs for the regression models Cadmus used to determine the Washington manufactured home duct sealing and duct insulation realization rates.

Table C14. Manufactured Home Ductwork Regression Model for Washington (Overall + Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,292,728	1,073,182	8,037	<.0001
Error	14,131	1,886,753	133.51872		
Corrected Total	14,135	6,179,481			
Root MSE		11.55503	R-Square		0.6947
Dependent Mean		2.86E-16	Adj. R-Square		0.6946
Coefficient of Variation		4.05E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	**1**	0.4156	0.21888	1.90	0.0576
PartPost	**1**	**-5.0002**	**0.48680**	**-10.27**	**<.0001**
AvgHdd	1	1.83052	0.01121	163.31	<.0001
AvgCdd	1	1.76543	0.02782	63.45	<.0001

Table C15. Manufactured Home Ductwork Regression Model for Washington (Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	3,541,955	885,489	6,288	<.0001
Error	11,884	1,673,483	140.8182		
Corrected Total	11,888	5,215,438			
Root MSE		11.8667	R-Square		0.6791
Dependent Mean		2.9E-16	Adj. R-Square		0.6790
Coefficient of Variation		4.00E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.31411	0.22505	1.40	0.1628
PartPost	**1**	**-8.21833**	**1.01982**	**-8.06**	**<.0001**
AvgHdd	1	1.80182	0.01241	145.16	<.0001
AvgCdd	1	1.79484	0.03128	57.38	<.0001

Table C16. Manufactured Home Ductwork Regression Model for Washington (Non-Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,085,584	1,021,396	7,687	<.0001
Error	13,562	1,801,936	132.8665		
Corrected Total	13,566	5,887,520			
Root MSE		11.52677	R-Square		0.6939
Dependent Mean		1.38E-16	Adj. R-Square		0.6938
Coefficient of Variation		8.34E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.38965	0.21841	1.78	.0744
PartPost	**1**	**-4.17586**	**0.53254**	**-7.84**	**<.0001**
AvgHdd	1	1.82036	0.01139	159.83	<.0001
AvgCdd	1	1.75465	0.02833	61.93	<.0001

CADMUS

Appendix D. Self-Reported Net-to-Gross Methodology

Net-to-gross (NTG) estimates are a critical part of demand-side management program impact evaluations, because they allow utilities to determine portions of gross energy savings that were influenced by and are attributable to their DSM programs. Freeridership and participant spillover are the two NTG components calculated in this evaluation. True freeriders are customers who would have purchased an incented appliance or equipment without any support from the program (e.g. taking the incentive). Participant spillover is the amount of additional savings obtained by customers investing in additional energy-efficient measures or activities due to their program participation. Various methods can be used to estimate program freeridership and spillover; for this evaluation, Cadmus used self-reports from survey participants to estimate NTG for appliances, HVAC, weatherization, and kit measure categories, as this method can gauge net effects for many measures at once and enables Cadmus to monitor freeridership and spillover over several evaluation efforts.

Survey Design

Direct questions (such as: "Would you have installed measure X without the program incentive?") tend to result in exaggerated "yes" responses. Participants tend to provide answers they believe surveyors seek; so a question becomes the equivalent of asking: "Would you have done the right thing on your own?" An effective solution, and an industry standard, for avoiding such bias involve asking a question in several different ways, then checking for consistent responses.

Cadmus used industry tested survey questions to determine why customers installed a given measure, and what influence the program had on their decisions. For rebate measure participants, we used the survey to establish what decision makers might have done in the program's absence, via five core freeridership questions:

1. Would participants have installed measures without the program?
2. Had participants ordered or installed the measures before learning about the program?
3. Would participants have installed the measures at the same efficiency levels without the program incentive?
4. Would participants have installed the same quantity of measures without the program?
5. In the program's absence, when would respondents have installed the measures?

Cadmus used a separate set of questions and scoring approach when estimating the freeridership for the kit measure category. After conducting participant surveys with energy efficient kit recipients, Cadmus utilized responses from three questions to estimate a freeridership score for each participant. Freeridership questions focused on whether the participant was already using the measure in their home and if they had plans to purchase the measure before signing up to receive the kit. For participants receiving energy efficiency kits, we used the kit survey to establish what decision makers might have done in the program's absence, via the core questions below:

1. Before the participant signed up for the kit, did they already have the measure installed in their home?
2. Was the participant already planning to purchase the measure before at the time they signed up for the kit?
3. If the participant was planning to purchase the measure before signing up for the kit, in terms of timing, when would they have purchased the CFLs? (ex. at the same time, later but within the same year, in one year or more)

Cadmus sought to answer three primary questions with our participant spillover survey design:

1. Since participating in the program evaluated, did participants install additional energy-efficient equipment or services incented through a utility program?
2. How influential was the evaluated program on the participants' decisions to install additional energy-efficient equipment in their homes?
3. Did customers receive incentives for additional measures installed?

Freeridership Survey Questions

The residential rebate survey's freeridership portion included 12 questions, addressing the five core freeridership questions. The survey's design included several skip patterns, allowing interviewers to confirm answers previously provided by respondents by asking the same question in a different format. The rebate freeridership questions (as asked in the survey format) included:

1. When you first heard about the incentive from Pacific Power, had you already been planning to purchase the measure?
2. Had you already purchased or installed the new measure before you learned about the incentive from the Home Energy Savings Program?
3. [*Ask if question 2 is Yes*] Just to confirm, you learned about the Pacific Power rebate program after you had already purchased or installed the new measure?
4. [*Ask if question 2 or 3 is No or Don't Know*] Would you have installed the same measure without the incentive from the Home Energy Savings Program?
5. [*Ask if question 4 is No or Don't Know*] Help me understand, would you have installed something without the Home Energy Savings Program incentive?
6. [*Ask if question 4 or 5 is Yes*] Let me make sure I understand. When you say you would have installed the measure, would you have installed the same one, that was just as energy efficient?
7. *[Ask if question 4 or question 5 is Yes AND measure quantity > 1]* Would you have installed the same quantity?
8. [*Ask if question 4 or question 5 is Yes*] Would you have installed the measure at the same time?
9. [*Ask if question 5 is No*] To confirm, when you say you would not have installed the same measure, do you mean you would not have installed the measure at all?

10. [*Ask if question 9 is No or Don't Know*] Again, help me understand. Would you have installed the same type of measure, but it would not have been as energy-efficient?
11. *[Ask if question 9 is No or Don't Know AND measure quantity > 1]* Would you have installed the same measures, but fewer of them?
12. [*Ask if question 9 is No or Don't Know*] Would you have installed the same measure at the same time?

The kit freeridership questions asked of each measure (as asked in the survey format) included:

1. Did you have any other high-efficiency [MEASURE] installed in your home at the time you signed up for the kit?
2. At the time you signed up for the kit, were you already planning on buying high-efficiency [MEASURE] for your home?
3. [*Ask if question 2 is Yes]* In terms of timing, when would you have purchased the high-efficiency [MEASURE]?

Participant Spillover Survey Questions

As noted, Cadmus used the results of the spillover questions to determine whether program participants installed additional energy-saving measures since participating in the program. Savings that participants received from additional measures were spillover if the program significantly influenced their decisions to purchase additional measures, and if they did not receive additional incentives for those measures.

With the surveys, we specifically asked residential participants whether they installed the following measures:

- Clothes washers
- Refrigerators
- Dishwashers
- Windows
- Fixtures
- Heat pumps
- Ceiling fans
- Electric water heaters
- CFLs
- Insulation

If the participant installed one or more of these measures, we asked additional questions about what year they purchased the measure, if they received an incentive for the measure, and how influential (highly influential, somewhat influential, not at all influential) the HES Program was on their purchasing decisions.

Cadmus combined the freeridership and spillover questions in the same survey, asked over the telephone with randomly selected program participants. Prior to beginning the survey effort, Cadmus pre-tested the survey to ensure that all appropriate prompts and skip patterns were correct. Cadmus also monitored the survey company's initial phone calls to verify that:

- Survey respondents understood the questions; and
- Adjustments were not required.

Freeridership Methodology

Cadmus developed a transparent, straightforward matrix for assigning freeridership scores to participants, based on their responses to targeted survey questions. We assigned a freeridership score to each question response pattern, and calculated confidence and precision estimates based on the distribution of these scores (a specific approach cited in the National Action Plan for Energy Efficiency's *Handbook on DSM Evaluation*, 2007 edition, page 5-1).

Cadmus left the response patterns and scoring weights explicit so that they could be discussed and changed. We used a rules-based approach to assign scoring weights to each response from each freeridership question. This allows for sensitivity analysis to be performed instantaneously and test the stability of the response patterns and scoring weights. Scoring weights can be changed for a given response option to a given question. This also provided other important features, including:

- Derivation of a partial freeridership score, based on the likelihood of a respondent taking similar actions in absence of the incentive.
- Use of a rules-based approach for consistency among multiple respondents.
- Use of open-ended questions to ensure quantitative scores matched respondents' more detailed explanations regarding program attribution.
- The ability to change weightings in a "what if" exercise, testing the stability of the response patterns and scoring weights.

This method offered a key advantage by including partial freeridership. Our experience has shown that program participants do not fall neatly into freerider and non-freerider categories. We assigned partial freeridership scores to participants who had plans to install the measure before hearing about the program, but for whom the program exerted some influence over their decisions. Further, by including partial freeridership, we could use "don't know" and "refused" responses rather than removing those respondents entirely from the analysis.

Cadmus assessed rebated measure freeridership at three levels:

1. We converted each participant survey response into freeridership matrix terminology.
2. We gave each participant's response combination a score from the matrix.
3. We aggregated all participants into an average freeridership score for the entire program category.

Cadmus assessed freeridership for each kit measure by estimating up to two separate freeridership scores:

1. We estimated a *future intent* freeridership score from questions focused on a participant's *future intent* to buy the kit measure within one year at the time of signing up to receive the kit.
2. In some instances we estimated a *prior use* freeridership score from a question focused on the *prior use* of the kit measure in question in the respondent home.

Convert Rebated Measure Responses to Matrix Terminology

Cadmus evaluated and converted each survey question's response into one of the following values, based on assessing rebate measure participants' freeridership levels for each question:

- Yes (Indicative of freeridership)
- No (Not indicative of freeridership)
- Partial (Partially indicative of freeridership)

Table D1 lists the 12 rebate measure freeridership survey questions, their corresponding response options, and the values they converted to (in parentheses). "Don't know" and "refused" responses converted to "partial" for all but the first three questions. For those questions, if a participant was unsure whether they had already purchased or were planning to purchase the measure before learning about the incentive, we considered them as an unlikely freerider.

Table D1. Assignments of HES Rebate Measure Survey Response Options into Matrix Terminology*

Already planning to purchase?	Already purchased or installed?	Confirmatory: Already purchased installed?	Installed same measure without incentive?	Installed something without incentive?	Installed same efficiency?	Installed same quantity?	Installed at the same time?	Would not have installed measure?	Installed lower efficiency?	Installed lower quantity?	Installed at the same time?
Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Same time (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Same time (Yes)
No (No)	No (No)	No (No)	No (No)	No (No)	No (No)	No (No)	Within one year (P)	No (No)	No (No)	No (No)	Within one year (P)
DK (No)	DK (No)	DK (No)	DK (No)	DK (P)	DK (P)	DK (P)	Over one year (No)	DK (P)	DK (P)	DK (P)	Over one year (No)
RF (No)	RF (No)	RF (No)	RF (No)	RF (P)	RF (P)	RF (P)	DK (P)	RF (P)	RF (P)	RF (P)	DK (P)
							RF (P)				RF (P)

* In this table, (P) = partial, RF = refused, and DK = don't know.

Participant Freeridership Scoring

Non-lighting Rebate Measure

After converting survey responses into matrix terminology, Cadmus created a freeridership matrix, assigning a freeridership score to each participant's combined responses. We considered all combinations of survey question responses when creating the matrix, and assigned each combination a freeridership score of 0% to 100%. Using this matrix, we then scored every participant combination of responses.

Kit Measure

If a respondent was not planning to purchase a kit measure within one year at the time they signed up to receive the kit, they are automatically estimated at 0% freeridership for that measure. If a respondent did have plans to purchase the measure at the time of signing up for the kit, their *future intent* freeridership score derives from the prescribed values in Table D2.

Table D2. Kit Measure *Future Intent* Question Freeridership Scoring

Response	*Future Intent* FR Score
Around the same time I received the kit	100%
Later but within the same year	50%
In one year or more	0%
[DON'T READ] Don't Know	25%

If a respondent did not already have any of the measure installed in their home at the time they signed up for the kit, then they received a *prior-use* freeridership score of 0% and this *prior-use* freeridership estimate was then averaged with their *future intent* freeridership score only if they would have purchased the measure within one year of when they initially signing up for the kit. For example, if a respondent said they would have purchase the measure at the same time they received the kit but also said that they weren't using any of the measure in their home at the time they signed up for the kit, their *future intent* freeridership score of 100% is averaged with their *prior use* freeridership of 0% using the arithmetic mean to arrive at the participants final freeridership score of 50% for the measure. If respondent said they would have purchase the measure at the same time they received the kit and also were using the measure in their home at the time they signed up for the kit, their final freeridership score is 100%, which comes from their *future intent* freeridership score.

Measure Category Freeridership Scoring

Non-lighting Rebate Measures

After assigning a freeridership score to every survey respondent, Cadmus calculated a savings-weighted average freerider score for the program category. We individually weighted each respondent's freerider scores by the estimated savings from the equipment they installed, using the following calculation:

$$Savings\ Weighted\ Freeridership = \frac{\sum(Respondent\ FR\ Score) * (Rebated\ Measure\ kWh\ Savings)}{\sum(Rebated\ Measure\ kWh\ Savings\ of\ All\ Respondents)}$$

Kit Measures

After assigning freeridership scores to every survey respondent's kit measures, Cadmus calculated a savings-weighted average freerider score for each kit measure. We individually weighted each respondent's final measure level freeridership scores by the estimated savings from the equipment they installed, using the following calculation:

$$Measure\ Level\ Savings\ Weighted\ Freeridership = \frac{\sum(Kit\ Measure\ Respondent\ FR\ Score) * (Kit\ Measure\ kWh\ Savings)}{\sum(Kit\ Measure\ kWh\ Savings\ of\ All\ Respondents)}$$

Cadmus then weighted the kit measure level freeridership estimates by the evaluated gross program population kWh savings to arrive at the overall kit measure category freeridership estimate, using the following equation:

$$Kit\ Measure\ Category\ Weighted\ Freeridership = \frac{\sum(Measure\ Level\ FR\ Score) * (Measure\ Level\ kWh\ Population\ Savings)}{\sum(All\ Kit\ Measures\ Population\ kWh\ Savings)}$$

The Cadmus Rebate Measure Freeridership Scoring Model

Cadmus developed an Excel-based model to use for calculating freeridership, and to improve the consistency and quality of our results. The model translated raw survey responses into matrix terminology, and then assigned a matrix score to each participant's response pattern. Cadmus then aggregated the program participants into program categories to calculate average freeridership scores.

The model incorporated the following inputs:

- Raw survey responses from each participant, along with the program categories for their incented measures, and their energy savings from those measures, if applicable;
- Values converting raw survey responses into matrix terminologies for each program category; and
- Custom freeridership scoring matrices for each unique survey type.

The model displayed each participant's combination of responses and corresponding freeridership score, then produced a summary table with the average score and precision estimates for the program category. The model used the sample size and a two-tailed test target at the 90% confidence interval to determine the average score's precision.

The Cadmus Kit Measure Freeridership Scoring Model

The evaluation team developed a freeridership score for each survey respondent using a rules-based assignment of responses to survey items. The team estimated up to two freeridership scores for CFLs, LEDs, faucet and bathroom aerators, and showerheads, using two sets of questions, and in certain instances taking the arithmetic mean of the two estimates for each participant's measure to calculate final freeridership scores.

The first set of questions and freeridership score was focused on the participant's *future intent* to buy the kit measure within one year at the time they signed up to receive the kit. In some instances, a second freeridership score was estimated from a question focused on the *prior use* of the program measure in question. In cases where the respondent had *future intent* to buy the kit measure within one year and they reported not having any *prior use* of the measure in their home at the time of signing up for the kit, the arithmetic mean of the *future intent* and *prior use* freeridership scores was used as the participant's final freeridership score for that measure.

By averaging individual measure-level participant freeridership scores, weighted by participant's evaluated savings, the team calculated measure-level freerider scores. Then, the team averaged these scores to calculate a kit measure category level freeridership score, weighted by each measure's gross evaluated population energy savings.

Participant Spillover Methodology

For the HES Program, Cadmus measured participant spillover by asking a sample of participants about their purchases and whether they received an incentive for a particular measure (if they installed another efficient measure or undertook another energy-efficiency activity because of their program participation). We also asked these respondents to rate the HES Program's (and incentive's) relative influence (highly, somewhat, or not at all) on their decisions to pursue additional energy-efficient activities.

Participant Spillover Analysis

Cadmus used a top-down approach to calculate spillover savings. We began our analysis with a subset of data containing only survey respondents who indicated they installed additional energy-savings measures after participating in the HES Program. From this subset, we removed participants who said the program had little influence on their decisions to purchase additional measures, thus retaining only participants who rating the program as highly influential. We also removed participants who applied for an HES incentive for the additional measures they installed.

For the remaining participants with spillover savings, we estimated the energy savings from additional measures installed. Cadmus calculated savings values, which we matched to the additional measures installed by survey participants.

Cadmus calculated the spillover percentage by dividing the sum of additional spillover savings by the total incentivized gross savings achieved by all respondents in the program category:

$$Spillover\ \% = \frac{\sum Spillover\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}{\sum Program\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}$$

CADMUS

Appendix E. Self-Reported Net-to-Gross Findings

For non-lighting measure categories (including kits), Cadmus conducted freeridership and participant spillover analysis using responses from the non-lighting survey and participant kit survey.

Further, Cadmus included a series of questions in the general population survey to estimate nonparticipant spillover, that is, the savings generated by customers who were motivated by the program's reputation and marketing to conduct energy efficiency installations for which they did not receive an incentive. However, the analysis did not apply these nonparticipant spillover to program savings for this period; these were instead calculated for informational purposes at 13% of total HES program savings. Appendix F provides detailed nonparticipant spillover analysis methods and results.

Non-Lighting Evaluated Net Savings

Cadmus relied on the non-lighting participant surveys to determine NTG for appliance, HVAC, weatherization, and kit measure categories for 2013 and 2014 participants.

Freeridership and participant spillover constitute the NTG. Cadmus used the following formula to determine the final NTG ratio for each non-lighting program measure category:

Net-to-gross ratio = (1 – Freeridership) + Spillover

Methodology

Cadmus determined the freeridership amount for the appliance, HVAC, and weatherization measure categories based on a previously developed approach for Pacific Power, which ascertained freeridership using patterns of responses to a series of survey questions. These questions—answered as "yes," "no," or "don't know"—asked whether participants would have installed the same equipment in the program's absence, at the same time, and in the same amount and efficiency. Question response patterns received freerider scores, and confidence and precision estimates were calculated based on score distributions.[1]

Cadmus used a separate set of questions and scoring approach when estimating the freeridership for the kit measure category. After conducting participant surveys with energy efficiency kit recipients, Cadmus studied responses from three questions to estimate a freeridership score for each participant, using the scoring approach described in Appendix D. Freeridership questions focused on whether the participant was already using the measure in their home and if they had plans to purchase the measure before signing up to receive the kit.

[1] This approach was outlined in Schiller, Steven, et al. "National Action Plan for Energy Efficiency." Model Energy Efficiency Program Impact Evaluation Guide. 2007. Available online: https://www.epa.gov/sites/production/files/2015-08/documents/evaluation_guide.pdf.

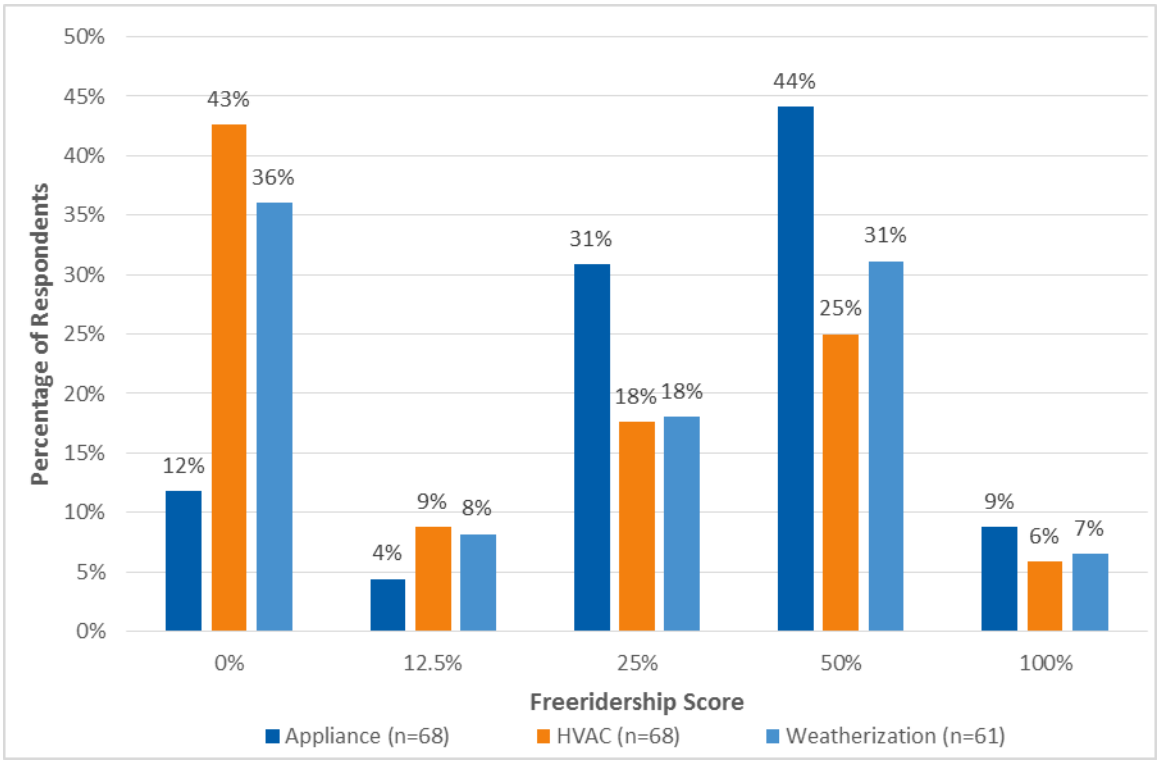
Cadmus determined participant spillover by estimating the savings amount derived from additional measures installed and whether respondents' credited Pacific Power with influencing their decisions to install additional measures. Cadmus included measures eligible for program incentives, provided the respondent did not request or receive the incentive.

Cadmus then used the measure category freeridership and spillover results to calculate the program's NTG ratio. Appendix D provides a detailed explanation of Cadmus' self-reported NTG methodology.

Appliance, HVAC, and Weatherization Freeridership

After conducting surveys with appliance, HVAC, and weatherization participants, Cadmus converted the responses to six freeridership questions to a score for each participant, using the Excel-based matrix approach described in Appendix D. Cadmus then derived each participant's freerider score by translating his or her responses into a matrix value and applying a rules-based calculation. Figure E1 shows freeridership score distributions for appliances, HVAC, and weatherization survey respondents.

Figure E1. Distribution of Freeridership Scores by Measure Category*



*Totals may not sum to 100% due to rounding. This figure is not weighted by measure savings and does not reflect the final freeridership rates.

Approximately 12% of appliance respondents, 43% of HVAC measure respondents, and 36% of weatherization respondents indicated no freeridership. That is, these respondents would not have

purchased the efficient measure in the absence of Pacific Power's program. More appliance respondents indicated high freeridership (scores of 50% to 100%) than the other measure categories.

Kit Freeridership

Table E1 summarizes freeridership findings by measure for the kit measure category. The measure-level freeridership estimates are weighted by the evaluated program population kWh savings to arrive at a 12% freeridership estimate for the kit measure category.

Table E1. HES Kit Measure Category Freeridership by Measure

Measure	Responses (n)	Freeridership Ratio	Evaluated Program Population kWh Savings
CFL	60	29%	723,106
LED	41	25%	43,175
Kitchen Faucet Aerator	60	8%	1,556,165
Bathroom Faucet Aerator	33	8%	861,316
Showerhead	73	12%	3,282,194
Overall		**12%***	**6,465,955**

*Weighted by evaluated program population kWh savings.

Spillover

This section presents the results from additional, energy-efficient measures customers installed after participating in the HES program. Although many participants installed such measures after receiving incentives from Pacific Power, Cadmus attributed program spillover only to additional purchases significantly influenced by HES program participation and not claimed through the program.[2] Only kit participants fell into this category.

Cadmus used evaluated savings values from the deemed savings analysis to estimate spillover measure savings. This involved estimating the spillover percentage for the kit measure category by dividing the sum of the additional spillover savings by the total program savings achieved by all 130 kit respondents. Table E2 shows the results.

[2] "Highly Influential" response for question "How influential would you say the wattsmart Home Energy Savings program was in your decision to add the [MEASURE] to your home? Was it...?" qualifies the measure for being significantly influenced by HES.

Table E2. Non-Lighting Rebate Spillover Responses

Measure Category	Spillover Measure Installed	Quantity	Total Electric Savings (kWh)	Surveyed Measure Category Savings	Spillover Ratio
Kit	Clothes washer	2	343	67,701	9%
Kit	Electric heat pump water heater	1	995		
Kit	Evaporative cooler	1	1,308		
Kit	Heat pump	1	2,679		
Kit	Refrigerator	1	65		
Kit	Windows	1,400 sq. ft.	898		
Kit	**Overall**		**6,288**	**67,701**	**9%**

Non-Lighting NTG Findings

Cadmus conducted 68 surveys with appliance measure category participants, 68 with HVAC measure category participants, and 61 with weatherization measure category participants. Additionally, 130 surveys were conducted with customers who received energy efficiency kits. Cadmus used these participant responses to generate NTG ratios of 60% for appliance measures, 74% for HVAC, 80% for weatherization, and 97% for kits. Table E3 lists these findings.

Table E3. Non-Lighting NTG Ratio by Measure Category

Program Category	Responses (n)	Freeridership Ratio*	Spillover Ratio*	NTG*	Absolute Precision at 90% Confidence
Appliances	68	40%	0%	60%	±7%
HVAC	68	26%	0%	74%	±6%
Weatherization	61	20%	0%	80%	±7%
Kit	130	12%	9%	97%	±16%

*Weighted by evaluated program savings.

The NTG column indicates the percentage of energy savings attributable to the program. For example, participants purchasing an appliance measure received a 60% NTG, which indicates 60% of energy savings for appliance measures could be attributed to the HES program.

Table E4 shows freeridership, spillover, and NTG estimates for appliance and HVAC rebate programs reported for prior Pacific Power program years as well as for other utilities with similar programs and measure offerings.

Table E4. Non-Lighting NTG Comparisons*

Utility/Region	Reported Year	Responses (n)	FR** %	Spillover %	NTG
Appliances					
Pacific Power Washington 2013–2014 HES Evaluation: Appliances	**2016**	**68**	**40%**	**0%**	**60%**
Northeast Utility—Appliances	2015	65	65%	3%	38%
Northwest Utility—Appliances	2014	73	79%	2%	23 %
HVAC					
Pacific Power Washington 2013–2014 HES Evaluation: HVAC	**2016**	**68**	**26%**	**0%**	**74%**
Midwest Utility—HVAC	2015	73	51%	1%	50%
Northwest Utility—HVAC	2014	48	72%	1%	29%
Weatherization					
Pacific Power Washington 2013–2014 HES Evaluation: Weatherization	**2016**	**61**	**20%**	**0%**	**80%**
Midwest Utility—Weatherization	2015	208	30%	2%	72%
Midwest Utility—Weatherization	2015	79	36%	2%	66%
Kit					
Pacific Power Washington 2013–2014 HES Evaluation: Kit	**2016**	**130**	**12%**	**9%**	**97%**
Mideast Utility—Kit	2015	150	8%	1%	93%

*NTG values derive from self-response surveys, though differences in analysis and scoring methodologies may vary across evaluations.

**FR = freeridership

The 2011–2012 Washington HES Evaluation did not include NTG estimates. The 2013–2014 appliance measure category exhibited an NTG estimate of 60%, which is higher than other utilities' comparable appliance programs. The 2013–2014 HVAC measure category exhibited an NTG estimate of 74%, which is also higher than other utilities' comparable HVAC programs. Similarly, the weatherization measure category's 80% NTG estimate was also higher than were other utilities' comparable weatherization programs.

In 2013–2014, the kit measure category's 97% NTG is higher than a recent estimate from a Mideast utility kit program. This utility introduced energy efficiency kits to its program in 2014, so Cadmus could not compare the results to prior evaluations. The Mideast utility kit program did not include light bulbs and was focused on water heating saving measures such as showerheads, kitchen aerators, bathroom aerators, and pipe wrap.

Appendix F. Nonparticipant Spillover Analysis

Effective program marketing and outreach generates program participation and increases general energy efficiency awareness among customers. The cumulative effect of sustained utility program marketing can affect customers' perceptions of their energy usage and, in some cases, motivate customers to take efficiency actions outside of the utility's program. This is generally called nonparticipant spillover (NPSO)—results in energy savings caused by, but not rebated through, utilities' demand-side management activities.

To understand whether Pacific Power's general and program marketing efforts generated energy efficiency improvements outside of the company's incentive programs, Cadmus collected spillover data through the general population survey, conducted with randomly selected residential customers.

Methodology

Cadmus randomly selected and surveyed 250 customers from a sample of 10,000 randomly generated residential accounts provided by Pacific Power. From the 250 customers surveyed, Cadmus screened out customers who self-reported that they participated in a Pacific Power residential program during 2013 or 2014. When estimating NPSO, Cadmus excluded these customers from analysis, focusing on identified nonparticipants; thus the analysis avoided potential double-counting program savings and/or program-specific spillover.

Cadmus limited the NPSO analysis to the same efficiency measures rebated through Pacific Power programs (known as "like" spillover). Examples included installing a high-efficiency clothes washer and installing high-efficiency insulation for which participants (for whatever reason) did not apply for and receive an incentive. Cadmus did exclude one notable category of "like" measures: lighting products. This precluded potentially double-counting NPSO lighting savings already captured through the upstream lighting incentives.

Using a 1 to 4 scale, with 1 meaning "not at all important" and 4 meaning "very important," the survey asked customers to rate the importance of several factors on their decisions to install energy efficient equipment without receiving an incentive from Pacific Power. This question determined whether Pacific Power's energy efficiency initiatives motivated energy-efficient purchases. The surveys asked respondents to address the following factors:

- Information about energy efficiency provided by Pacific Power;
- Information from friends or family who installed energy-efficient equipment and received an incentive from Pacific Power; and
- Their experiences with past Pacific Power incentive programs.

Cadmus estimated NPSO savings from respondents who rated any of the above factors as "very important" for any energy-efficient actions or installations reported.

Cadmus leveraged measure-level estimated gross savings from the 2013–2014, residential wattsmart evaluation activities for the reported NPSO measures.

Using the variables shown in Table F1, Cadmus determine total NPSO generated by Pacific Power's marketing efforts during the 2013–2014 evaluation year.

Table F1. NPSO Analysis Method

Variable	Metric	Source
A	Number of "like spillover" nonparticipant measures	Survey data
B	Total Nonparticipant Customers Surveyed	Survey disposition
C	Weighted Average of Per Unit Measures Savings in kWh	Variable C from Table F2
D	Total Residential Customer Population	PacifiCorp December 2014 305 Report
E	NPSO kWh Savings Applied to Population	[(A÷B)×C)] × D
F	Total Gross Reported Savings	2013-2014 Evaluation
G	NPSO as a Percentage of Total residential Portfolio Reported Savings	E ÷ F

Results

Of the 250 Pacific Power Washington customers surveyed, four nonparticipant respondents reported installing five different measure types attributed to Pacific Power's influence. Table F2 presents measures and gross evaluated kWh savings Cadmus attributed to Washington Pacific Power, generating average savings per NPSO measure of 107 kWh.

Table F2. NPSO Response Summary

Reported Spillover Measures	Quantity	Unit Energy Savings (kWh)*	Total Savings (kWh)	Average Savings Per Spillover Measure (kWh)
ENERGY STAR Refrigerator	6	47.0 per unit	282	n/a
ENERGY STAR Room Air Conditioner	4	64.7 per unit	259	
Efficient Clothes Washer	5	171.6 per unit	858	
Efficient Showerhead	7	187.8 per unit	939	
Efficient Faucet Aerator	8	99.5 per unit	796	
Efficient Water Heater	1	133.5 per unit	133	
Efficient Wall Insulation	20**	2.2 per sq. ft.	43	
Efficient Windows	14**	0.64 per sq. ft.	9	
Total	**31****		**3,319**	**107 (Variable C)**

*Unit energy savings (kWh) estimated for each measure were generated from average 2013–2014 HES evaluated gross savings by measure.

*One respondent installed efficient wall insulation and one respondent installed efficient windows, each being counted as a quantity of one in the total quantity value of 31.

Table F3 presents variables used to estimate overall NPSO for the HES Program, a figure Cadmus estimated as 13% of total Pacific Power residential wattsmart program reported savings.

Table F3. NPSO Analysis Results

Variable	Metric	Value	Source
A	Number of Like Spillover Nonparticipant Measures	31	Survey data
B	Total Nonparticipant Customers Surveyed	220	Survey disposition
C	Weighted Average of Per Unit Measures Savings in kWh	107	Calculated in Table F2
D	Total Residential Customer Population	106,503	PacifiCorp December 2014 305 Report
E	NPSO kWh Savings Applied to Population	1,606,780	((A÷B)×C)) × D
F	Total Gross Reported Savings	12,205,221	2013-2014 Residential wattsmart Reported Savings
G	NPSO as a Percentage of Total Residential Portfolio Reported Savings	13%	E ÷ F

Cadmus then distributed the residential, portfolio-level result of 1,606,780 kWh NPSO to Pacific Power's residential programs, based on each program's size in terms of total gross reported kWh savings. Two programs were credited with achieving the greatest NPSO: Home Energy Savings (accounting for almost 83% of total reported energy savings) at 1,340,919 kWh; and Refrigerator Recycling (accounting for 13% of total energy savings) at 211,593 kWh. The distribution of NPSO savings for each program, based on their percentage of the combined residential reported portfolio savings, resulted in a 13% NPSO percentage for each program relative to their total reported gross savings.

Table F4. NPSO by Residential Program

Residential wattsmart Program	Program Reported Gross Savings (kWh)	Total NPSO (kWh)	Percentage of Combined Savings	Program-Specific NPSO (kWh)
Home Energy Savings	10,185,725	1,606,780	83%	1,340,919
Low Income Weatherization	412,216		3%	54,267
Refrigerator Recycling	1,607,280		13%	211,593
Total	**12,205,221**	**1,606,780**	**100%**	**1,606,780**

CADMUS

Appendix G. Lighting Retailer Allocation Review

Pacific Power subsidizes CFL and LED costs throughout its service territory. As shown in the leakage study findings (main report), some individuals who are not Pacific Power customers benefit from the program. These discounted bulbs "leak" outside of the service territory.

Cadmus met with the program administrator in early October 2015 to review the RSAT and any updates made since last year's analysis. Overall, the process of calculating a store's RSAT score followed the same process outlined below. Updates included streamlining a number of data processing steps to reduce the likelihood of human error. In addition, the tool can now handle LED purchases.

The program administrator developed a screening process to minimize the number of leaked bulbs. Using a proprietary RSAT[1] and Buxton Company's MicroMarketer[2] software, the program administrator only targeted stores where 90% or more of CFL purchases could be attributed to Pacific Power customers.

Through a series of meetings, e-mail exchanges, and software documentation reviews, Cadmus evaluated the program administrator's process for reducing CFL and LED leakage. This section outlines six key aspects of this:

1. Retail customer drive-time calculation
2. Retailer locations
3. Retailer trade areas
4. Pacific Power's service territory
5. Customer purchasing power
6. Retail sales allocation

Retail Customer Drive-Time Calculation

The time a customer willingly takes to drive to purchase efficient lighting from a brick-and-mortar store greatly impacts the degree of leakage. Partnering with the Buxton Company, the program administrator determined three main factors that affected customer drive times: retail class, products sold, and urban density.

Retail Class

The program administrator/Buxton Company research indicated store types affect customer drive times. For example, customers commonly drive farther to a Costco than to a local hardware store. The program

[1] http://www.peci.org/retail-sales-allocation-tool

[2] Buxton specializes in retailer analysis and customer profiling: http://buxtonco.com/

administrator divided the retailer list into five classes (classes A through F), based on the North American Industry Classification System (NAICS).[3] Table G1 provides examples of NAICS classes.

Table G1. NAICS Classification Examples

NAICS Code	NAICS Title
44411	Home Centers
44413	Hardware Stores
443141	Household Appliance Stores

Products Sold

The program administrator categorized products sold by retailers into three classes: White Goods; Over the Counter (Retrofit); and Over the Counter (Plug and Play).[4] CFLs fell within the last of these categories.

Urban Density

The program administrator assigned stores with an urban or rural designation, based on the Buxton Urban Density Score (BUDS), which examines population per square foot to account for population density changes when moving farther from an urban center.

The program administrator modeled the 30 possible drive time factor combinations with over 500,000 survey responses from seven states to establish the amount of time customers drove for a given product and store type. Figure G1 reflects the drive time results capturing 80% of product sales for a particular retail class.

---

3 http://www.census.gov/eos/www/naics/

4 White Goods include clothes washers, refrigerators, and freezers. Characterized as major purchases, customers usually undertake a degree of product research and/or assistance from a store sales person. Over the Counter (Retrofit) includes lighting fixtures (both CFLs and LEDs) and lighting controls. Characterized as midrange cost ($20–$200) products, the category sells as over-the-counter home improvement or retrofit products. Over the Counter (Plug and Play) includes bulbs (both CFLs and LEDs) and showerheads. Characterized as low-cost ($1–$20) products, this category sells through a variety of store types; an average consumer can reasonably install these products without assistance.

Figure G1. Example of Product Drive-Time Calculation

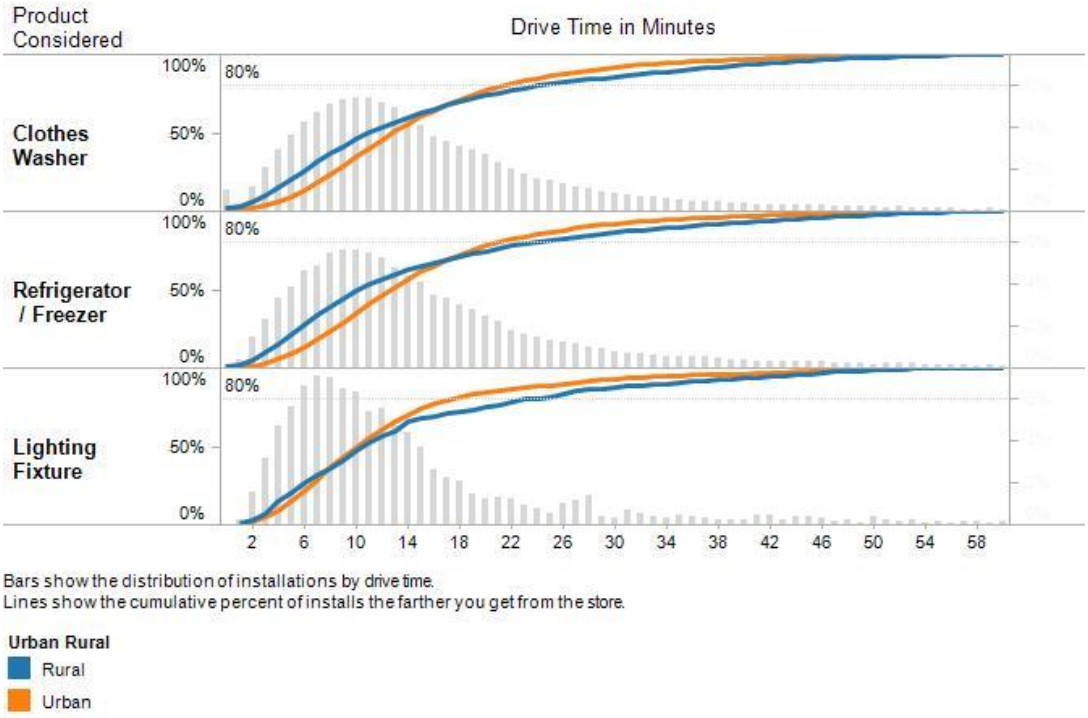


Table G2 summarizes the program administrator's calculated drive times by retail class and product type.

Table G2. Drive Times Calculated by Program Administrator

Retail Class	Product Type	Trade Area Drive Time	
		Urban	Rural
Class A	White Goods	12	17
	Over the Counter (Retrofit)	9	19
	Over the Counter (Plug and Play)	**7**	**14**
Class B	White Goods	17	22
	Over the Counter (Retrofit)	15	24
	Over the Counter (Plug and Play)	**13**	**16**
Class C	White Goods	22	27
	Over the Counter (Retrofit)	15	23
	Over the Counter (Plug and Play)	**11**	**17**
Class D	White Goods	24	26
	Over the Counter (Retrofit)	20	22
	Over the Counter (Plug and Play)	**15**	**16**
Class E	White Goods	21	26
	Over the Counter (Retrofit)	18	22
	Over the Counter (Plug and Play)	**13**	**16**
Class F	White Goods	22	29
	Over the Counter (Retrofit)	23	34
	Over the Counter (Plug and Play)	**17**	**25**

Retailer Locations

Retailers and manufacturers provided retailer address information to the program administrator, which geocoded[5] the addresses using a Coding Accuracy Support System (CASS) certified[6] geocoder, housed within the Buxton Company's MicroMarketer software and loaded into a geographic information system (GIS). If the geocoder could not find a match, the program administrator used Google Earth to visually geocode a store. Overall, the program administrator reported a 98% geocoding match rate.

Retailer Trade Areas

The program administrator created drive-time polygons, representing retailer trade areas using NAVTEQ's Guzzler™ utility,[7] housed within the Buxton Company's MicroMarketer software. Drive-time calculations require a specialized road network dataset that contains roads, indicators for one-way roads, locations of turn restrictions (e.g., no left turn intersections), the grade (slope) of roads, and other

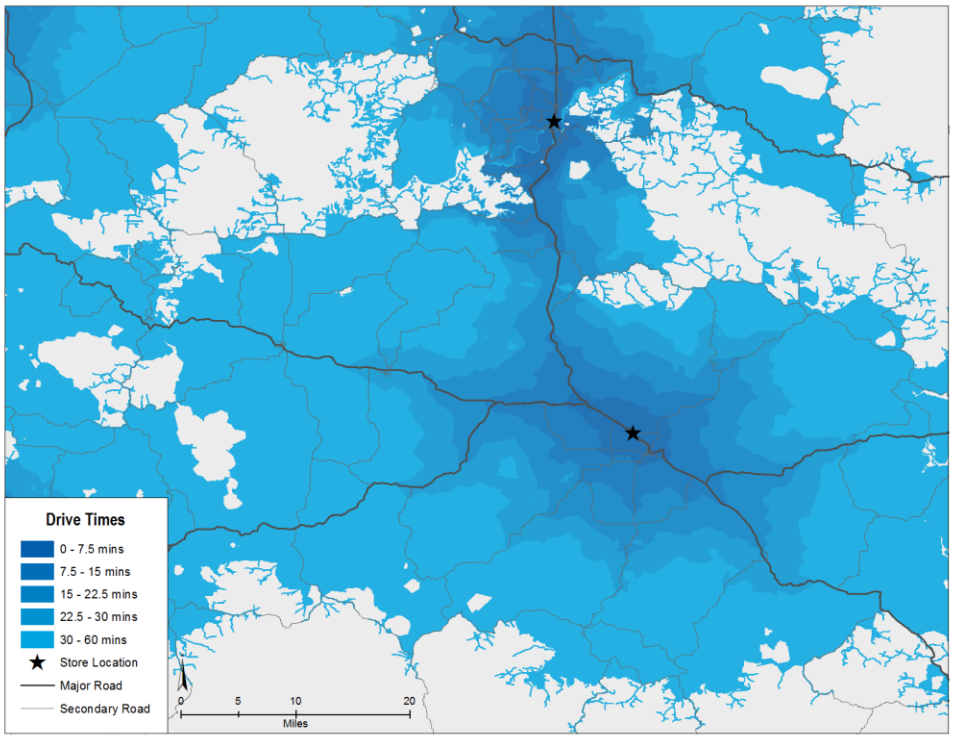
5 This process converts a street address to latitude and longitude coordinate points.

6 The United States Postal Service (USPS) developed CASS to evaluate the accuracy of software that provides mailing-related services to customers: https://www.usps.com/business/certification-programs.htm

7 http://www.navmart.com/drivetime_by_guzzler.php

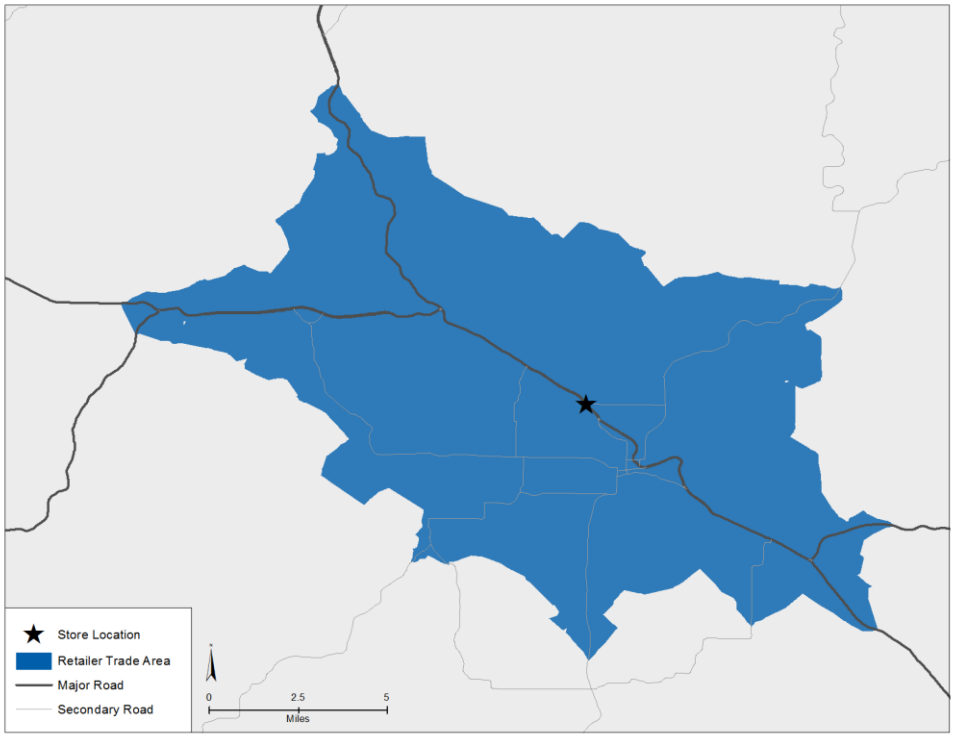
ancillary attributes that impact drive times. Figure G2 provides an example of concentric zones, representing increasing amounts of travel time from a store.

Figure G2. Example of Drive-Time Zones



The program administrator established retailer trade areas for each geocoded store using drive times, capturing 80% of CFL sales, as shown in Figure G3.

Figure G3. Example of Retailer Trade Area



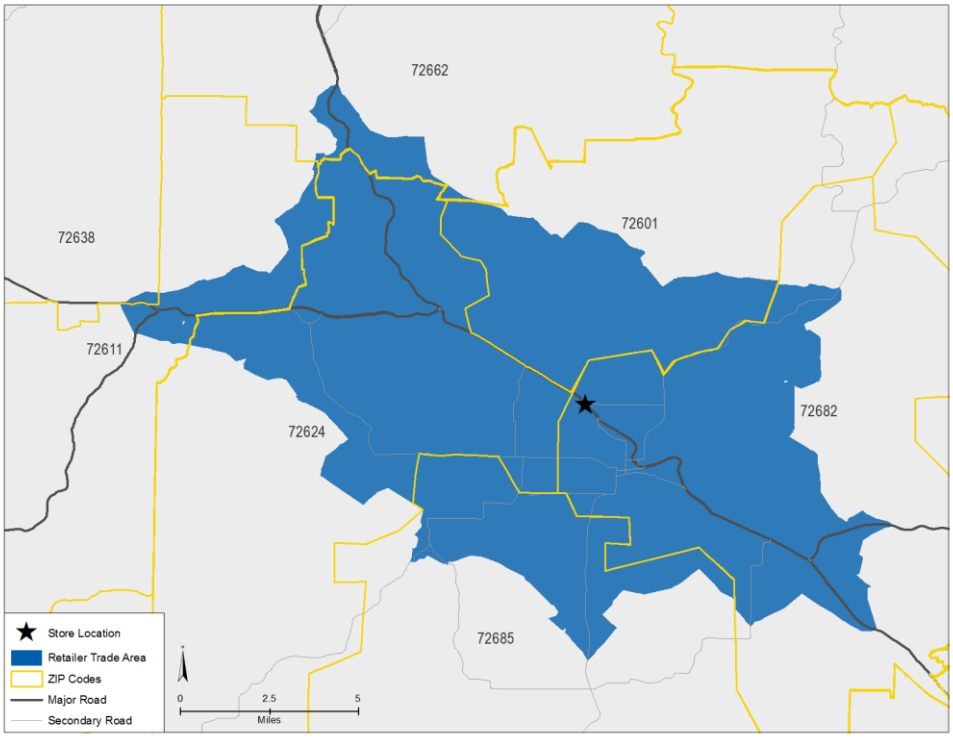
Pacific Power Service Territory

In 2007, the program administrator purchased utility service area data through a DOE contractor for all utilities in the Pacific Northwest and the Western parts of the United States. The data lists utilities serving each zip code. Data also include a utility's type (municipal or other) and whether it serves as a zip code's primary electric provider.

After contacting utilities to confirm their zip code-based territory, the program administrator created a Pacific Power GIS data layer using Zip Code Tabulation Area boundaries.[8] The administrator laid this service area designation over the retailer trade area layer to identify intersecting zip codes. In the example shown in Figure G4, all zip codes intersect with the retailer trade area.

[8] Generalized aerial representations of USPS zip code service areas. Available online: http://www.census.gov/geo/reference/zctas.html

Figure G4. Example of Zip Codes and a Retailer Trade Area



While the program administrator still relies on zip code-based tables to define utility service areas, the use of utility service area polygons is being explored. Given not all utility service areas can be cleanly defined within polygons and due to situations with multiple utility service area polygons overlapping, the program administrator has yet to decide whether to pursue this polygon approach.

Customer Purchase Power

For each retailer trade area, the program administrator determined the likelihood that households within the area would purchase CFLs or LEDs and weighted zip code household counts within a retailer's trade area, based on a GreenAware[9] index score and the retailer's core market segments.

GreenAware Index Score

Experian's Marketing Mosaic® USA software[10] assigns each household[11] to one of 71 unique market segments. According to the GreenAware segmentation system, each market segment receives a score[12]

---

9 These categories are outlined online: http://www.fusbp.com/pdf/BeGreenBeAwareBeGreenAware.pdf.

10 A household-based consumer lifestyle segmentation system that classifies all U.S. household and neighborhoods. More information is available online: http://www.experian.com/assets/marketing-services/brochures/mosaic-brochure.pdf

on a scale of 0–200 for each of the four GreenAware categories: Behavioral Greens, Think Greens, Potential Greens, and True Browns.

The program administrator applied weights to GreenAware category scores, based on the category's propensity to buy energy efficiency products. Table G3 provides category names, descriptions, and weights.

Table G3. GreenAware Categories, Descriptions, and Weights

Category Name	Description	Weight
Behavior Green	Think and act green, hold negative attitudes toward products that pollute, and incorporate green practices on a regular basis.	3x
Think Green	Think green, but do not necessarily act green.	2x
Potential Green	Neither behave nor think along particularly environmentally conscious lines, and remain on the fence about key green issues.	1x (no weighting)
True Brown	Not environmentally conscious, and may have negative attitudes about the green movement.	-1x (negative weighting)

The sum of weighted GreenAware category scores divided by five determined a new weighted GreenAware score for each market segment. The program administrator considered a market segment as "Green Aware" if it received a weighted GreenAware score greater than 100.

Core Market Segments

The program administrator applied weights to market segment household counts identified as a retailer's core[13] market segment, and calculated new weighted household counts using the weights shown in Table G4.

Table G4. Core Market Segment Weighting

Segment Category	Weight
Green Aware *and* part of the core retail segment	3x
Either Green Aware *or* part of the core retail segment	2x
Neither Green Aware *nor* part of the core retail segment	1x (no weighting)

The sum of weighted market segment household counts determined a new weighted population count for each zip code.

---

11 Households are assigned at the block group level. See: http://www.census.gov/geo/reference/pdfs/geodiagram.pdf.

12 Determined by Experian.

13 Determined by Experian.

Retail Sales Allocation

Using the weighted zip code population count and utility service area data, the program administrator determined a Total Utility Score for each zip code corresponding to retailer's trade area. The weight '*w*' of the $'i'^{\text{th}}$ utility was expressed as:

$$W_i = \frac{p_i + m_i + 1}{U + M + 1}$$

Where:

p_i = 1 if the $'i'^{th}$ utility is the primary provider, 0 otherwise.

m_i = 1 if the $'i'^{th}$ utility is municipal, 0 otherwise.

U = Total number of utilities.

M = Total number of municipalities.

Thus:

Total Utility Score = $\sum Z_k W_i$

Where:

Z_k = Total weighted household count of the $'k'^{th}$ zip code.

The sum of a retailer's Total Utility Scores, divided by the sum of the weighted zip code population counts, determined a store's retail sales allocation score. The program administrator only approached stores that could allocate 90% or more of CFL purchases to Pacific Power customers for inclusion in the HES Program.

Overall, Cadmus found the program administrator's method for reducing and controlling for CFL leakage both thorough and innovative. The analysis used current and relevant data in conjunction with computer-aided geospatial analysis techniques to assist the program administrator's store inclusion process. Relevant considerations included drive times, customer purchasing behaviors, and store type/locations, appropriately factored into the overall calculation.

Appendix H. Measure Category Cost-Effectiveness

Completed at the measure category level, cost-effectiveness was reported for evaluated savings and net savings. Net results apply the evaluated NTG to evaluated gross savings. Table H1 shows cost-effectiveness inputs for the evaluated results.

Table H1. Washington Measure Category Cost-Effectiveness Inputs

Input Description	2013	2014	Total
Average Measure Life*			
Appliance	14	15	15
HVAC	19	19	19
Lighting	5	7	6
Weatherization	45	45	45
New Homes	40	44	44
Kits	N/A	9	9
Evaluated Energy Savings (kWh/year)**			
Appliance	171,727	130,438	302,165
HVAC	455,498	2,006,967	2,462,464
Lighting	6,526,248	4,909,832	11,436,081
Weatherization	580,723	463,288	1,044,011
New Homes	10,226	129,707	139,933
Kits	0	6,465,955	6,465,955
Total Utility Cost (including incentives)***			
Appliance	$86,711	$65,979	$152,690
HVAC	$157,138	$818,109	$975,247
Lighting	$771,699	$572,065	$1,343,764
Weatherization	$331,144	$245,499	$576,643
New Homes	$6,504	$96,567	$103,071
Kits	$0	$444,802	$444,802
Incentives			
Appliance	$68,040	$56,784	$124,824
HVAC	$93,000	$633,440	$726,440
Lighting	$512,593	$409,201	$921,793
Weatherization	$132,826	$146,035	$278,860
New Homes	$3,319	$69,108	$72,428
Kits	$0	$159,890	$159,890
Retail Rate	**$0.0874**	**$0.0841**	**N/A**

*Weighted average measure category lives are based on individual measure lifetimes and weighted by savings and the frequency of installations.

**Evaluated savings reflect impacts at the customer meter.

***Pacific Power provided program costs and incentives in annual report data, allocating program costs by weighted savings.

Appliances – Evaluated Savings

Cost-effectiveness results for evaluated savings excluding non-energy benefits are shown in Table H2, Table H3, and Table H4. The appliance measure category (excluding non-energy benefits) proved cost-effective from the UCT perspective (Table H2). Table H5 provides the annual program non-energy benefits. Table H6, Table H7, and Table H8 provide the cost-effectiveness results including non-energy benefits. The appliance measure category (including non-energy benefits) proved cost-effective from all perspectives except for the RIM (Table H6).

Table H2. Washington Appliance 2013-2014 (Excluding Non-Energy Benefits)
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.147	$454,387	$251,514	($202,873)	0.55
TRC	$0.147	$454,387	$228,649	($225,738)	0.50
UCT	$0.048	$148,441	$228,649	$80,207	1.54
RIM		$425,073	$228,649	($196,425)	0.54
PCT		$427,113	$397,800	($29,313)	0.93
Lifecycle Revenue Impacts ($/kWh)					$0.000003966
Discounted Participant Payback (years)					N/A

Table H3. Washington Appliance 2013 (Excluding Non-Energy Benefits)
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.182	$325,104	$143,306	($181,798)	0.44
TRC	$0.182	$325,104	$130,278	($194,825)	0.40
UCT	$0.048	$86,711	$130,278	$43,567	1.50
RIM		$246,514	$130,278	($116,236)	0.53
PCT		$306,433	$227,844	($78,589)	0.74
Lifecycle Revenue Impacts ($/kWh)					$0.000002504
Discounted Participant Payback (years)					N/A

Table H4. Washington Appliance 2014 (Excluding Non-Energy Benefits)
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.100	$138,180	$115,654	($22,526)	0.84
TRC	$0.100	$138,180	$105,140	($33,040)	0.76
UCT	$0.048	$65,979	$105,140	$39,162	1.59
RIM		$190,847	$105,140	($85,707)	0.55
PCT		$128,985	$181,653	$52,667	1.41
Lifecycle Revenue Impacts ($/kWh)					$0.000001762
Discounted Participant Payback (years)					7.24

Table H5. Washington Appliance Annual Non-Energy Benefits

Measure	Annual Value	Perspective Adjusted
Clothes Washer - 2013	$58,906	PTRC, TRC, PCT
Dishwasher – 2013	$77	PTRC, TRC, PCT
Clothes Washer - 2014	$21,384	PTRC, TRC, PCT
Dishwasher – 2013	$13	PTRC, TRC, PCT

Table H6. Washington Appliance 2013-2014 (Including Non-Energy Benefits)
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.147	$454,387	$995,224	$540,837	2.19
TRC No Adder	$0.147	$454,387	$965,067	$510,680	2.12
UTC	$0.048	$148,441	$233,458	$85,017	1.57
RIM		$425,073	$130,278	($294,795)	0.31
PCT		$427,113	$1,166,176	$739,063	2.73
Lifecycle Revenue Impacts ($/kWh)					$0.000003966
Discounted Participant Payback (years)					3.42

Table H7. Washington Appliance 2013 (Including Non-Energy Benefits) (2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.182	$325,104	$698,560	$373,456	2.15
TRC No Adder	$0.182	$325,104	$685,532	$360,429	2.11
UTC	$0.048	$86,711	$130,278	$43,567	1.50
RIM		$246,514	$130,278	($116,236)	0.53
PCT		$306,433	$783,098	$476,665	2.56
Lifecycle Revenue Impacts ($/kWh)					$0.000002504
Discounted Participant Payback (years)					3.48

Table H8. Washington Appliance 2014 (Including Non-Energy Benefits) (2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.100	$138,180	$317,080	$178,900	2.29
TRC No Adder	$0.100	$138,180	$306,566	$168,385	2.22
UTC	$0.048	$65,979	$105,140	$39,162	1.59
RIM		$190,847	$105,140	($85,707)	0.55
PCT		$128,985	$383,078	$254,093	2.97
Lifecycle Revenue Impacts ($/kWh)					$0.000001762
Discounted Participant Payback (years)					2.28

Appliances – Net Savings

Cost-effectiveness results for net savings excluding non-energy benefits are shown in

Table H9, Table H10, and Table H11. The appliance measure category (excluding non-energy benefits) proved not cost-effective from all perspectives (

Table H9). Table H12 provides the annual program non-energy benefits. Table H13, Table H14, and Table H15 provide the cost-effectiveness results including non-energy benefits. The appliance measure category (including non-energy benefits) proved cost-effective from all perspectives except for the RIM and UCT (Table H13).

Table H9. Washington Appliance 2013-2014 Net (Excluding Non-Energy Benefits)
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.153	$283,541	$150,908	($132,633)	0.53
TRC	$0.153	$283,541	$137,189	($146,352)	0.48
UCT	$0.080	$148,441	$137,189	($11,252)	0.92
RIM		$314,421	$137,189	($177,231)	0.44
PCT		$427,113	$397,800	($29,313)	0.93
Lifecycle Revenue Impacts ($/kWh)					$0.000003579
Discounted Participant Payback (years)					N/A

Table H10. Washington Appliance 2013 Net (Excluding Non-Energy Benefits)
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.188	$202,530	$85,984	($116,547)	0.42
TRC	$0.188	$202,530	$78,167	($124,364)	0.39
UCT	$0.081	$86,711	$78,167	($8,544)	0.90
RIM		$182,593	$78,167	($104,426)	0.43
PCT		$306,433	$227,844	($78,589)	0.74
Lifecycle Revenue Impacts ($/kWh)					$0.000002250
Discounted Participant Payback (years)					N/A

Table H11. Washington Appliance 2014 Net (Excluding Non-Energy Benefits) (2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.104	$86,586	$69,393	($17,193)	0.80
TRC	$0.104	$86,586	$63,084	($23,502)	0.73
UCT	$0.079	$65,979	$63,084	($2,895)	0.96
RIM		$140,900	$63,084	($77,816)	0.45
PCT		$128,985	$181,653	$52,667	1.41
Lifecycle Revenue Impacts ($/kWh)					$0.000001600
Discounted Participant Payback (years)					7.24

Table H12. Washington Appliance Annual Non-Energy Benefits

Measure	Annual Value	Perspective Adjusted
Clothes Washer - 2013	$58,906	PTRC, TRC, PCT
Dishwasher – 2013	$77	PTRC, TRC, PCT
Clothes Washer - 2014	$21,384	PTRC, TRC, PCT
Dishwasher – 2013	$13	PTRC, TRC, PCT

Table H13. Washington Appliance 2013-2014 Net (Including Non-Energy Benefits) (2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.153	$283,541	$894,618	$611,077	3.16
TRC No Adder	$0.153	$283,541	$874,608	$591,066	3.08
UTC	$0.080	$148,441	$140,075	($8,366)	0.94
RIM		$314,421	$78,167	($236,254)	0.25
PCT		$427,113	$1,166,176	$739,063	2.73
Lifecycle Revenue Impacts ($/kWh)					$0.000003579
Discounted Participant Payback (years)					3.42

Table H14. Washington Appliance 2013 Net (Including Non-Energy Benefits) (2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.188	$202,530	$641,238	$438,707	3.17
TRC No Adder	$0.188	$202,530	$633,421	$430,891	3.13
UTC	$0.081	$86,711	$78,167	($8,544)	0.90
RIM		$182,593	$78,167	($104,426)	0.43
PCT		$306,433	$783,098	$476,665	2.56
Lifecycle Revenue Impacts ($/kWh)					$0.000002250
Discounted Participant Payback (years)					3.48

Table H15. Washington Appliance 2014 Net (Including Non-Energy Benefits) (2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.104	$86,586	$270,818	$184,232	3.13
TRC No Adder	$0.104	$86,586	$264,510	$177,924	3.05
UTC	$0.079	$65,979	$63,084	($2,895)	0.96
RIM		$140,900	$63,084	($77,816)	0.45
PCT		$128,985	$383,078	$254,093	2.97
Lifecycle Revenue Impacts ($/kWh)					$0.000001600
Discounted Participant Payback (years)					2.28

HVAC – Evaluated Savings

Table H16, Table H17, and Table H18 show HVAC measure category cost-effectiveness results for evaluated savings. The HVAC measure category proved cost-effective from all perspectives except for the RIM (Table H16).

Table H16. Washington HVAC 2013-2014
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.059	$1,695,696	$2,538,977	$843,281	1.50
TRC	$0.059	$1,695,696	$2,308,161	$612,465	1.36
UCT	$0.032	$922,570	$2,308,161	$1,385,592	2.50
RIM		$3,561,647	$2,308,161	($1,253,486)	0.65
PCT		$1,458,780	$3,324,731	$1,865,951	2.28
Lifecycle Revenue Impacts ($/kWh)					$0.000026379
Discounted Participant Payback (years)					4.85

Table H17. Washington HVAC 2013
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.082	$448,764	$471,708	$22,944	1.05
TRC	$0.082	$448,764	$428,825	($19,938)	0.96
UCT	$0.029	$157,138	$428,825	$271,687	2.73
RIM		$657,897	$428,825	($229,072)	0.65
PCT		$384,626	$593,759	$209,133	1.54
Lifecycle Revenue Impacts ($/kWh)					$0.000004935
Discounted Participant Payback (years)					8.76

Table H18. Washington HVAC 2014
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.054	$1,332,747	$2,209,539	$876,793	1.66
TRC	$0.054	$1,332,747	$2,008,672	$675,925	1.51
UCT	$0.033	$818,109	$2,008,672	$1,190,563	2.46
RIM		$3,103,586	$2,008,672	($1,094,914)	0.65
PCT		$1,148,078	$2,918,917	$1,770,840	2.54
Lifecycle Revenue Impacts ($/kWh)					$0.000023551
Discounted Participant Payback (years)					3.05

HVAC – Net Savings

Table H19, Table H20, and Table H21 show HVAC measure category cost-effectiveness results for net savings. The HVAC measure category proved cost-effective from all perspectives except for the RIM (Table H19).

Table H19. Washington HVAC 2013-2014 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.062	$1,314,213	$1,878,784	$564,571	1.43
TRC	$0.062	$1,314,213	$1,707,985	$393,772	1.30
UCT	$0.044	$922,570	$1,707,985	$785,416	1.85
RIM		$2,875,423	$1,707,985	($1,167,438)	0.59
PCT		$1,455,757	$3,324,731	$1,868,974	2.28
Lifecycle Revenue Impacts ($/kWh)					$0.000024568
Discounted Participant Payback (years)					4.83

Table H20. Washington HVAC 2013 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.086	$348,761	$349,064	$303	1.00
TRC	$0.086	$348,761	$317,331	($31,430)	0.91
UCT	$0.039	$157,138	$317,331	$160,193	2.02
RIM		$527,700	$317,331	($210,369)	0.60
PCT		$384,626	$593,759	$209,133	1.54
Lifecycle Revenue Impacts ($/kWh)					$0.000004532
Discounted Participant Payback (years)					8.76

Table H21. Washington HVAC 2014 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.056	$1,031,894	$1,634,995	$603,101	1.58
TRC	$0.056	$1,031,894	$1,486,359	$454,465	1.44
UCT	$0.045	$818,109	$1,486,359	$668,250	1.82
RIM		$2,509,294	$1,486,359	($1,022,934)	0.59
PCT		$1,144,847	$2,918,917	$1,774,071	2.55
Lifecycle Revenue Impacts ($/kWh)					$0.000022003
Discounted Participant Payback (years)					3.03

Lighting – Evaluated Savings

Cost-effectiveness results for evaluated savings are shown in Table H22, Table H23, and Table H24. The lighting measure category proved cost-effective from all perspectives except for the RIM (Table H22).

Table H22. Washington Lighting 2013-2014
(2013 IRP West Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.061	$3,685,522	$4,423,369	$737,848	1.20
TRC	$0.061	$3,685,522	$4,021,245	$335,723	1.09
UCT	$0.022	$1,306,929	$4,021,245	$2,714,316	3.08
RIM		$6,388,659	$4,021,245	($2,367,414)	0.63
PCT		$3,274,038	$5,977,175	$2,703,137	1.83
Lifecycle Revenue Impacts ($/kWh)					$0.000057428
Discounted Participant Payback (years)					2.95

Table H23. Washington Lighting 2013
(2013 IRP West Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.071	$2,277,078	$2,289,569	$12,491	1.01
TRC	$0.071	$2,277,078	$2,081,426	($195,652)	0.91
UCT	$0.024	$771,699	$2,081,426	$1,309,727	2.70
RIM		$3,431,154	$2,081,426	($1,349,728)	0.61
PCT		$2,017,972	$3,172,048	$1,154,076	1.57
Lifecycle Revenue Impacts ($/kWh)					$0.000039099
Discounted Participant Payback (years)					2.75

Table H24. Washington Lighting 2014
(2013 IRP West Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.049	$1,505,373	$2,280,649	$775,276	1.52
TRC	$0.049	$1,505,373	$2,073,317	$567,944	1.38
UCT	$0.019	$572,065	$2,073,317	$1,501,252	3.62
RIM		$3,161,040	$2,073,317	($1,087,723)	0.66
PCT		$1,342,508	$2,998,176	$1,655,667	2.23
Lifecycle Revenue Impacts ($/kWh)					$0.000027355
Discounted Participant Payback (years)					2.22

Lighting – Net Savings

Cost-effectiveness results for net savings are shown in Table H25, Table H26, and Table H27. The lighting measure category proved cost-effective from all perspectives except for the RIM (Table H25).

Table H25. Washington Lighting 2013-2014 Net
(2013 IRP West Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.060	$2,705,568	$3,266,455	$560,887	1.21
TRC	$0.060	$2,705,568	$2,969,504	$263,936	1.10
UCT	$0.029	$1,306,929	$2,969,504	$1,662,575	2.27
RIM		$5,065,847	$2,969,504	($2,096,343)	0.59
PCT		$3,274,038	$5,977,175	$2,703,137	1.83
Lifecycle Revenue Impacts ($/kWh)					$0.000050852
Discounted Participant Payback (years)					2.95

Table H26. Washington Lighting 2013 Net
(2013 IRP West Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.070	$1,672,556	$1,701,900	$29,344	1.02
TRC	$0.070	$1,672,556	$1,547,181	($125,374)	0.93
UCT	$0.032	$771,699	$1,547,181	$775,483	2.00
RIM		$2,751,168	$1,547,181	($1,203,986)	0.56
PCT		$2,017,972	$3,172,048	$1,154,076	1.57
Lifecycle Revenue Impacts ($/kWh)					$0.000034877
Discounted Participant Payback (years)					2.75

Table H27. Washington Lighting 2014 Net
(2013 IRP West Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.049	$1,104,104	$1,672,228	$568,124	1.51
TRC	$0.049	$1,104,104	$1,520,207	$416,103	1.38
UCT	$0.026	$572,065	$1,520,207	$948,142	2.66
RIM		$2,473,976	$1,520,207	($953,768)	0.61
PCT		$1,342,508	$2,998,176	$1,655,667	2.23
Lifecycle Revenue Impacts ($/kWh)					$0.000023986
Discounted Participant Payback (years)					2.22

Weatherization – Evaluated Savings

Table H28, Table H29, and Table H30 show weatherization measure category cost-effectiveness results for evaluated savings. The weatherization measure category proved cost-effective from all perspectives except for the RIM (Table H28).

Table H28. Washington Weatherization 2013-2014
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.064	$1,001,313	$1,531,464	$530,150	1.53
TRC	$0.064	$1,001,313	$1,392,240	$390,926	1.39
UCT	$0.036	$560,836	$1,392,240	$831,404	2.48
RIM		$2,007,015	$1,392,240	($614,776)	0.69
PCT		$709,934	$1,715,636	$1,005,702	2.42
Lifecycle Revenue Impacts ($/kWh)					$0.000010570
Discounted Participant Payback (years)					5.93

Table H29. Washington Weatherization 2013
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.062	$558,231	$870,621	$312,389	1.56
TRC	$0.062	$558,231	$791,473	$233,242	1.42
UCT	$0.037	$331,144	$791,473	$460,329	2.39
RIM		$1,160,178	$791,473	($368,705)	0.68
PCT		$359,913	$961,860	$601,947	2.67
Lifecycle Revenue Impacts ($/kWh)					$0.000006339
Discounted Participant Payback (years)					4.90

Table H30. Washington Weatherization 2014
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.066	$473,575	$706,322	$232,747	1.49
TRC	$0.066	$473,575	$642,111	$168,536	1.36
UCT	$0.034	$245,499	$642,111	$396,612	2.62
RIM		$905,116	$642,111	($263,005)	0.71
PCT		$374,110	$805,652	$431,541	2.15
Lifecycle Revenue Impacts ($/kWh)					$0.000004545
Discounted Participant Payback (years)					6.31

Weatherization – Net Savings

Table H31, Table H32, and Table H33 show weatherization measure category cost-effectiveness results for net evaluated savings. The weatherization measure category proved cost-effective from all perspectives except for the RIM (Table H31).

Table H31. Washington Weatherization 2013-2014 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.068	$859,326	$1,225,171	$365,845	1.43
TRC	$0.068	$859,326	$1,113,792	$254,465	1.30
UCT	$0.044	$560,836	$1,113,792	$552,956	1.99
RIM		$1,717,779	$1,113,792	($603,988)	0.65
PCT		$709,934	$1,715,636	$1,005,702	2.42
Lifecycle Revenue Impacts ($/kWh)					$0.000010385
Discounted Participant Payback (years)					5.93

Table H32. Washington Weatherization 2013 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.067	$486,249	$696,497	$210,248	1.43
TRC	$0.067	$486,249	$633,179	$146,930	1.30
UCT	$0.046	$331,144	$633,179	$302,034	1.91
RIM		$994,372	$633,179	($361,193)	0.64
PCT		$359,913	$961,860	$601,947	2.67
Lifecycle Revenue Impacts ($/kWh)					$0.000006210
Discounted Participant Payback (years)					4.90

Table H33. Washington Weatherization 2014 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$398,753	$565,058	$166,305	1.42
TRC	$0.069	$398,753	$513,689	$114,936	1.29
UCT	$0.043	$245,499	$513,689	$268,190	2.09
RIM		$773,193	$513,689	($259,504)	0.66
PCT		$374,110	$805,652	$431,541	2.15
Lifecycle Revenue Impacts ($/kWh)					$0.000004485
Discounted Participant Payback (years)					6.31

Kits – Evaluated Savings

Table H34 shows the kit measure category cost-effectiveness results for evaluated savings. The kit measure category proved cost-effective from all perspectives except for the RIM (Table H34).

Table H34. Washington Kits 2014
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.009	$471,674	$3,899,959	$3,428,286	8.27
TRC	$0.009	$471,674	$3,545,418	$3,073,744	7.52
UCT	$0.009	$444,802	$3,545,418	$3,100,616	7.97
RIM		$4,810,088	$3,545,418	($1,264,670)	0.74
PCT		$186,762	$4,525,176	$4,338,414	24.23
Lifecycle Revenue Impacts ($/kWh)					$0.000041469
Discounted Participant Payback (years)					0.26

Kits – Net Savings

Table H35 shows the kit measure category cost-effectiveness results for net savings. The kit measure category proved cost-effective from all perspectives except for the RIM (Table H35).

Table H35. Washington Kits 2014 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.010	$466,071	$3,782,961	$3,316,890	8.12
TRC	$0.010	$466,071	$3,439,055	$2,972,984	7.38
UCT	$0.009	$444,802	$3,439,055	$2,994,254	7.73
RIM		$4,679,129	$3,439,055	($1,240,074)	0.73
PCT		$186,762	$4,525,176	$4,338,414	24.23
Lifecycle Revenue Impacts ($/kWh)					$0.000040663
Discounted Participant Payback (years)					0.26

New Homes – Evaluated Savings

Table H36, Table H37, and Table H38 show the new homes measure category cost-effectiveness results for evaluated savings. The new homes measure category proved cost-effective from all perspectives except for the RIM (Table H36).

Table H36. Washington New Homes 2013-2014
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.038	$75,930	$197,891	$121,962	2.61
TRC	$0.038	$75,930	$179,901	$103,972	2.37
UCT	$0.048	$96,853	$179,901	$83,048	1.86
RIM		$282,398	$179,901	($102,497)	0.64
PCT		$47,054	$253,523	$206,468	5.39
Lifecycle Revenue Impacts ($/kWh)					$0.000001762
Discounted Participant Payback (years)					1.56

Table H37. Washington New Homes 2013
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.043	$6,357	$14,168	$7,811	2.23
TRC	$0.043	$6,357	$12,880	$6,523	2.03
UCT	$0.044	$6,504	$12,880	$6,376	1.98
RIM		$20,073	$12,880	($7,193)	0.64
PCT		$3,172	$16,889	$13,716	5.32
Lifecycle Revenue Impacts ($/kWh)					$0.000000124
Discounted Participant Payback (years)					0.75

Table H38. Washington New Homes 2014
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.037	$74,361	$196,367	$122,006	2.64
TRC	$0.037	$74,361	$178,515	$104,155	2.40
UCT	$0.048	$96,567	$178,515	$81,948	1.85
RIM		$280,378	$178,515	($101,862)	0.64
PCT		$46,902	$252,919	$206,017	5.39
Lifecycle Revenue Impacts ($/kWh)					$0.000001760
Discounted Participant Payback (years)					0.58

New Homes – Net Savings

Table H39, Table H40, and Table H41 show the new homes measure category cost-effectiveness results for net savings. The new homes measure category proved cost-effective from all perspectives except for the RIM (Table H39).

Table H39. Washington New Homes 2013-2014 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

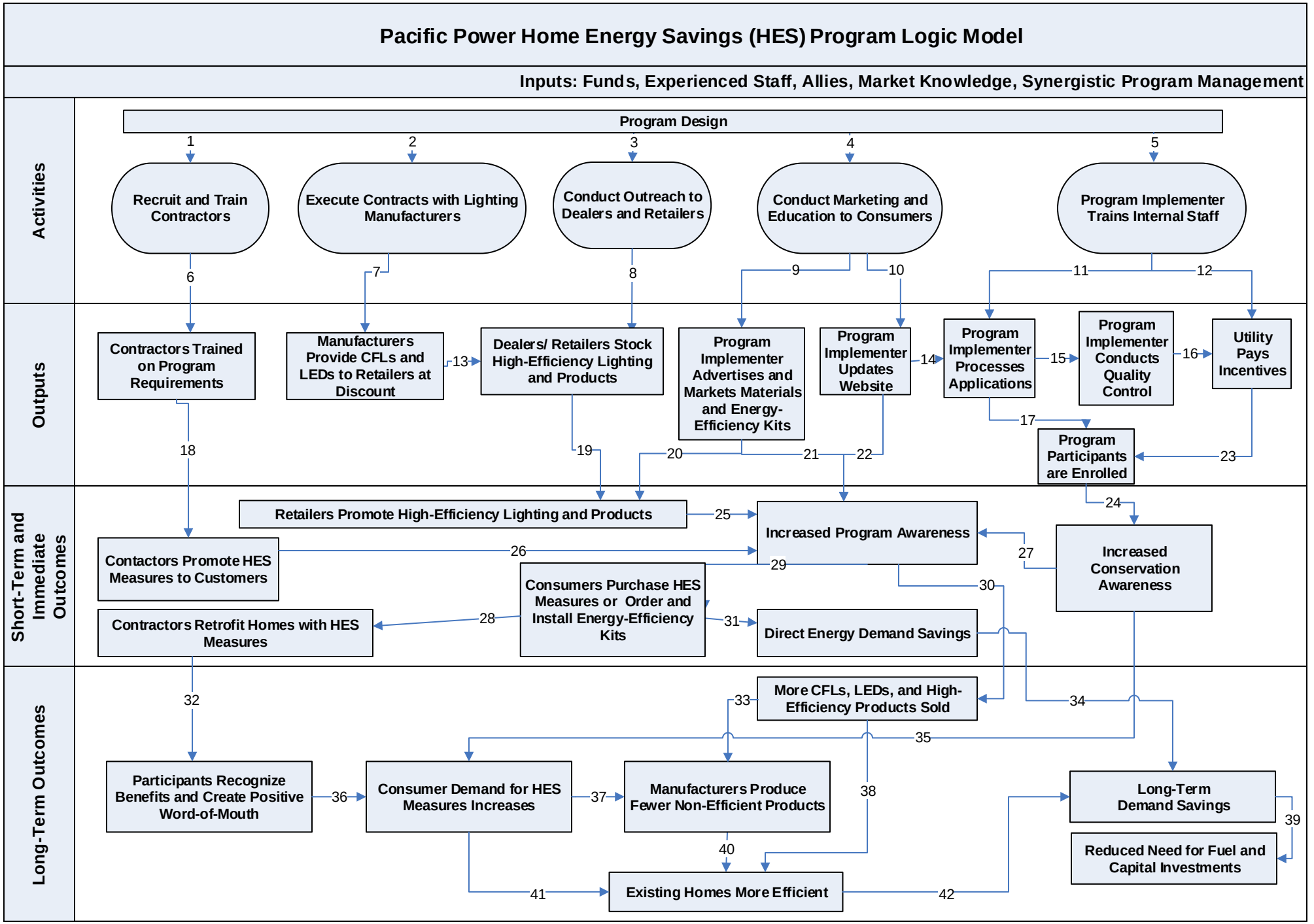
Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.036	$71,901	$195,472	$123,571	2.72
TRC	$0.036	$71,901	$177,701	$105,801	2.47
UCT	$0.049	$96,853	$177,701	$80,848	1.83
RIM		$279,877	$177,701	($102,176)	0.63
PCT		$47,054	$253,523	$206,468	5.39
Lifecycle Revenue Impacts ($/kWh)					$0.000001757
Discounted Participant Payback (years)					1.56

Table H40. Washington New Homes 2013 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.040	$5,628	$13,520	$7,892	2.40
TRC	$0.040	$5,628	$12,291	$6,663	2.18
UCT	$0.046	$6,504	$12,291	$5,787	1.89
RIM		$19,416	$12,291	($7,125)	0.63
PCT		$3,172	$16,889	$13,716	5.32
Lifecycle Revenue Impacts ($/kWh)					$0.000000123
Discounted Participant Payback (years)					0.75

Table H41. Washington New Homes 2014 Net
(2013 IRP West Residential Whole House 49% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.036	$70,834	$194,474	$123,639	2.75
TRC	$0.036	$70,834	$176,794	$105,960	2.50
UCT	$0.049	$96,567	$176,794	$80,227	1.83
RIM		$278,387	$176,794	($101,593)	0.64
PCT		$46,902	$252,919	$206,017	5.39
Lifecycle Revenue Impacts ($/kWh)					$0.000001756
Discounted Participant Payback (years)					0.58


Pacific Power Home Energy Savings (HES) Program Logic Model
Inputs: Funds, Experienced Staff, Allies, Market Knowledge, Synergistic Program Management
Activities
Outputs
Short-Term and Immediate Outcomes
Long-Term Outcomes
Program Design
1
2
3
4
5
Recruit and Train Contractors
Execute Contracts with Lighting Manufacturers
Conduct Outreach to Dealers and Retailers
Conduct Marketing and Education to Consumers
Program Implementer Trains Internal Staff
6
7
8
9
10
11
12
Contractors Trained on Program Requirements
Manufacturers Provide CFLs and LEDs to Retailers at Discount
13
Dealers/ Retailers Stock High-Efficiency Lighting and Products
Program Implementer Advertises and Markets Materials and Energy-Efficiency Kits
Program Implementer Updates Website
14
Program Implementer Processes Applications
15
Program Implementer Conducts Quality Control
16
Utility Pays Incentives
17
Program Participants are Enrolled
18
19
20
21
22
23
24
Retailers Promote High-Efficiency Lighting and Products
25
Increased Program Awareness
Contactors Promote HES Measures to Customers
26
27
Increased Conservation Awareness
29
30
Consumers Purchase HES Measures or Order and Install Energy-Efficiency Kits
Contractors Retrofit Homes with HES Measures
28
31
Direct Energy Demand Savings
32
More CFLs, LEDs, and High-Efficiency Products Sold
33
34
35
Participants Recognize Benefits and Create Positive Word-of-Mouth
36
Consumer Demand for HES Measures Increases
37
Manufacturers Produce Fewer Non-Efficient Products
38
Long-Term Demand Savings
39
40
Reduced Need for Fuel and Capital Investments
41
Existing Homes More Efficient
42