2015–2016 Washington Home Energy Savings Program Evaluation

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Glossary of Terms

APS
Advanced Power Strips

CDD
Cooling Degree Days

CSA
Conditional Savings Analysis

CV
Coefficient of Variation

DHW
Domestic Hot Water

Downstream
Programs offering rebates on targeted products after purchase. When the buyer applies for the rebate, the program verifies that the intended use meets program requirements, sometimes even including verification that the buyer has a gas or electric account with a sponsoring utility

DSMC
Demand Side Management Central

EISA
Energy Independence and Security Act of 2007

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:

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

GPM
Gallons per Minute

HDD
Heating Degree Day

HES
Home Energy Savings

HOU
Hours of Use

In-Service Rate
Also called the installation rate, the ISR is the proportion of incented measures actually installed. The average measure life of a light bulb takes burn-outs into account. A light bulb that is installed but later removed as a result of a burn-out is counted as in-service.

IMEF
Integrated Modified Energy Factor

IWF
Integrated Water Factor

KWYS
Key What You See

MEF
Modified Water Factor

MHDS
Manufactured Homes Duct Sealing

Midstream
Programs implemented as agreements between the program and a range of market intermediaries, including distributors, retailers, and contractors. As noted, midstream intermediaries must apply a defined rebate amount to the measure's retail price.

NEI
Non-energy impact (NEI) is used in place of NEB's (non-energy benefits) to account for the fact that non-energy factors could be a benefit or a cost.

PTRC
PacifiCorp Total Resource Cost

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.

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

Regional Technical Forum
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.

Reported Savings
The savings reported by Pacific Power in the annual report for conservation acquisition.

RIM
Ratepayer Impact Measure

RSAT
Retail Sales Allocation Tool

SKU
Stock Keeping Unit

SPIF
Sales Performance Incentive Funds

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
Trade allies include retailers and contractors who supply and install discounted light bulbs and fixtures, appliances, HVAC, or insulation through the program.

TRL
Technical Reference Library

UES
Unit Energy Savings

Upstream
Programs implemented as agreements between the product manufacturer, distributors or retailers, and the program. The distributor or retailer must pass the entire product discount to buyers, resulting in target products offered at below-market prices.

WSEC
Washington State Energy Code

WF
Water Factor

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Executive Summary

In 2006, Pacific Power first began offering 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), midstream (retailers), and downstream (customer and contractor) incentive mechanisms.

During the 2015 and 2016 program years, Pacific Power's HES program reported site electricity savings of 19,037,448 kWh. The HES program contributed 51% of the reported Washington residential portfolio savings and 19% of Washington's total energy efficiency portfolio savings in 2015 and 2016.[1]

The 2015–2016 evaluation spans two biennial periods of the HES program. The program significantly changed in 2016, including the addition of some measures and elimination of others. The HES program provided incentives for the following measure categories during the 2015–2016 period, though not all measures were offered during both years:

- ***Appliances:*** efficient clothes washers, refrigerators, freezers, and hybrid heat pump clothes dryers
- ***Building Shell:*** attic, wall, and floor insulation, air sealing, and high-efficiency windows
- ***Electronics:*** advanced power strips (APS)[2]
- ***Heating, ventilation, and air conditioning (HVAC):*** high-efficiency heating and cooling equipment, including central air conditioners, evaporative coolers, heat pumps, ductless heat pumps, smart thermostats, and services (e.g., duct-sealing, tune-ups, best practice installation)
- ***Lighting:*** CFL and LED bulbs and lighting fixtures
- ***Water Heating:*** high-efficiency electric and heat pump water heaters
- ***wattsmart Starter Kits:*** low-cost (or, for some configurations, no-cost) mailed kits, containing various combinations and quantities of CFLs, LEDs, bathroom and kitchen faucet aerators, and high-efficiency showerheads
- ***Whole Home:*** whole-home performance path efficiency improvements for new homes

Pacific Power contracted with Cadmus to conduct impact and process evaluations of the Washington HES program for program years 2015 and 2016. For the impact evaluation, Cadmus assessed energy impacts and program cost-effectiveness. For the process evaluation, Cadmus assessed program delivery and efficacy, bottlenecks, barriers, customer satisfaction, and opportunities for improvements. Cadmus

[1] Residential portfolio and total portfolio savings (at the customer site) were sourced from the 2015 and 2016 Pacific Power Washington annual reports. Includes NEEA savings.

[2] Pacific Power offered APS incentives to customers through upstream, mail by request, direct install, and downstream channels.

also benchmarked select HES program features against other similar utility programs. This document presents the results of Cadmus' impact and process evaluations.

Key Findings

Cadmus' impact evaluation addressed 99% 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 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, representing 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, 2016. Where RTF market baselines proved unavailable, Cadmus defaulted to federal or state equipment efficiency standards. Given the market baseline approach, this report presents evaluated gross savings that account for freeridership. Freeridership is a measure of actions that customers would have undertaken in the program's absence, thus freeriders were participants that did not need the financial incentive to obtain the energy efficient measure. Cadmus did not apply a calculated freeridership value to savings calculations utilizing a market baseline (as opposed to a code minimum baseline) because those savings accounted for customers that would have already bought the equipment above the code minimum. Cadmus calculated participant spillover and nonparticipant spillover for use in cost-effectiveness analyses.

While Cadmus used 2015 market baselines, it also used updated workbook versions where engineering assumptions might differ from those used when Pacific Power designed its program. Cadmus used updated RTF workbooks, but kept the 2015 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 from program implementation estimates. This report analyzes the impacts of changes from each of these assumptions on program savings. The report notes any deviations from RTF workbook assumptions.

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

- ***Appliances:*** Overall, Cadmus estimated a 108% realization rate for reported savings in the appliance measure category. Incented appliances showed a 100% overall, weighted-average, installation rate. Cadmus evaluated a 109% savings realization rate for clothes washers due to a slightly higher number for average loads of laundry per year verified in participant surveys than assumed in reported savings.
- ***Building Shell:*** Overall, Cadmus estimated a 159% realization rate for the building shell measures. The attic, wall, and floor insulation measures had a 162% realization rate using a billing analysis.

- ***Electronics:*** The electronics category achieved a 100% realization rate. Cadmus agreed with the program's and RTF's assumptions used by the program to calculate APS reported savings.
- ***HVAC:*** Overall, the HVAC measure category realized 80% of reported savings. Cadmus estimated these realization rates using RTF workbooks, participant survey results, and engineering analysis. Evaluated savings realization rates ranged from 63% for duct sealing in manufactured homes to 115% for ductless heat pump installations in new homes.
- ***wattsmart Starter Kits:*** Cadmus evaluated kit measures (e.g., lighting and water saving devices) separately, but, when combined at the kit level, these measures realized 111% of reported savings. Installation rates varied from 60% for kitchen aerators to 90% for LEDs. High realization rates for water-saving measures, especially kitchen faucet aerators, drove the high realization rate for kits overall.
- ***Lighting:*** The HES lighting component realized 65% of reported savings. CFLs and LED bulbs contributed equally to program-reported savings, while LED fixtures contributed 100 times more than CFL fixtures. Incented CFL and LED bulbs realized 70% and 78% installation rates, respectively, based on installation, storage, and removal practices reported through evaluation telephone surveys. The evaluation estimated lower savings variables for CFLs and LEDs than planned (i.e., in-service rates [ISRs], hours-of use, and delta watts); the program realized only 49% of reported CFL savings, while realizing 74% for LEDs.
- ***Water Heating:*** The water heating category achieved an 89% realization rate. Heat pump water heaters had realization rates ranging from 87% to 92% based on detailed engineering reviews by Cadmus, which took the size and location of the water heaters installed into account. The study did not evaluate electric water heaters due to small participation rates.
- ***Whole Home:*** The whole home component realized 100% of savings, with 12 claimed and verified participants in the new construction performance program. Cadmus reviewed and agreed with the program modeling and saving estimates.

Table 1. 2015 and 2016 HES Program Savings*

Measure Category	Reported Units**	Evaluated Units**	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate	Precision (at 90% Confidence)
Appliances	372	372	43,979	47,595	108%	± 1.8%
Building Shell	446,690	446,690	390,413	619,396	159%	± 10.1%
Electronics	86	86	25,800	25,800	100%	N/A
HVAC	1,877	1,877	4,000,769	3,191,893	80%	± 7.1%
Kits	9,746	9,746	3,298,085	3,646,359	111%	± 7.3%
Lighting	626,711	626,711	11,101,305	7,238,564	65%	± 2.6%
Water Heating	133	133	146,418	130,728	89%	± 5.4%
Whole Home	12	12	30,680	30,680	100%	N/A
Total	**1,085,627**	**1,085,627**	**19,037,448**	**14,931,016**	**78%**	**± 2.7%**

*Totals in tables may not add exactly due to rounding.
**Cadmus counted each square foot of incented insulation or windows as one unit for the Building Shell measure category.

Table 2 and Table 3 show impact evaluation findings by program year. The lighting measure category realization rate increased significantly from 2015 to 2016, primarily due to decreased LED bulbs' and fixtures' reported per unit savings. Between 2015 and 2016, reported average per unit savings went from 21 kWh to 16 kWh for LED bulbs, and from 49 kWh to 19 kWh for LED fixtures (for more information on the differences between 2015 and 2016 savings, see the section titled CFL and LED Bulbs on page 29). In 2015, HVAC savings almost spread evenly between heat pump measures and duct-sealing measures. In contrast, heat pump measures dominated 2016 HVAC savings.

Table 2. 2015 HES Program Savings*

Measure Category	Reported Units**	Evaluated Units**	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Appliances	201	201	22,203	23,372	105%
Building Shell	264,738	264,738	273,910	440,087	161%
HVAC	1,205	1,205	2,108,185	1,589,173	75%
Kits	6,783	6,783	2,300,906	2,542,218	110%
Lighting	376,079	376,079	7,241,052	3,954,816	55%
Water Heating	75	75	60,384	53,937	89%
Total* **	**649,081**	**649,081**	**12,006,640**	**8,603,603**	**72%**

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

**Cadmus counted each square foot of incented insulation or windows as one unit for the Building Shell measure category.

***Pacific Power did not offer whole home and electronic measure categories in 2015.

Table 3. 2016 HES Program Savings*

Measure Category	Reported Units**	Evaluated Units**	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Appliances	171	171	21,776	24,223	111%
Building Shell	181,952	181,952	116,503	179,310	154%
Electronics	86	86	25,800	25,800	100%
HVAC	672	672	1,892,584	1,602,720	85%
Kits	2,963	2,963	997,179	1,104,141	111%
Lighting	250,632	250,632	3,860,253	3,283,748	85%
Water Heating	58	58	86,034	76,791	89%
Whole Home	12	12	30,680	30,680	100%
Total	**436,546**	**436,546**	**7,030,808**	**6,327,412**	**90%**

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

**Cadmus counted each square foot of incented insulation or windows as one unit for the Building Shell measure category.

Key Process Evaluation Findings

Key process evaluation findings include the following:

- Retailers (31%) served as the most commonly cited sources of program awareness for non-lighting participants. The general population (Pacific Power's residential customers surveyed about lighting and APS measure purchases), most commonly cited bill inserts (43%) and Pacific Power's website/social media (12%) as ways they learned about ***watt***smart offerings. Manufactured homes participants also learned about the duct-testing and sealing offer through bill inserts (47%) and word-of-mouth (20%). ***watt***smart Starter Kit participants also learned about the program through bill inserts (59%), word-of-mouth, and Pacific Power's website (9% each).
- As in 2013–2014, general population survey respondents for 2015–2016 expressed high satisfaction levels for LED purchases.
- Pacific Power customers largely remain unfamiliar with APS, with 80% not having heard of this technology. Of the seven general population survey respondents purchasing APS, five reported being very satisfied with their purchase.
- Non-lighting participants expressed satisfaction with their involvement with different program aspects, with 95% reporting satisfaction with the program overall. In addition, non-lighting participants exhibited high satisfaction levels with measures they installed, their contractors, and incentive amounts they received.
- Manufactured home participants' heating systems averaged 21 years old vs. 14 years old for Pacific Power's general customer base. Similarly, the average age of manufactured home participants' cooling systems averaged 13 years old, compared to nine years old for general customer population.
- The program distributed 9,746 kits in 2015–2016, and customers reported high satisfaction levels with the program, the kit contents, and the ease of ordering a kit.
- ***watt***smart Starter Kit participants said their desire to save energy and reduce costs motivated them to order kits. Participants upgrading to LED kits did so for the increased energy efficiency benefit and longer bulb life.

Benchmarking

- For the upstream lighting program, the evaluated Pacific Power savings per unit value is lower than the evaluated net savings reported by some utilities outside the region. One reason for this is that Pacific Power's evaluated savings are based on the RTF's residential lighting saving calculation workbook[3] market baseline (published in 2016), which reflects the market transition

[3] Parameters used to determine evaluated savings were taken from the workbook *ResLighting_Bulbs_v4_2.xlsm*, January 21, 2016. Available on the RTF website: https://rtf.nwcouncil.org/measure/residential-lighting

to a high percentage of CFLs, LEDs, and efficient fixtures, while other utilities base savings on the Energy Independence and Security Act of 2007 (EISA) requirements.

- Pacific Power is similar to other utilities in terms of delivery channel strategies. Lighting measures use an upstream/midstream incentive mechanism to provide a discount at the point of sale. Pacific Power's and other utilities' use of midstream channels (i.e., instant rebates available from contractors and retailers) is increasing as a strategy to encourage adoption of new technologies and big-ticket items. Downstream incentives are paid post-purchase, using mail-in or online incentive applications.
- The most effective new construction programs offer greater incentives for homes built to operate at substantially higher efficiency levels than code or than ENERGY STAR minimum requirements. Although Pacific Power does not offer a standalone new construction program in Washington, it addresses the new construction market through its downstream incentives, including a whole-home performance-based incentive.

Cost-Effectiveness Results

As shown in Table 4 and Table 5, the program proved cost-effective (including non-energy impacts [NEIs]) across the 2015–2016 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 1.93.

Table 4. 2015–2016 Evaluated HES Program Cost-Effectiveness Summary (Including NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit-Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$9,502,938	$18,373,440	$8,870,502	1.93
Total Resource Cost (TRC) No Adder	$0.069	$9,502,938	$17,297,269	$7,794,331	1.82
Utility Cost Test (UCT)	$0.026	$3,527,382	$10,761,707	$7,234,325	3.05
RIM Test		$15,983,156	$10,761,707	($5,221,449)	0.67
Participant Cost Test (PCT)		$7,589,198	$20,604,978	$13,015,781	2.72
Life Cycle Revenue Impacts ($/kWh)					$0.000083432
Discounted Participant Payback (years)					3.23

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 targeting the highest marginal cost hours (i.e., marginal costs greater than rates).

Table 5 shows that the HES program proved cost-effective (excluding NEIs) across the 2015–2016 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 1.25.

Table 5. 2015–2016 Evaluated HES Program Cost-Effectiveness Summary (Excluding NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit-Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$9,505,211	$11,837,878	$2,332,667	1.25
TRC No Adder	$0.069	$9,505,211	$10,761,707	$1,256,496	1.13
UCT	$0.026	$3,526,732	$10,761,707	$7,234,975	3.05
RIM		$15,982,506	$10,761,707	($5,220,799)	0.67
PCT		$7,589,198	$14,066,492	$6,477,295	1.85
Lifecycle Revenue Impacts ($/kWh)	$0.000083421				
Discounted Participant Payback (years)	5.47				

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):

- ***watt*smart Kit Participant Phone Numbers:** As the ***watt***smart kit measure administrator did not collect kit participant phone numbers or e-mail addresses, Pacific Power filled in data, where available, using their own customer database. While this is a small detail to operate the program efficiently, it created additional strain on evaluation efforts and Pacific Power to update program administrator data with kit participant phone numbers.

  Recommendation: wattsmart kit program administrator to collect kit participant phone numbers and e-mail addresses for kit program survey data collection activities.

- **Upstream Lighting Point-of-Sale Merchandizing Data:** Program tracking data did not include information about high-visibility product placements or merchandising within retail locations. Decreasing the price of efficient lighting products primarily drives sales, but merchandising also can generate substantial sales lift. Without these data, Cadmus cannot attribute merchandizing's effect on the program.

  Recommendation: Track dates and locations for all merchandising and product placement the program is responsible for. Providing model numbers, store locations, dates, and display types (e.g., end caps, pallet displays) allows more precise estimates of program-generated sales lift.

- **Lighting Reported Savings:** Pacific Power updated its reported lighting unit energy savings in January 2015 and again in January 2016, based on the latest RTF measure workbooks available in mid-2013 and 2015, respectively. The majority of bulbs were incented during 2015, with reported savings based on older versions of the RTF workbooks. Seventy-seven percent of 2015–2016 CFL bulbs derived reported savings using wattage baselines from the RTF CFL v2.2 workbook and the RTF specialty CFL v1.3 workbook, both of which were published in 2012. Fifty-eight percent of 2015–2016 LED bulb savings used baseline wattages derived from RTF LED v2.12, published in 2013. The evaluation employed RTF v4.2, published in January 2016—

approximately during the middle of the evaluation period. The misalignment between the market baseline wattages assumed in reported and evaluated savings (and not program delivery) affected the lighting realization rates.

> ***Recommendation:*** Cadmus recognizes program planning and the release of new RTF workbooks may not always align. Where feasible and applicable, Cadmus recommends adhering to the latest RTF workbook.

- **Non-Lighting Incentive Processing Times.** Although 79% of non-lighting participants reported satisfaction with the time between submitting their application and receiving their incentive payment, 27%, a significant increase over 2013 2014, waited more than eight weeks. This increase became most apparent in 2016 (effective January 1, 2016) and likely resulted from large-scale program changes to DSM Central (DSMC), which still was relatively new to PacifiCorp and CLEAResult. Additionally, staffing changes at the program administrator and incomplete applications submitted by customers confused about supplemental paperwork requirements contributed to incentive payment delays.

  > ***Recommendation***: Provide customers and contractors with clear, concise directions via applications and the website regarding submittal requirements specific for each measure. Monitor training and performance of administrator staff managing incentive processing. Review incentive payment timeframes compared to those at the end of 2016 to determine whether the number of projects paid in less than four weeks are increasing or those paid in more than eight weeks are decreasing.

Introduction

Program Description

Pacific Power contracted with CLEAResult to administer the Home Energy Savings (HES) Program during the 2015 and 2016 program years, and to provide prescriptive incentives to residential customers who purchased qualifying high-efficiency appliances, HVAC, water heating, whole home, and weatherization measures.[4] The HES program included an upstream lighting component, which provided high-efficiency lighting options by offering incentives for eligible CFLs, LED lamps, and CFL or LED fixtures at the retail level. The program also continued to offer low- and no-cost ***watt***smart Starter Kits. In 2016, Pacific Power began offering customers incentives to purchase and install advanced power strips (APS).

For part or all of the 2015–2016 evaluation period, the HES program offered the following energy efficiency measures:

- Appliances:
  - Clothes washer
  - Freezer
  - Refrigerator (2015 only)
  - Hybrid heat pump clothes dryer (2016 only)
- Building Shell:
  - Insulation (attic, floor, wall)
  - Windows
  - Air sealing
- Electronics: APS
- HVAC:
  - Central air conditioner
  - Central Air Conditioner Best Practice Installation and Sizing
  - Ductless heat pump
  - Ductless heat pump for manufactured homes
  - Evaporative cooler
  - Duct sealing and insulation
  - Duct sealing manufactured homes
  - Heat pump conversion
  - Heat pump upgrade

[4] CLEAResult's contract for HES administration expired at the end of 2015. PacifiCorp rebid the administration contract, and, in March 2016, issued a new three-year contract to CLEAResult.

  - Heat Pump—Performance Tested Comfort Systems (PTCS) Commissioning, Controls, and Sizing
  - Smart thermostats (added 2016)
  - Room air-conditioner
- Lighting:
  - CFLs
  - LEDs
  - Efficient Light fixtures
- Water Heating:
  - Electric water heater (2015 only)
  - Heat pump water heater
- ***watt***smart Starter Kits (including CFLs, LEDs, aerators, high-efficiency showerheads)
- Whole Homes: whole-home performance improvement

Program Participation

During the 2015–2016 HES program years, Pacific Power provided prescriptive incentives to nearly 2,000 residential customers, ***watt***smart Starter Kits to more than 9,700 customers, and upstream discounts for more than 600,000 products.[5] Table 6 shows participation and savings by measure and measure categories for this period.

Table 6. HES Program Reported Quantity and Savings by Measure, 2015–2016*

Measure Category	Measure Name	Reported Quantity	Quantity Type	Reported kWh Savings
Appliance	Energy Efficient Clothes Washer	328	Units	42,271
	Energy Efficient Freezer	40	Units	1,211
	Energy Efficient Refrigerator	2	Units	131
	Hybrid Heat Pump Clothes Dryer	2	Units	366
Building Shell	Air Sealing	6,652	Square Feet	2,585
	Air Sealing—Manufactured Homes	1,152	Square Feet	968
	Insulation-Attic	243,243	Square Feet	163,772
	Insulation-Attic—Multifamily Homes	60,684	Square Feet	63,360
	Insulation-Floor	84,568	Square Feet	90,141
	Insulation-Wall	33,938	Square Feet	50,552
	Windows	7,754	Square Feet	6,769
	Windows—New Homes	8,700	Square Feet	12,266
Electronics	Advanced Power Strip	86	Units	25,800

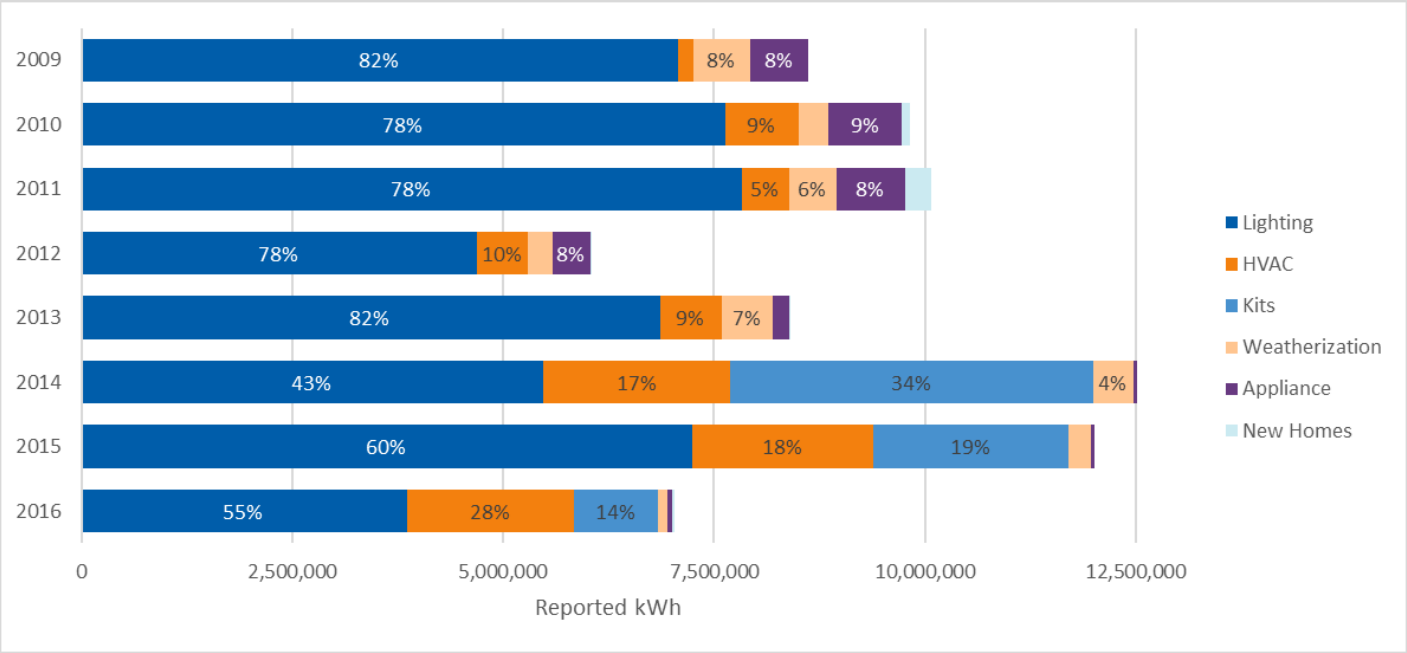
[5] Detailed counts of participants are provided in Table 8 under Sample Design and Data Collection Methods.

Measure Category	Measure Name	Reported Quantity	Quantity Type	Reported kWh Savings
HVAC	Central Air Conditioner Best Practice Installation and Sizing	5	Units	660
	Central Air Conditioner Equipment	102	Units	27,644
	Duct Leakage Test—Manufactured Homes	1	Measures	0
	Duct Sealing	24	Measures	22,674
	Duct Sealing—Manufactured Homes	616	Measures	947,797
	Duct Sealing and Insulation	99	Measures	290,894
	Duct Sealing and Insulation—Multifamily Homes	1	Measures	3,458
	Duct Sealing w/Crossover—Manufactured Homes	11	Measures	16,973
	Electric System to Heat Pump Conversion	238	Units	1,331,115
	Electric System to Heat Pump Conversion—Manufactured Homes	32	Units	148,128
	Energy Efficient Room Air Conditioner	177	Units	11,682
	Evaporative Cooler—Tier 2	4	Units	2,096
	Heat Pump—PTCS Commissioning, Controls, and Sizing	123	Units	129,168
	Heat Pump to Heat Pump Upgrade	58	Units	28,420
	Heat Pump to Heat Pump Upgrade—Manufactured Homes	17	Units	11,186
	Heat Pump, Ductless	166	Units	494,670
	Heat Pump, Ductless—Manufactured Homes	14	Units	63,298
	Heat Pump, Ductless—Multifamily Homes	34	Units	105,284
	Heat Pump, Ductless—New Homes	125	Units	346,782
	Smart Thermostat	30	Units	18,840
Kits	Basic Kit	7,355	Kits	2,839,970
	Better Kit	106	Kits	44,537
	Best Kit	763	Kits	321,827
	CFL Kit	1,389	Kits	83,340
	LED Kit	133	Kits	8,411
Lighting	Light Bulbs—CFL	317,194	Bulbs	4,939,630
	Light Bulbs—LED	269,584	Bulbs	4,900,155
	Light Fixtures—CFL	277	Fixtures	13,573
	Light Fixtures—LED	39,656	Fixtures	1,247,946
Water Heating	Electric Water Heater	33	Units	4,761
	Heat Pump Water Heater	65	Units	97,328
	Heat Pump Water Heater—New Homes	35	Units	44,329
Whole Home	Whole Home Performance Path—New Homes	12	Units	30,680
Total				**19,037,448**

Source: Pacific Power 2015 and 2016 annual reports; and 2015–2016 kits, lighting, and non-lighting databases, provided by the program administrator.

Historically, lighting has made the largest contribution to HES program savings. As shown in Figure 1, 2014 marked the first year where lighting contributed less than 50% of HES program savings (although it remained the largest individual contributor). In 2014, reported savings from CFL and LED bulbs decreased by approximately 20% from 2013 levels, as the total number of CFL program bulbs dropped by 29%. While lighting savings increased in 2015 (nearly matching lighting savings from 2011), lighting savings and total HES program savings decreased significantly.

Figure 1. Reported kWh Savings by Measure Category from 2009–2016*



*Percentages may not add to 100% due to rounding. In 2015, lighting fixtures were moved from the appliance category to the lighting category. To allow comparisons with previous years, heat pump water heaters were categorized under HVAC in 2015 and 2016.

After accounting for 34% of program savings in its introductory year (2014), ***watt***smart Starter Kits savings decreased in successive years. ***watt***smart starter kits savings decreased more than 3,000,000 kWh from 2014, and contributed 14% of program savings in 2016.

HVAC participation increased drastically between 2013 and 2014 due to increases in heat pump and heat pump water heater incentive amounts, leading to consistently higher energy savings. While HVAC savings fell slightly lower in 2016 than in 2014–2015, they accounted for an increased percentage of total savings due to more significant reductions in energy savings from lighting and kits. Lastly, appliance savings have dropped significantly since 2013, reflecting market transformation due to codes and standards stringency at the federal level.

Data Collection and Evaluation Activities

For the impact evaluation, Cadmus assessed energy impacts and program cost-effectiveness. For the process evaluation, Cadmus assessed program design and process effectiveness, participant satisfaction, bottlenecks, barriers, marketing effectiveness, and opportunities for improvements. Cadmus also benchmarked select program aspects of HES against other similar utility programs.

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 Rebate Surveys (Non-Lighting)	X	X
Participant Kit Surveys	X	X
Participant Manufactured Homes Survey		X
General Population Surveys (Upstream Lighting/APS)	X	X
Weatherization and HVAC Billing Analysis	X	
Engineering Reviews	X	
Evaluated Savings Analysis	X	
Logic Model Review		X
Benchmarking Review		X

Sample Design and Data Collection Methods

For each measure category, Cadmus developed a sample to be representative of each surveyed population and to achieve precision of ±10% with 90% statistical confidence. Cadmus assumed a coefficient of variation (CV)[6] equal to 0.5 for computing initial sample sizes. For a small surveyed population, Cadmus applied a finite population adjustment factor, which effectively reduced the necessary sample size while maintaining the target 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.[7]

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

[7] Simple random samples are drawn from an entire population, whereas stratified random samples are drawn randomly from subpopulations (strata) and 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	2	2
Program Administrator Interview	N/A	N/A	1	3
Non-Lighting Participant Survey *	1,984	1,251	240	224
Kit Participant Survey*	9,746	9,415	140	140
Manufactured Homes Duct Sealing Participant Survey**	635	635	15	15
General Population Survey (Used for Upstream Lighting/APS)***	99,452	96,090	250	250

*The non-lighting and kit participant populations represents all unique participants by account number, according to program tracking data from the administrator.

**The Manufactured Homes Duct Sealing (MHDS) participant number represents all unique MHDS participants by account number. Though the MHDS population is a subset of the Non-Lighting Participant Population, the sampling frames are separate, and any duplicate account numbers from the Non-Lighting Participant sample frame were removed from the MHDS sample frame.

***The general population survey derived from Pacific Power's number of residential customers billed during May 2017 in Washington. Pacific Power provided the customer data.

Non-Lighting Participant Telephone Surveys

Cadmus surveyed 224 non-lighting participants, gathering measure-level and measure category-level information on installations, program awareness and satisfaction, and demographics. In organizing the non-lighting participants into three measure categories (e.g., appliances, HVAC, weatherization), Cadmus randomly selected participants within each category. Table 9 provides the population of non-lighting participants, targets, and numbers of surveys achieved. Due to the small population of appliance participants, Cadmus could not achieve the target number of completed surveys. All efforts were made to attain the target without placing undue burden on customers, with up to five attempts made to reach each participant.

Cadmus also selected a sample of manufactured homes' duct-sealing participants (a subset of the HVAC category participants) for the manufactured homes duct-sealing survey. This survey covered all topic areas addressed in the non-lighting participant survey, though it was particularly tailored towards gathering insights into the direct install measure delivery process.

Table 9. Non-Lighting Participant Survey Targeted and Achieved

Measure Category	Population*	Sampling Frame*	Targeted	Achieved
Appliances	405	331	80	66
HVAC	1,237	702	80	80
HVAC Manufactured Homes Duct Sealing	635	635	15	15
Weatherization	459	271	80	78
Total	**2,747***	**1,939***	**255**	**239**

*The populations and sampling frames differ from Table 8 as some participants participated in multiple measure categories.

Participant Kit Surveys

In gathering measure-level information on installations, program awareness and satisfaction, and demographics, Cadmus surveyed 140 customers who received ***watt***smart Starter Kits in 2015–2016.

Cadmus targeted samples to achieve statistically significant results for kits containing CFLs and those containing LEDs, and 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 survey participants. Table 10 lists the population of kit participants, targets, and the numbers of surveys achieved.

Table 10. Participant Kit Survey Targeted and Achieved

Lighting Type	Population	Sampling Frame	Targeted	Achieved
CFL	8,850	8,549	70	70
LED	896	866	70	70
Total	**9,746**	**9,415**	**140**	**140**

General Population Surveys

The general population surveys collected information on HES program awareness, key data for lighting and APS' engineering reviews, and nonparticipant spillover from a random group of customers in Washington. Cadmus drew the general population survey sample from a random list of 2,500 Washington residential customers (provided by Pacific Power) and achieved 250 completed responses.

Impact Evaluation

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

- Participant and general population surveys
- Billing analysis
- Engineering reviews

Reported savings represent electricity savings (kWh) reported by Pacific Power in the 2015 and 2016 Washington Annual Report on Conservation Acquisition (i.e., annual reports).[8] To determine evaluated savings, Cadmus applied Steps 1 through 3:

- **Step one** (verify the participant database): this included reviewing the program tracking database to ensure participants and reported savings matched 2015 and 2016 annual reports.
- **Step two** (adjust savings using the actual installation rate): using telephone surveys, Cadmus determined the number of program measures installed and those that remained installed.
- **Step three** (estimate unit energy savings [UES]): this 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 11 lists the methodologies used for each evaluation savings step in the 2015–2016 HES program.

[8] Pacific Power Washington Annual Reports: 2015–2016. Available online:
2016 Report:
http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2016/2016_WA_DSM_Annual_Report%2BAppendix.pdf
2015 Report:
http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2016/2015_WA_Annual_Report.pdf

Table 11. 2015–2016 HES Impact Methodology by Measure*

Measure Category	Measure Name	Percentage of Savings	Method		
			Step 1: Database Review	Step 2: Verification	Step 3: Unit Energy Savings
Appliance	Energy Efficient Clothes Washer	0.2%	Non-Lighting Tracking Database Review	In-Service Rate: Non-Lighting Survey	Engineering Review
	Energy Efficient Freezer	0.0%			Reported
	Energy Efficient Refrigerator	0.0%			
	Hybrid Heat Pump Clothes Dryer	0.0%			
Building Shell	Air Sealing	0.0%			
	Air Sealing—Manufactured Homes	0.0%			
	Insulation-Attic	0.9%		Billing Analysis	Billing Analysis
	Insulation-Attic—Multifamily Homes	0.3%			
	Insulation-Floor	0.5%			
	Insulation-Wall	0.3%			
	Windows	0.0%		In-Service Rate: Non-Lighting Survey	Reported
	Windows—New Homes	0.1%			
Electronics	Advanced Power Strip	0.1%		In-Service Rate: General Population Survey	Engineering Review
HVAC	Central Air Conditioner Best Practice Installation and Sizing	0.0%		In-Service Rate: Non-Lighting Survey	Reported
	Central Air Conditioner Equipment	0.1%			
	Duct Leakage Test—Manufactured Homes	0.0%		Billing Analysis	Billing Analysis
	Duct Sealing	0.1%			
	Duct Sealing—Manufactured Homes	5.0%			
	Duct Sealing and Insulation	1.5%			
	Duct Sealing and Insulation—Multifamily Homes	0.0%			
	Duct Sealing w/Crossover—Manufactured Homes	0.1%			
	Electric System to Heat Pump Conversion	7.0%		In-Service Rate: Non-Lighting Survey	Engineering Review
	Electric System to Heat Pump Conversion—Manufactured Homes	0.8%			
	Energy Efficient Room Air Conditioner	0.1%			Reported
	Evaporative Cooler—Tier 2	0.0%			

Measure Category	Measure Name	Percentage of Savings	Method		
			Step 1: Database Review	Step 2: Verification	Step 3: Unit Energy Savings
	Heat Pump—PTCS Commissioning, Controls, and Sizing	0.7%			Engineering Review
	Heat Pump to Heat Pump Upgrade	0.1%			Reported
	Heat Pump to Heat Pump Upgrade—Manufactured Homes	0.1%			
	Heat Pump, Ductless	2.6%			Engineering Review
	Heat Pump, Ductless—Manufactured Homes	0.3%			
	Heat Pump, Ductless—Multifamily Homes	0.6%			
	Heat Pump, Ductless—New Homes	1.8%			
	Smart Thermostat	0.1%			Reported
Kits	Basic Kit	14.9%	Kit Tracking Database Review	In-Service Rate: Kit Participant Survey	Engineering Review
	Better Kit	0.2%			
	Best Kit	1.7%			
	CFL Kit	0.4%			
	LED Kit	Less than 0.1%			
Lighting	Light Bulbs—CFL	25.9%	Lighting Tracking Database Review	In-Service Rate: General Population Survey	
	Light Bulbs—LED	25.7%			
	Light Fixtures—CFL	0.1%			
	Light Fixtures—LED	6.6%			
Water Heating	Electric Water Heater	0.0%	Non-Lighting Tracking Database Review	In-Service Rate: Non-Lighting Survey	Reported
	Heat Pump Water Heater	0.5%			Engineering Review
	Heat Pump Water Heater—New Homes	0.2%			
Whole Home	Whole Home Performance Path—New Homes	0.2%			

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 measures that accounted for 99% of program savings. Table 12 presents the share of savings and the evaluated savings' evaluation methods used for measures representing the applicable percentage during the 2015–2016 period.

Table 12. Measure Selection for Step 3: Engineering and Billing Analysis

Measure Category	Measure	Percentage of Reported kWh Savings	Step 3: Evaluation Method
Appliances	Clothes Washer	Less than 1%	Engineering Review
Building Shell	Attic, Floor, and Wall Insulation	2%	Billing Analysis
HVAC	Heat Pump Water Heater	1%	Engineering Review
	Heat Pump Ductless	5%	Engineering Review
	Duct Sealing and Insulation	7%	Billing Analysis
	Heat Pump PTCS Cx, Controls, Sizing	1%	Engineering Review
	Heat Pump Conversion	8%	Engineering Review
Kits	***watt***smart Starter Kits	17%	Engineering Review
Lighting	Light Bulbs—CFL	26%	Engineering Review
	Light Bulbs—LED	26%	Engineering Review
	Fixtures	7%	Engineering Review
Whole Home	Whole Home*	Less than 1%	Engineering Review
Summary Percentage of Reported Savings Evaluated		**99%**	

* Cadmus agreed with the assumptions used to calculate deemed savings for the whole home performance measures and applied a 100% realization rate to those measures.

Table 13 provides evaluation results for evaluated quantities, evaluated savings, and realization rates by measure type.

Table 13. Reported and Evaluated HES Program Savings for 2015–2016

	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
Appliance	Energy Efficient Clothes Washer	328	42,271	45,887	109%
	Energy Efficient Freezer	40	1,211	1,211	100%
	Energy Efficient Refrigerator	2	131	131	100%
	Hybrid Heat Pump Clothes Dryer	2	366	366	100%
Building Shell*	Air Sealing	7,804	3,552	3,552	100%
	Insulation	422,433	367,825	596,808	162%
	Windows	16,453	19,036	19,036	100%
Electronics	Advanced Power Strip	86	25,800	25,800	100%

	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
HVAC	Central Air Conditioner	107	28,304	28,304	100%
	Duct Leakage Test - Manufactured Homes	1	0	0	N/A
	Duct Sealing	123	313,568	283,605	90%
	Duct Sealing - Manufactured Homes	627	964,770	608,645	63%
	Duct Sealing & Insulation - Multifamily Homes	1	3,458	2,274	66%
	Electric System to Heat Pump Conversion	238	1,331,115	976,096	73%
	Electric System to Heat Pump Conversion - Manufactured Homes	32	148,128	156,839	106%
	Energy Efficient Room Air Conditioner	177	11,682	11,682	100%
	Evaporative Cooler - Tier 2	4	2,096	2,096	100%
	Heat Pump - PTCS Commissioning, Controls, and Sizing	123	129,168	89,144	69%
	Heat Pump to Heat Pump Upgrade	75	39,606	39,606	100%
	Heat Pump, Ductless	166	494,670	432,925	88%
	Heat Pump, Ductless - Manufactured Homes	14	63,298	60,463	96%
	Heat Pump, Ductless - Multifamily Homes	34	105,284	81,447	77%
	Heat Pump, Ductless - New Homes	125	346,782	399,926	115%
	Heat Pump, Single-Head, Ductless	0	0	0	N/A
	Smart Thermostat	30	18,840	18,840	100%
Kits	Basic Kit	7,355	2,839,970	3,172,122	112% %
	Better Kit	106	44,537	48,329	109%
	Best Kit	763	321,827	354,066	110%
	CFL Kit	1,389	83,340	64,439	77%
	LED Kit	133	8,411	7,404	88%
Lighting	Light Bulbs - CFL	317,194	4,939,630	2,405,501	49%
	Light Bulbs - LED	269,584	4,900,155	3,644,520	74%
	Light Fixtures - CFL	277	13,573	4,096	30%
	Light Fixtures - LED	39,656	1,247,946	1,184,447	95%
Water Heating	Electric Water Heater	33	4,761	4,761	100%
	Heat Pump Water Heater	65	97,328	85,013	87%
	Heat Pump Water Heater - New Homes	35	44,329	40,954	92%
Whole Home	Whole Home Performance Path - New Homes	12	30,680	30,680	100%
Total**			**19,037,448**	**14,931,016**	**78%**

*Quantities for building shell 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 covering all 2015 and 2016 participation for the three delivery methods: lighting, kits, and non-lighting rebates (e.g., HVAC, appliance, water heating, whole home, electronics, weatherization).

The upstream lighting measures database contained information such as tracking lighting at a per-bulb level; including data about retailers, electric savings, purchase dates, models, and stock keeping units [SKUs].[9] Cadmus' review of database tracking for 2015 and 2016 did not find discrepancies in total reported quantities or total savings compared to the 2015 and 2016 annual reports.

The ***watt***smart Starter Kit database provided account numbers, addresses, names, and types and quantities of kit types, but the program administrator did not track or provide phone numbers from 2015 to 2016 (necessary for conducting surveys). Pacific Power provided participant phone numbers by mapping participant account numbers to their customer database. Cadmus' review of ***watt***smart Starter Kit tracking database for 2015 and 2016 did not find discrepancies in total reported quantities or total savings when compared to the 2015 and 2016 annual reports.

Cadmus also reviewed the program administrator's tracking database of 2015 and 2016 non-lighting measures. The database collected measure-level information (e.g., efficiency standards, unit quantities, purchase dates, incentive amounts). Total quantities and savings matched the 2015 and 2016 annual reports.

During the 2015-2016 evaluation cycle, Cadmus conducted lighting demand elasticity modeling to estimate freeridership for lighting incentives. The demand elasticity modeling results are provided in Appendix B. but are not used in the evaluated savings calculations. To conduct this analysis, Cadmus requested merchandising and product placement data from the program administrator and included these in the demand elasticity model. Ideally, the program administrator would track products featured on high-visibility, off-shelf displays (i.e., end caps or pallet displays) within each store location along with the time frame for each display. With these data, Cadmus could estimate sales lift due to price effects as well as product merchandising separately.

As the program administrator's merchandising and product placement data were unavailable, Cadmus could only account for program price changes and not program merchandising. This may have led to bias in Cadmus' freeridership estimates. Any merchandising that coincided with price changes and led to increased sales, when unaccounted in the model, could potentially lead to upward bias in the price elasticity coefficients and cause the model to ultimately underestimate freeridership. Any merchandising, however, that did not coincide with price changes and was unaccounted in the model would not be credited to the program, leading the model to overestimate freeridership.

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

Step 2: Verification

To verify in-service rates (ISRs)—that is, the 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 bulbs (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 14 shows ISRs for each measure. All survey respondents reported installing all measures listed in the survey, resulting in 100% ISRs for all non-lighting measures. Table 14 also shows the breadth and quantity of measures addressed by the survey.

Table 14. ISR by Measure Category, 2015–2016

Measure Category	Measure	2015 and 2016			
		Total Surveyed Measures	Total Measures In-service	Percentage Installed	Percentage Average Weighted Installation
Appliances	Clothes Washer	56	56	100%	100%
	Dishwasher	0	0	n/a	
	Electric Water Heater	7	7	100%	
	Freezer	4	4	100%	
	Light Fixture	0	0	n/a	
	Refrigerator	0	0	n/a	
	Room Air Conditioner	0	0	n/a	
HVAC	Air Sealing	0	0	n/a	100%
	Central Air Conditioner Equipment	4	4	100%	
	Duct Sealing and Insulation	0	0	n/a	
	Ductless Heat Pump	21	21	100%	
	Evaporative Cooler	0	0	n/a	
	Heat Pump	37	37	100%	
	Heat Pump Best Practice	0	0	n/a	
	Heat Pump Water Heater	10	10	100%	
	Smart Thermostat	4	4	100%	
Weatherization*	Attic Insulation	61,144	61,144	100%	100%
	Floor Insulation	29,836	29,836	100%	
	Wall Insulation	3,180	3,180	100%	
	Windows	1,382	1,382	100%	

*Quantities for building shell measures are in square feet.

wattsmart Starter Kit ISRs

Cadmus calculated ISRs for each ***watt***smart Starter Kit measure using data collected through a survey that Cadmus conducted with 140 Washington kit recipients. The survey, administered six months to one year after kit delivery, verified the number of kit measures received and installed at the time of the survey. If respondents reported they did not have measures currently installed, the survey asked what happened to the uninstalled measures (e.g., stored, discarded) and why.

Table 15 shows measure-level ISR results along with total measures distributed and reportedly installed.

Table 15. ISRs by Kit Measure, 2015–2016

Measure	Total Surveyed Measures	Measures Reported Installed	ISR
Bathroom Aerator	189	117	62%
CFLs*	249	209	84%
Kitchen Aerator	116	75	65%
LEDs*	279	251	90%
Showerheads	197	120	61%

*Consistent with upstream CFL and LED ISR analysis, Cadmus considered bulbs removed after burning out as "installed" rather than "removed."

Kit participant survey results indicated LEDs and CFLs achieved the highest reported ISRs (90% and 84%, respectively) at the time of the survey. Customers paid a nominal cost ($4.99 each) for kits with LEDs, which could contribute to a higher ISR for LEDs than CFLs. Showerheads achieved the lowest ISRs (61%).

Cadmus compared ***watt***smart Starter Kit ISRs with those of two other utilities' residential energy efficiency kit programs, in which free energy- and water-saving products were delivered to customers at their request. As shown in Table 16, ISRs from other kit programs were similar to those from the HES program.

Table 16. Mail-by-Request Kit Program ISRs Comparison

Measure	PPL Electric Utilities PA 2015*	Iowa Energy Wise IA 2016**	Washington HES 2013–2014	Washington HES 2015–2016
Kitchen Faucet Aerator	65%	74%	61%	**62%**
Bathroom Faucet Aerators	N/A	70%	63%	**65%**
Showerheads	60%	74%	63%	**60%**
CFLs	N/A	79%	85%	**84%**
LEDs	97%	75%	90%	**90%**

* Cadmus, on behalf of PPL Electric Utilities. *EDC Program Year 7 Annual Report*. 2016.

** Cadmus, on behalf of Iowa Energy Wise. *Final Report: Iowa 2016 Energy Wise Program.* 2017.

CFL and LED Bulb ISRs

Cadmus calculated LED first-year ISRs for 2015–2016 using data collected through the general population survey (i.e., 250 Pacific Power Washington customers). To reflect the program's move away from CFL incentives, the 2015–2016 survey did not include questions related to CFL purchases;

therefore, CFL first-year ISR values reported for the current evaluation are the same as those reported for the 2013–2014 evaluation.

Each survey asked participants about the number of CFL and LEDs bulbs they purchased, installed, removed, and/or stored within the prior 12 months. If respondents reported removing bulbs, the survey asked why the removal took place, and it adjusted the ISRs based on an assumption that bulbs removed due to burning out would have remained in place had they remained functional. The calculated ISRs did not account for installations occurring after the first year of purchase.

CFLs

Cadmus used data from 148 respondents surveyed in 2015 to calculate the ISR. Table 17 provides ISR results for 2013–2014 CFLs.

Table 17. First-Year CFL ISR based on results of 2013–2014 General Population Survey*

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 18 compares first-year ISRs evaluated for similar programs across the country (and for past HES program evaluations in Washington). As shown, Washington's CFL ISR has fluctuated slightly year to year. As stated, the CFL ISR used in the current evaluation was based on the ISR evaluated for the program during the 2013–2014 evaluation period.

Table 18. 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%
Northeast Utility	Self-Reporting: 200 telephone surveys	2012	73%
Midwest Utility 2	Self-reporting: 301 customer surveys	2012	68%
Pacific Power Washington 2009-2010 HES Evaluation	Self-reporting: 250 in-territory lighting surveys	2011	69%
Pacific Power Washington 2011–2012 HES Evaluation	Self-reporting: 245 in-territory lighting surveys	2014	65%
Pacific Power Washington 2013–2014 HES Evaluation	**Self-reporting: 148 in-territory lighting surveys**	**2016**	**70.5%**

LEDs

Cadmus calculated first-year LED ISRs using the same methodology used for CFLs, except the customer sample drew upon the current 2015–2016 general population survey. After filtering results for those purchasing LEDs and providing reliable responses, 64 customers remained for inclusion in the LED ISR analysis. Table 19 lists LED ISR results, indicating a higher LED ISR than CFL ISR. LEDs' higher costs and satisfactory performance most likely drove the higher ISR.

Table 19. First-Year LED ISR (Based on the Results of 2015–2016 General Population Surveys)*

Bulb Status	Bulbs Reported	ISR
Purchased	**708**	77.7%
Installed	552	
Stored	171	
Removed	17	
Removed After Burning Out	15	
In-Service Bulbs (including burned out)	**550**	

* n = 64 respondents

Table 20 compares LED ISR values to those calculated for LEDs in other jurisdictions. Fewer comparable studies have assessed LED ISRs due to LED technology's more recent emergence. Cadmus determined other LED ISR values from data collected through site visits, which may also contribute to ISR differences. LED ISRs have declined from the previous evaluation, from 84.8% to 77.7%.

Table 20. 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%
Southwest Utility	70 Residential Site Visits	2015	84%
Pacific Power Washington 2013–2014 HES Evaluation	Self-reporting: 79 General Population Survey	2016	84.8%
Pacific Power Washington 2015–2016 HES Evaluation	**Self-reporting: 64 General Population Survey**	**2017**	**77.7%**

The reduced LED ISR from the 2013–2014 evaluation to 2015–2016 appears to correspond to several factors. As shown in Table 21, the average number of reported LEDs purchased increased from 7.7 in 2013-2014 to 11.3 per household in 2015-2016, possibly due to lower LED prices. Cadmus also observed that the storage rate increased from 15% to 22%, while the total number of customers stating they stored bulbs increased from 28% to 38%. Therefore, it appears customers bought more bulbs, but put more into storage and at a greater rate, presumably until they need to install those bulbs thereby decreasing the percentage installed during the first year.

Table 21. Changes in LED Purchasing and Storage Behaviors Based on 2013-2014 Upstream Lighting and 2015-2016 General Population Surveys

Variable	2013-14	2015-16
First Year ISR	85%	78%
LED Storage Rate	15%	22%
Ratio of Customers Storing Bulbs	28%	38%
Average Number of LEDs Purchased	7.7	11.3

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:

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

- New Homes[10]

Cadmus evaluated the following measures using billing analysis:

- Attic, wall, and floor insulation
- Duct sealing
- Duct sealing and insulation

Cadmus applied 100% realization rates to measures not listed above (when combined, these contributed less than 1% of program savings). As shown in Table 22, UES realization rates for evaluated measures ranged from 49% (for CFL lamps) to 162% (for insulation).

[10] Cadmus agreed with the assumptions used to calculate deemed savings for whole home performance measures and applied a 100% realization rate to those measures.

Table 22. 2015–2016 Unit Realization Rate Summary Table for Evaluated Measures

Measure Category	Measure	Average UES (kWh/Unit)		UES Realization Rate*	UES Method
		Reported	Evaluated		
Appliance	Clothes Washer	128.9	139.9	109%	Engineering Review
HVAC	Duct Sealing	944.8	854.5	90%	Billing Analysis
	Duct Sealing - Manufactured Homes	1,538.7	970.7	63%	Billing Analysis
	Duct Sealing and Insulation	2,938.3	2,657.5	90%	Billing Analysis
	Duct Sealing & Insulation - Multifamily	3,458.0	2,273.7	66%	Billing Analysis
	Heat Pump Conversion	5,592.9	4,101.2	73%	Engineering Review
	Heat Pump Conversion - Manufactured Homes	4,629.0	4,901.2	106%	Engineering Review
	Heat Pump Ductless	2,979.9	2,608.0	88%	Engineering Review
	Heat Pump, Ductless - Manufactured Homes	4,521.3	4,318.8	96%	Engineering Review
	Heat Pump, Ductless - Multifamily	3,096.6	2,395.5	77%	Engineering Review
	Heat Pump, Ductless - New Homes	2,774.3	3,199.4	115%	Engineering Review
	Heat Pump PTCS Cx, Controls, Sizing	1,050.1	724.8	69%	Engineering Review
	Heat Pump Water Heater	1,497.4	1,307.9	87%	Engineering Review
	Heat Pump Water Heater - New Homes	1,266.5	1,170.1	92%	Engineering Review
Kits	***watt***smart Starter Kits	338.4	374.1	111%	Engineering Review
Lighting	CFL Lamps	15.6	7.6	49%	Engineering Review
	LED Lamps	18.2	13.5	74%	Engineering Review
	Fixtures	31.6	29.8	94%	Engineering Review
Weatherization	Attic Insulation**	0.7	1.1	162%	Billing Analysis
	Attic Insulation – Multifamily**	1.0	1.7	162%	Billing Analysis
	Floor Insulation**	1.1	1.7	162%	Billing Analysis
	Wall Insulation**	1.5	2.4	162%	Billing Analysis
Whole Home	Whole Home	2,556.7	2,556.7	100%	Engineering Review

*The UES realization rate may not calculate exactly due to rounding the reported and evaluated UES values.

**Attic, floor, and wall insulation units are kWh/square foot.

The following sections describe the methodology and measurement activity results for each measure listed in Table 22.

CFL and LED Bulbs

During the 2015–2016 program years, Pacific Power provided incentives for 317,194 CFLs and 269,584 LEDs[11] through 12 different Washington retailers, representing 30 stores. Table 23 shows quantities and savings for the 18 different bulb types. Overall, upstream light bulb incentives represented 52% of the total reported HES savings.

Table 23. 2015–2016 Incented CFL and LEDs Bulbs by Type

Lighting Type	Bulb Type	Reported Quantity (Bulbs)	Percentage Reported Quantity (Bulbs)	Reported Savings (kWh)
CFL	A-Lamp	3,575	less than 1%	57,200
	Spiral	201,924	34.4%	3,230,784
	Candelabra	503	less than 1%	8,551
	Globe	671	less than 1%	11,407
	Reflector	6,994	1.2%	118,898
	Daylight	31,840	5.4%	541,280
	3-Way	125	less than 1%	2,125
	Dimmable	39	less than 1%	663
	Outdoor	68	less than 1%	1,156
	General Purpose	54,834	9.3%	506,666
	Specialty	16,621	2.8%	460,900
CFL Total		**317,194**	**54.1%**	**4,939,630**
LED	A-Lamp	99,186	16.9%	1,633,593
	Candelabra	14,117	2.4%	403,887
	Globe	8,756	1.5%	250,509
	Downlight	33,202	5.7%	949,909
	3-Way	47	less than 1%	1,345
	General Purpose	78,420	13.4%	1,203,747
	Specialty	35,856	6.1%	457,164
LED Total		**269,584**	**45.9%**	**4,900,155**
Overall Total		**586,778**	**100.0%**	**9,839,785**

For the 2015–2016 evaluation period, LEDs made up 46% of the upstream program sales. As shown in Table 24, this fraction has increased year-over-year since 2013. LED participation dramatically increased from 2014 to 2015, and, in 2016, LEDs made up the majority of program bulbs.

[11] All quantities, totals, and averages listed for Washington in this report include sales in certain Oregon stores on the border of the two states. Pacific Power determined these stores served Washington customers.

Table 24. CFL and LED Upstream Program Participation, 2013 - 2016

Year	CFL Quantity	LED Quantity	Total	LED %
2013	307,677	19,960	327,637	6%
2014	274,565	28,125	302,690	9%
2015	223,754	135,174	358,928	38%
2016	92,182	134,410	226,592	59%

Savings Calculation

The following equation provided evaluated lighting savings:

$$\text{Evaluated Per Unit Savings (kWh per unit)} = \frac{\Delta\text{Watts} \cdot \text{ISR} \cdot \text{HOU} \cdot 365.25 \cdot \text{WHF}}{1{,}000}$$

Where:

- ΔWatts = Delta watts, the wattage difference between a baseline bulb (W_{BASE}) and an evaluated efficient bulb (W_{EFF})
- ISR = In-service rate, the percentage of incented units installed within the first year
- HOU = Hours of use, the daily lighting operating hours
- WHF = Waste heat factor, accounting for interactive effects between a home's heating and cooling systems

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

Table 25. CFL and LED Bulb Evaluated Savings Activities

Savings Variable	Lighting Type	Activity / Source
ΔWatts	CFL + LED	RTF v4.2—grouped by lumen range and bulb type
ISR	CFL	2013–2014 General Population Survey (n=148)
	LED	2015–2016 General Population Survey (n=64)
HOU	CFL + LED	RTF v4.2—grouped by lumen range and bulb type
WHF	CFL + LED	RTF v4.2—grouped by lumen range and bulb type

Cadmus used the RTF v4.2 workbook,[12] published near the middle of the evaluation period in January 2016, for many evaluated inputs.[13] This workbook divided bulbs into five categories, and further divided those categories into five lumen bins. As discussed below, Cadmus assigned separate values for W_{BASE},

[12] Regional Technical Forum. "Residential Lighting." ResLighting_Bulbs_v4_2.xlsm. Jan. 21, 2016. Available online: https://rtf.nwcouncil.org/measure/residential-lighting

[13] Pacific Power updated their reported lighting UES values in January of 2015 and again in January of 2016, based on the latest RTF measure workbooks available in mid-2013 and 2015, respectively. Pacific Power followed advisory group guidance in establishing UES values using the latest RTF values at the time of planning.

HOU, and WHF to each bulb type and lumen bin. Table 26 shows 2015–2016 bulb quantities for each of the five RTF bulb types and the five lumen RTF lumen bins.

Table 26. Bulb Types and Lumen Bins in RTF v4.2 Workbook, with 2015–2016 Upstream Quantities

Lumen Range	Upstream Quantity, By Bulb Type				
	Standard	Decorative	Globe	EISA-Exempt	Reflector
250–309	0	16,522	236	0	46
310–749	45,799	2,938	10,010	0	27,290
750–1,049	343,114	0	262	0	38,283
1,050–1,489	20,190	0	0	0	4,467
1,490–2,600	77,200	0	0	174	247
Total	**486,303**	**19,460**	**10,508**	**174**	**70,333**
Total Percentage	**82.9%**	**3.3%**	**1.8%**	**0.0%**	**12.0%**

Delta Watts

Delta watts represents the wattage difference between a baseline bulb and an equivalent CFL or LED. Cadmus determined baseline wattages using the 2015–2016 lighting tracking data, which included CFL and LED sales data by model number and bulb type for 586,778 bulbs sold through the program.

The lumen equivalency method generally produces delta watts for a given lamp by first determining the lamp's lumen output and type. Each lamp type corresponds to a set of lumen bins, and each bin corresponds with an assumed baseline wattage.

Cadmus used the bulb types and lumen bins outlined in the RTF v4.2 document to obtain baseline wattages for each lamp model in the upstream database. Cadmus chose this version of the RTF lighting workbook because it was published in January 2016, approximately in the middle of the evaluation period. For each of these, delta watts equaled the difference between the baseline wattage and the model's listed efficient wattage. Whenever possible, Cadmus estimated each lamp's lumen output and efficient wattage by mapping these to the ENERGY STAR® database. When this proved impossible, Cadmus interpolated lumen outputs from efficient wattages, based on a best-fit line derived from the ENERGY STAR database.

The RTF v4.2 workbook derived market baselines for five lumen bins in each of the five bulb categories. Table 27 outlines these market baselines, derived from 2014 shelving data and from 2011-2012 Residential Building Stock Assessment data.[14,15]

[14] Northwest Energy Efficiency Alliance. *2014–2015 Northwest Residential Lighting Long-Term Market Tracking Study.* Prepared by: DNV GL – Energy. REPORT #E15-320. August 20, 2015.

[15] Northwest Energy Efficiency Alliance. *Residential Building Stock Assessment: Metering Study*. Prepared by: Ecotope Inc. Report #E14-283. April 28, 2014.

Table 27. Lumen Bins for Standard Lamps and Lamp Quantities, from RTF v4.2

Lumen Range	W_{BASE}, By Bulb Type				
	Standard	Decorative	Globe	EISA-Exempt	Reflector
250–309	6.0	14.4	13.1	45.0	41.1
310–749	25.9	47.9	41.0	42.8	51.4
750–1,049	29.6	33.9	16.7	98.3	48.4
1,050–1,489	38.7	53.0	21.4	117.2	64.1
1,490–2,600	34.7	27.7	72.0	95.7	38.9

Overall, for a given lumen output, standard lamps possess a lower baseline wattage than reflectors, globes, or Energy Independence and Security Act (EISA)-exempt lamps.

ENERGY STAR Qualified Product List Analysis

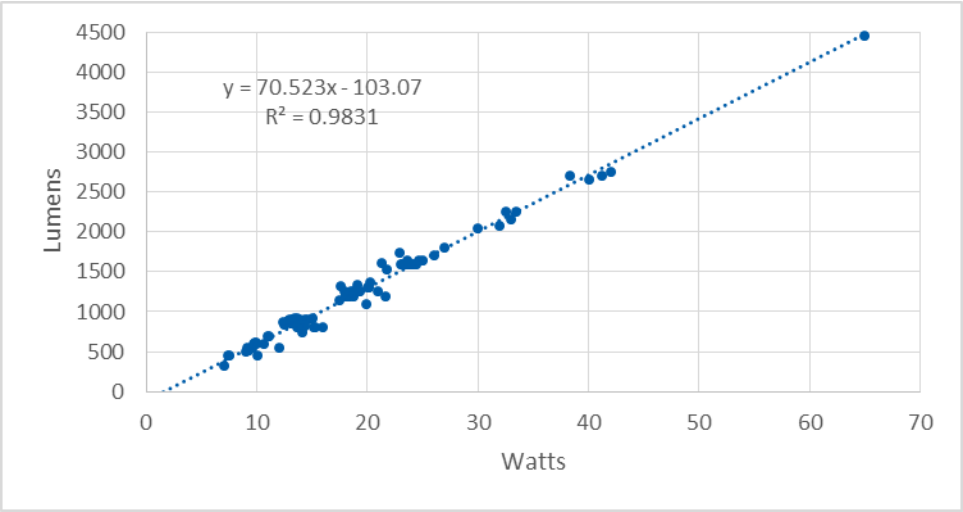
While all program bulbs had to be ENERGY STAR certified, 3% of bulbs by quantity did not match the compiled ENERGY STAR-qualified product list used by Cadmus. This does not imply the models are not ENERGY STAR certified; it only indicates these 198 models (out of 863) did not automatically match to the ENERGY STAR database. Further, the results involved quantities too low to justify looking up the models manually. To estimate these bulbs' lumen outputs, Cadmus created linear fits of lumens to wattage, based on the ENERGY STAR-qualified product list.

To determine relationships between CFL and LED wattages and lumen outputs, Cadmus used the ENERGY STAR-qualified bulb product lists, captured in October 2015 and October 2016.[16] The database consists of approximately 8,300 CFL products and 36,900 LED products, along with their associated wattages and lumens. The lumen outputs for a given lamp wattage varied significantly; for example, 90 CFL products rated for 20 watts had lumen outputs ranging from 1,000 to 1,367.

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 with model numbers not matched the ENERGY STAR-qualified lamp product list.

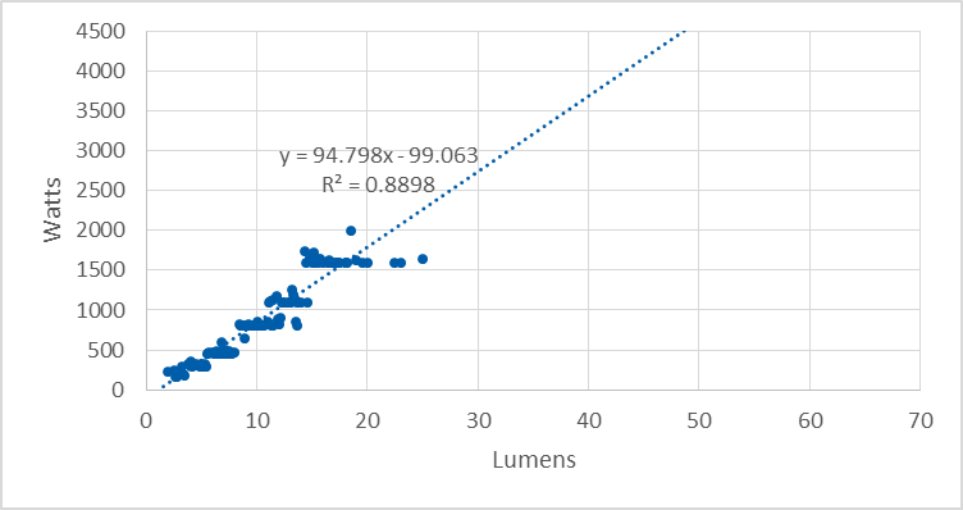
[16] The ENERGY STAR-qualified bulb list can be downloaded from ENERGY STAR's webpage: "Find and Compare Products." http://www.energystar.gov/productfinder/product/certified-light-bulbs/results.

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



In Figure 3, the same chart for LED standard lamps indicates an even wider spread of efficacies, though the average efficacy is clearly higher (based on the slope of the linear fit).

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



In total, the analysis employed six linear best-fit lines for LED and CFL standard, reflector, and specialty lamps (such as those shown in Figure 3). Cadmus also created two additional trend lines, drawn from ENERGY STAR's database for CFL and LED fixtures. Appendix B lists all trend lines employed.

Hours of Use

Cadmus used hours of use (HOU) values from the RTF v4.2 workbook, with values differing across bulb types and lumen bins, as shown in Table 28. All bulbs had a quantity-weighted average HOU value of 2.01 hours.

Table 28. HOU by Lamp Type and Lumen Range

Lumen Range	W_{BASE}, By Bulb Type				
	Standard	Decorative	Globe	EISA-Exempt	Reflector
250–309	1.90	1.96	1.33	1.70	2.42
310–749	1.83	2.04	1.33	1.73	2.42
750–1,049	1.94	2.06	1.37	1.88	2.54
1,050–1,489	2.11	2.02	1.56	2.33	2.86
1,490–2,600	2.05	1.44	2.09	2.28	3.17

Waste Heat Factor

Cadmus used WHF values from the RTF v4.2 workbook, which differed across bulb types and lumen bins, as shown in Table 29. Across 2015 and 2016, all bulbs had a quantity-weighted average WHF value of 0.934.

Table 29. WHF by Lamp Type and Lumen Range

Lumen Range	W_{BASE}, By Bulb Type				
	Standard	Decorative	Globe	EISA-Exempt	Reflector
250–309	0.933	0.927	0.924	0.924	0.929
310–749	0.930	0.928	0.925	0.924	0.928
750–1,049	0.934	0.931	0.926	0.924	0.933
1,050–1,489	0.938	0.929	0.927	0.924	0.947
1,490–2,600	0.940	0.928	0.935	0.924	0.977

In-Service Rate

Cadmus conducted general population surveys to calculate ISRs, with surveys asking 250 respondents if they installed or stored purchased bulbs. Using the 2015–2016 survey for LED bulbs resulted in a 77.7% ISR; and using the 2013–2014 survey for CFL bulbs resulted in a 70.5% ISR. The CFL and LED Bulb ISRs section of this report provides a detailed discussion of ISR calculation methods.

CFL and LED Bulbs Total Savings

Table 30 shows reported and evaluated savings inputs and input sources for CFL bulbs, along with reported and evaluated energy savings per unit (UES). Cadmus determined evaluated savings and inputs using assumptions provided by Pacific Power and using information drawn from the tracking database. Reported savings, inputs, and sources varied widely across and within the bulb categories and years. Therefore, all reported values in Table 30 represent weighted averages, and the displayed weighted average inputs do not precisely produce the average reported UES. The same holds true for all evaluated inputs, except ISR (i.e., 70.5% for all CFL bulbs). The table's far-right column shows the fraction produced by dividing the evaluated savings or input by the reported savings or input. As such, its value for UES is the realization rate for CFL bulbs. The value also functions as an approximate "partial realization rate" for each of the other inputs—WHF, HOU, and ISR.

Table 30. 2015–2016 Reported and Evaluated CFL Bulb Savings and Inputs

Input[1]	Reported		Evaluated		Evaluated/ Reported
	Value	Source	Value	Source	
UES (kWh/bulb)	15.57	Tracking database	7.58	Tracking database	49%
W_{EFF}	15.7	65%: Standard lamps, from RTF v2.2[2] 17%: Standard lamps, from RTF v4.0[3] 13%: Specialty lamps, from RTF v1.3[4] 5%: Specialty lamps, from RTF v4.0[3] Generally, single weighted-average values were used from each RTF source	15.9		101%
W_{BASE}	51.7		31.7	RTF v4.2 Values used were binned for each model based on bulb type and lumens	61%
ΔWatts (W)	35.0		15.8		45%
WHF	0.876		0.935		107%
HOU (hr/day)	2.04		1.98		97%
ISR	67.8%		70.5%	2013-2014 upstream lighting survey	104%

[1]Weighted average values
[2]Regional Technical Forum. "Residential Lighting." ResCFLLighting_v2_2.xlsm. July 3, 2012. Available online: https://rtf.nwcouncil.org/measure/residential-lighting
[3]Regional Technical Forum. "Residential Lighting." ResLighting_Bulbs_v4_0.xlsm. Aug 28, 2015. Available online: https://rtf.nwcouncil.org/measure/residential-lighting
[4] Regional Technical Forum. "Residential Lighting." ResSpecialtyCFL_v1_3.xlsm. Dec 11, 2012. Available online: https://rtf.nwcouncil.org/measure/residential-lighting

These weighted average input values were used to identify general drivers of differences between evaluated and reported CFL savings. CFL bulbs achieved a 49% overall realization rate, as shown in the Evaluated/Reported column for UES. Delta watts serves as the main driver of this, with evaluated delta watts equaling only 45% of reported delta watts and the majority of that difference driven by a difference in average W_{BASE}. Other evaluated inputs remained close to reported inputs, varying between 97% and 107%.

To explain differences in W_{BASE}, Cadmus examined reported and evaluated sources for W_{BASE}. Pacific Power updated their reported lighting UES in January of 2015 and again in January of 2016, based on the latest RTF measure workbooks available in mid-2013 and 2015, respectively. Consequently, reported W_{BASE} values during the 2015-2016 evaluation period used one of the three RTF workbook versions cited in Table 30. A majority of CFL bulbs (65%) used RTF workbook v2.2 for reported savings. This was the latest CFL lighting workbook available in mid-2013. The workbook appears to obtain a market baseline and average efficient wattage from a 2010 CPUC report.[17] Evaluated delta watts, however, used RTF workbook version 4.2, which employs more recent 2014 data to produce a market baseline much lower than that from RTF workbook v2.2. The RTF version 1.3 W_{BASE} value (used for 13% of specialty CFLs) is also higher than the average evaluated value. This was the latest specialty CFL lighting workbook available in mid-2013. While the W_{BASE} value drawn from the RTF v4.0 workbook actually was slightly

[17] KEMA, Inc. *Final Evaluation Report: Upstream Lighting Program, Volume 1*. February 8th, 2010. Available online: http://www.energydataweb.com/cpucfiles/18/finalupstreamlightingevaluationreport_2.pdf

lower than the average evaluated value,[18] Cadmus used this workbook only to produce reported savings for 23% of CFL bulbs. Therefore, the main driver for CFL bulbs' very low realization rates is a significant difference in baseline wattages between RTF v4.2 and the older RTF workbook versions used to derive most reported savings.

Table 31 shows reported and evaluated savings inputs and input sources for LED lamps. The table provides all UES values and inputs representing weighted averages, except for the evaluated ISR. As shown, Table 31 indicates that the two biggest contributors to LEDs' 74% realization rate were differences in delta watts and ISRs.

Table 31. 2015–2016 Reported and Evaluated LED Bulb Savings and Inputs

Input	Reported		Evaluated		Evaluated/ Reported
	Value	Source	Value	Source	
UES (kWh/bulb)	18.18	Tracking database	13.52	Cadmus analysis	74%
W_{EFF}	11.3	37%: Standard lamps, from RTF v2.12** 29%: Standard lamps, from RTF v4.0 21%: Specialty lamps, from RTF v2.12 13%: Specialty lamps, from RTF v4.0	9.7	RTF v4.2	85%
W_{BASE}	39.3		33.8		86%
Watts (W)	28.0		24.1		86%
WHF	0.895		0.932		104%
HOU (hr/day)	2.03		2.04		101%
ISR	100%		77.7%	15/16 general population survey	78%

*Input and UES values represent weighted averages, except for evaluated ISRs.

**Regional Technical Forum. "Residential Lighting." ResLightingLED_v2_12.xlsm. Aug 26, 2013. Available online: https://rtf.nwcouncil.org/measure/residential-lighting

As with CFLs, the reported W_{BASE} and delta watts values from RTF v4.0 actually ran slightly lower than the average evaluated values, which are based on RTF workbook v4.2. This slightly drove up realization rates for these lamps, which make up only 42% of LED bulbs. The delta watts difference arose chiefly from the 58% of LED bulbs' derived W_{BASE} from RTF workbook v2.12. Dating from 2013, the workbook version—as with v1.3 and v2.2—derived its W_{BASE} from older datasets.

The 77.7% evaluated ISR value, as discussed above, is based on the 2015–2016 General Population Survey conducted by Cadmus. In contrast, reported savings values derived from RTF workbooks v2.12 and v4.0 assumed a 100% ISR.

[18] This does not necessarily mean that market W_{BASE} rose between these workbooks, but it likely indicates differently applied RTF W_{BASE} values; reported W_{BASE} is a single population-weighted value, derived from the RTF v4.0 bins for type and lumens, while evaluated W_{BASE} is set for each bulb model, based on bulb types and lumens (per RTF v4.2).

Table 32 provides evaluated CFL and LED quantities, evaluated savings, and realization rates by bulb types. While CFLs actually exhibited high realization rates for decorative, EISA-exempt, and reflector lamps, these lamps made up a small minority of the market. Overall, standard lamps drove CFL realization rates, with a 47% realization rate (as discussed above, chiefly driven by differences in delta watts due to different RTF versions referenced). Overall, CFLs exhibited a 49% realization rate. The overall, 74% LED realization rate was driven by differences in delta watts and ISRs. The program achieved a 61% overall upstream lighting realization rate.

Table 32. 2015–2016 Evaluated and Reported HES Program CFL and LED Savings (kWh)

Bulb Type	Reported		Evaluated		Realization Rate		
	CFL	LED	CFL	LED	CFL	LED	Overall
Standard	4,780,530	2,842,387	2,227,672	1,785,135	47%	63%	53%
Decorative	8,369	466,120	9,038	135,646	108%	29%	30%
Globe	15,089	262,853	5,275	110,815	35%	42%	42%
EISA-Exempt	2,125	1,370	4,313	2,256	203%	165%	188%
Reflector	133,518	1,327,424	159,204	1,610,668	119%	121%	121%
Overall	**4,939,630**	**4,900,155**	**2,405,501**	**3,644,520**	**49%**	**74%**	**61%**

Light Fixtures

During the 2015–2016 program period, Pacific Power provided incentives for 39,933 ENERGY STAR light fixtures, representing 7% of reported program savings. As with the 2013–2014 evaluation period, Cadmus grouped and analyzed savings for fixtures within three categories:

- Downlight fixtures
- Fluorescent fixtures
- Miscellaneous fixtures

Downlights contributed 74.1% of fixtures, fluorescents contributed 0.02% of fixtures (nine fixtures total), and miscellaneous fixtures contributed 25.6% of program fixtures by quantity (0.3% were unidentifiable). Generally, Cadmus used the same methodology to calculate fixture savings as that employed for light bulbs, though the three fixture types required slight variations in their energy savings calculations. Again, the lighting saving evaluation used the following general equation:

$$\text{Evaluated Per Unit Savings (kWh per unit)} = \frac{\Delta\text{Watts}*\text{ISR}*\text{HOU}*365.25*\text{WHF}}{1{,}000}$$

To calculate various light fixture component inputs, Cadmus conducted the primary and secondary data collection activities shown in Table 33.

Table 33. Light Fixture Evaluated Savings Activities and Results

Savings Variables	Activity	Mean Value
ΔWatts	Downlights and Miscellaneous: RTF v4.2 Fluorescents: RTF delta watts	39.8*
ISR	2013-2014 Non-lighting participant survey	100%
HOU	RTF v4.2	2.46*
WHF	RTF v4.2	0.936*

*Weighted average for all fixtures.

Cadmus applied the same HOU and WHF approach used in the CFL and LED bulb analysis. Lighting fixture incentives were primarily administered upstream, so Cadmus could not verify fixture ISRs through participant surveys and the quantity of fixtures incented limited the opportunity to verify an ISR through the general population survey. Therefore, Cadmus used a 100% ISR based on the previous evaluations of HES program in Washington.[19] For delta watts, Cadmus conducted an RTF v4.2 lumens equivalence approach whenever possible (and when appropriate for the fixture type), as addressed by the detailed discussion of delta watts calculations, following for each fixture category.

Downlight Fixtures

Figure 4 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. The report used lumen bins presented in the RTF workbook v4.2, with reflector lamp types applied to downlight fixtures.

Figure 4. Example of a Downlight Fixture

[19] Cadmus. *2013-2014 Washing Home Energy Savings Program Evaluation.* December 21, 2016. Available at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2016/2013-2014_Pacific_Power_Washington_HES_Evaluation_Report.pdf

Fluorescent Fixtures

The Uniform Methods Project (UMP) did not specify a lumens equivalence approach for fluorescent lamps (0.02% of fixtures), and EISA legislation did not provide discrete lumen bins or baseline wattages for these such lamps. To calculate savings for the lamps, Cadmus applied a single delta watts value for all fluorescent lamps in the database.

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 for a 43-watts value for the same fixtures installed in garages.[20] As the installation locations for these fixtures was unknown, Cadmus applied a 42.5 delta watts value for all fluorescent lamp fixtures in the database, and applied the CFL values for ISRs.

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 consisted of single-lamp CFL fixtures, one-third consisted of two-lamp CFL fixtures, and one-third consisted of various LED fixtures. Cadmus applied the RTF v4.2 lumens equivalence approach in evaluating these fixtures, assuming they were standard lamps.

Unknown Fixtures

The database included 0.3% of fixtures falling within unknown categories. Of these, 14% had no model numbers in the database. The remainder could not be matched to the ENERGY STAR database. Consequently, Cadmus applied the weighted average UES for the downlight, fluorescent, and miscellaneous fixture categories.

Lighting Fixture Findings

In 2015–2016, the HES program provided incentives for 39,933 light fixtures. Table 34 provides lamp quantities, savings, and realization rates by fixture type for 2015–2016. Miscellaneous fixtures have savings that are far below downlight fixtures. This results from miscellaneous and downlight fixtures following HOU and W_{BASE} values for standard and reflector lamps, respectively. Table 28 shows that reflector HOU values are slightly higher than standard HOU values, and Table 27 shows that reflector W_{BASE} values are much higher than standard W_{BASE} values.

[20] 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

Table 34. 2013–2014 Light Fixture Quantity and Evaluated Savings

Fixture Category	CFL/ LED	Quantity	Reported Savings (kWh)	Evaluated Savings (kWh)	Reported UES (kWh/unit)*	Evaluated UES (kWh/unit)*	Realization Rate
Downlight	CFL	9	441	303	49.0	33.6	69%
	LED	29,572	917,689	1,068,978	31.0	36.1	116%
Fluorescent	N/A	9	441	269	49.0	29.9	61%
Miscellaneous	LED	234	11,466	2,996	49.0	12.8	26%
	CFL	9,995	326,958	114,139	32.7	11.4	35%
Unknown	N/A	114	4,524	1,859	39.7	16.3	41%
Total		**39,933**	**1,261,519**	**1,188,543**	**31.6**	**29.8**	**94%**
* Weighted averages							

Pacific Power updated their reported lighting UES in January of 2015 and again in January of 2016, based on the latest RTF measure workbooks available in mid-2013 and 2015, respectively. All CFL fixtures and 2015 LED fixtures, comprising 41% of program fixtures, have a single reported UES value of 49.0 kWh. This is also true for 6.5% of LED fixtures in 2016. This is the designated RTF workbook v2.2 savings for an ENERGY STAR fixture, with delta watts from various studies dating from 2010 through 2013. This workbook assumes that each fixture has two bulbs, resulting in a delta watts value of 81.3W—over 2.3 times the evaluated delta watts value. Reported and evaluated values for HOU, ISR, and WHF generally align more with fixtures using this 49.0 kWh UES value.

The remaining fixtures, all LEDs from 2016 and comprising 52.5% of the total, have a reported UES value of 15.81 kWh. According to the deemed savings assumptions workbook, this value is derived from RTF v4.0 and represents a weighted average for general purpose and specialty bulbs, multiplied by a factor of 1.125. However, the derivation of the weighted average and the source for the factor of 1.125 are unclear.

wattsmart Starter Kits

Pacific Power's HES program includes eight varieties of ***watt***smart Starter Kits. These contain unique combinations of 13-watt CFLs, 10-watt LEDs, kitchen aerators, bathroom aerators, and showerheads. Table 35 shows the components in the eight kits available for 2015 and 2016.

Table 35. 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 kits provided 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):[21]

$$\Delta\text{kWh} = \left(\frac{W_{Base} - W_{EE}}{1{,}000}\right) * ISR * HOU * (1 + WHF)$$

Table 36 defines key variables in the above equation and provides values used in the evaluation and sources for these values.

[21] 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 36. *watt*smart Starter Kit Lighting Key Variables and Assumptions

Parameter	Definition	CFL	LED	Unit	Source(s)
W_{Base}	Baseline wattage	33.9	33.9	W	RTF v4.2 market baseline, values used were binned for each model based on bulb type and lumens*
W_{EE}	Measure wattage	13.0	10.5	W	Program materials
ISR	In-service rate	83.9	90.0	%	2015–2016 kit participant surveys (n= 63 - CFL, 71 - LED)
HOU	Hours of use	708	708	$\frac{hours}{year}$	RTF*
WHF	Waste heat factor	-0.066	-0.066		RTF*
ΔkWh	**Energy Savings**	**11.6**	**13.9**	$\frac{kWh}{year}$	**Calculated**

*Regional Technical Forum. "Residential Lighting." ResLighting_Bulbs_v4_2.xlsx. Jan. 21, 2016. Available online: https://rtf.nwcouncil.org/measure/residential-lighting

Pacific Power based its CFL reported savings inputs for HOU (694 hours), ISR (64%), WHF (0.850), and baseline and efficient wattages (57.8 W and 17.2 W, respectively) on the RTF Residential CFL Lighting Workbook version 2.2.[22] Pacific Power based its LED reported savings inputs for HOU (694 hours), ISR (100%), WHF (0.850), and baseline and efficient wattages (57.8 W and 17.2 W, respectively) on the RTF Residential LED Lighting Workbook version 3.0.[23] Cadmus based its evaluated savings inputs for baseline wattage, HOU, and WHF on RTF Residential Lighting Workbook version 4.2.[24] It developed distinct ISRs for CFLs and LEDs based on kit participant survey results.

Table 37 compares ***watt***smart Starter Kit lighting measure ISRs from 2015 and 2016 to those from 2013 and 2014, producing very consistent results.

Table 37. Kit Lighting Measure ISRs by Program Year

Program Years	CFL ISR	LED ISR
2013–2014	85%	90%
2015–2016	84%	90%

Table 38 shows reported and evaluated savings for each bulb type, along with realization rates.

[22] Regional Technical Forum. "Residential CFL Lighting." ResCFLLighting_v2_2.xlsm. July 3, 2012. Available online: https://rtf.nwcouncil.org/measure/residential-lighting

[23] Regional Technical Forum. "Residential LED Lighting." ResLightingLED_v3_0.xlsm. Oct. 22, 2013. Available online: https://rtf.nwcouncil.org/measure/residential-lighting

[24] Regional Technical Forum. "Residential Lighting." ResLighting_Bulbs_v4_2.xlsm. Jan. 21, 2016. Available online: https://rtf.nwcouncil.org/measure/residential-lighting

Table 38. Kit Lighting per Unit Reported and Evaluated Savings

Bulb Type	Reported Savings Per Unit (kWh)	Evaluated Savings Per Unit (kWh)	Realization Rate
CFL	15.0	11.6	77%
LED	15.8	13.9	88%

CFLs and LEDs fell short of achieving 100% of reported savings primarily because of significantly smaller evaluated delta watts (23.4 W and 20.9 W, respectively) compared to reported (40.6 W). CFLs and LEDs also achieved lower realization rates in 2015 and 2016 (77% and 88%, respectively) than in 2013 and 2014 (103% and 113%) because of lower baseline wattages in 2015–2016 than in 2013–2014 (43.0 W, based on the lumens equivalence method).

Kit Aerators

Cadmus evaluated faucet aerator electric savings using the following equation:

$$\Delta kWh = ISR * (GPM_{Base} - GPM_{EE}) * MPD * 365.25 * \frac{PH}{FH} * (T_{Mix} - T_{In}) * \frac{8.345}{RE * 3{,}412.14} * \%DHW$$

Table 39 defines the equation's key variables and provides values used in the analysis, along with sources for these values. The RTF does not provide savings estimates for faucet aerators, thus Cadmus based savings on other sources.

Table 39. *watt*smart Starter Kit Aerator Key Variables and Assumptions

Parameter	Definition	Kitchen Aerator	Bathroom Aerator	Unit	Source(s)*
ISR	In-service rate	64.7	61.9	%	2015–2016 kit participant survey (n=116 - kitchen, 113 - bathroom)
GPM_{Base}	Baseline flow rate	2.20	2.20	$\frac{gal}{min}$	Federal rated maximum flow rate (10CFR430.32) (DOE 1998)
GPM_{EE}	Measure flow rate	1.5	0.5	$\frac{gal}{min}$	Program materials
MPD	Minutes of use per person per day	4.5	1.6		2013 Cadmus Study**
PH	People per household	2.99	2.99		2015–2016 kit participant survey (n=136)
FH	Faucets per household	1	2.06		Bathroom: 2015–2016 kit participant survey (n=138). Kitchen: One per household.
T_{Mix}	Usage water temperature	93	86	$°F$	2013 Cadmus Study**
T_{In}	Inlet water temperature	62.66	62.66	$°F$	DOE Hot Water Scheduler, 2016 U.S. Census Bureau
RE	Recovery efficiency of electric water heater	98	98	%	NREL, "Building America Research Benchmark Definition"***
$\%DHW$	Households with electric hot water	93.4	93.4	%	2015–2016 kit participant survey (n=126)
ΔkWh	**Energy Savings**	**156.8**	**48.4**	$\frac{kWh}{year}$	**Calculated**

*Survey results reflect averages only for those receiving water-saving measures.

**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

Pacific Power derived several reported savings values for kit aerators from a 2013 Cadmus potential study.[25] The calculations assume kitchen and bathroom faucet aerators are used identically in terms of annual HOU. Pacific Power derived its ISR (76%), which is higher than Cadmus' values (65% for kitchen

[25] 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.

aerators, 62% for bathroom aerators), from RTF Residential DHW Showerhead RTF workbook version 2.1.[26] It also derived its percentage of homes with electric hot water (64%) from the RTF workbook.

For its evaluated savings values, Cadmus assumed a baseline flow rate of 2.2 GPM specified by the Department of Energy (DOE). It derived values for people per household and fixtures per household (for bathroom aerators) from its 2015–2016 kit participant survey. Cadmus only assigned energy savings to the 93% of households with electric water heaters. It calculated the change in water temperature using calculations from a 2013 Cadmus metering study[27] and data from the Census Bureau and the DOE's hot water scheduler.

Table 40 shows reported and evaluated savings for each aerator type, along with realization rates.

Table 40. Kit Kitchen and Bathroom Aerator per Unit Reported and Evaluated Savings

Kit Product	Reported Savings Per Unit (kWh)	Evaluated Savings Per Unit (kWh)	Realization Rate
Kitchen Aerator	11.1	156.8	1,419%
Bathroom Aerator	26.8	48.4	181%

Realization rates remained steady for kitchen aerators (1,419%, up from 1,354% in 2013–2014) and bathroom aerators (181%, down slightly from 184% in 2013–2014) primarily due to larger reported average household sizes and smaller reported average numbers of bathroom faucets per household. Each kit aerator product produced discrepant realization rates most likely because of very different assumptions in the reported and evaluated savings calculations, such as those for water temperature difference (75°F versus 62.7°F) and percentage of homes with electric water heat (64% versus 93%).

The Pacific Power reported kitchen aerator savings were developed using a different methodology than the one used in this evaluation. The reported savings are based on whole house savings estimates from a 2013 Cadmus potential study,[28] where all faucets (bathrooms and kitchen) are replaced with 1.5 GPM aerators (the deemed savings workbook divides the whole house savings by the average number of faucets per home, and applies a realization rate). Averaging savings between kitchen and bathroom aerators underestimates kitchen aerator savings, since kitchen faucets have higher daily use and average outlet water temperature.

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[26] Regional Technical Forum. "Residential: DHW – Showerheads." ResShowerheads_v2_1.xlsm. July 12, 2011. Available online: https://rtf.nwcouncil.org/measure/showerheads

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

Additionally, neither the evaluated nor the reported kitchen aerator savings account for a drain factor, the percentage of kitchen faucet flow that fills a fixed volume (e.g. the kitchen sink). If the faucet is used to fill a sink, a faucet aerator will not result in water or electrical energy savings. Available drain factor estimates of 25% to 50% are based on professional judgement and thus not included in the evaluation analysis. The evaluated kitchen aerator savings are overestimating the savings due to not accounting for a drain factor.

Kit Showerheads

Cadmus evaluated showerhead electric savings using the following equation:

$$\Delta kWh = (GPM_{Base} * MPS_{Base} - GPM_{EE} * MPS_{EE}) * EV * \frac{PH}{SH} * \Delta T * \frac{8.345}{RE * 3{,}412.14} * ISR * \%DWH$$

Table 41 defines the equation's key variables, and provides values used in the analysis, along with the sources for these values.

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

Parameter	Definition	Value	Unit	Source(s)
MPS_{Base}	Baseline shower duration	7.4	$\frac{min}{shower}$	RTF: Aquacraft study
MPS_{EE}	Measure shower duration	9.2	$\frac{min}{shower}$	RTF: Aquacraft study
GPM_{Base}	Baseline flow rate*	2.3	$\frac{gal}{min}$	RTF**: RBSA (2011) - *In situ* flow rate
GPM_{EE}	Efficient flow rate	1.5	$\frac{gal}{min}$	Program materials
EV	Showers per person per year	250		RTF: EPA New Homes study (2011)
PH	People per household	2.99		2015–2016 kit participant survey (n=136)
SH	Showerheads per household	1.84		2015–2016 kit participant survey (n=137)
ΔT	Water temperature increase from inlet to use	52.5	$°F$	RTF: LBNL data
RE	Recovery efficiency	98	%	RTF: constant
ISR	In-service rate	60.9	%	2015–2016 kit participant survey (n=121)
$\%DHW$	Households with electric hot water	93.4	%	2015–2016 kit participant survey (n=126)
ΔkWh	**Energy Savings**	**94.1**	**$\frac{kWh}{year}$**	**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.

** Regional Technical Forum. *Residential: DHW – Showerheads Measure Workbook*. Version 3.1. Nov. 11, 2016. Available online: https://rtf.nwcouncil.org/measure/showerheads-0

Pacific Power based its reported savings values, including people per household (2.51), showers per person per year (193), percentage of homes with electric water heat (64%), ISR (76%), and difference

between usage and inlet water temperatures (75°F), on the RTF Residential DHW Showerhead RTF workbook version 2.1.[29]

Cadmus based its evaluated values on people per household, showerheads per household, and percentage of homes with electric hot water from its kit participants surveys, baseline flow rate from DOE, and the number of shower events per person per year and water temperature change from a 2013 Cadmus metering study.

Table 42 shows reported and evaluated savings for kit showerheads, along with realization rates.

Table 42. Kit Showerhead per Unit Reported and Evaluated Savings

Kit Product	Reported Savings Per Unit (kWh)	Evaluated Savings Per Unit (kWh)	Realization Rate
Showerhead	170.0	94.1	55%

The realization rates for kit showerheads fell by roughly half from 2013–14 (110%) to 2015–16 (55%). The overall method of evaluation changed from RTF Residential DHW Showerhead RTF workbook version 2.2, used in the 2013–14 evaluation, to RTF Residential DHW Showerhead RTF workbook version 3.1. The assumptions changed as well; 2015–16 inputs for temperature difference, showers per person per year, and percentage of homes with electric hot water decreased from 2013–14, and the RTF lengthened the shower time for efficient showerheads to account for lower water flow. The combination of all these changes resulted in a much lower realization rate than in the previous evaluation year.

Showerheads did not realize 100% of reported savings because of very different assumptions in the reported and evaluated savings calculations, such as those for ISR (61% reported versus 76% evaluated) and water temperature difference (75°F reported versus 52.5°F evaluated).

*watt*smart Starter Kit Summary

Using evaluated savings (shown above) for CFLs, LEDs, aerators, and showerheads, Cadmus calculated savings for each kit type. Table 43 shows the percentage of evaluated savings attributable to each kit product.

[29] Regional Technical Forum. "Residential: DHW – Showerheads." ResShowerheads_v2_1.xlsx. July 12, 2011. Available online: https://rtf.nwcouncil.org/measure/showerheads

Table 43. Percent of Evaluated Savings Attributable to each Kit Product

Kit Name	Percent of Kit Evaluated Savings				
	CFL Bulbs	LED Bulbs	Kitchen Aerators	Bathroom Aerators	Showerheads
Basic 1	13%	0%	45%	14%	27%
Basic 2	10%	0%	32%	20%	39%
Better 1	13%	0%	45%	14%	27%
Better 2	10%	0%	32%	20%	39%
Best 1	0%	16%	44%	14%	27%
Best 2	0%	11%	32%	19%	38%
CFL Only	100%	0%	0%	0%	0%
LED Only	0%	100%	0%	0%	0%

For all kits that included water-saving measures in addition to lighting, kitchen aerators accounted for the greatest share of evaluated savings, followed by showerheads.

For each of the eight ***watt***smart Starter Kit configurations, Table 44 shows quantities of each product making up the kits distributed in 2015 and 2016, reported and evaluated savings per kit, and realization rates.

Table 44. Products 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	2,937	268	346	129%
Basic 2	4	0	1	2	2	4,418	465	488	105%
Better 1	4	0	1	1	1	24	268	346	129%
Better 2	4	0	1	2	2	82	465	488	105%
Best 1	0	4	1	1	1	179	271	355	131%
Best 2	0	4	1	2	2	584	468	497	106%
CFL Only	4	0	0	0	0	1,389	60	46	77%
LED Only	0	4	0	0	0	133	63	56	88%
Total*	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**9,746**	**3,298,085**	**3,646,359**	**111%**

*Total kits distributed and savings achieved.

In 2015 and 2016, the overall program realization rate declined (i.e., 111%, down from 150% in 2013–2014), primarily due to substantially lower evaluated savings for showerheads, which were expected to achieve the most savings per unit among the five available kit measures.

Clothes Washers

Cadmus estimated clothes washer energy savings using version 5.4 of the RTF workbook for residential clothes washers.[30] Published on December 2, 2016, the RTF workbook compared energy consumption of efficient clothes washers to a market baseline. With the change in federal standards for energy efficient clothes washers in 2015, the Integrated Modified Energy Factor (IMEF) and Integrated Water Factor (IWF) replaced the tracked parameters of Modified Energy Factor (MEF) and Water Factor (WF) as best practices to estimate clothes washer energy consumption.

Cadmus used the ENERGY STAR Clothes Washer database to find IMEF and IWF for the evaluated clothes washers. Expected savings were expressed relative to efficient unit performance (divided into four performance tiers) and whether dryers or 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 324 average loads expected per year—a result 18% greater than that predicted by the RTF (273 average loads). This is an increase from previous evaluations, which estimated 293 loads per year in 2013–2014 and 283 loads per year in 2011–2012.

Cadmus estimated an average evaluated savings value of 140 kWh per unit, yielding a 109% realization rate for program years 2015–2016.

Cadmus estimated savings for each combination of domestic hot water (DHW) fuel and dryer fuel. If the DHW or dryer fuel were 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.

Table 45 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.

[30] RTF. "Residential: Appliances – Clothes Washers." ResClothesWashersSF_v5.4.xlsm. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=118

Table 45. Clothes Washer Savings by Performance Level and DWH/Dryer Fuel

Efficiency Level	MEF Low	MEF High	DHW Fuel	Dryer Fuel	Evaluated Quantity		Reported UES		Evaluated UES		Realization Rate*		Percentage of Reported Savings**	
					2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
CEE Tier 1	2.38	2.73	Electric	Electric	30	21	143	150	221	221	155%	147%	20%	15%
			Electric	Other	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
			Other	Electric	8	5	106	34	73	44	69%	130%	4%	2%
			Other	Other	1	0	8	n/a	-2	n/a	-31%	n/a	0%	0%
CEE Tier 2	2.74	2.91	Electric	Electric	82	68	72	76	87	87	122%	116%	56%	48%
			Electric	Other	0	2	n/a	42	n/a	48	n/a	114%	0%	1%
			Other	Electric	29	28	53	38	38	38	71%	99%	15%	10%
			Other	Other	6	3	8	8	-2	-2	-21%	-21%	0%	0%
CEE Tier 3	2.92	N/A	Electric	Electric	5	15	72	76	100	100	140%	132%	3%	11%
			Electric	Other	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
			Other	Electric	2	4	53	34	44	44	82%	130%	1%	1%
			Other	Other	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0%	0%
All Levels	2	N/A	Electric	Electric	117	104	143	152	165	174	130%	115%	80%	85%
			Electric	Other	0	2	n/a	84	n/a	96	n/a	114%	0%	1%
			Other	Electric	39	37	106	74	73	73	72%	99%	20%	14%
			Other	Other	7	3	16	16	-2	-2	-52%	-21%	1%	0%
Weighted Average* **					**163**	**146**	**129**	**128**	**136**	**144**	**106%**	**111%**	**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 and model numbers in the tracking data with no match in the Energy Star database.

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

As shown in Table 45, a clothes washer, paired with a non-electric dryer and a non-electric water heater, offered lower savings than a unit paired with an electric dryer and/or water heater. In 2015 and 2016, the tracking database indicated that units combining natural gas dryers and water heaters accounted for 4% 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 on an electric dryer and/or water heater.

Table 46 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 2013–2014 and 2015–2016 performance periods.

Table 46. Clothes Washer Percentage of Electric DHW and Dryer Fuel

Input Categories		2013–2014 Saturation of Fuel Types	2015–2016 Saturation of Fuel Types	Source
DHW Fuel	Electric	73%	74%	WA 2013–2014 and 2015–2016 Non-Lighting Tracking Databases
	Other	27%	26%	
Dryer Fuel	Electric	96%	96%	
	Other	4%	4%	

Heat Pumps

As Pacific Power offers incentives for several heat pump-related measures, Cadmus evaluated savings for these measures using the relevant RTF workbooks.[31] Table 47 shows measures incented by Pacific Power and the RTF workbooks used in this evaluation.

[31] 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 47. 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—PTCS Commissioning, Controls, and Sizing	[5]
Heat Pump, Ductless—Single-Family and Multifamily*	[3]
Heat Pump, Ductless—Manufactured Homes	[4]
Heat Pump, Ductless—New Homes	[3]
Heat Pump to Heat Pump Upgrade	Not Evaluated
Heat Pump to Heat Pump Upgrade—Manufactured Homes	Not Evaluated

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

[1] RTF. "Air Source Heat Pump Conversions SF." ResSFExistingHVAC_v4_1.xlsm. July 18, 2016. Available online: https://rtf.nwcouncil.org/measure/air-source-heat-pump-conversions-sf

[2] RTF. "Air Source Heat Pump Conversions MH." ResMHExistingHVAC_v3_4.xlsm. March 1, 2017. Available online: https://rtf.nwcouncil.org/measure/air-source-heat-pump-conversions-mh

[3] RTF. "Ductless Heat Pumps for Zonal Heat SF." ResSFExistingHVAC_V4_1.xlsm. July 18, 2016, Available online: https://rtf.nwcouncil.org/measure/ductless-heat-pumps-zonal-heat-sf

[4] RTF. "Ductless Heat Pumps for Zonal Heat MH." ResMHExistingZonalDHP_v2_1.xlsm. July 18, 2016. Available online: https://rtf.nwcouncil.org/measure/ductless-heat-pumps-zonal-heat-mh

[5]RTF. "Commissioning, Controls, and Sizing SF." ResHeatingCoolingCommissioningControlsSizingSF_v3_6.xlsx. December 2, 2016. Available online: https://rtf.nwcouncil.org/measure/commissioning-controls-sizing-sf

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. An estimated 48% of customers had central air conditioning prior to installing a heat pump. In addition, Cadmus surveyed both heat pump conversion and ductless heat pump customers about baseline heating systems. Ninety percent of heat pump conversion customers (19 out of 21) upgraded from electric forced air furnace, while 2 customers upgraded from zonal heating to heat pump. Eighty-two percent (14 out of 17) of customers with ductless heat pump measures upgraded from zonal heating, and 3 customers upgraded from electric forced air to a ductless heat pump. Cadmus used this breakdown of equipment as a baseline, proportionally applying the RTF-modeled savings for the baseline.

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

Table 48 shows the quantity of each heat pump measure incented in 2015 and 2016, reported and evaluated savings, and realization rates.

Table 48. 2015–2016 Reported and Evaluated Heat Pump Savings

Measure	Quantity 2015	Reported Per Unit Savings 2015	Evaluated Per Unit Savings 2015	Realization Rate 2015	Quantity 2016	Reported Per Unit Savings 2016	Evaluated Per Unit Savings 2016	Realization Rate 2016
Heat Pump System Conversion*	128	4,557	3,314	73%	142	6,310	3,110	49%
Ductless Heat Pump*	96	3,500	3,718	106%	243	2,774	3,667	132%
PTCS Commissioning, Controls, and Sizing	84	1,152	630	55%	39	831	929	112%
Weighted Average**	**308**			**82%**	**424**			**85%**

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 were based on EnergyGauge USA modeling, while evaluated savings were based on RTF workbooks. Across Heat Pump Conversion, 2016 reported savings were closer than evaluated savings than in 2015. For ductless and PTCS measures, however, 2016 Realization Rates were higher.

For the ductless heat pump measure, Pacific Power used 3,500 kWh per unit savings in 2015, but reduced and updated these savings in 2016 to reflect the variation in savings for multifamily, manufactured, new and existing homes. Since expected savings decreased in 2016, and Cadmus used the same savings values from the most updated RTF for both years, the realization rate increased from 106% in 2015 to 132% in 2016.

Heat Pump Water Heaters

Pacific Power offered incentives for several heat pump-related measures, and Cadmus evaluated savings for these measures using the relevant RTF workbooks. Table 49 shows measures incented by Pacific Power and RTF workbooks used in this evaluation.

Table 49. Heat Pump Water Heater Measure List and Evaluation Sources

Measure	Source
Heat Pump Water Heater	[1]
Heat Pump Water Heater—New Homes	[1]

[1] RTF. "Heat Pump Water Heaters." ResHPWH_v3_4.xlsx. April 5, 2017. Available online: https://rtf.nwcouncil.org/measure/hpwh

Whenever possible, Cadmus refined the RTF model by incorporating program or Washington-specific data. The RTF provided unique savings values for distinct heating and cooling zones, defined by average annual HDDs and CDDs. Cadmus used customer zip codes to map to specific heating and cooling

zones. In addition, Cadmus used the efficiency tiers in the Pacific Power tracking database to match to corresponding RTF savings values. The evaluation resulted in an 89% realization rate, as shown in Table 50.

Table 50. 2015–2016 Reported and Evaluated Heat Pump Water Heater Savings

Measure	Quantity 2015	Reported Per Unit Savings 2015	Evaluated Per Unit Savings 2015	Realization Rate 2015	Quantity 2016	Reported Per Unit Savings 2016	Evaluated Per Unit Savings 2016	Realization Rate 2016
Heat Pump Water Heater	42	1,324	1,171	88%	58	1,483	1,324	89%

Attic, Wall, and Floor Insulation

Cadmus conducted a billing analysis to assess evaluated energy savings associated with installations of insulation measures. While RTF workbooks are generally based on several assumptions to determine the savings, billing analysis uses customer data to produce the results that actually took place in Pacific Power's territory.

Cadmus used a pooled, conditional savings analysis (CSA) regression model, which involved two groups:

- 2015–2016 insulation participants (combined attic, wall, and floor insulation).
- Nonparticipant homes, serving as the comparison group

Cadmus used program participants, a control group, billing consumption, and Washington weather data specific to participants' zip codes to create a final database for conducting the billing analysis. This required matching participant program data, including 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 2014 (before measure installations occurred) and the post-period as June 2016 through May 2017.[32]

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

Insulation Results

Cadmus estimated average insulation savings of 2,027 kWh per participant, translating to a 162% evaluated realization rate for insulation measures. This analysis produced evaluated savings by comparing participant usage trends to a nonparticipant group, accounting for market conditions outside of the program.

[32] As participants installing measures in late 2016 had less than 10 months of post-period data, Cadmus removed them from the analysis. Similarly, Cadmus removed customers participating in 2015, but with measure installation dates before November 2014 (as this produced less than 10 months of pre-period data).

With an average participant pre-usage of 19,720 kWh, savings represented a 10% reduction in total energy usage from the insulation measures installed. Table 51 presents the overall evaluated savings estimate for wall, floor, and attic insulation.

Table 51. 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 *	**89**	**1,249**	**2,027**	**162%**	**±24%**	**123%–202%**
Electric Heat	66	1,668	2,479	149%	±27%	149%–258%
Electric Heat (HP)	44	1,681	2,028	121%	±33%	81%–160%
Electric Heat (Non-HP)	22	1,642	3,442	210%	±27%	154%–265%

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

Cadmus not only used overall model results (which included electric and gas heat) to determine measure-level evaluated savings, but to provide detailed results for electric space heating fuel, the presence of heat pumps, and homes without heat pumps. Overall, electrically heated homes achieved insulation savings of 2,479 kWh per home. The program expected average, electrically heated, insulation savings of 1,668 kWh, translating to a 149% realization rate. With average, electrically heated, participant pre-usage of 21,972 kWh, savings represented an 11% reduction in energy usage from insulation measures. Participants with heat-pumps achieved savings of 2,028 kWh (9%); those without heat pumps achieved 3,442 kWh (16%).

Separate results could not be estimated for gas heated homes due to the small sample size (n=23).

Duct Sealing and Insulation

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

- 2015–2016 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-

date periods. The process defined the billing analysis pre-period as 2014 (before measure installations occurred) and the post-period as June 2016 through May 2017.[33]

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

Duct Sealing and Insulation Results

Cadmus estimated overall duct sealing and duct insulation savings of 1,082 kWh per home. Expected average duct sealing and duct insulation savings equaled 1,645 kWh, translating to a 66% evaluated realization rate for duct sealing and insulation measures.

With average participant pre-usage of 16,434 kWh, savings represented a 7% reduction in total energy usage from duct sealing and duct insulation measures installed. Table 52 presents overall savings estimated for duct sealing and duct insulation.[34]

Table 52. 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*	**471**	**1,645**	**1,082**	**66%**	**±14%**	**57%–75%**
Electric Heat	467	1,659	1,085	65%	±14%	56%–75%
Electric Heat (HP)	62	2,320	2,106	91%	±19%	74%–108%
Electric Heat (Non-HP)	405	1,557	933	60%	±17%	50%–70%

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

Though only using overall Washington model results, Cadmus' results addressed electric heat, heat pump, and non-heat pump participants.

Overall, electrically heated homes achieved duct sealing and duct insulation savings of 1,085 kWh per home. Expected average, electrically heated, duct sealing, and duct insulation savings accrued 1,659 kWh, translating to a 65% evaluated realization rate. With average, electrically heated, participant pre-usage of 16,442 kWh, savings represented a 7% reduction in energy usage from duct sealing and duct insulation measures. Electrically heated participants' homes with heat-pumps achieved savings of 2,106 kWh (11%); those without heat pumps achieved 933 kWh (6%).

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[33] Because participants installing measures in late 2016 had less than 10 months of post-period data, Cadmus removed them from analysis. Similarly, Cadmus removed customers participating in 2015 if having measure installation dates before November 2014, as this produced less than 10 months of pre-period data.

[34] Appendix C includes the manufactured homes and single-family billing analysis results. The overall results presented here apply only to the multifamily duct-sealing measure.

Cadmus could not obtain a separate savings estimate for gas heated homes due to small sample sizes (n=4).

On-Site Insulation Inspections

Site visits conducted with insulation participants sought to evaluate the quality and quantity of Pacific Power-incented measures. Based on these visits, Cadmus concluded that claimed and verified square footages did not vary significantly or that installers underestimated or overestimated attic insulation R-Values.

Approach

To verify claimed insulation savings, Cadmus completed 11 site visits at homes receiving attic insulation, as shown in Table 53.

Table 53. 2015–2016 Attic Insulation Verification Sample

Insulation Type	Population	Verified Sample	Precision at 80% Confidence
Attic Insulation	178	11	±20

The site visits sought to accomplish the following:

- Verify that installed insulation square footage matched amounts claimed in the program administrator's tracking database; ensure the maximum incentive amount did not exceed the claimed incentive.[35]
- Confirm customers met HES insulation eligibility requirements:
  - The home was constructed before 2008.
  - The home had electric or gas heat, or a central air conditioning system or heat pump serving at least 80% of its floor area.
  - The home had preexisting wall insulation below R-10, with added wall insulation of R-11 or more.
  - The home had preexisting attic or floor insulation below R-18, with added attic or floor insulation of R-19 or more.[36]
- Check the installation quality of measure insulation, specifically verifying levels of attic insulation installed.

[35] The HES Insulation Incentive Application indicates participants can receive up to $0.35 per square foot of insulation installed.

[36] The existing attic insulation was verified by measuring the thickness of the bottom layer of insulation and corresponding the insulation type with thickness.

To verify attic insulation R-Values, field staff first visually identified insulation types for each insulation layer (e.g., loose-fill fiber glass, loose-fill rock wool, loose-fill cellulose, fiberglass batt, perlite, or polystyrene). Field staff then measured the average thickness of each layer, and calculated the corresponding R-Value, based on an assumed R-Value per inch for the given insulation type.[37]

Attic Insulation Findings

Claimed and Observed Insulation Square Footage

Based on data collected during the site visits, Cadmus calculated attic insulation square footage for each insulation type, comparing it to claimed square footage in the program administrator's database. The 11 attic insulation sites averaged 1,441 claimed square feet, but averaged 1,305 verified square feet—roughly a 135-square-foot (i.e., 10%) difference. At three of the 11 sites (30%), field staff observed measurable differences between claimed and verified square footage.

The average difference between claimed and verified square feet was 51 square feet with a standard deviation of 31 square feet. This small difference reflected two key points:

- Claimed and verified square footage were nearly identical for most of the sites (70%).
- At three sites, however, claimed square footage exceeded verified by an average of 268 square feet. At another three sites, verified square footage exceeded that claimed by over 100 square feet. When calculating the average difference for the entire sample, these differences largely offset each other.

Cadmus performed a difference-of-means t-test to check for statistically significant differences between reported and verified square footage. Table 54 shows the results.

Table 54. Reported and Verified Square Footage Difference of Means T-Test

	n	Average Claimed	Average Verified	Average Difference	Standard Deviation	t stat	p-value
Square Feet of Attic Insulation	11	1,441.2	1,354.6	86.54	26.11	1.048	0.32

As this test's p-value did not fall below 0.10, small observed differences could be attributed to random error.

Pacific Power allowed participants to receive incentives for attic insulation on a square-foot basis. Specifically, participants or contractors could receive incentives up to $0.35 per square foot of attic insulation installed. The statistically insignificant differences between claimed and verified attic insulation square footage indicated, on average, Pacific Power paid the correct incentive amounts.

[37] Cadmus used R-Values per inch assumptions consistent with Pacific Power's HES Insulation Calculator: http://homeenergysavings.net/Downloads/InsulationCalculator.pdf

Attic Insulation Qualification Requirements

To verify if participants met program qualification requirements, Cadmus verified heating fuels, cooling system types, home construction years, old insulation R-Values, and added insulation R-Values. Table 55 summarizes the percentage of eligible and ineligible participants.

Table 55. Attic Insulation Criteria*

Criteria	Evaluated	Percent	Confidence and Precision
Total Eligible	**11**	**100%**	**80%/±20%**
Could Not Verify	0	–	
Total Participants	**11**	**–**	**80%/±20%**

Claimed preexisting attic insulation R-Values averaged 1.8 greater than those verified. For added attic insulation, average claimed R-Values were R-4 less than verified. Table 56 shows average differences between claimed and verified, preexisting and added attic insulation R-Values.

Table 56. Average Differences between Claimed and Verified R-Values

R-Value For	n	Average Claimed R-Value	Average Verified R-Value	Average Difference	Standard Deviation	T Stat	p-value
Pre-Existing Attic Insulation	11	14.63	14.59	0.04	7.2	0.04	0.41
Added Attic Insulation	11	34.3	35.7	-1.38	10.2	0.45	0.56

Claimed and verified R-Values for preexisting and added insulation did not differ statistically. Contractors and participants accurately recorded preexisting attic insulation R-Values and R-Values for added insulation. Generally, reported R-Values were conservative, indicating contractors and participants did not exaggerate R-Values to qualify for the program.

Process Evaluation

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

- Effectiveness of the program design, marketing, and process
- Customer satisfaction and participation barriers
- HES upstream/midstream/downstream delivery channels vs. those used by other similar utility programs

Cadmus focused the research activities on key topics identified during the evaluation kick-off and on topics of interest identified by program stakeholders. Table 57 lists primary research questions used.

Table 57. Research Areas

Research Areas	Researchable Questions and Topics
Program status	How did the program perform in 2015–2016, 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 LEDs, APS, ***watt***smart Starter Kits, incented non-lighting measures, or contractors? Why?
Motivations/ Behaviors	What actions have customers taken to save energy, and what has motivated them to purchase a rebated LED, APS, ***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
- Manufactured Homes participant survey
- Benchmarking of selected program components

Program Materials Review

The program materials review concentrated on critical program documents, past evaluation reports, and the program logic model: [38]

- In assessing program progress and analyzing trends across program years, Cadmus considered the findings and conclusions from the *Pacific Power 2013–2014 Washington Residential Home Energy Savings Evaluation*
- Cadmus reviewed the HES program logic model and updated it to reflect the 2015–2016 program processes (see Appendix H)
- Cadmus reviewed Pacific Power's online materials and website, and compared messages conveyed to challenges and motivations described by customers

Utility and Administrator Staff Interviews

Cadmus developed stakeholder interview guides and collected information about key topics from program management staff. The evaluation involved four interviews: one with program staff at Pacific Power; and three 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
- Customer and trade ally experiences
- Barriers and areas for improvements
- Data tracking

Cadmus conducted the interviews by telephone, contacting interviewees via e-mail for follow-up questions or clarification requests, as needed.

Participant Surveys

Cadmus conducted telephone surveys with non-lighting participants, manufactured homes participants, 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 program processes
  - Program awareness
  - Participation motivations and barriers

[38] CLEAResult. ***watt****smart Homes—Program Manual*. Pacific Power. Updated June 2016. CLEAResult. *Home Energy Savings—Implementation Manual*. Pacific Power. Updated August 2015. ***watt****smart Homes 2015–2016 Marketing Activities* excel file provided by CLEAResult. Updated March 9, 2017.

- Behavior changes (manufactured homes participants)
- Customer satisfaction
- Program strengths and/or areas for improvements

- ***Customer information***. Demographic information and household statistics.

General Population Survey

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

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

Benchmarking

Cadmus, in conversation with Pacific Power, selected to benchmark the HES upstream/midstream/ downstream delivery channels and measures offered through each channel, against other similar utility programs across the country. Cadmus conducted this benchmarking utilizing the company's ESource data resource as well as a library of Cadmus' current and past utility program evaluations.

Program Implementation and Delivery

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

Program Overview

During the evaluation period, Pacific Power offered energy efficiency measures in three primary categories (e.g., lighting/APS, non-lighting, and ***watt***smart Starter Kits). The lighting/APS component used an upstream incentive mechanism with a discount applied at the point of sale, whereas the non-lighting component paid incentives post-purchase using mail-in or online incentive applications. In 2015, Pacific Power added APS to the program, initially offering it to customers in 2015 through the upstream channel. In November 2016, Pacific Power expanded the delivery channels for APS to include upstream, and also mail by request, direct install, and downstream.

Participants could order ***watt***smart Starter Kits through Pacific Power's website, with delivery by mail. Alternatively, the kits were offered as direct-install measures to manufactured home duct-sealing participants and multifamily properties. Pacific Power offered eight kit types, containing a mix of measures that depended on the participant's lighting preferences (i.e., CFLs or LEDs) and on whether the participant used an electric water heater. As LEDs have become more common and less expensive

nationwide, and due to of changing customer preferences for LEDs over CFLs, Pacific Power changed the kits' lighting component to LEDs only, effective December 31, 2016.

Pacific Power delivered the basic kit package—including four CFLs—at no cost to customers. If customers reported using an electric water heater, they qualified for water-savings measures (e.g., bath and kitchen faucet aerators, a high-efficiency showerhead). The 2015 and 2016 program offered a kit upgrade option from CFLs to LEDs for $4.99.

Measure and Eligibility Changes

HES program incentives or eligibility requirements did not change in 2015. In 2016, however, Pacific Power added new non-lighting measures, including the following:

- Smart thermostats
- Heat pump clothes dryers
- Heat pumps for manufactured homes

The program also removed measures with reduced savings or low consumer interest, including the following:

- Refrigerators
- Freezers
- Central AC

Pacific Power moved lighting fixtures from downstream to upstream incentives to simplify sales tracking; to simplify communications with customers, the company also made minor changes to program requirements and incentives, effective November 7, 2016.

Delivery Structure and Processes

In 2015, following a successful direct-install duct sealing pilot in 2014, CLEAResult partnered with a third-party trade ally to market direct-install duct sealing to owners of manufactured homes. Customers responded strongly, requiring CLEAResult to consider meeting the demand by extending the marketing opportunity to local trade allies in 2017. However, after reaching out to local trade allies, the program found it challenging to find trade allies to work within the program's established cost rates. The program continues to use a Utah-based trade ally, while searching for additional local trade ally partners.

Additionally, CLEAResult increased retailer support to expand product LED selection in response to the market shift from CFL to LED technologies and to raise awareness of the benefits and incentives offered by smart thermostats.

Pacific Power offered their midstream and upstream lighting incentives through retailers, identifying retailers using the Retail Sales Allocation Tool (RSAT), developed in partnership with Bonneville Power Administration. RSAT helped Pacific Power reduce sales of incentivized measures to people residing outside of the company's territory. The program administrator reported that the RSAT approach helped

the program reach customers in outlying areas, while also enabling the program to stop incentivizing measures as funds became exhausted for the year.

Data Tracking

Program Data

CLEAResult reported that it enters downstream rebate application data into the program's Key What You See (KWYS) system, a Microsoft Access-based tool that performs an auto check to ensure the applicant's eligibility and that all required information has been provided on the application. From KWYS, information transmits to Sprocket, a Salesforce database. Weekly, the program administrator pulls data from Sprocket into a DSM Central (DSMC) spreadsheet for invoicing. DSMC serves as Pacific Power's project management and reporting database.

Monthly, the program administrator provides Pacific Power with a snapshot of the program's actual performance compared to forecasts (a technique that Pacific Power reported as easy to use). In late 2016, the administrator began specifically addressing the program's quarterly progress toward goals, seeking to identify areas at risk of under-delivery or over-delivery, and to initiate more frequent program delivery strategy conservations to address these risks.

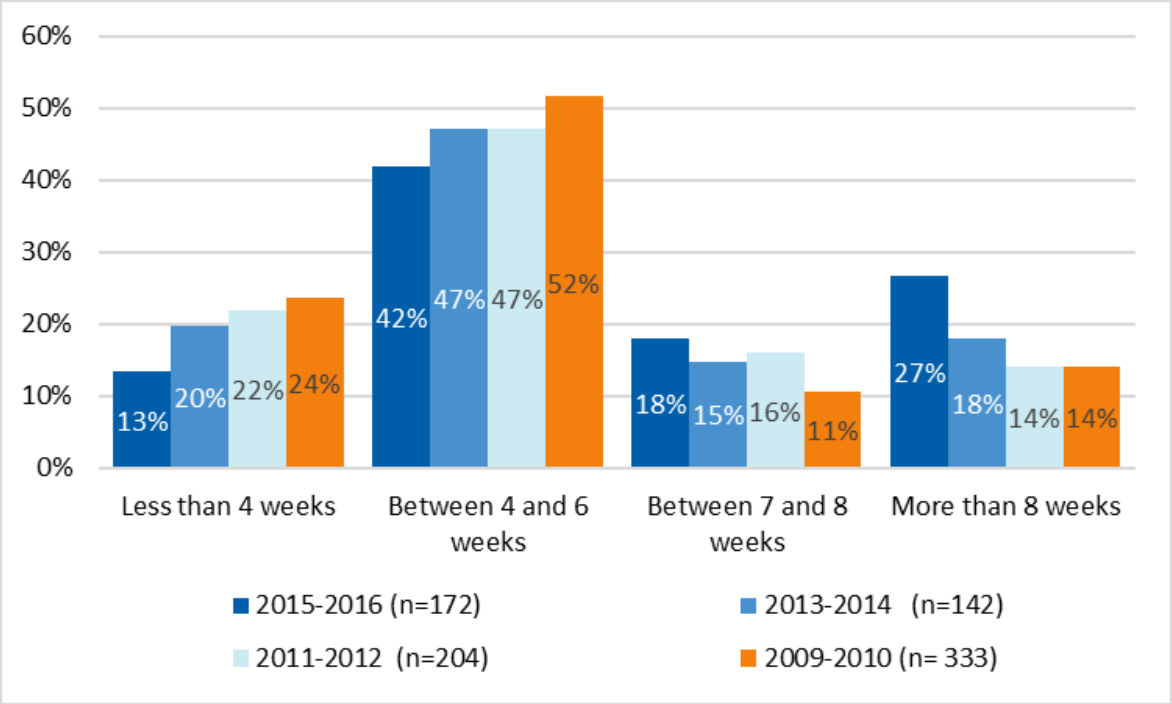
Application Processing

In 2016, CLEAResult expanded online applications to include smart thermostats, evaporative coolers, heat pumps, heat pump water heaters, and windows. These actions sought to streamline the submittal process and reduce missing information required to process the applications. Program staff, however, said customers still struggle to provide clear, legible images of their invoices. CLEAResult also launched an online portal in 2016, allowing customers to enter their account numbers and track the status of their applications and incentives.

Customers' reported times between application submission and incentive receipt varied somewhat from times reported in previous evaluation periods. As shown in Figure 5, in 2015–2016, customers receiving incentives in less than four weeks declined significantly, and those receiving incentives in more than eight weeks increased significantly.[39]

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

Figure 5. Time Between Non-Lighting Application Submission and Incentive Receipt (2009–2016)



Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A) (QE7 2015-2016, 2013-2014, QF6 2011-2012 and 2009-2010). Don't know and refused responses and, those who had not received the incentive at the time of the survey.

Regarding the time required to receive the incentive, 79% of non-lighting customers expressed satisfaction (compared to 87% in 2013–2014). Overall, 65% of non-lighting customers expressed high satisfaction rates (i.e., very satisfied) with the application process, and 30% said they were somewhat satisfied. These satisfaction levels resembled satisfaction levels in 2013–2014. The 5% reporting they were not very or not at all satisfied offered the following reasons:

- Having to resubmit rejected projects multiple times
- An overly confusing process that lacked explanations
- The time and "hassle" to go through the process

Retailers and Trade Allies

The program administrator continued its use of a tiered system for trade allies, reflecting savings delivered to the HES Program by a trade ally and the attention level provided by the administrator. At a minimum, Tier 1 trade allies—those delivering 80% of program savings—will receive monthly calls from the administrator. The administrator provides a full-time trade ally account manager and a staff person part-time to work with retailers in Washington.

The administrator also noted that, as the program moved more rebate applications online, trade allies reacted positively.

Marketing

Approach

In 2015–2016, the ***watt***smart program shifted resources toward marketing renewables and business solutions more than the residential market. HES, however, continued utilizing a variety of channels to communicate with customers, retailers, and trade allies. The administrator marketed the HES program using a combination of tactics, including bill inserts, Opower ads, and content in Pacific Power customer newsletters and social media channels. The administrator described the call-to-action for each tactic, is to visit the category or measure landing page on the HES website, enabling then to tie website sessions back to specific in-market activities.

In executing these tactics, the program followed several key marketing strategies, including the following:

- Focusing on priority measures during key seasonal selling windows (e.g., heating season, cooling season, lighting season)
- Promoting ***watt***smart Starter Kits throughout the year, using targeted customer communication, multiple communication channels, and including bill inserts in both Spanish and English
- Promoting specially priced ($5.00) LED bulb three-packs bulbs through participating Washington retailers (in April)

In 2015, the program also targeted the manufactured homes market through a free duct testing and duct sealing offer. In 2016, the program introduced the online Home Energy Advisor tool, a survey that allowed customers to visit the program website, quickly compare their home's energy usage to similar homes in their area, and receive savings estimates along with recommendations of incentivized measures to help them save energy.

Effectiveness

In the 2013-2014 program evaluation the program administrator's tracking of marketing effectiveness had only been in effect for a short time, and results were not reported. However for the 2015-2016 evaluation, the administrator provide a more comprehensive update, describing their tracking efforts including measuring web traffic to landing pages for the month in which a marketing tactic was deployed and comparing web traffic to prior and subsequent months to determine lift in traffic.

The administrator noted that "other Google Analytics, such as length of sessions and bounce rates are not particularly valuable metrics because of the reasons people use the website (quick information about rebates available and as a path to the online application website)."

As cited by the administrator and illustrated in Table 58, bill inserts were effective vehicles for building awareness of the incentives available and savings benefits from featured measures. Articles in Pacific Power newsletters and social media—which the administrator noted do not notably increase website traffic—were utilized to maintain baseline awareness of Pacific Power's energy efficiency offerings.

Table 58, illustrates several direct-to-customer tactics deployed by the program in 2015-2016 and the reported lift in visits to the website, as reported by the program administrator. Because customers purchased qualified products through retail outlets or contractors, the administrator could not make a direct link between program marketing to actual purchases and installations.

Table 58. Direct-to-Customer Marketing Tactics (2015-2016)

Tactic	Date	Lift
2015		
DHP and insulation bill insert	June, 2015	67%
Starter Kit bill insert	September, 2015	19%
LED bill insert, Opower LED Ad	April, 2015	98%
Kits Bill Insert	April, 2015	208%
2016		
Opower cooling ad	July, 2016	9%
Smart thermostat bill inset	February, 2016	38%
Cooling/DHP bill insert	June, 2016	91%

Source: Data included in this table was provided by CLEAResult, in response to follow-up question submitted by Cadmus. Response via email dated September, 20, 2017.

The administrator described the primary objective of the HES website is to drive customers toward applying online for incentives, adding they have seen a significant increase in the number of year-over-year visits to the application landing page (i.e., 1,131 visits in 2015, increasing to 6,026 in 2016).

Program Challenges and Successes

At the request of Pacific Power, the program administrator reached out to new homes energy raters to increase program engagement within the new homes market. The program engaged two raters; and processed 236 New Homes applications in 2016. The administrator also set up a formal process for builders to apply for new homes measures.

In 2015–2016, the program distributed more than 9,700 kits, compared to distributing more than 12,000 kits in 2013–2014. The difference resulted from phasing out CFLs from the kits and charging $4.99 for kits containing LEDs. The administrator worked with the kit vendor to lower this price; currently (2017), Pacific Power offers LED kits at no charge.

The program experienced significant delays in making some incentive payments in both 2015 and 2016, however these were more prevalent in 2016. Pacific Power and the program administrator cited multiple events that occurred in 2015-2016 which impacted their ability to process some payments, these included:

- Pacific Power's earlier migration to DSMC, which was still relatively new for both PacifiCorp and the program administrator staff
- Significant changes in the program in 2016, which required new configuration in DSMC

- Program administrator staff changes

According to the program administrator, investments have been made to insure staffing issues have been addressed.

Customer Response

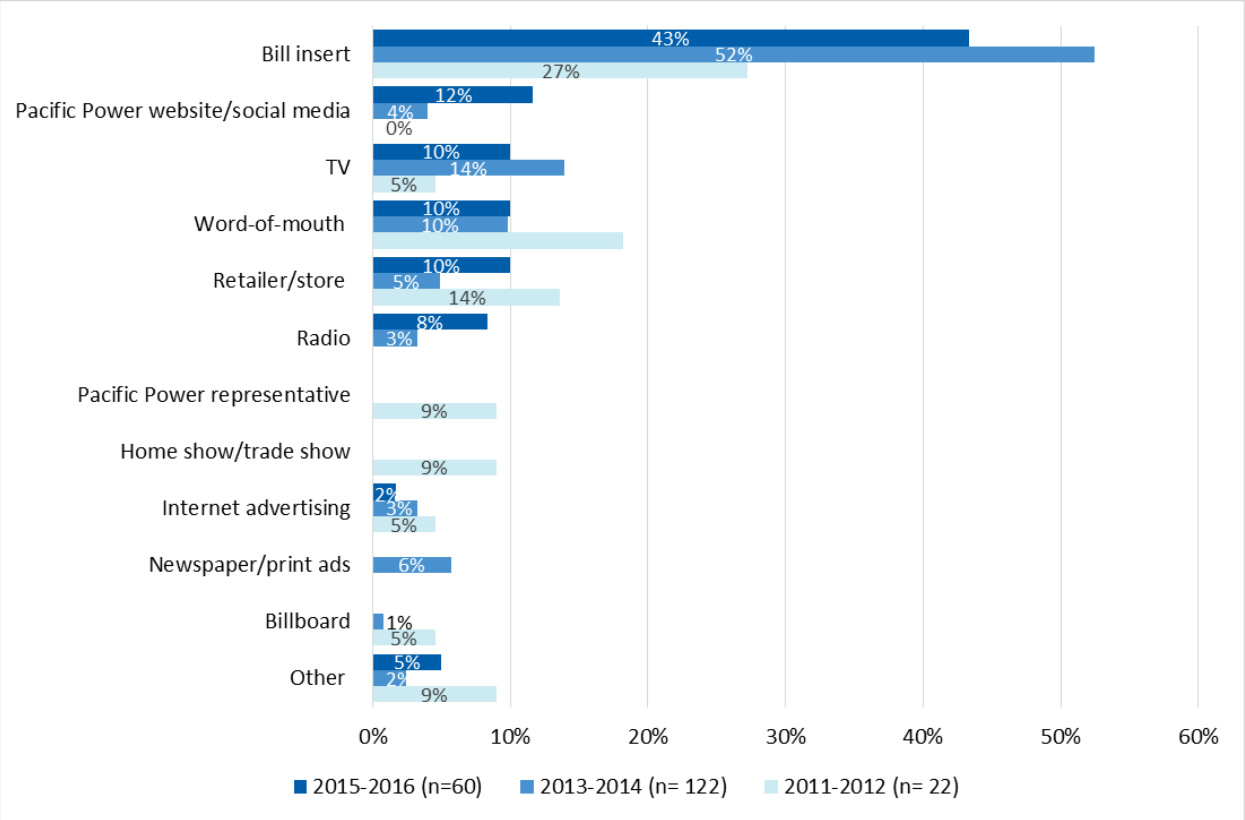
Awareness

Sixty-seven of 250 general population customers surveyed knew of the ***watt***smart HES program, learning of the program from a variety of sources. Of those recalling where they first learned about the program, 43% (n=60) cited reported bill inserts—the most frequently reported awareness source during the 2015–2016, 2013–2014, and 2011–2012 program periods. Customers also more commonly cited Pacific Power's website/ ***watt***smart Business website/social media as awareness sources than in prior evaluation periods.[40] "Other" responses included receiving a home energy report, and learning about the program at work or through their apartment building management.

The general population did not report frequent visits to the ***watt***smart website. Those visiting the site (n=14) found it very helpful or somewhat helpful, and said they were looking for incentives on specific equipment or were just curious about possible program changes. Figure 6 presents awareness sources from 2011 to 2016.

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

Figure 6. General Population Source of *watt*smart Awareness

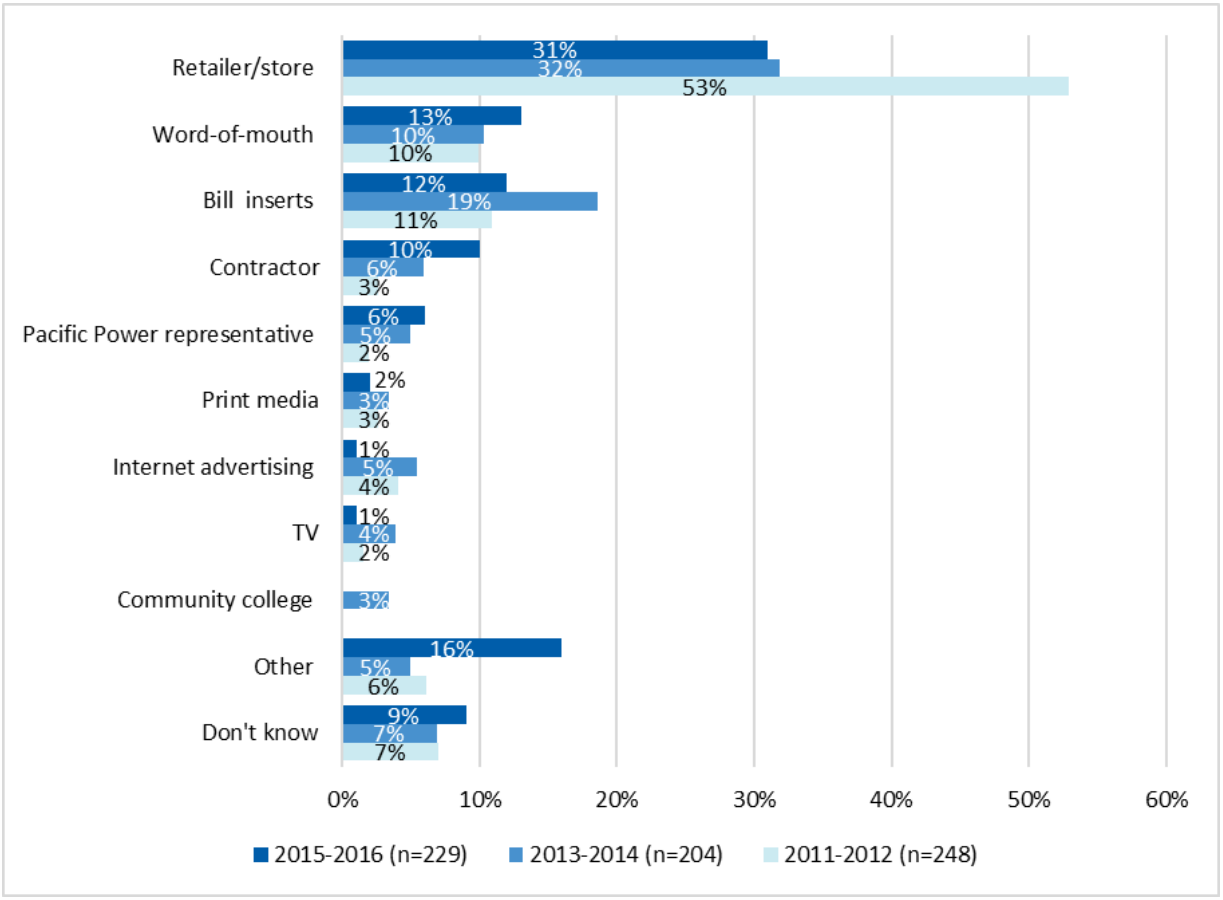


Source: 2015–2016 Pacific Power Washington HES Residential General Population Survey (Appendix A) (QE3, 2015-2016, QD3 2013-2014, QB2 2011-2012). Don't know and refused responses removed.

As shown in Figure 7, 31% of non-lighting participants reported learning about the program through a retailer. While a significant decrease in participants reported this source between the 2011 and 2014,[41] the change between the 2013–2014 program period and 2015–2016 did not show a further significant decline. Customers also reported learning about the program through word-of-mouth (13%) and bill inserts (12%). "Other" responses included billboard and outdoor advertisements, home energy reports, and websites (e.g., Pacific Power, ***watt***smart HES, non-program).

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

Figure 7. Non-Lighting Participant Source of Awareness

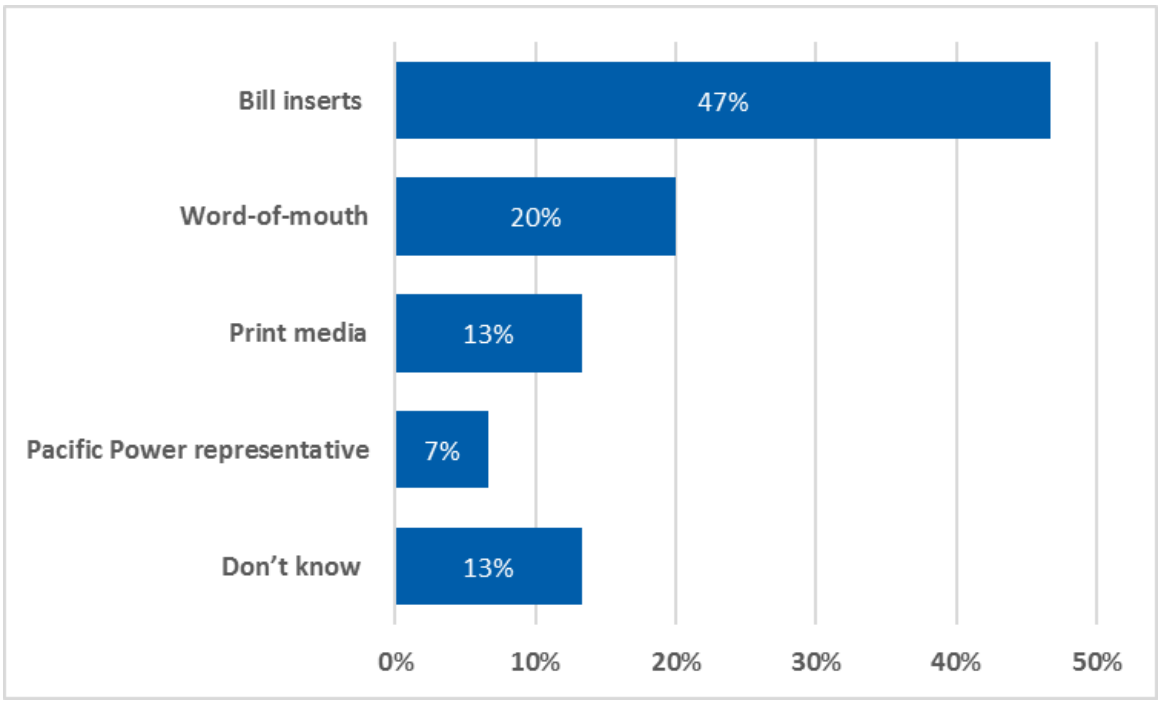


Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A) (QC1 2015-2016 and 2013-2014, QM1 2011-2012). Refused responses removed.

Almost half of the non-lighting participants (46%, n=221) visited the ***watt***smart website and found it very or somewhat helpful. Of those visiting the website, 50% said it needed nothing more to make it more helpful; the other 50% said it would be helpful if the site improved its navigation, made the program information clearer and more concise, and provided a tool or "quiz" that customers could easily take to determine rebates for which they qualified.

Manufactured homes participants most frequently reported learning about the program through bill inserts (47%) or word-of-mouth (20%). Four of the 15 participants said they visited the program website and found it very helpful. Figure 8 shows how manufactured homes participants learned about the program.

Figure 8. Manufactured Homes Participant Source of Awareness

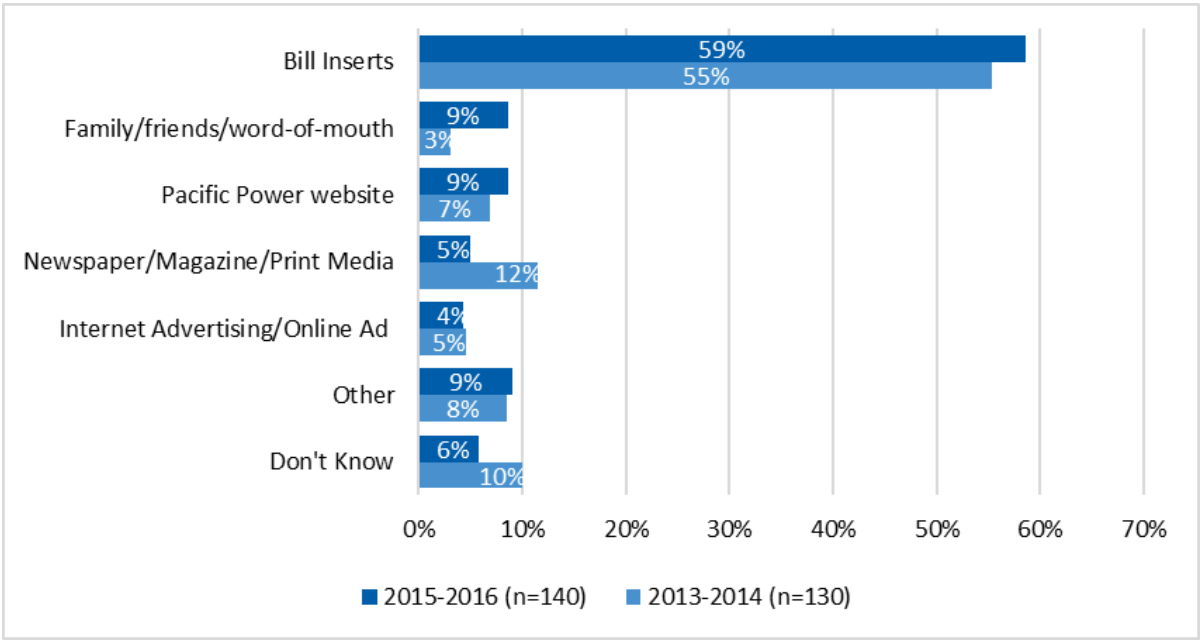


Source: Pacific Power Washington HES Residential Manufactured Homes Participant Survey (Appendix A) (QB1). (n=15)

Of kit customers, 59% reported learning about the program through bill inserts, 9% cited family/friends/word-of-mouth, and 9% cited Pacific Power's website. "Other" responses included the HES website, other websites, Pacific Power representatives, e-mail, radio, social media, "read it somewhere," and previous experience with the kits. Customers reporting family/friends/word-of-mouth increased in 2015–2016, though those reporting newspaper/magazine/print media decreased.[42] Seventeen kit customers (n=67) participated in the Home Energy Reports web portal. Figure 9 shows how participants learned about the ***watt***smart Starter Kits.

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

Figure 9. Sources of Awareness (*watt*smart Starter Kits)



Source: Pacific Power Washington HES Kit Survey (Appendix A) (QE5 2015-2016 and 2013-2014). Refused responses removed.

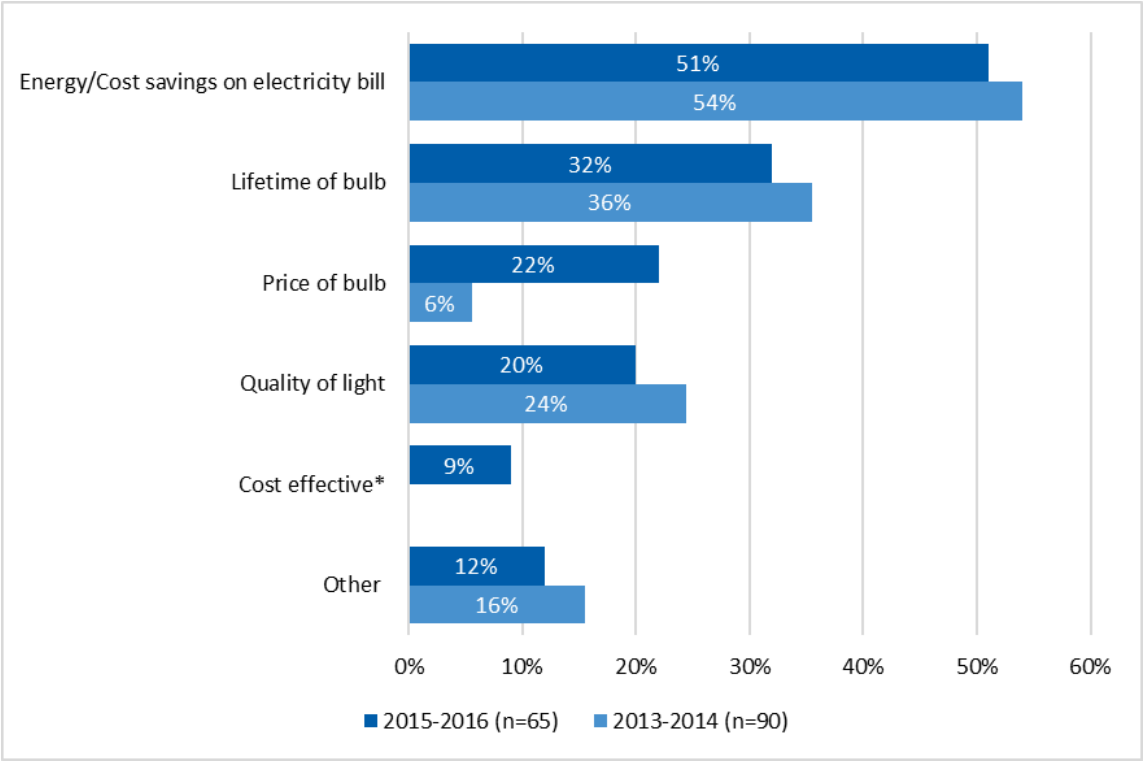
Lighting and APS Purchasing Decisions

In the general population survey, Pacific Power's Washington customers reported a variety of reasons for purchasing LEDs, most commonly citing energy or cost savings (51%) or the bulb's lifetime (32%). As shown in Figure 10, significantly more customers cited price compared to customers in 2013–2014.[43] "Other" reasons included recommendations received, LEDs' reputation for working well, bulbs required by a lighting fixture, environmental and CFL disposal concerns, availability of LEDs, bulb temperatures, and curiosity about and interest in the latest technology. Customers purchasing LEDs in the past 12 months intended to purchase LEDs over other bulb types.

Of 41 participants that chose not to buy LEDs, they most commonly cited the bulbs' cost, with 46% considering the LEDs expensive (19 of 41). Respondents' second most cited reason was a preference for and familiarity with CFLs and incandescent bulbs (9 of 41), with the lack of LED availability cited as the third most common reason (8 of 41). Five participants reported other reasons.

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

Figure 10. General Populations Reasons for Choosing to Buy LEDs



Source: Pacific Power Washington HES Residential General Population Survey (Appendix A) (QC7 2015-2016 and 2013-2014). Don't know responses removed. Multiple responses allowed each reporting year. *Cost effectiveness response option was not included in 2013–2014.

When asked, 80% of general population customers had not heard of APS (n=235). Seven customers purchased and installed an APS in the last 12 months, but only five could recall how many they purchased, and none knew APS was part of Pacific Power's sponsored discounts. Of these five customers, three purchased the APS due to interest in acquiring the latest technology, APS safety, or protecting their equipment.

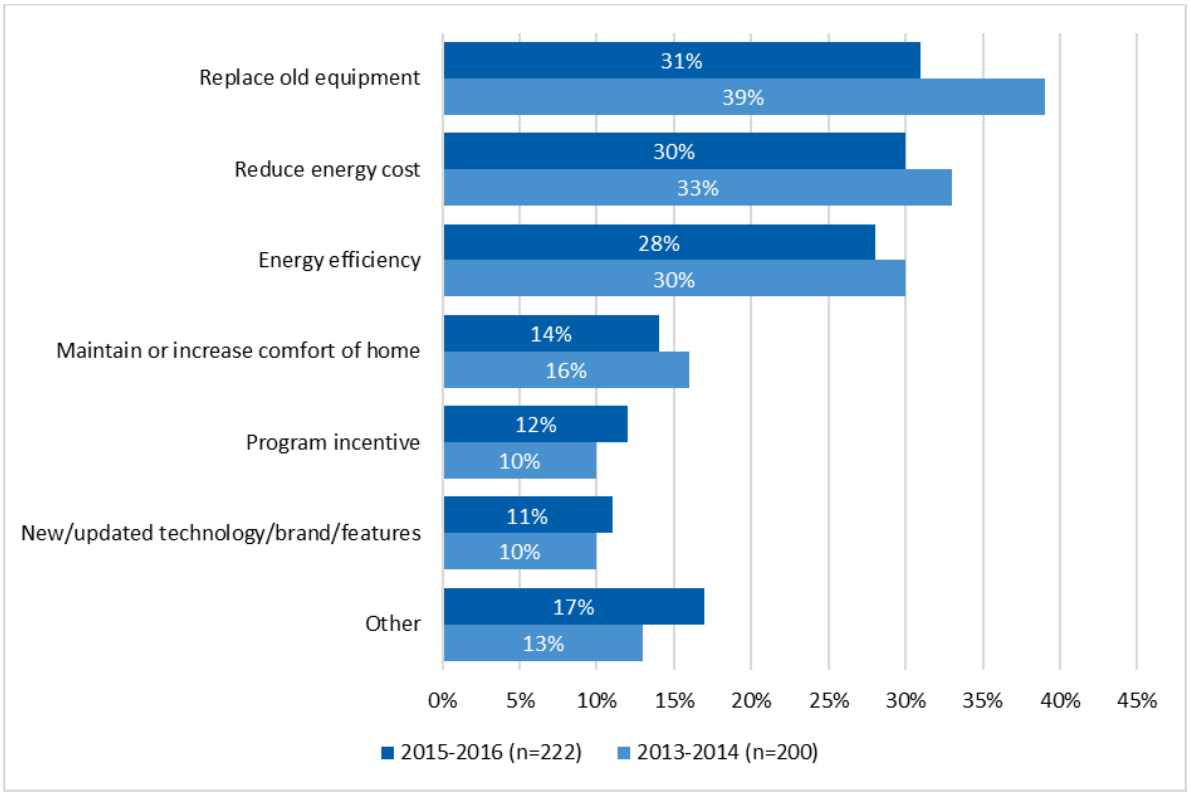
Non-Lighting Participation Decisions

As shown in Figure 11, Pacific Power non-lighting participants described a number of different factors influencing their decisions to participate in the HES program. Most commonly, participants cited an interest in replacing old, non-working or poorly-working equipment (31%), wanting to reduce energy costs (30%), energy efficiency (28%), or to maintain or increase comfort of their homes (14%). Only replacement of old equipment showed a significant change from 2013–2014.[44]

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

"Other" responses included home remodels, personal preferences, spatial or other home requirements, health or environmental concerns, recommendations, prior experience with the program, and online reviews.

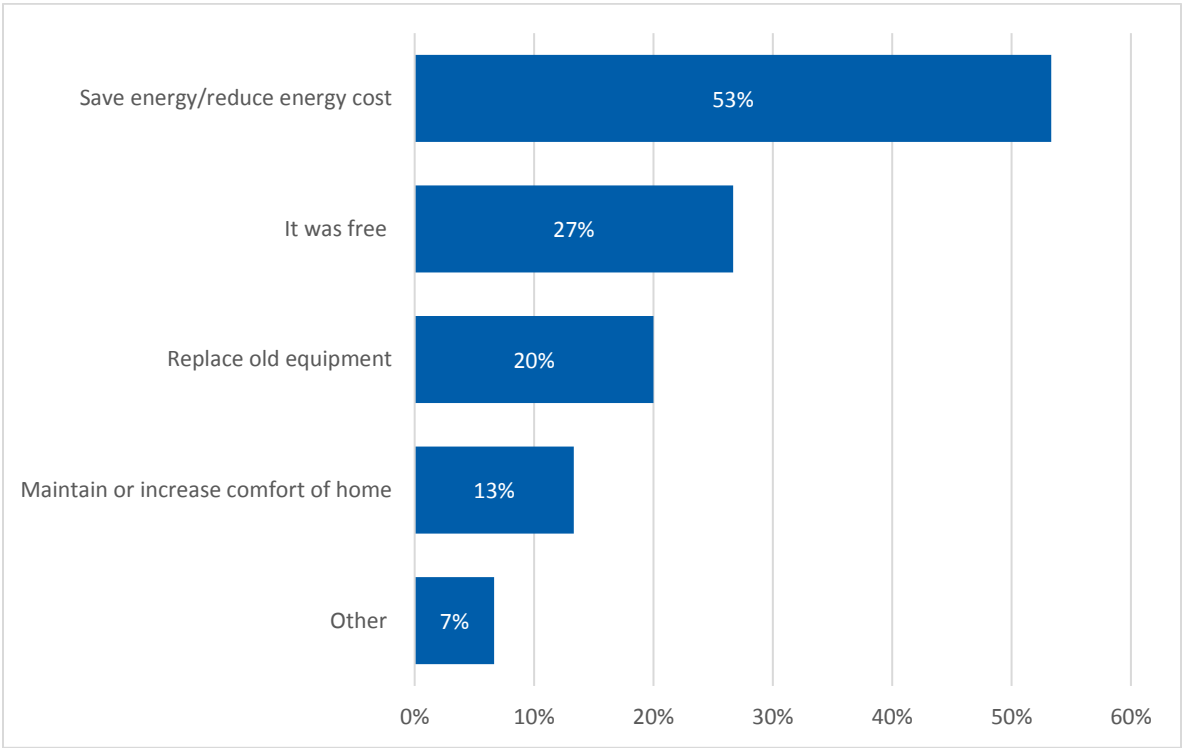
Figure 11. Participation Reasons (Non-Lighting)



Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A) (QC5 2015-2016 and 2013-2014).
Don't know and refused responses removed. Multiple responses allowed in each reporting year.

A majority of manufactured homes participants acted to save energy and reduce energy costs (53%), but 27% participated as the service was offered at no cost. One customer—an "other" response—said they "might as well get them checked again." Figure 12 shows all respondents' reasons.

Figure 12. Participation Reasons (Manufactured Homes)



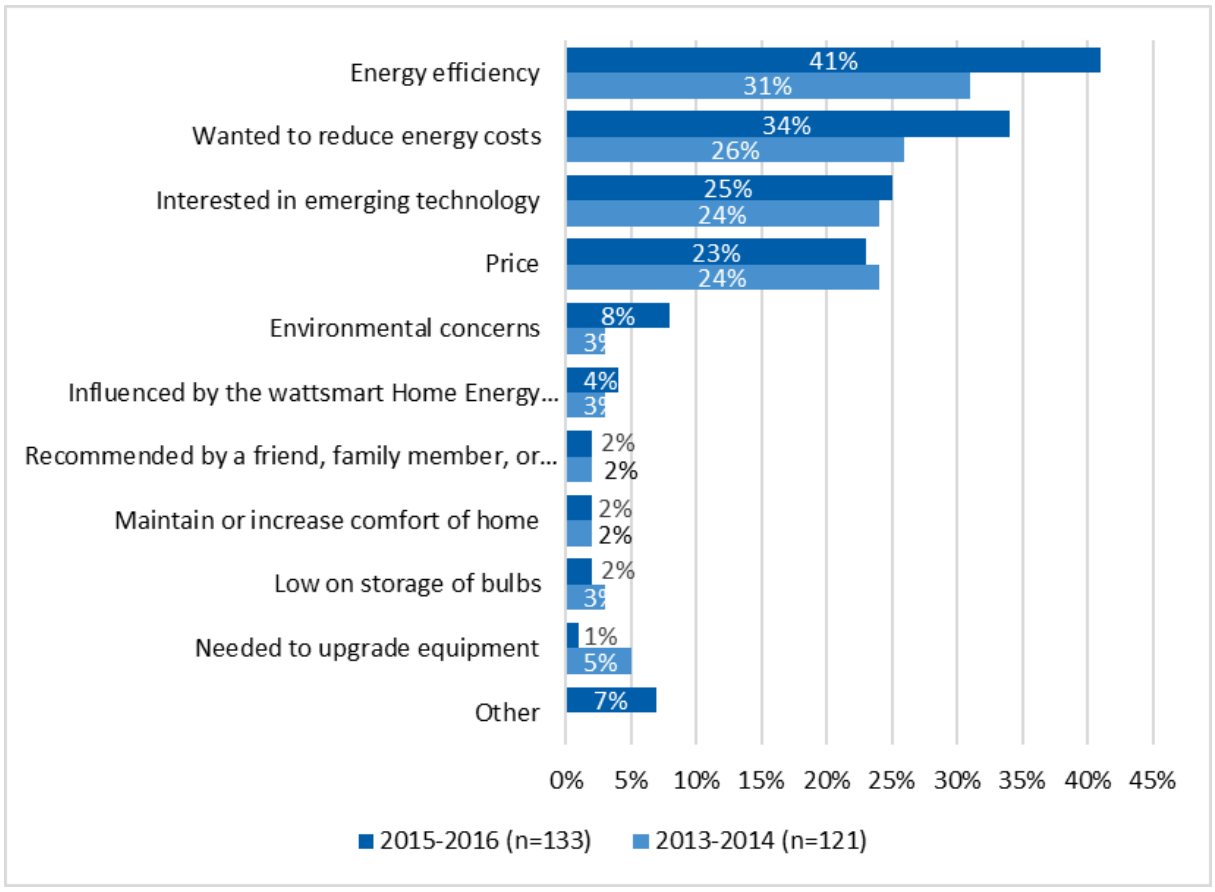
Source: Pacific Power Washington HES Residential Manufactured Homes Participant Survey (Appendix A) (QB5). Multiple responses allowed (n=15).

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 reported energy efficiency (41%) and wanting to reduce energy costs (34%) as their main reasons. Many customers' interest in emerging technology (25%) and price (23%) motivated their applications for kits. Customers cited energy efficiency and environmental concerns at significantly higher rates than in 2013–2014, and cited the need to upgrade equipment at significantly lower rates.[45] Figure 13 illustrates customers' motivation for requesting kits.

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

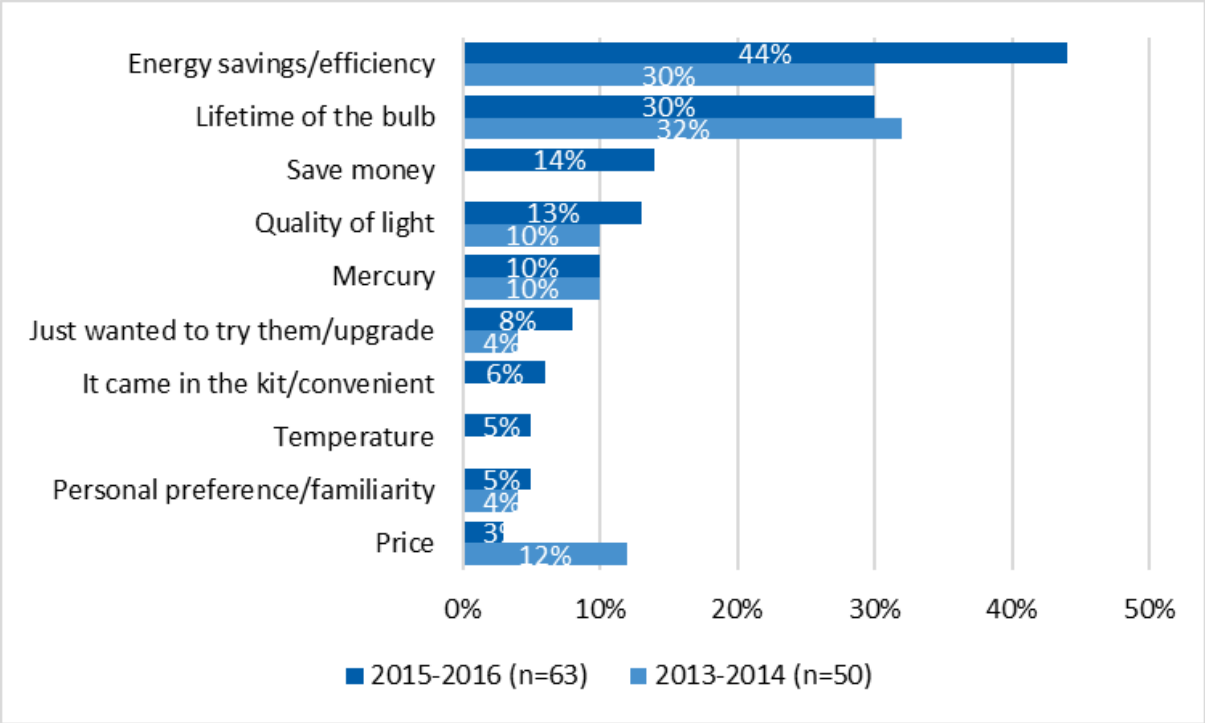
Figure 13. Reasons for Requesting a *watt*smart Starter Kit



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (QE10 2015-2016 and 2013-2014). Don't know and refused responses removed. Multiple responses allowed in each reporting year.

During the application process, customers could upgrade their kits from CFLs to LEDs for $4.99 (down from $19.99 in 2013–2014). Of 63 customers paying to upgrade their kits, top motivating factors included energy efficiency (44%), bulb lifetimes (30%), and saving money (14%). Customers also noted LED bulbs' quality of light and lack of mercury as motivating factors in upgrading their kits. Forty-two percent (n=64) of respondents already planned to purchase the same type of LEDs they received in the kits, and 25 customers already averaged 4.6 LEDs in their homes. Figure 14 shows reasons that customers upgraded their kits to include LEDs rather than CFLs.

Figure 14. Reasons for LED Upgrade



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (QB20 2015-2016 and 2013-2014). This was asked as an open-ended question, multiple response allowed.

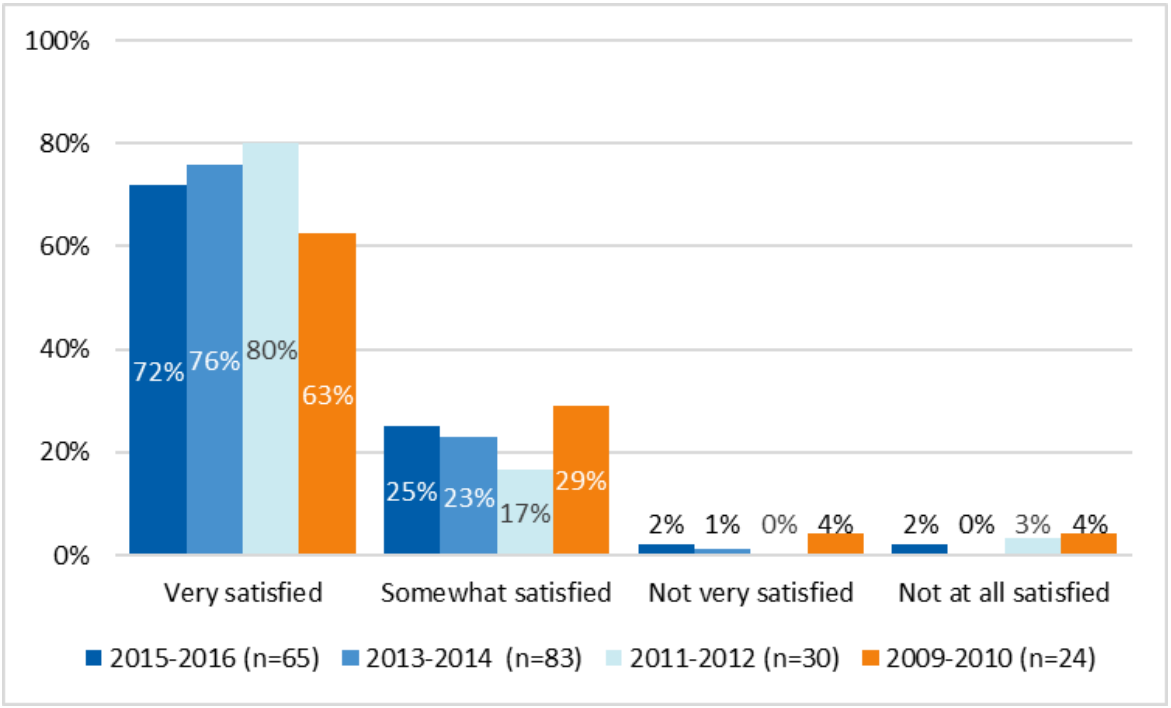
Cadmus asked customers selecting CFL kits why they chose not to upgrade their kits to include LEDs. Of six customers responding to this question, one knew of the upgrade option, but chose not to do so due to costs. Of the remaining five customers, three said they would have upgraded had they known of the option. In the 2013–2014 evaluation period, 14 customers found upgrading the kit cost-prohibitive.

Satisfaction

Lighting and APS

As shown in Figure 15, general population customers purchasing LEDs expressed satisfaction levels similar to those recorded from 2009–2014, with 72% very satisfied and 25% somewhat satisfied with products purchased in 2015–2016. All five general population customers purchasing APS in the last 12 months were very satisfied with their purchases.

Figure 15. General Population LED Satisfaction Levels



Source: Pacific Power Washington HES Residential General Population Survey (Appendix A) (QC16 2015-2016, QC14 2013-2014, QM8 2011-2012, QM5 2009-2010). Don't know and refused responses removed.

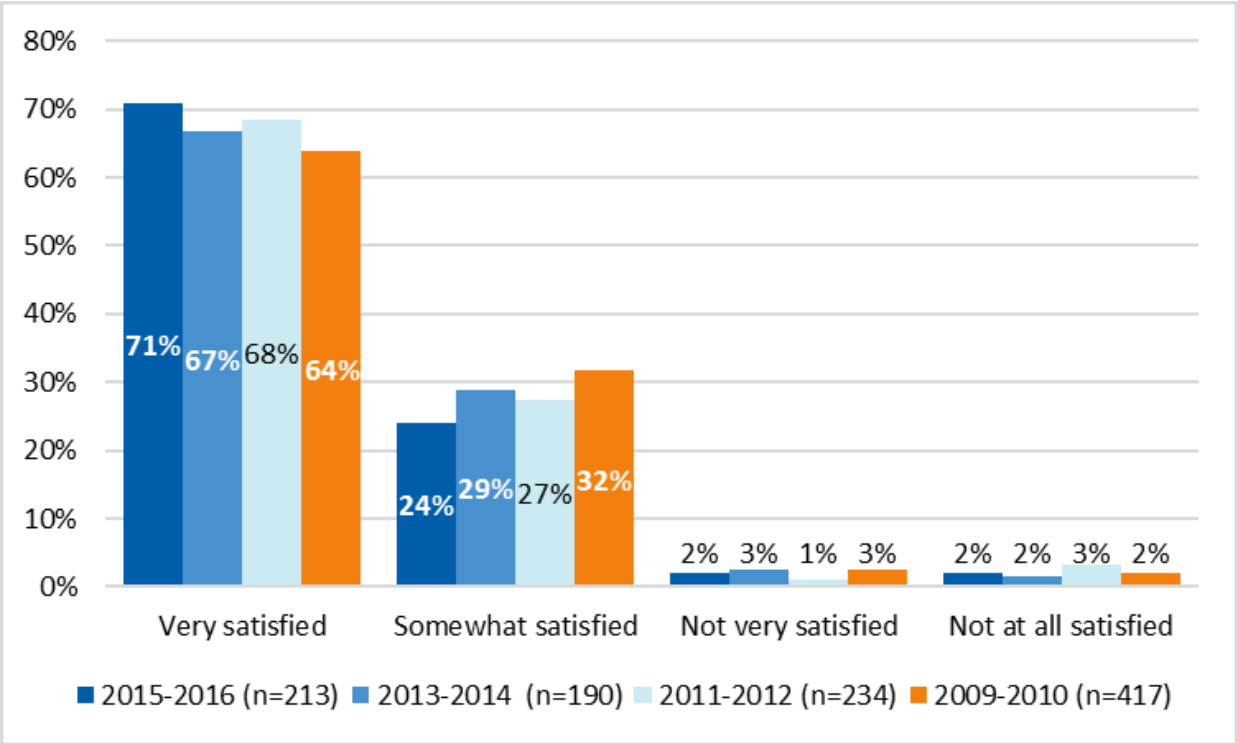
Non-Lighting

Similar to 2013–2014 findings, non-lighting customers in 2015–2016 overwhelmingly expressed satisfaction with the HES program, with 95% of participants reporting they were very or somewhat satisfied with the program. Participants provided many reasons for these satisfaction levels, including the following representative statements:

- "It's helping us do what we all should do, which is buy more energy-efficient appliances."
- "The application process went well and was easy, and made it easy to purchase an affordable appliance."
- "They [CLEAResult] helped me throughout the process whenever I had questions."
- "My bill went down."
- "It provided some good work here and saves on the heating bill."

The few dissatisfied customers (10 of 213 respondents) expressed dissatisfaction regarding the effort required compared to the incentive amount, dissatisfaction with the contractor, non-qualifying equipment, delayed receipt of incentives, and a preference for lower power bills overall vs. receiving an incentive for specific items. Satisfaction levels have remained consistent since 2009. Figure 16 illustrates trends year over year.

Figure 16. Non-Lighting Satisfaction with HES Program



Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A) (QE10 2015-2016 and 2013-2014, QF9 2011-2012 and 2009-2010). Don't know and refused responses removed.

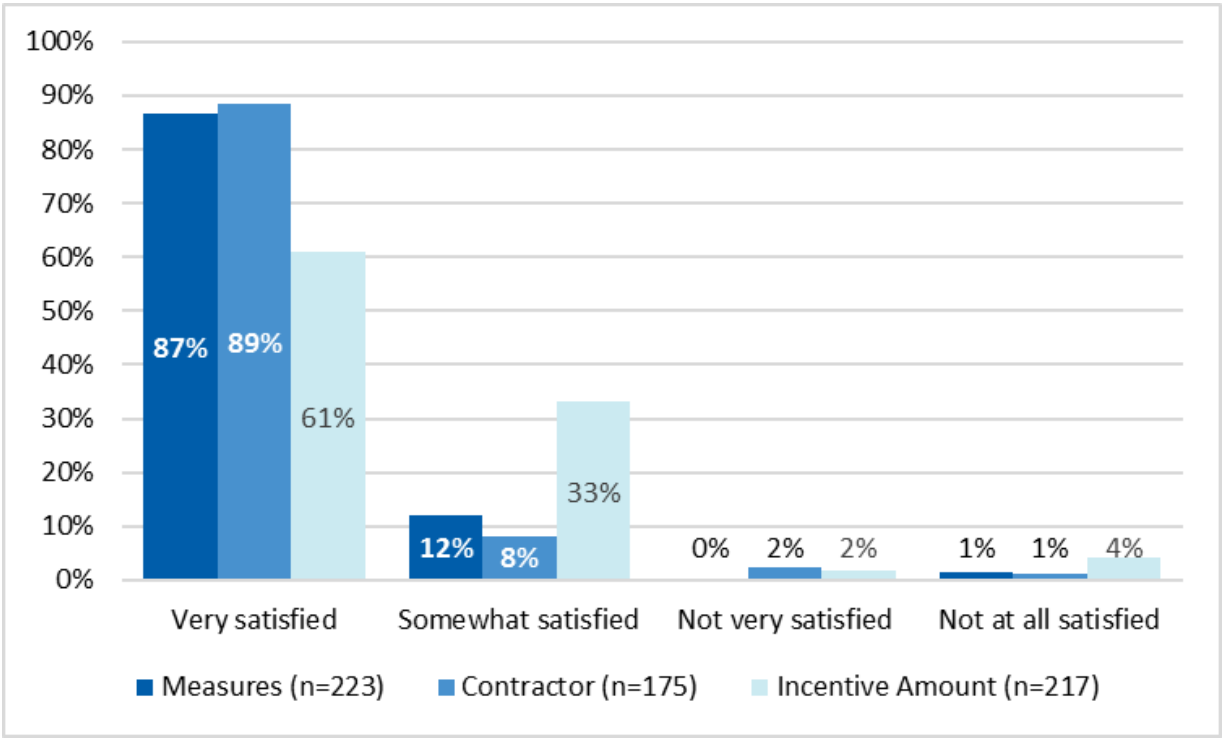
As in 2013–2014, program participation in 2015–2016 appears to have positive or neutral effects on most non-lighting customers' perceptions of Pacific Power. When asked whether participation in the HES program caused their satisfaction with Pacific Power to change, 42% said participation increased their satisfaction, 49% said their satisfaction stayed the same, and 9% said their satisfaction decreased.

In addition to overall HES program satisfaction levels, non-lighting customers expressed high satisfaction levels with measures they installed and with their contractors, but fewer were very satisfied with incentive amounts they received.

As shown in Figure 17, 87% of non-lighting customers were very satisfied with measures installed, and 12% were somewhat satisfied.

About three-quarters of non-lighting participants hired contractors to install measures for which they received program incentives. As shown in Figure 17, 89% of these participants reported being very satisfied with their contractors, with 8% somewhat satisfied.

Figure 17. Non-Lighting Satisfaction with Measures, Contractors, Incentive Amounts



Source: Pacific Power Washington HES Residential Non-lighting Survey (Appendix A) (QE1, QE3, QE6). Don't know and refused responses removed.

Participant satisfaction with incentive amounts did not run quite as strongly, with 61% reporting they were very satisfied with incentive amounts. An additional 33% reported being somewhat satisfied, and just 6% reported being not very or not at all satisfied.

Non-lighting customers found the HES program incentive application easy to fill out, with 67% of respondents reporting it very easy to fill out and 26% reporting it somewhat easy. Participants who reported difficulties with filling out the application (7%) cited challenges regarding the amount of information required and understanding the terminology used—all issues very similar to those cited in the 2013–2014 evaluation.

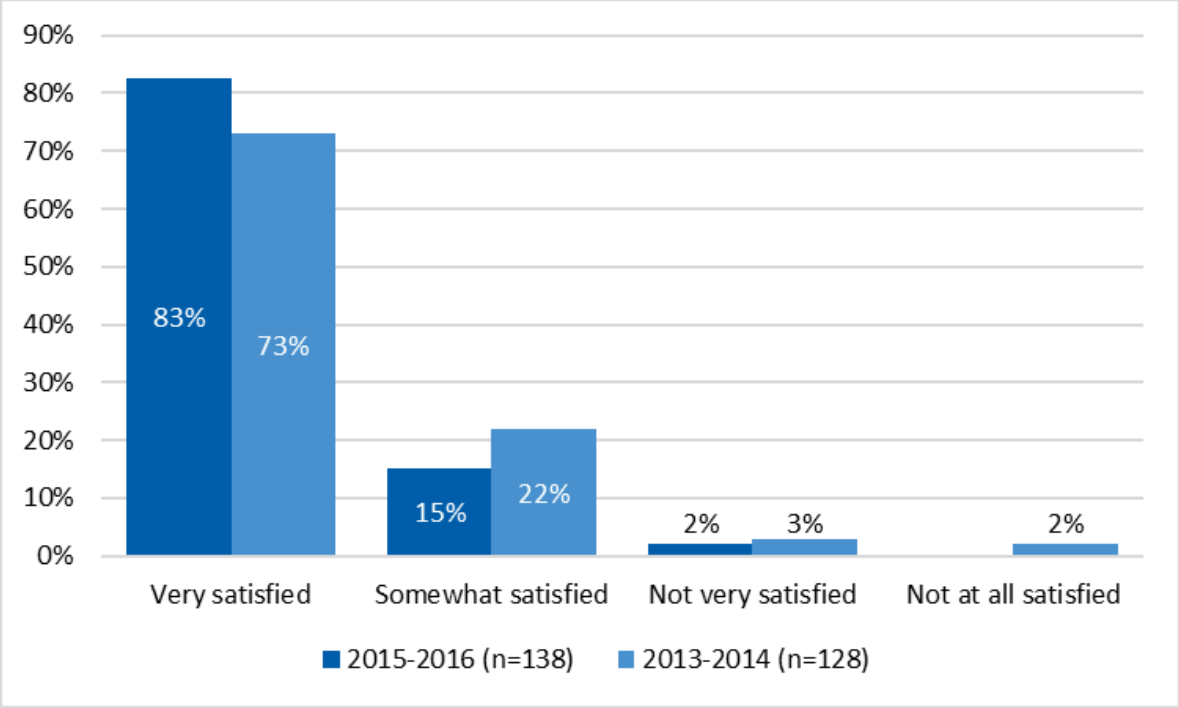
Participants in manufactured homes duct sealing reported high satisfaction levels with the professionalism and attitude of contractors performing the measure, with 83% very satisfied and 17% somewhat satisfied (n=12). A majority of participants expressed satisfaction with the application process (92%, n=13). On average, four days passed between arranging the appointment and the contractor's first visit to the home (n=8); contractors completed the work in one day (n=14).

Though 42% found their homes more comfortable after duct sealing, 53% noticed no change (n=15). Forty percent of manufactured homes participants said participation in duct testing and sealing increased their satisfaction with Pacific Power, and 60% said their satisfaction levels stayed the same.

*watt*smart Starter Kits Program Satisfaction

As shown in Figure 18, nearly all kit recipients expressed satisfaction with the HES program, with 98% of participants reporting they were very or somewhat satisfied with the program. Participants reporting very satisfied in 2015–2016 increased, compared to participants reporting very satisfied in 2013–2014.[46]

Figure 18. *watt*smart Starter Kit Satisfaction with the HES Program



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (QE4 2015-2016 and 2013-2014). Don't know responses were removed.

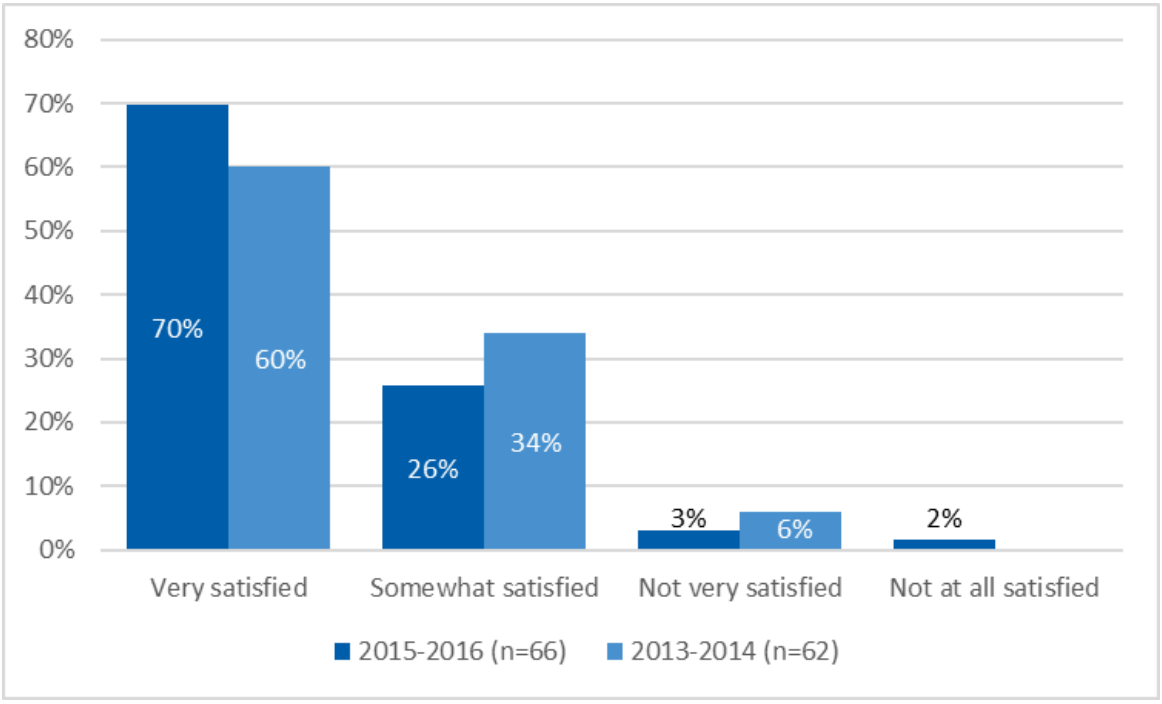
Satisfaction with Kit Measures

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 pertaining only to their specific kit's contents.

As shown in Figure 19, 70% of CFL kit respondents were very satisfied with CFLs they received, 26% said they were somewhat satisfied, 3% were not very satisfied, and 2% were not at all satisfied. Not satisfied customers reported CFLs burned out too fast or did not produce bright enough light.

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

Figure 19. Satisfaction with CFLs in *watt*smart Starter Kit

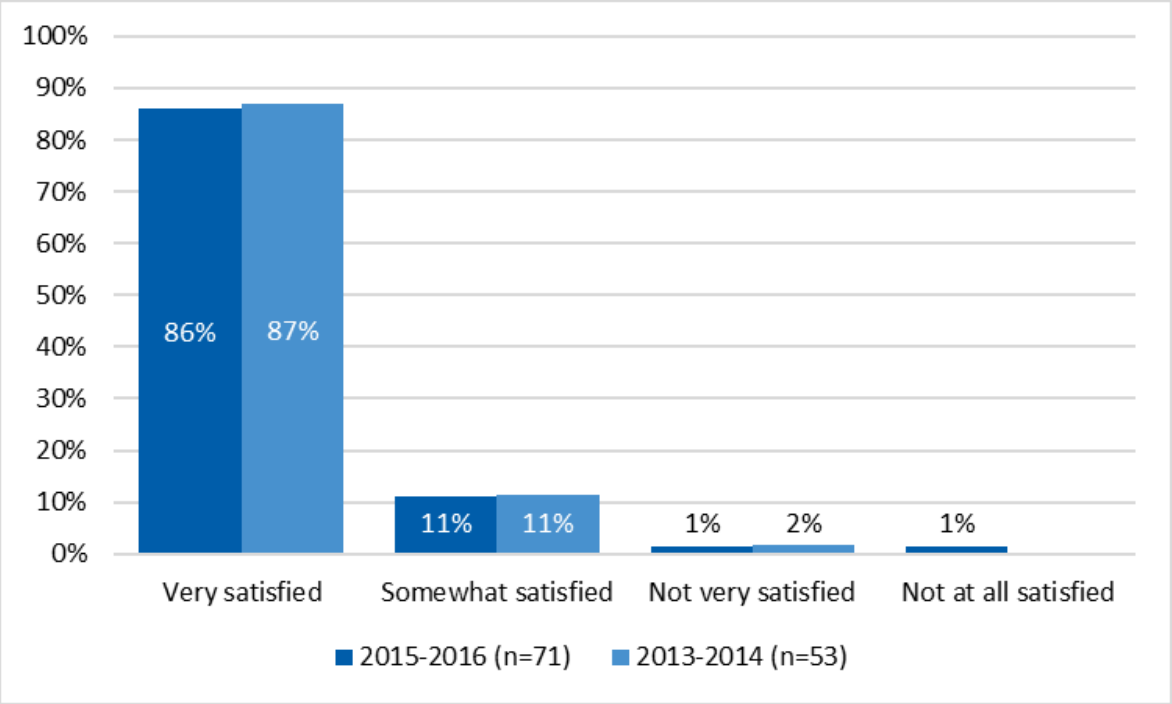


Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (QB6 2015-2016 and 2013-2014). Don't know and refused responses removed.

Customers also expressed high satisfaction levels with LEDs in their kits, with 86% very satisfied, 11% somewhat satisfied, and 1% not very satisfied. As shown in Figure 20, another 1% were not satisfied at all. As with CFL customers, not satisfied LED customers said LEDs burned out too fast or produced light of insufficient brightness.

Kit participants expressed satisfaction with the number of CFL and LED bulbs provided: 67% of customers receiving a CFL kit and 69% of customers receiving an LED kit reported being very satisfied with the number of bulbs in the kit. Overall, customers installed 81% (n=244) of the CFLs received and 90% (n=279) of the LEDs received.

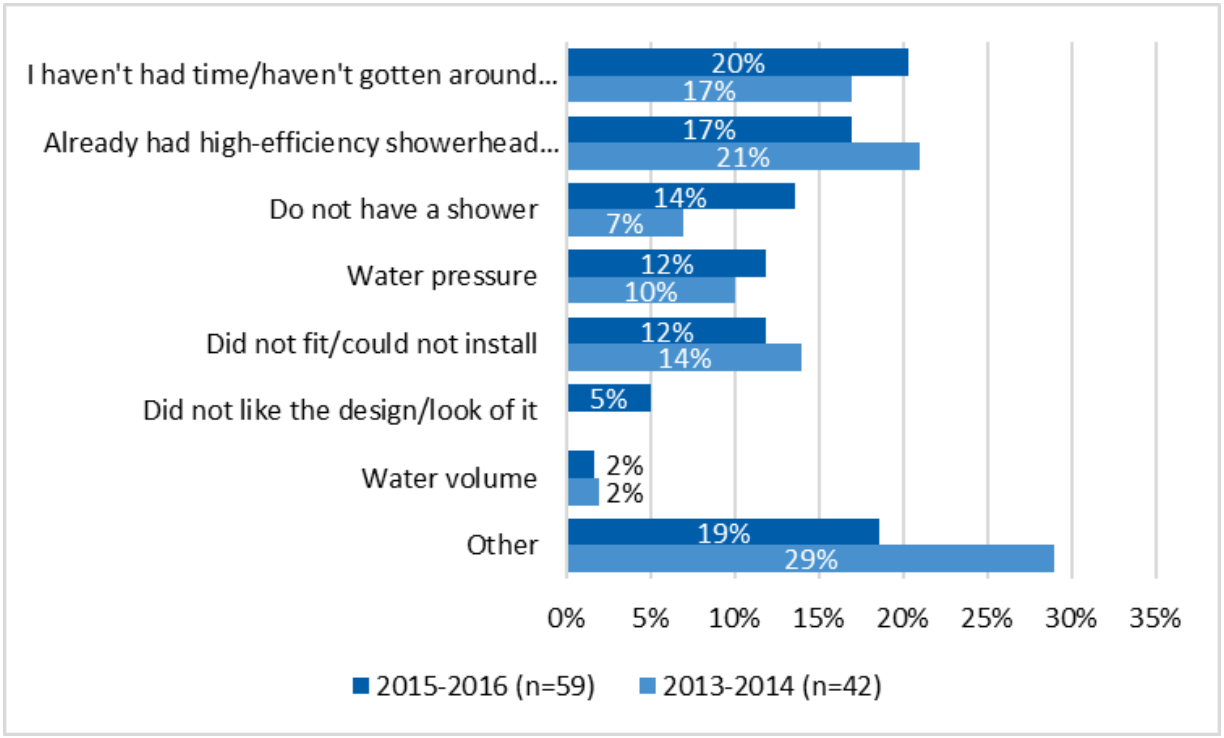
Figure 20. Satisfaction with LEDs in *watt*smart Starter Kit



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (QB21 2015-2016 and 2013-2014). Don't know and refused responses removed. One "other" response removed from 2015–2016—not relevant.

Customers reported lower installation rates for kit water measures than for CFLs or LEDs, with customers installing 61% (n=197) of the showerheads received. Of customers saying they did not install all units provided: 20% had yet to install units; 17% already had a high-efficiency showerhead; and 14% said they did not have a shower. Of "other "responses, 45% (5 of 11) preferred the showerhead they already had. Figure 21 shows the results. The majority (74%) of these customers put unused showerheads in storage.

Figure 21. Reasons for Not Installing Both High-Efficiency Showerheads



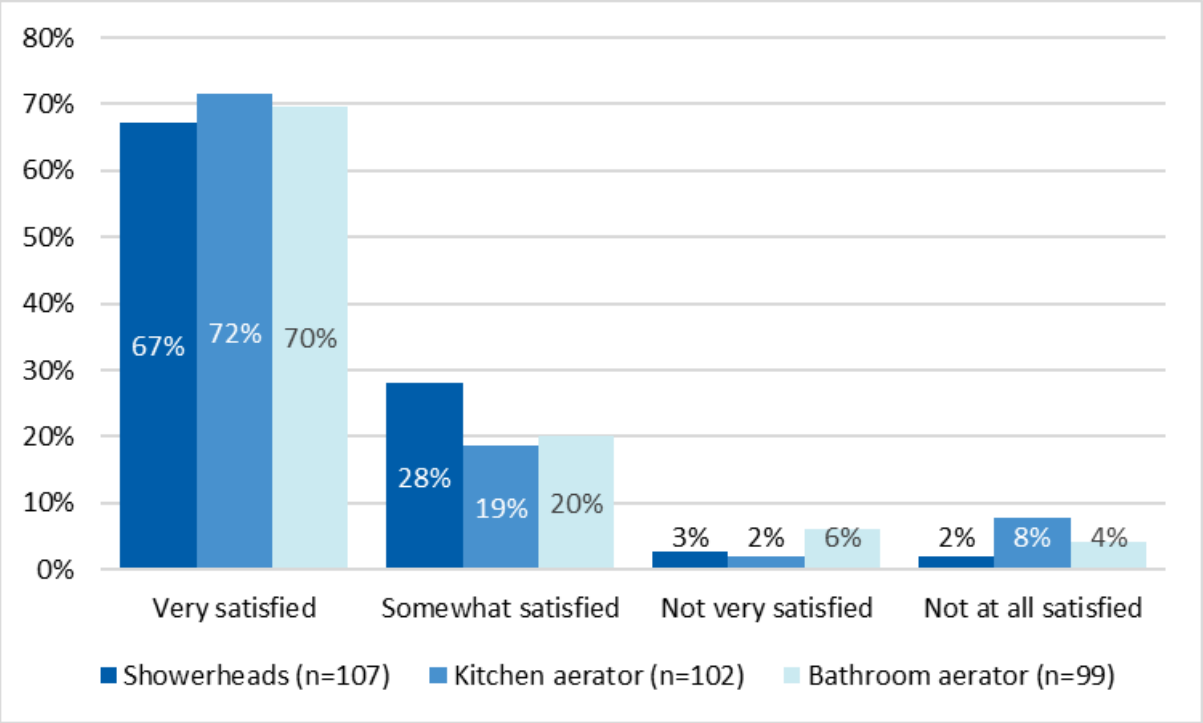
Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (QC2 2015-2016 and 2013-2014). Don't know removed.

Customers expressed satisfaction with showerheads received: 67% of respondents said they were very satisfied with the showerhead; 28% said they were somewhat satisfied; and 73% noted they found the showerheads very easy to install.

Respondents installed 65% (n=116) of kitchen faucet aerators. Over one-third (38%, n=41) of respondents who did not install the kitchen faucet aerators said they did not fit; and 17% said they already had kitchen faucet aerators installed in every possible location. Respondents also installed 62% (n=189) of bath aerators. Twenty-five percent (n=48) of respondents who did not install the aerator said it did not fit, and 25% said they already had bathroom faucet aerators installed in every possible location. Seventy-seven percent of respondents not installing the kitchen aerator and 84% not installing the bathroom aerators said they put the units in storage.

Kit recipients expressed similar satisfaction levels with aerators as with showerheads. Figure 22 shows satisfaction levels for each water measure.

Figure 22. Water Measure Satisfaction



Source: Pacific Power Washington HES Residential Kit Survey (Appendix A) (QC4, QD4, QD12 2015-2016 and 2013-2014).

Customers found the application easy to fill out, with 79% of respondents reporting it very easy to fill out and 16% reporting it somewhat easy.

Customer Demographics

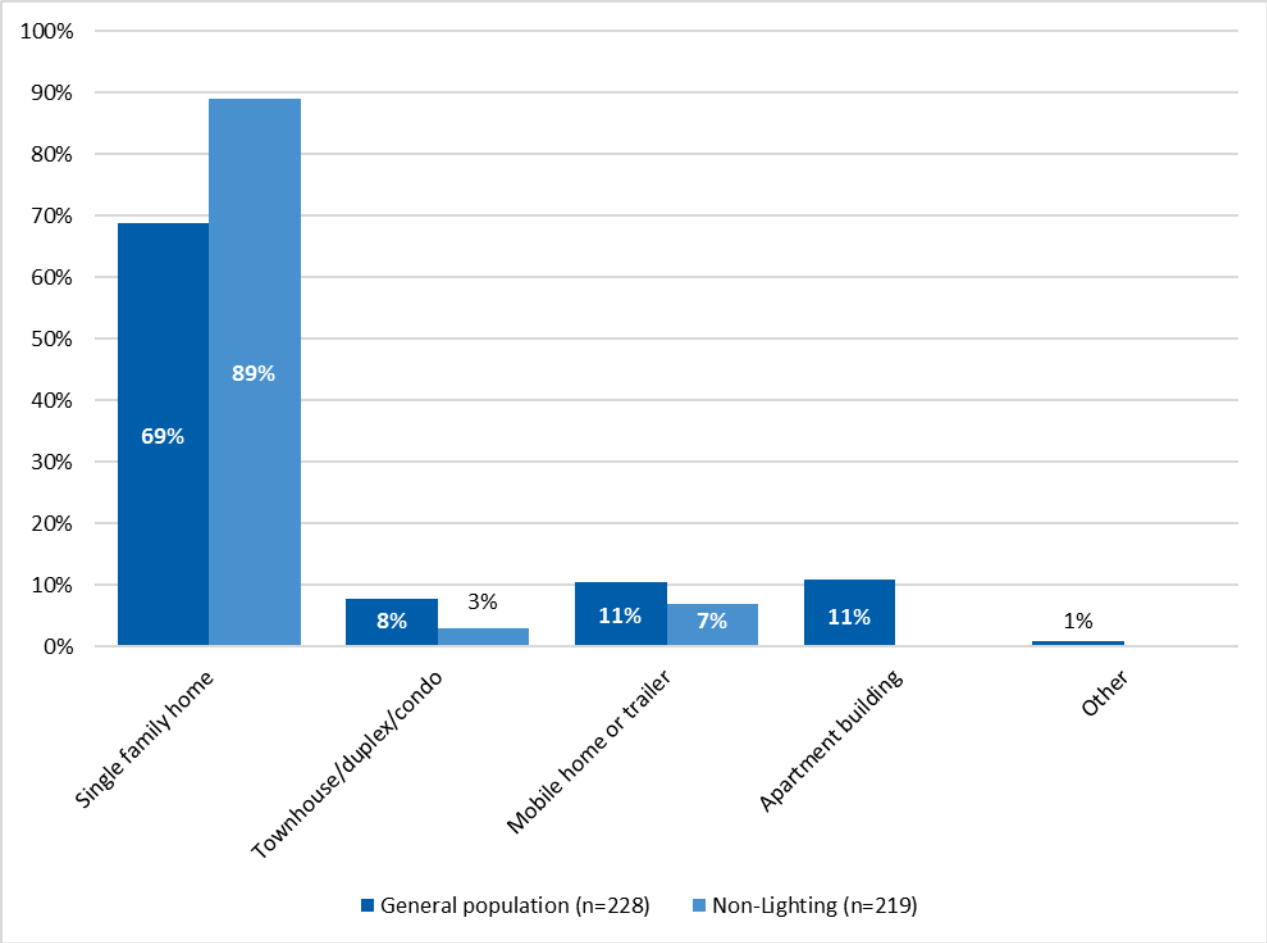
As shown in Figure 23, most general population and non-lighting participants surveyed lived in single-family homes, with a small percentage of customers residing in condominiums, townhomes, apartments, or mobile homes. “Other” responses represented general population customers living in modular homes.

Sixty-nine percent of the general population surveyed, 94% of non-lighting participants surveyed, and 87% of manufactured homes participants surveyed reported owning their own homes, with an average of less than three people residing there. Eighty-three percent of non-lighting participants, 79% of general population customers, and 100% of manufactured homes participants used electricity to heat their water. Additionally, 63% of non-lighting participants and 71% of manufactured homes participants reported living in a home of 2,000 square feet or less.

Most general population customers used forced air (30%) or baseboard heating systems (24%, n=239), with the average age of all heating systems reported as 14.3 years, and most general population customers also used central air conditioning (46%) and/or room air conditioners (23%, n=217, multiple

responses allowed). Seven percent reported no cooling system. All cooling systems reported an average age of 9.26 years.

Figure 23. General Population and Non-Lighting Residence Types



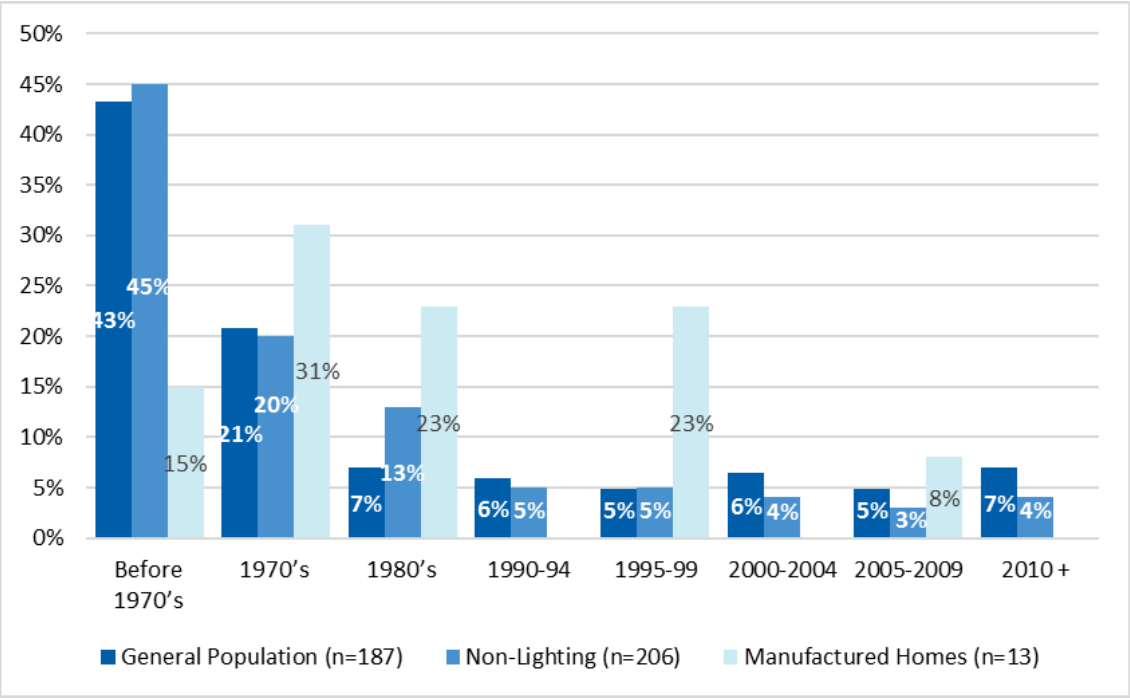
Source: Pacific Power Washington HES Residential General Population and Non-lighting Surveys (Appendix A) (QG1 General Population, QH1 Non-lighting). Don't know and refused responses removed. Apartment buildings break down as follows: 4% were four units or less, 7% were five or more units.

The majority of manufactured homes participants heated their homes with an electric furnace (73%) or an air-source heat pump (13%, n=15), with an average age of all heating systems reported as 21.6 years. Most manufactured homes customers also used central air conditioning (47%), a window air conditioner (20%), or an air source heat pump (20%, n=15). Cooling systems reported an average age of 13.75 years.

During summer, manufactured home participants set their thermostats at an average of 73.13 degrees before duct sealing (n=8) and an average of 72.75 degrees after duct sealing (n=4). During winter, participants set their thermostats at an average of 72.77 degrees before duct sealing (n=13), and an average of 70.25 degrees after duct sealing (n=8).

Figure 24 shows survey respondents in the general population and non-lighting groups reported similar home vintages for all vintage categories except the 1980s (which had significantly fewer general population responses than non-lighting responses).[47] Manufactured home participants reported significantly fewer pre-1970 vintage homes than the general population or non-lighting participants.[48]

Figure 24. General Population, Non-Lighting and Manufactured Home Age



Source: Pacific Power Washington HES Residential General Population and Non-lighting and Manufactured Homes Participants Surveys (Appendix A) (QG3 General Population, QH4 Non-lighting, QG6 Manufactured Homes). Don't know and refused responses removed.

Benchmarking

This section describes the findings from Cadmus' benchmarking review of comparable programs offered by utilities across the United States.

In conducting the benchmarking process, Cadmus sought to achieve the following objectives:

- Establish consistent definitions of upstream, midstream, and downstream; so programs could be characterized consistently in these terms
- Collect information on specific residential programs of interest to Pacific Power. Specifically, this research focused on the following program and measure categories: lighting, non-lighting, and new construction.

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

[48] Ibid.

The main report document presents findings at a high level. Appendix I. Benchmarking provides additional detail on programs, channels, and measures.

Definitions

As Pacific Power has specifically expressed interest in delivery channels used to implement residential programs, Cadmus developed definitions of descriptive terms consistently used in this report to characterize program delivery.

Cadmus found that a primary distinction between upstream, midstream, and downstream programs is whether a payment made at some point in the supply chain had to be passed through to the end customer. In practice, this meant midstream and upstream program participants only had to pay the measure price after applying applications of discounts. In contrast, participants in downstream programs had to pay the full price of a measure, at which point they could apply for a rebate. If the program determined that they qualified, the rebate could be paid.

Cadmus summarizes these definitions as follows:

- **Upstream programs**: implemented as agreements between the product manufacturer, distributors or retailers, and the program. Through these agreements, specific products—lighting in all instances Cadmus identified—are offered at reduced prices to distributors and retailers. The distributor or retailer must pass the entire product discount to buyers, resulting in target products offered at below-market prices. Cadmus notes that upstream programs typically do not enforce buyer requirements such as use in a residence or use within the service territory. Consequently, product use outside the service territory (i.e., leakage) and cross-sector sales (into nonresidential applications) raise concerns for upstream lighting programs. Such programs may offer compensation to distributors or retailers through Sales Performance Incentive Funds (SPIF) or bonuses.
- **Midstream Programs**: implemented as agreements between the program and a range of market intermediaries, including distributors, retailers, and contractors. As noted, midstream intermediaries must apply a defined rebate amount to the measure's retail price. Again, intermediaries may receive a separate SPIF or bonus for their role in the program. Unlike upstream programs, however, midstream programs sometimes enforce program requirements (e.g., use of the measure in a residence or use of the measure in the service territory, reducing the potential for leakage or cross-sector participation). Examples of midstream programs include those allowing retailers to offer instant rebates on home appliances and those allowing HVAC installers to offer discounted prices that target high-efficiency equipment.
- **Downstream Programs:** offering rebates on targeted products after purchase. When the buyer applies for the rebate, the program verifies that the intended use meets program requirements, sometimes even including verification that the buyer has a gas or electric account with a sponsoring utility.

Cadmus notes that midstream programs offer an advantage in enabling the program administrator to wield greater influence on products stocked by distributors, retailers, and contractors than downstream programs. This factor often proves important as programs work to support adoption of new technologies (e.g., heat pump clothes dryers in markets where products would otherwise not be available or recommended by installers).

Cadmus also notes that, for new home programs, the homebuilder serves as the primary participant. As the builder retains the incentive payment (i.e., no adjustment to home price is required), these meet Cadmus' definitions for downstream programs.

Upstream: Lighting

Cadmus reviewed residential lighting programs offered by four other utilities, comparing these to the Pacific Power program, as shown in Table 59.

Table 59. Summary of Upstream Lighting Programs

Utility/PA, State	Administrator	Measures	Program Year	Participation Units	Net MWh*	kWh/Unit
Pacific Power, WA	CLEAResult	CFLs, LEDs, Fixtures	2015–2016	626,711	6,969**	11**
Ameren, MO	ICF	LEDs	2016	917,013	24,418	27
EmPOWER, MD	ICF, Honeywell	CFLs, LEDs, Fixtures	1/1/2016-5/31/2016	2,442,683	47,519	19
SRP, AZ	SRP	CFLs	6/1/2016-5/31/2017	693,595	30,488	44
PPL, PA	Ecova	LEDs	6/1/2015-5/31/2016	1,419,223	42,219	30

* Net MWh are values determined by evaluators and were taken from final evaluation reports.

** Cadmus determined the Pacific Power savings value using the RTF 4.2 market baseline. Other utility evaluations typically calculate gross values based on EISA requirements and net values adjusted for freeridership.

Program administrators expect savings may be substantially impacted when the second lighting standard tiers included in EISA become effective. At one time the standard was expected to take effect in 2020 and to require baseline efficiency similar to CFL lamps but there is now some uncertainty on the timing and requirements of the standard.

Midstream and Downstream: Non-lighting

Cadmus reviewed residential programs focused on measures other than lighting as offered by four other utilities and the Energy Trust of Oregon. Table 60 summarizes key aspects of these programs.

Table 60. Summary of Midstream and Downstream Non-Lighting Programs

Utility/PA, State	Year	Measures	Delivery Notes
Ameren, MO	2016	HPWHs, Room ACs, Room Air Purifiers, Pool pumps, Smart T-stats	**Downstream:** Participants receive rebates by mail after approval of their applications
EmPOWER, MD	1/1/16–5/31/16	Clothes W+D, Pool Pump, Refrigerators, HPWHs AS/GS Heat pumps, Central ACs, Furnaces	**Downstream/Midstream mix:** Retail locations are primary channel HPWHs and pool pumps available from trade allies (instant rebates to customers)
PPL, PA	PY7	Refrigerators, HPWHs, Efficient WHs	**Downstream:** Participants receive rebates by mail after approval of their applications
PSE, WA	2013-2015	APS, Refrigerators, Clothes W+D, Smart T-stats, Energy Reports, Insulation, Air/Duct Sealing, Heat System	**Downstream/Midstream mix** (single-family, multifamily up to four units): Low-income weatherization; direct-install downstream rebates; midstream rebates through retailers and contractors
Energy Trust, OR	2015	Smart T-stats, Energy Reports, Kits, Heat Pumps, Pool pumps, HPWHs Insulation, Air/Duct Sealing	**Downstream/Midstream mix:** Recent effort to increase midstream engagement (distributor SPIFs and information sessions); instant incentives through trade allies; specialized offers for moderate-income rental properties

New Construction Programs

Cadmus reviewed residential new construction programs offered by three other utilities and a similar program offered by the Energy Trust of Oregon, with key program aspects summarized in Table 61.

Note: Due to the relatively small new construction volumes in eastern Washington, Pacific Power does not operate a dedicated new construction program in this service territory. Instead, the HES program offers a whole-home performance measure.

Table 61. Summary of New Construction Programs

Utility/PA, State	Admin.	Measure(s)	Program Year	Homes	Gross MWh*	kWh/ Home*	Notes
SRP, AZ	SRP	ES V3	FY17	6,613	32,079	4,851	ENERGY STAR Homes have over 70% market share in Phoenix area.
EmPOWER, MD	ICF	ES V3.1 guidelines; at least 90% of lamps use CFLs, LEDs	1/1/2016-5/31/2016	1,987	4,061	2,044	New single-family homes account for most program savings (53% of total), followed by new townhomes, accounting for 30% of the total.
Focus On Energy, WI**	WECC	Level 1 15% above code Level 2 25% Level 3 35% Level 4 45%	2016	2,400	4,735	1,973	Distribution of homes completed in 2016: Level 1: 18% Level 2: 62% Level 3: 15%
Energy Trust, OR	CLEAResult	Energy Trust developed the performance-based EPS track in 2008, in response to a more stringent state building code.	2015	4,192	3,420	816	The program continues to perform well, with the market share of program homes in Oregon increasing from 21% in 2013 to 36% in 201; the program attained its electric and gas savings goals in both 2014 and 2015.

* Gross MWh are values determined by evaluators and were taken from final evaluation reports. These values were also used to calculate kWh/home.

**Measures shown for the Focus On Energy program reflect a 5% increase in efficiency for all tiers (implemented in 2016). The program is currently being redesigned with updates to be introduced in October 2017.

ENERGY STAR certification alone does not ensure savings. A recent evaluation of the ENERGY STAR homes program offered by Wisconsin's Focus on Energy did not find electric savings and found only small gas savings. Consequently, the Wisconsin program is being redesigned to incent beyond-code construction. This approach is expected to deliver greater future savings.

Generally, program participation is dependent on factors that are more likely to be present in urban areas. Such factors include the presence of high volume "production" builders, access to a pool of efficiency raters, available inventory of efficient equipment, and subcontractors—such as HVAC technicians, insulation specialists, electricians, and plumbers—skilled in efficient home construction.

The Energy Trust of Oregon 2014–2015 process evaluation[49] specifically discussed challenges faced by program participation in rural eastern Oregon. Cadmus notes that similar challenges constrain participation in new home programs within Pacific Power's eastern Washington territory. As discussed, Pacific Power offers new construction measures through the HES program within this service territory.

[49] Evergreen Economics. *2014–2015 New Homes Program Process Evaluation.* March 17, 2016.

Cost-Effectiveness

In assessing HES program cost-effectiveness, Cadmus analyzed program benefits and costs from five different perspectives using the company's DSM Portfolio Pro model.[50] The California Standard Practice Manual for assessing demand-side management (DSM) programs' 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 the combined perspectives of Pacific Power and its customers. On the benefit side, this 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 the combined perspectives of Pacific Power and its Power customers. 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. 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. 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, and costs included a measure's incremental cost (compared to the baseline measures), plus installation costs incurred by the customer.

Table 62 summarizes the five tests' components.

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

Table 62. 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 63 provides selected cost analysis inputs for each year, including evaluated energy savings, discount rates, line losses, inflation rates, and total program costs. Pacific Power provided all of these values, except energy savings.

Table 63. Selected Cost Analysis Inputs

Input Description	2015	2016	Total
Evaluated Energy Savings (kWh/year)*	8,603,603	6,327,421	14,931,016**
Discount Rate	6.66%	6.66%	N/A
Line Loss	9.67%	9.67%	N/A
Inflation Rate**	1.9%	1.9%	N/A
Total Program Costs	**$2,597,143**	**$2,458,678**	**$5,055,821**

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

**Savings may not sum due to rounding.

***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.[51] For all analyses, Cadmus used avoided costs associated with Pacific Power's 2015 *IRP Westside Class 2 DSM Decrement Values*.[52]

Cadmus analyzed HES program cost-effectiveness for evaluated savings.

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

[52] PacifiCorp's *Class 2 DSM Decrement Study* details the IRP decrements. August 8, 2015. Available online: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2015/2015_Class_2_DSM_Decrement_Study.pdf

Table 64 provides the annual program non-energy benefits (NEIs) from the appliance measure category.

Table 64. HES Annual NEIs

Measure	Year	Annual Value	Perspective Adjusted	NEIs	Source
Clothes Washer	2015	$ 6,787.32	PTRC, TRC, PCT	Water, Sewer, and Detergent	Washington TRL
Kits	2015	$ 211,319.18	PTRC, TRC, PCT	Water, Sewer, and Avoided Light Bulb Replacement	Washington TRL
Light Bulbs—CFL	2015	$ 188,062.35	PTRC, TRC, PCT	Avoided Lightbulb Replacement	Washington TRL
Light Bulbs—LED	2015	$ 188,902.56	PTRC, TRC, PCT	Avoided Lightbulb Replacement	Washington TRL
Clothes Washer	2016	$ 4,300.20	PTRC, TRC, PCT	Water, Sewer, and Detergent	Washington TRL
Hybrid Heat Pump Clothes Dryer	2016	$ 5.70	PTRC, TRC, PCT	Operation and Maintenance	Washington TRL
Kits	2016	$ 91,481.66	PTRC, TRC, PCT	Water, Sewer, and Avoided Light Bulb Replacement	Washington TRL
Ductless Heat Pump	2016	$ 7,868.07	PTRC, TRC, PCT	Operation and Maintenance	Washington TRL
Light Bulbs—CFL	2016	$ 121,505.48	PTRC, TRC, PCT	Avoided Lightbulb Replacement	Washington TRL
Light Bulbs—LED	2016	$ 120,833.34	PTRC, TRC, PCT	Avoided Lightbulb Replacement	Washington TRL

Table 65 presents the 2015–2016 program cost-effectiveness analysis results, accounting for NEIs. Under this scenario, the HES program proved cost-effective from all perspectives, except the RIM test. In Washington, the primary criterion for assessing cost-effectiveness is the PTRC with NEIs, which achieved a 1.93 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: while energy efficiency programs reduce costs, they also reduce energy sales. As a result, the average rate per energy unit 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 65. 2015–2016 Gross Evaluated HES Program Cost-Effectiveness Summary (Including NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits*	Benefit-Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$9,502,938	$18,373,440	$8,870,502	1.93
TRC No Adder	$0.069	$9,502,938	$17,297,269	$7,794,331	1.82
UCT	$0.026	$3,527,382	$10,761,707	$7,234,325	3.05
RIM Test		$15,983,156	$10,761,707	($5,221,449)	0.67
PCT		$7,589,198	$20,604,978	$13,015,781	2.72
Life Cycle Revenue Impacts ($/kWh)					$0.000083432
Discounted Participant Payback (years)					3.23

*Net benefits may not total due to rounding.

Table 66 presents the 2015 program cost-effectiveness analysis results, accounting for NEIs. For this scenario, the HES program proved cost-effective from all perspectives, except for RIM.

Table 66. Gross HES Program Cost-Effectiveness Summary for 2015 (Including NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits*	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$5,563,212	$11,045,064	$5,481,852	1.99
TRC No Adder	$0.069	$5,563,212	$10,426,652	$4,863,439	1.87
UCT	$0.020	$1,596,714	$6,184,126	$4,587,412	3.87
RIM		$8,816,605	$6,184,126	($2,632,480)	0.70
PCT		$4,680,341	$12,176,260	$7,495,919	2.60
Lifecycle Revenue Impacts ($/kWh)					$0.000042226
Discounted Participant Payback (years)					3.09

*Net benefits may not total due to rounding.

Table 67 presents the 2016 program cost-effectiveness analysis results, accounting for NEIs. For this scenario, the HES program again proved cost-effective from all perspectives, except for the RIM test.

Table 67. Gross HES Program Cost-Effectiveness Summary for 2016 (Including NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits*	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$4,201,759	$7,816,445	$3,614,686	1.86
TRC No Adder	$0.069	$4,201,759	$7,328,200	$3,126,442	1.74
UCT	$0.034	$2,058,557	$4,882,448	$2,823,891	2.37
RIM		$7,643,149	$4,882,448	($2,760,701)	0.64
PCT		$3,102,586	$8,989,728	$5,887,142	2.90
Lifecycle Revenue Impacts ($/kWh)					$0.000044194
Discounted Participant Payback (years)					2.43

*Net benefits may not total due to rounding.

Table 68 presents the 2015–2016 program cost-effectiveness analysis results, excluding NEIs. For this scenario, the HES program proved cost-effective from the PTRC, UCT, and PCT perspectives, and achieved a 1.25 benefit-cost ratio for the combined years' evaluated savings.

Table 68. 2015–2016 Evaluated Gross HES Program Cost-Effectiveness Summary (Excluding NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits*	Benefit-Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$9,505,211	$11,837,878	$2,332,667	1.25
TRC No Adder	$0.069	$9,505,211	$10,761,707	$1,256,496	1.13
UCT	$0.026	$3,526,732	$10,761,707	$7,234,975	3.05
RIM		$15,982,506	$10,761,707	($5,220,799)	0.67
PCT		$7,589,198	$14,066,492	$6,477,295	1.85
Lifecycle Revenue Impacts ($/kWh)					$0.000083421
Discounted Participant Payback (years)					5.47

*Net benefits may not total due to rounding.

Table 69 presents the 2015 program cost-effectiveness analysis results, not accounting for NEIs (except those represented by the 10% conservation adder included in the PTRC). For this scenario, the HES program proved cost-effective from all test perspectives, except for the RIM test.

Table 69. HES Program Cost-Effectiveness Summary for 2015 (Excluding NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits*	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$5,563,212	$6,802,538	$1,239,326	1.22
TRC No Adder	$0.069	$5,563,212	$6,184,126	$620,913	1.11
UCT	$0.020	$1,596,714	$6,184,126	$4,587,412	3.87
RIM		$8,816,605	$6,184,126	($2,632,480)	0.70
PCT		$4,680,341	$7,933,734	$3,253,393	1.70
Lifecycle Revenue Impacts ($/kWh)					$0.000042226
Discounted Participant Payback (years)					5.80

*Net benefits may not total due to rounding.

Table 70 presents the 2016 program cost-effectiveness analysis results, not accounting for NEIs (except those represented by the 10% conservation adder included in the PTRC). For this scenario, the HES program proved cost-effective from the all test perspectives except the RIM test perspective.

Table 70. HES Program Cost-Effectiveness Summary for 2016 (Excluding NEIs)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits*	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.069	$4,204,536	$5,370,693	$1,166,157	1.28
TRC No Adder	$0.069	$4,204,536	$4,882,448	$677,913	1.16
UCT	$0.034	$2,058,557	$4,882,448	$2,823,891	2.37
RIM		$7,643,149	$4,882,448	($2,760,701)	0.64
PCT		$3,102,586	$6,541,200	$3,438,614	2.11
Lifecycle Revenue Impacts ($/kWh)					$0.000044194
Discounted Participant Payback (years)					4.02

*Net benefits may not total due to rounding.

Conclusions and Recommendations

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

- ***watt*smart Kit Participant Phone Numbers:** As the ***watt***smart kit measure administrator did not collect kit participant phone numbers or e-mail addresses, Pacific Power filled in data, where available, using their own customer database. While this is a small detail to operate the program efficiently, it created additional strain on evaluation efforts and Pacific Power to update program administrator data with kit participant phone numbers.

  Recommendation: wattsmart kit program administrator to collect kit participant phone numbers and e-mail addresses for kit program survey data collection activities.

- **Upstream Lighting Point-of-Sale Merchandizing Data:** Program tracking data did not include information about high-visibility product placements or merchandising within retail locations. Decreasing the price of efficient lighting products primarily drives sales, but merchandising also can generate substantial sales lift. Without these data, Cadmus cannot attribute merchandizing's effect on the program.

  Recommendation: Track dates and locations for all merchandising and product placement the program is responsible for. Providing model numbers, store locations, dates, and display types (e.g., end caps, pallet displays) allows more precise estimates of program-generated sales lift.

- **Lighting Reported Savings:** Pacific Power updated their reported lighting unit energy savings in January of 2015 and again in January of 2016, based on the latest RTF measure workbooks available in mid-2013 and 2015, respectively. The majority of bulbs were incented during 2015 with reported savings based on older versions of the RTF workbooks. 77% of 2015–2016 CFL bulbs deriving reported savings using wattage baselines from the RTF CFL v2.2 workbook and the RTF specialty CFL v1.3 workbook, both of which were published in 2012. 58% of LED bulb savings using baseline wattages derived from RTF LED v2.12, published in 2013. The evaluation employed RTF v4.2, published in January 2016—approximately during the middle of the evaluation period. The misalignment between the market baseline wattages assumed in reported and evaluated savings, and not program delivery, impacted the lighting realization rates.

  Recommendation: Cadmus recognizes program planning and the release of new RTF workbooks may not always align. Where feasible and applicable, Cadmus recommends adhering to the latest RTF workbook.

- **Non-Lighting Incentive Processing Times.** Although 79% of non-lighting participants reported satisfaction with the time between submitting their application and receiving their incentive payment, 27%, a significant increase over 2013 2014, waited more than eight weeks. This increase became most apparent in 2016 (effective January 1, 2016) and likely resulted from large-scale program changes to DSM Central (DSMC), which still was relatively new to PacifiCorp and CLEAResult. Additionally, staffing changes at the program administrator and incomplete

applications submitted by customers confused about supplemental paperwork requirements contributed to incentive payment delays.

Recommendation: Provide customers and contractors with clear, concise directions via the applications and the website, regarding submittal requirements specific for each measure. Monitor training and performance of administrator staff managing incentive processing. At the end of 2017, review incentive payment timeframes compared to those at the end of 2016, to determine whether the number of projects paid in less than four weeks are increasing and those paid in more than eight weeks, are decreasing.

Appendices

A separate volume contains the following appendices:

Appendix A. Survey and Data Collection Forms

Appendix B. Lighting Demand Elasticity Modeling

Appendix C. Billing Analysis

Appendix D. Self-Report NTG Methodology

Appendix E. Self-Report NTG Findings

Appendix F. Nonparticipant Spillover

Appendix G. Measure Category Cost-Effectiveness

Appendix H. Logic Model

Appendix I. Benchmarking

CADMUS

Appendix A. Survey Instruments and Data Collection Tools

PacifiCorp HES Program Management Interview Guide
PY 2015-2016

Name:

Title:

Interviewer:

Date of Interview:

Introduction

The purpose of the interview is to collect background and insight on the design and implementation of the HES program, from your perspective. We will use input from a variety of staff involved with the program to describe how the program worked during 2015 and 2016, 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. How long have you been involved?
2. Who are the other key PacifiCorp staff involved in the 2015 and 2016 program period and what are their roles?

Program Goal and Objectives:

3. How would you describe the main objective of the 2015 and 2016 HES Program?
4. In general, how did the program perform in 2015 and 2016, relative to what you expected? Did any measure not meet, or exceed, participation targets? If appropriate, please review state by state.
5. 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)?

Program Design:

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

6. Were there any major changes in program design in 2015 and 2016 relative to 2013 and 2014? For example, with regard to eligible measures, eligible customers, delivery channel, or other aspects of program design? [For each change: what led to the change? Was the objective of the change realized, in your opinion? Verify the following are discussed:
    a. Upstream
        i. Adding LEDs/reducing CFLs
        ii. Adding APS
    b. Rebates
        i. Eliminating lighting fixtures
        ii. Changes to clothes washers, other appliances]
7. How did the program differ among the five states in 2015 - 2016?
8. According to staff interviews in 2014, the HES program is designed to deliver prescriptive efficiency measures across residential market segments, which might include low- and standard income, rural and urban, etc. How did the program target different segments within the residential market in 2015 - 2016?
    a. How has the program's approach to serving multifamily customers changed over the past two years, if at all?
    b. How has the program's approach to serving the new single family homes market changed over the past two years, if at all?
9. [If not answered above] In 2013-2014, the program introduced kits and Simple Steps retailer participation for lighting. How did these initiatives perform in 2015-2016?
10. What do you think are the program's most notable successes in the 2015-2016 period?
11. Conversely, what aspects of the program do you think did not work as well as anticipated?
12. What barriers or challenges did the program face in 2015-2016? What was done/what is planned to address them?
13. Could you describe [PacifiCorp's/CLEAResult's] QA/QC processes in 2015-2016? [Probe: what are PC/CLEAResults methods for validating Trade Ally workmanship, verifying rebate application information, review of program data tracking, or other QC?]

14. Now I would like to know about any changes you anticipate for the 2017-18 cycle. Let's start with eligible measures. What measures do you think you might add to the program, or expand to new states? What measures might be eliminated, or pulled out of certain states? Are there any measures that you are planning to research for possible inclusion in the future?
15. Are there any other changes you anticipate for 2017-18? These might include changes to rules for participating retailers or trade allies, changes to application forms or processing, or new marketing approaches.

Program Marketing

These next questions will go into more detail on particular aspects of program implementation, starting with marketing.

16. Do you have a marketing plan from 2015-2016 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 ***watt***smart vs program specific (HES)?
    d. Is marketing targeted to specific segments of the population? If so, how is it tailored to different groups?
17. Did any of the marketing in 2015-2016 represent a change from previous years? Which strategies were new, and why did you adopt those new strategies?
18. Did you track marketing effectiveness? What did you track?
    a. What was the most effective marketing channel? (Why do you say this?)
    b. What do you think is the most important messaging, by retail channel?

Customer Experience

Thank you. Next I'd like to learn more about the customer's experience, and how you monitor that.

19. Do 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? Feedback may come through exit surveys, call center reports, or other channels.)

20. What feedback did you receive from customers about the program? (Probe: incentive levels, timing for project approvals, incentive payments, satisfaction with studies, trade allies, etc.)
21. What are the most common questions you get from customers about the program?
22. What do you think participants are most pleased with, in terms of their experience with the program?
23. What do you think they are least please with? Why do you say that?
24. Do you monitor customer satisfaction ratings by contractor?
25. Please describe the process to complete, submit, correct and approve a rebate application. (Probe: responsible party, method of submittal, check recipient.)
26. Were any changes made to the rebate application forms in 2015 or 2016? (Note: recommendations from last evaluation included reviewing applications for duct sealing and insulation applications for opportunities to streamline, and offering additional training for contractors to mitigate data entry error issues (UT 2013-14 Report))
27. Does CLEAResult have a target application processing time? What is the average time to process an application?
28. Are you aware of any common application errors, or parts of the application that customers have difficulty completing?
29. Do you track the rate of application errors? Have you noticed any change in the number of customer or contractor errors on rebate applications since 2014?

Trade Ally Experience

Now I'd like to discuss Trade Allies.

30. Please tell me about how the program works with trade allies. What are trade ally roles and responsibilities with regard to the program?
31. How many trade allies participated in the program, by state? (I can follow up later for the exact figures.) Was this more or fewer than the 2013-14 cycle?
32. How did the program recruit trade allies (contractors and retailers)? [Probe: program staff have indicated that it has been difficult to recruit trade allies this year.]
33. Do you feel you had sufficient trade allies to support the program? Why or why not?

34. What barriers have the trade allies said they encounter with the program, if any?
    a. How has the program addressed these barriers?
35. What kind of training was required and/or offered for trade allies? How frequently and on what topics? How was training distributed across states?
36. What marketing resources or sales training id the program provide to trade allies?
37.

Data Tracking and Savings

These last questions ask about data tracking activities.

38. Please tell us about program data tracking for each channel: upstream, rebates, and kits.
39. Did the data tracking systems in place meet your needs? Why or why not?
40. How do PacifiCorp program staff receive tracking data during the year? Does CLEAResult send reports, or do they have access to real-time data, such as through an online portal?
41. How do PacifiCorp and CLEAResult Program staff monitor progress against savings goals? (Probe: how often is progress reviewed? Is it reviewed at the measure level, or channel level? Is it reviewed in the same manner for all states?)
42. How were savings deemed for each program measure? How often were the unit energy savings values updated in the tracking data?]

Closing

43. Cadmus has budgeted for benchmarking research for the 2015-2016 process evaluation. We would like to know what aspects of program design or performance you would be interested in comparing to other programs around the country. Typically, this might include participation level, incentive levels, comparison of eligible measures, or other aspects of program design or performance.
44. Are there other topics you are interested in learning more about from our evaluation this year?

Thank you very much for your time today!

CADMUS

PacifiCorp Home Energy Savings *watt*smart Starter Kit Survey (2016 Participants)

*Audience: This survey is designed for PacifiCorp residential customers in Idaho, Utah, California, Wyoming and Washington who received energy efficiency kits through HES in 2016. The primary purpose of this survey is to collect information on receipt of the kit, installation and satisfaction of kit items, **watt**smart/Homes Energy Savings Program awareness and satisfaction. This survey will be administered through telephone calls.*

Quota: 35 completed surveys for CFLs and 35 for LEDs for each state (ID, UT, CA, WY and WA) (350 total)

Topics	Researchable Questions	Survey Questions
Receipt of kit	Did the customer receive (or recall receiving) the ***watt***smart 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, D3, D9D11
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,D2, D3
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,D4-D5,E1-E4,E10
Program awareness	How did the customer hear about the ***watt***smart Home Energy Savings Starter Kit? Are kit recipients familiar with Home Energy Savings program (Home Energy Savings)? Have they received other incentives from ***watt***smart?	E5, E6, E7
NTG	What is the freeridership and spillover associated with this program.	B8-B14, B23-B26, C6-C8, D6-D8, D14-D16, 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, California: Pacific Power

Idaho, Utah, Wyoming: Rocky Mountain Power

[KIT TYPE]

Kit Name	Kit Type	Quantity CFLs	Quantity LEDs	Quantity Kitchen Aerators	Quantity Bath Aerators	Quantity Showerheads	Cost of Kit
Basic 1	1	4	0	1	1	1	$0
Basic 2	2	4	0	1	2	2	$0
Better 1	3	4	0	1	1	1	$4.99
Better 2	4	4	0	1	2	2	$4.99
Best 1	5	0	4	1	1	1	$4.99
Best 2	6	0	4	1	2	2	$4.99
CFL Only	7	4	0	0	0	0	$0
LED Only	8	0	4	0	0	0	$4.99

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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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 *WATT*SMART 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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"]***

2. Yes
3. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**
98. Don't Know
99. Refused

A6b. One kitchen faucet aerator

4. Yes
5. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**
98. Don't Know
99. Refused

A6c. **[BATHROOM FAUCET AERATOR QUANTITY]** bathroom faucet aerator(s)

6. Yes
7. No **[ASK: WHAT DID YOU RECEIVE IN YOUR KIT?]**
98. Don't Know
99. Refused

A6d. **[SHOWERHEAD QUANTITY]** showerhead (s)

8. Yes
9. 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= 7 AND A5=1] OR [KIT TYPE=8 AND A5=2 AND CORRECTED BULB TYPE IS CFL] OR [KIT TYPE = 1-4 AND A6A=1] OR [KIT TYPE= 5-6 AND A6A=2 AND CORRECTED BULB TYPE IS CFL] OTHERWISE SKIP TO B15]

[IF [A5 = 98 OR 99] OR [A6.A6A = 98 OR 99] OR [IF A6.A6A = 2 AND THE CORRECTED QUANTITY IS ZERO] OR [A5=2 AND THE CORRECTED QUANTITY IS 0] THEN SKIP TO SECTION C]

B1. Of the ***[CORRECTED CFL QUANTITY]*** 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 ***[[CORRECTED CFL QUANTITY]-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 [CORRECTED CFL QUANTITY] -B1.1– B2.1>0 (CONTINUE)]

B4. Why wasn't/weren't the ***[QUANTITY NEVER INSTALLED: [CORRECTED CFL QUANTITY]-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. ***O***verall, 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 ***watt***smart 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. **[ASK IF KIT TYPE = 7]** Were you aware of the option to upgrade your kit from CFLs to LED bulbs for $4.99?

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 $4.99, 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 =8 AND A5=1] OR [KIT TYPE=7 AND A5=2 AND CORRECTED BULB TYPE IS LED] OR [KIT TYPE = 1-4 AND A6A=2 AND CORRECTED BULB TYPE IS LED] OR [KIT TYPE = 5-6 AND A6A=1] OTHERWISE SKIP TO SECTION C]

B15. Of the ***[CORRECTED LED QUANTITY]*** 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 ***[[CORRECTED LED QUANTITY]-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 [corrected led quantity] - B15.1- B16 >0 (CONTINUE)]

B18. Why wasn't/weren't the ***[QUANTITY NEVER INSTALLED: [CORRECTED LED QUANTITY] - 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 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 , 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 CAND D IF KIT TYPE = 1-6, OTHERWISE SKIP TO SECTION E]

C. High-Efficiency Showerheads

[IF A6D= 98 OR 99, OR IF A6D = 2 AND THE CORRECTED QUANTITY IS ZERO THEN SKIP TO SECTION D]

C1. How many of the ***[CORRECTED SHOWERHEAD QUANTITY]*** high-efficiency showerhead(s) you received are currently installed in your home?

1. Record _____ ***[IF RESPONSE = CORRECTED SHOWERHEAD QUANTITY, SKIP TO C4]***
98. Don't know ***[SKIP TO C5]***

C2. Why is/are the ***[CORRECTED SHOWERHEAD QUANTITY - INSERT C1.1 QUANTITY]*** high-efficiency showerhead(s) not currently installed?? **[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

[IF A6B = 98 OR 99, OR IF A6B = 2 AND THE CORRECTED QUANTITY IS ZERO THEN SKIP TO D9]

D1. Is the kitchen faucet aerator you received in the kit currently installed in your home?

1. Yes ***[SKIP TO D4]***
2. No ***[CONTINUE]***

98. Don't know ***[SKIP TO D5]***

D2. 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

D3. 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

D4. 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

D5. **[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

D6. 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)

D7. 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)

D8. **[ASK IF D7 = 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)

[IF A6C = 98 OR 99, OR IF A6C = 2 AND THE CORRECTED QUANTITY IS ZERO THEN SKIP TO SECTION E]

D9. How many of the ***[CORRECTED BATHROOM FAUCET AERATOR QUANTITY]*** bathroom faucet aerator(s) you received are currently installed in your home?

1. Record_____ ***[IF RESPONSE = CORRECTED BATHROOM FAUCET AERATOR QUANTITY, SKIP TO D12***
98. Don't know ***[SKIP TO D13]***

D10. Why is/are the ***[CORRECTED BATHROOM FAUCET AERATOR QUANTITY]*** bathroom faucet aerator(s) not currently installed? **[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

D11. 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

D12. 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

D13. **[IF D9.1 = 0 OR D9= 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

D14. 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)

D15. 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)

D16. **[ASK IF D15 = 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 ***watt***smart 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 watt***smart 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart Home Energy Savings Program
16. Other **[RECORD]**
98. Don't Know
99. Refused

F. Spillover

F1. Since receiving the ***watt***smart Home Energy Savings Starter Kit have you added any other energy efficient equipment or services in your home that were not incentivized through the ***watt***smart 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 receiving the Kit? ***[IF NEEDED: WE ARE INTERESTED IN KNOWING ABOUT ANY EQUIPMENT OR SERVICES YOU ADDED TO YOUR HOME, BESIDES THOSE INCLUDED IN THE KIT, FOR WHICH YOU DID NOT RECEIVE AN INCENTIVE THROUGH THE WATTSMART HOME ENERGY SAVINGS PROGRAM. PROMPT IF NEEDED] MULTIPLE RESPONSE***

1. Clothes Washer **[RECORD QUANTITY]**
2. Refrigerator **[RECORD QUANTITY]**
3. Dishwasher **[RECORD QUANTITY]**
4. Windows **[RECORD QUANTITY IN SQ FT]**
5. Light 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. LED bulbs **[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 = 19 (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. 2015
2. 2016
4 2017
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 ***watt***smart 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 **[IF KIT TYPE = 1-6, ASK "ARE YOU AWARE THAT YOU HAVE TO HAVE AN ELECTRIC WATER TO RECEIVE ANY FAUCET AERATORS OR SHOWERHEADS?" (RESPONSE OPEN END)]**
3. Fuel oil **[IF KIT TYPE = 1-6, ASK "ARE YOU AWARE THAT YOU HAVE TO HAVE AN ELECTRIC WATER TO RECEIVE ANY FAUCET AERATORS OR SHOWERHEADS?" (RESPONSES OPEN END)]**
4. Other **[OPEN ENDED, WRITE RESPONSE] [IF KIT TYPE = 1-6, ASK "ARE YOU AWARE THAT YOU HAVE TO HAVE AN ELECTRIC WATER TO RECEIVE ANY FAUCET AERATORS OR SHOWERHEADS?" (RESPONSE OPEN END)]**
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

PacifiCorp Manufactured Homes Duct Sealing 15-16 Participant Survey

Audience: This survey is designed for PacifiCorp residential customers in California, Idaho, and Washington that participated in the manufactured homes duct sealing offer in 2016.

Purpose: this survey will collect information on HES program awareness, motivations to participate, satisfaction, freeridership and spillover effects. This survey will be administered through telephone calls.

Quota: Aim for the following number of completed surveys for each state (CA, ID, and WA)

	Sample (survey quota)
CA	15
ID	59
WA	15

Topics	Researchable Questions	Survey Questions
Program Awareness and Participation Decisions	How did the customer learn about the duct sealing retrofit measure? What role did the website play in informing the customer? Why did the customer choose to participate?	Section B
Behavioral Changes	Has customer heating or cooling behavior changed since the duct sealing? Has the customer noticed a difference in home comfort?	Section C
Satisfaction	With the contractor? With the process to sign up and time it took to complete the work? With the offer overall?	Section D
Net-to-Gross	Self-reported freeridership and spillover	Section E and Section F
Demographics	Customer household information for statistical purposes	Section G

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

[UTILITY]
Washington and California: Pacific Power

Idaho: Rocky Mountain Power

[YEAR OF PARTICIPATION]

[SITE ADDRESS]

A. Introduction

A1. **[TO RESPONDENT]** Hello, I'm ***[INSERT FIRST NAME]*** and I am calling from ***[INSERT SURVEY FIRM]*** on behalf of ***[INSERT UTILITY].*** We are exploring the impacts of ***[INSERT UTILITY]'S*** energy efficiency improvement offerings in your area. I would like to ask you some questions about your recent participation in the duct sealing offer from ***[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 DUCT SEALING OFFER 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 THE FREE DUCT SEALING THAT YOU RECEIVED.

(SALES CONCERN: I AM NOT SELLING ANYTHING; WE WOULD SIMPLY LIKE TO LEARN ABOUT YOUR EXPERIENCE WITH THE PROGRAM. YOUR RESPONSES WILL BE KEPT CONFIDENTIAL. IF YOU WOULD LIKE TO TALK WITH SOMEONE FROM THE WATTSMART HOME ENERGY SAVINGS PROGRAM TO VERIFY THE LEGITIMACY OF THIS STUDY, PLEASE CALL NIKKI KARPAVICH AT 801-220-4439.)

(WHO IS DOING THIS STUDY: [INSERT UTILITY], YOUR ELECTRIC UTILITY, IS CONDUCTING EVALUATIONS OF SEVERAL OF ITS EFFICIENCY PROGRAMS, INCLUDING THE WATTSMART HOME ENERGY SAVINGS PROGRAM.)

(WHY YOU ARE CONDUCTING THIS STUDY: STUDIES LIKE THIS HELP [INSERT UTILITY] BETTER UNDERSTAND CUSTOMERS' NEEDS AND INTEREST IN ENERGY PROGRAMS AND SERVICES.)

A2. Our records show that in ***[INSERT YEAR], [INSERT UTILITY]*** provided you with a free inspection and sealing of your HVAC ducts. We're talking with customers about their experiences with this offer. 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 participate?

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 ***[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. Program Awareness & Participation Decisions

B1. How did you first hear about ***[INSERT UTILITY]***'s ***watt***smart Home Energy Savings program? **[IF NEEDED: "THIS IS THE NAME OF THE PROGRAM YOU PARTICIPATED IN TO TEST AND SEAL YOUR HVAC DUCTS."] [DO NOT PROMPT. RECORD ONLY THE FIRST WAY HEARD ABOUT THE PROGRAM.]**

1. Property Operator
2. A program affiliated contractor
3. Bill Inserts
4. Neighbor/family/friends/word-of-mouth
5. Rocky Mountain Power/Pacific Power Representative
6. Rocky Mountain Power/Pacific Power website
7. ***watt***smart Home Energy Savings website
8. Home Energy Reports
9. Home and Garden Shows
10. Social Media/Internet Advertising/Online Ad
11. Newspaper/Magazine/Print Media
12. Other website
13. Radio
14. Retailer/Store
15. Social Media
16. Sporting event
17. TV
18. Other **[RECORD VERBATIM]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

B2. ***[ASK IF E5 <> 6 0R 7, OTHERWISE SKIP TO B3]*** Prior to participating in the duct sealing offer, did you visit the ***[INSERT UTILITY]*** ***watt***smart Home Energy Savings program website to learn about the details of the offer? **[DO NOT READ RESPONSES]**

1. Yes
2. No

B3. ***[ASK IF E5 = 6 0R 7, OR IF B2 = 1, OTHERWISE SKIP TO E10]*** How helpful did you find the website—would you say it was … **[READ]**

1. Very helpful ***[SKIP TO E10]***
2. Somewhat helpful
3. Not very helpful
4. Not at all helpful
98. **[DO NOT READ]** Don't Know[SKIP TO B5]
99. **[DO NOT READ]** Refused[SKIP TO B5]

B4. ***[ASK IF B3= 2, 3, OR 4. OTHERWISE SKIP TO E10]*** 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
3. Make program information more clear and concise
4. Incorporate more visual information and less text
5. Provide easier access to customer service or FAQs
6. Other **[RECORD]**

B5. Please think back to the time when you were deciding to participate in the duct sealing offer**.** What factors motivated you to have your ducts tested and sealed through the ***watt***smart Home Energy Savings Program**?** **[DO NOT READ. INDICATE ALL THAT APPLY. ONCE THEY RESPONDENT HAS FINISHED, SAY: "ARE THERE ANY OTHER FACTORS?"]**

1. HVAC/heating/cooling equipment working poorly
2. Health or medical reasons
3. Maintain or increase comfort of home
4. The fact that it was offered for free
5. Wanted to save energy and reduce energy costs
6. Environmental concerns
7. Recommendation from friend, family member, or colleague
8. Recommendation from a contractor
9. Other **[RECORD]**

98. Don't Know
99. Refused

B6. What type of heating system do you primarily use? Do you use… **[READ]**

1. Electric Furnace
2. Gas Furnace
3. Boiler
4. Air Source Heat Pump
5. Ground Source Heat Pump
6. Wood or Pellet Stove
7. Baseboard electric heaters
8. Portable electric heaters
9. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

B7. How many years old is the heating system?

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

B8. What type of central cooling system do you primarily use? Do you use a… **[READ, MULTIPLE CHOICES ALLOWED]**

1. Evaporative Cooler
2. Air Source Heat Pump
3. Ground Source Heat Pump
4. Whole house fan
5. Central Air Conditioner (other than those listed above)
6. Window Air Conditioner
7. No central cooling system ***[SKIP TO C3]***
8. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

B9. How many years old is your current cooling system?

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

C. Behavioral Changes

C1. Prior to having your ducts inspected and sealed, at what temperature did you typically set your thermostat for cooling in the summer? If you change the setting regularly, please estimate the average setting.

1. **[RECORD RESPONSE]**
2. Don't use thermostat in the summer/don't have central cooling ***[SKIP TO C3]***
98. Don't Know ***[SKIP TO C3]***
99. Refused ***[SKIP TO C3]***

C2. And since having your ducts inspected and sealed, at what temperature do you typically set your thermostat for cooling in the summer?

1. **[RECORD RESPONSE]**
2. Same/no change
98. Don't Know
99. Refused

C3. Prior to having your ducts inspected and sealed, at what temperature did you typically set your thermostat for heating in the winter? If you change the setting regularly, please estimate the average setting.

1. **[RECORD RESPONSE]**
2. Don't use thermostat in the winter/don't have central heating ***[SKIP TO C5]***
98. Don't Know ***[SKIP TO C5]***
99. Refused ***[SKIP TO C5]***

C4. And since having your ducts sealed, at what temperature do you typically set your thermostat for heating in the winter?

1. **[RECORD RESPONSE]**
2. Same/no change
98. Don't Know
99. Refused

C5. In general, have you noticed any difference in your home thermal comfort since having your ducts sealed? Do you feel… **[READ]**

1. More comfortable
2. Less comfortable
3. No change

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

D. Satisfaction

D1. Thank you. Now I would like to ask a few questions about your satisfaction with the duct sealing retrofit in your home. ***HOW SATISFIED WERE YOU WITH THE PROFESSIONALISM AND ATTITUDE OF THE CONTRACTOR THAT PERFORMED THE DUCT TESTING AND SEALING?*** **[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

D2. **[IF D1 = 3 OR 4]** Why were you not satisfied with the contractor that performed the duct testing and sealing?

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

D3. How easy or difficult did you find the process to sign up for the initial duct testing appointment? **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Easy
2. Somewhat Easy
3. Somewhat difficult **[PROBE: WHY DO YOU SAY THAT? RECORD]**
4. Very difficult **[PROBE:WHY DO YOU SAY THAT? RECORD]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D4. About how many days passed from when you first set up an appointment to have your ducts tested and sealed, and when a contractor first visited your house?

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

D5. About how many days passed from when the contractor first visited your house and when they completed the work?

1. **[RECORD]**
2. None, the work was completed in the same day
98. Don't know
99. Refused

D6. All in all, how many visits did the contractor (or contractors) make to your house to complete the work?

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

D7. Did your participation in ***[INSERT UTILITY]***'s duct sealing offer 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

E. Freeridership

Now I'd like to talk with you a little more about the duct sealing project.

E1. When you first heard about the duct sealing offer from ***[INSERT UTILITY] THROUGH THEIR watt***smart Home Energy Savings program, had you already been planning to have your ducts sealed?

1. Yes
2. No ***[SKIP TO E7]***
98. Don't Know ***[SKIP TO E7]***
99. Refused ***[SKIP TO E7]***

E2. Would you have had your ducts tested and sealed without the ***watt***smart Home Energy Savings program?

1. Yes
2. No ***[SKIP TO E5]***
98. Don't Know
99. Refused

E3. Let me make sure I understand: without the program would you have had your ducts both tested and sealed?

1. Yes, I would have had the ducts both tested and sealed
2. I would have had the ducts sealed, without the testing
3. I would have had the ducts tested, but not necessarily sealed
4. No, I would not have had any work done on my ducts at all ***[SKIP TO E5]***
98. Don't Know
99. Refused

E4. Without the program incentive would you have had this work on your ducts done**… [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

E5. ***[ASK IF E2=2 OR E3=4]*** To confirm, when you say you would not have had your ducts tested and sealed without the program**,** do you mean you would not have had any work done to your duct system at all?

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

E6. ***[ASK IF E5= 2, 98 OR 99]*** Can you clarify what work you might have done to your duct system without the program?

1. **[RECORD RESPONSE]**

E7. In your own words, please tell me the influence the ***watt***smart Home Energy Savings program incentive had on your decision to test and seal your ducts**?**

1. **[RECORD RESPONSE]**

F. Spillover

F1. Since participating in the duct sealing offer, have you added any other energy efficient equipment or services in your home that were not incentivized through the ***watt***smart Home Energy Savings Program? **[IF NEEDED: IN OTHER WORDS, HAVE YOU PURCHASED ANY HIGH-EFFICIENCY EQUIPMENT OR APPLIANCES, OR MADE ANY EFFICIENCY UPGRADES, THAT YOU PAID FOR YOURSELF AND FOR WHICH YOU DID NOT RECEIVE A REBATE FROM THE UTILITY.]**

1. Yes
2. No ***[SKIP TO G1]***
98. Don't Know ***[SKIP TO G1]***
99. Refused ***[SKIP TO G1]***

[IF F1 = 2, 98 OR 99 SKIP TO G1]

F2. What high-efficiency energy-saving equipment or services have you purchased since participating in the duct sealing offer? ***[LIST OF OTHER ELIGIBLE APPLIANCES AND MEASURES OFFERED IN THE PROGRAM OTHER THAN DUCT TESTING AND SEALING. 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 Tankless 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 = 19, 98 OR 99 SKIP TO G1. REPEAT F3 THROUGH F5 FOR ALL RESPONSES TO F2]

F3. In what year did you purchase the ***INSERT MEASURE TYPE FROM F2]***?

1. 2015
2. 2016
3. 2017
4. Other ***[RECORD YEAR]***
98. Don't Know
99. Refused

F4. Did you receive an incentive for the ***[INSERT MEASURE TYPE FROM F2]?***

1. Yes **[PROBE : Who paid you the incentive for the [MEASURE]?]**
2. No
98. Don't Know
99. Refused

F5. How influential would you say the ***watt***smart Home Energy Savings program was in your decision to add the ***[INSERT MEASURE FROM F2]*** to your home? Was it… **[REPEAT FOR EACH MEASURE LISTED IN F2]**

1. Highly Influential
2. Somewhat Influential
3. Not very influential
4. Not at all influential
98. Don't Know
99. Refused

G. Demographics

I have just a few more questions about the house at ***[SITE ADDRESS]***. Again, all your answers will be strictly confidential.

G1. Do you own this home, or are you the renter?

1. Own
2. Rent
3. Other **[RECORD]**
98. Don't Know
99. Refused

G2. Is this your primary residence?

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

G3. ***[IF G2=2]*** Is the home occupied year-round?

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

G4. ***[IF G3=2]*** How many months of the year is the home occupied, on average?

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

G5. How many people currently live in your home?

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

G6. About when was this home 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

G7. Approximately how many square feet is the home in which the ***DUCT SEALING WAS PERFORMED***? **[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

G8. 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

G9. Can you tell me which of the following categories applies to your total household income for the year 2016? Please stop me when I get to the right one.

1. Under $20,000
2. $20,000 to under $30,000
3. $30,000 to under $40,000
4. $40,000 to under $50,000
5. $50,000 to under $60,000
6. $60,000 to under $80,000
7. $80,000 to under $100,000
8. $100,000 to under $120,000
9. $120,000 or more
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

PacifiCorp HES General Population Survey

Audience: This survey is designed for PacifiCorp residential customers in Utah, Idaho, Washington, Wyoming and California. 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)

Topics	Researchable Questions	Survey Questions
Awareness	Are respondents aware of LED lighting products? Are respondents aware of advanced power strip products?	B1, D1
Installation	What percent of LEDs purchased in the past 12 months were installed in the home? Where were the purchased LEDs installed (room)? What percent of purchased advanced power strips in the past 12 months were installed in the home? Where are the purchased advanced power strips installed (entertainment center or home office)?	C1, C9, C14 D6, D10, D14
Removal and Storage	What percent of LEDs purchased in the past 12 months were removed and why? What percent of LEDs purchased in the past 12 months are in storage for future use? What percent of advanced power strips in the past 12 months were removed and why? What percent of advanced power strips purchased in the past 12 months are in storage for future use?	C10-C13 D11-D13
Satisfaction with LEDs and advanced power strips	How satisfied are respondents with their LEDs? What do they like or dislike about them? How satisfied are respondents with their advanced power strips? What do they like or dislike about them?	C4-C7, C11, C16, C17 D12, D15, D16
Program Awareness	Are respondents aware of the PacifiCorp programs? How did they hear about them? Have respondents visited the Home Energy Savings Website?	Section E
Nonparticipant Spillover	What actions are respondents taking to save energy? Did they receive a rebate from PacifiCorp during the 2015-2016 program period for other equipment purchased? How influential were the PacifiCorp programs in their decision to install the equipment?	Section F

Demographics	How do awareness /activities/behaviors vary by demographic characteristics?	Section G

- 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 energy use and would like to ask you some questions about your household's lighting and appliances. 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 15 to 20 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 APPLIANCE ENERGY USE)

(**Sales concern:** I am not selling anything; we would simply like to learn about your household lighting and appliance 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 and household equipment and appliances 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. Awareness and Purchase of LEDs

B1. Before this call today, had you heard of light emitting diode light bulbs or L-E-D **[SAY THE LETTERS L-E-D]** for short? **[IF NEEDED: THESE BULBS HAVE REGULAR SCREW BASES THAT FIT INTO MOST HOUSEHOLD SOCKETS.]**

1. Yes
2. No

B2. Have you purchased any regular screw base light bulbs in the last twelve months? **[IF NEEDED, REGULAR SCREW BASE LIGHT BULBS ARE THOSE THAT FIT INTO MOST HOUSEHOLD SOCKETS. PLEASE DON'T INCLUDE BULBS YOU MAY HAVE RECEIVED FOR FREE AS PART OF A KIT.]**

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

B3. What kind of regular screw base light bulbs did you purchase in the last twelve months? **[READ RESPONSE OPTIONS AND SELECT ALL THE APPLY]**

1. CFLs **[IF NEEDED: THESE ARE SPIRAL SHAPED INSIDE AND FIT INTO MOST HOUSEHOLD SOCKETS]**
2. ***LED LIGHT BULBS*** **[IF NEEDED: THESE ARE THE NEWEST TECHNOLOGY BULBS THAT FIT INTO MOST HOUSEHOLD SOCKETS]**
3. ***INCANDESCENT LIGHT BULBS*** **[IF NEEDED: THESE ARE THE OLDEST TECHNOLOGY BULBS WITH THE ELEMENT INSIDE]**

4. ***HALOGEN LIGHT BULBS*** **[IF NEEDED: THESE ARE GAS-FILLED INCANDESCENT BULBS THAT FIT INTO MOST HOUSEHOLD SOCKETS]**
5. Other: ***[RECORD VERBATIM]***
98. **[DON'T READ]** Don't Know ***[SKIP TO SECTION D]***
99. **[DON'T READ]** Refused ***[SKIP TO SECTION D]***

B4. ***[ASK IF B3<>2]*** Why did you not choose to purchase LEDs to meet your lighting needs?

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

[IF B3<>2 SKIP TO SECTION D]

C. LED Installation and Satisfaction

C1. In the last 12 months, how many regular screw base *LEDs* did you or your household purchase? Please try to estimate the total number of *individual LED bulbs you purchased*, as opposed to packages. Don't include LEDs you may have received for free as part of a kit. **[IF "DON'T KNOW," PROBE: "IS IT LESS THAN OR MORE THAN FIVE BULBS?" WORK FROM THERE TO GET AN ESTIMATE.**

1. **[RECORD # OF LEDS: NUMERIC OPEN END]** ***[IF C1.1= 0 SKIP TO SECTION D]***
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 SECTION D]***
99. Refused ***[SKIP TO SECTION D]***

C2. As far as you know, were any of the ***[C1.1]*** LEDs you purchased part of a ***[INSERT UTILTY]*** sponsored discount?

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

C3. ***[ASK IF C2= 1, OTHERWISE SKIP TO C4]*** 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

C4. When you purchased those LED bulbs, did you intend to definitely purchase LEDs, or did you consider any other bulb types?

1. I wanted LEDs ***[SKIP TO C7]***
2. Considered other bulb types
98. Don't Know ***[SKIP TO C7]***
99. Refused ***[SKIP TO C7]***

C5. ***[ASK IF C4=2]*** What other types of bulb did you consider? **[IF NEEDED: OTHER COMMON TYPES OF REGULAR SCREW BASE BULBS INCLUDE INCANDESCENT, HALOGEN, AND CFLS]** ***[SELECT ALL THAT APPLY]***

1. Incandescent bulbs
2. Halogen bulbs
3. CFL bulbs
4. Other **[RECORD]**
5. Any type/was not concerned with bulb type ***[SKIP TO C7]***
98. Don't know
99. Refused

C6. What types of regular screw base bulb, if any, would you be unwilling to purchase? **[IF NEEDED: OTHER COMMON TYPES OF REGULAR SCREW BASE BULBS INCLUDE INCANDESCENT, HALOGEN, AND CFL BULBS]** **[SELECT ALL THAT APPLY]**

1. There were no types I would NOT have purchased
2. Would not have purchased incandescent bulbs
3. Would not have purchased halogen bulbs
4. Would not have purchased CFLs
5. Other **[RECORD]**
98. Don't know
99. Refused

C7. What ***[IF C3=1 SAY "OTHER"]*** factors were most important to you when you made the decision to purchase the LED bulbs? **[DO NOT READ. MULTIPLE RESPONSES ALLOWED]**

1. Energy savings or cost savings on electricity bill
2. Price of bulb
3. Cost-effectiveness/best value for the money
4. Environmental concerns
5. CFL disposal concerns
6. Quality (brightness, color) of light
7. Lifetime of bulb
8. Interested in the latest technology
9. Brand (i.e., Philips, Sylvania, etc.)

10. ENERGY STAR
11. There were no other choices
12. Other **[RECORD]**
98. Don't Know
99. Refused

C8. Do you know how many, if any, of the LEDs you purchased are ENERGY STAR certified? **[IF NEEDED: ENERGY STAR CERTIFIED BULBS HAVE THE ENERGY STAR LABEL ON THE PACKAGE. SOME, BUT NOT ALL, LEDS ARE ENERGY STAR CERTIFIED.]**

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

C9. Now I'd like to ask you a few questions about the ***[C1.1]*** 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 C13]***
98. Don't Know ***[SKIP TO C16]***
99. Refused ***[SKIP TO C16]***

C10. Have you since removed any of those LED bulbs from the sockets?

1. Yes **[ASK "HOW MANY DID YOU REMOVE?" RECORD # OF LEDS]**
2. No ***[SET C10.1=0 AND SKIP TO C13]***
98. Don't Know ***[SKIP TO C16]***
99. Refused ***[SKIP TO C16]***

C11. ***[ASK IF C10= 1, OTHERWISE SKIP TO C13]*** What were the reasons you removed the ***[C10.1]*** purchased LEDs from the sockets? **[QUANTITIES SHOULD ADD TO C10.1, 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

C12. ***[ASK IF C10= 1, OTHERWISE SKIP TO C13]*** What type of light bulb did you replace the removed LEDs with? **[MULTIPLE RESPONSES ACCEPTED]**

1. Incandescent bulb
2. Halogen bulb
3. CFL
4. Other: ***[RECORD VERBATIM]***
98. Don't know
99. Refused

C13. ***[ASK IF C1.1-C9.1>0]*** Are any of the ***[C1.1]*** LEDs you purchased in the last twelve months currently in storage for later use? (these are bulbs that you never installed)

1. Yes **[ASK: "HOW MANY ARE NOW IN STORAGE?" RECORD # OF LEDS]** ***[IF C13.1=C1.1, SKIP TO C16]***
2. No
98. Don't Know
99. Refused

C14. ***[ASK IF (C9.1-C10.1)>0 OTHERWISE SKIP TO C16]*** Of the ***[C9.1-C10.1]*** ***LED*** bulbs that are currently installed in your home that were purchased during the last twelve months, can you tell me how many are installed in each room in your house? Please try to count only the LED bulbs that were purchased in the last 12 months.

1. All occupied bedrooms **[RECORD]**
2. All unoccupied bedrooms **[RECORD]**
3. Basement **[RECORD]**
4. All bathrooms **[RECORD]**
5. All closets **[RECORD]**
6. Dining **[RECORD]**
7. Foyer **[RECORD]**
8. Garage **[RECORD]**

9. Hallway **[RECORD]**
10. Kitchen **[RECORD]**
11. Office/Den **[RECORD]**
12. Living space including family rooms, living rooms, rec rooms and similar areas **[RECORD]**
13. Storage areas other than closets **[RECORD]**
14. Outside **[RECORD]**
15. Utility room **[RECORD]**
16. Other **[RECORD VERBATIM]**
98. Don't Know
99. Refused

C15. ***[ASK ONLY IF TOTAL BULBS IN C14 PLUS C10.1<C9.1 (IF TOTAL NUMBER OF BULBS LISTED IN EACH ROOM, PLUS THOSE REMOVED DOES NOT MATCH THE NUMBER OF BULBS INSTALLED STATED IN C9.1) OTHERWISE SKIP TO C16]*** Thanks, that accounts for **[TOTAL BULBS IN C14]** of the total quantity that were installed in your home. Can you tell me where the ***[C9.1 MINUS TOTAL BULBS IN C14 MINUS C10.1]*** other bulbs are installed?

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

C16. 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

C17. ***[ASK ONLY IF C16= 3 OR 4]*** Why would you say you are ***[INSERT ANSWER FROM C16]*** 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. Bulb started flickering

11. Bulb did not last/burnt out
12. Other **[RECORD VERBATIM]**
98. Don't Know
99. Refused

D. Advanced Power Strips

D1. Now I would like to ask you a few questions about the use of advanced power strips in your house. Before this call today, had you ever heard of a specific type of power strips called *advanced* power strips? **[EMPHASIS ON "ADVANCED" TO CLARIFY THAT THE QUESTION IS NOT ABOUT REGULAR POWER STRIPS]**

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

D2. ***[ASK IF D1=1 OTHERWISE SKIP TO D3]*** Can you tell me what you know about advanced power strips?

1. ***[RECORD VERBATIM THEN SKIP TO D4]***
98. Don't Know
99. Refused ***[SKIP TO D4]***

D3. ***[ASK IF D1=2, 98 OR D2= 98]*** Let me clarify what I am referring to: Many plugged in electronics continue to use electricity when they are turned off. An *advanced* power strip helps reduce this wasted electricity by utilizing a main outlet and a number of controlled outlets. The power strip senses when the TV or computer plugged into the main outlet is turned off, and automatically eliminates power to the controlled outlets, where any peripheral devices may be plugged in.

Given this clarification, had you heard of advanced power strips before today?

1. Yes
2. No ***[SKIP TO D5]***

D4. Have you purchased any advanced power strips in the last twelve months?

1. Yes ***[SKIP TO D6]***
2. No
98. Don't Know
99. Refused

D5. If you obtain an advanced power strip in the future where would you install it? **[READ RESPONSE OPTIONS AND SELECT ALL THAT APPLY]**

1. Home entertainment center (This is where your main TV is installed, and is typically in the family room or TV room)
2. Home office (This is where your home computer and any peripheral devices are installed)
3. Other **[RECORD VERBATIM]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D6. ***[ASK IF D4=1 OTHERWISE SKIP TO SECTION E]*** In the last 12 months, how many advanced power strips did you or your household purchase?

1. **[RECORD # OF ADVANCED POWER STRIPS]** ***[IF D6.1=0 SKIP TO SECTION E]***
98. Don't Know **[PROBE FOR ESTIMATES; IF UNABLE TO GET AN ANSWER, *SKIP TO SECTION E]***
99. Refused ***[SKIP TO SECTION E]***

D7. Were any of the ***[D6.1]*** advanced power strips you purchased part of a ***[INSERT UTILTY]*** sponsored sale?

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

D8. ***[ASK IF D7= 1, OTHERWISE SKIP TO D9]*** Did the ***[INSERT UTILTY]*** discount influence your decision to purchase an advanced power strip as opposed to a regular power strip?

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

D9. What ***[IF D8=1 SAY "OTHER"]*** factors were important in your decision to buy an advanced power strip as opposed to a regular one? **[DO NOT READ. MULTIPLE RESPONSES ALLOWED]**

1. Energy savings or cost savings on electricity bill
2. Good price of the advanced power strip compared to regular power strips
3. Ability to control multiple sockets
4. Environmental concerns
5. Interested in the latest technology
6. Other **[RECORD]**

98. Don't Know
99. Refused

D10. Thinking of the advanced power strip (s) you acquired in the last twelve months, how many did you install in your home since you purchased them?

1. **[RECORD # INSTALLED]**
2. None ***[SKIP TO D13]***

98. Don't Know ***[SKIP TO D13]***
99. Refused ***[SKIP TO D13]***

D11. Have you since removed any of the advanced power strips installed?

1. Yes **[ASK "HOW MANY DID YOU REMOVE?" RECORD #]**
2. No ***[SET D11.1=0 AND SKIP TO D13]***

98. Don't Know ***[SKIP TO D13]***
99. Refused ***[SKIP TO D13]***

D12. What were the reasons you removed the ***[D11.1]*** purchased advanced power strip(s) from the sockets? **[QUANTITIES SHOULD ADD TO D11.1, IF NOT, ASK "WHAT ABOUT THE REMAINING ADVANCED POWER STRIPS YOU REMOVED?] [DO NOT READ, MULTIPLE RESPONSES ALLOWED]**

1. Not working correctly **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
2. Turns appliances/electronics off too early or during use **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
3. Not compatible with my appliances/electronics **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
4. **INCONVENIENT/ANNOYING/CONFUSING/FRUSTRATING [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
5. **FLASHING LIGHT IS ANNOYING OR TOO BRIGHT [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
6. **CAUSED DAMAGE TO MY APPLIANCES/ELECTRONICS [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
7. **NO NEED FOR IT ANY MORE [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
8. **DID NOT LOOK GOOD [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**
9. Other **[RECORD VERBATIM] [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF ADVANCED POWER STRIPS]**

98. Don't Know
99. Refused

D13. ***[ASK IF D6.1-D10.1>0, OR IF D10=2, 98, OR 99]*** Are any of the ***[D6.1]*** **ADVANCED POWER STRIPS** you purchased in the last twelve months currently in storage for later use?

1. Yes **[ASK: "HOW MANY ARE NOW IN STORAGE?" RECORD #]**
2. No

98. Don't Know
99. Refused

D14. ***[ASK IF D10.1 MINUS D11.1>0]*** Of the ***[D10.1 MINUS D11.1]*** advanced power strip (s) that remain installed in your home, can you tell me where each one is installed? **[READ RESPONSE OPTIONS AND SELECT ALL THAT APPLY]**

1. Home entertainment center (This is where your main TV is installed, and is typically in the family room or TV room) **[RECORD # INSTALLED IN HOME ENTERTAINMENT CENTER]**
2. Home office (This is where your home computer and any peripheral devices are installed) **[RECORD # INSTALLED IN HOME OFFICE]**
3. Other **[RECORD # AND LOCATION VERBATIM]**

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

D15. How satisfied are you with the advanced power strips 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

D16. ***[ASK ONLY IF D15= 3 OR 4]*** Why would you say you are ***[INSERT ANSWER FROM D15]*** with the advanced power strips? **[DO NOT READ LIST AND RECORD ALL THAT APPLY]**

1. Not working properly
2. Turns appliances/electronics off too early (during use)
3. Not compatible with my appliances/electronics
4. **NOT USER-FRIENDLY**
5. **INCONVENIENT TO USE**
6. **FLASHING LIGHT ANNOYING OR TOO BRIGHT**
7. **CAUSED DAMAGE TO MY APPLIANCES/ELECTRONICS**
8. **NO CHANGE IN ELECTRICITY CONSUMPTION/BILL**
9. **DID NOT LOOK GOOD**
10. Other **[RECORD VERBATIM]**

98. Don't Know
99. Refused

E. Program Awareness

E1. 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 ***[SKIP TO SECTION F]***
98. Don't Know
99. Refused ***[SKIP TO SECTION F]***

E2. One of these ***[INSERT UTILITY]*** programs is the "***watt***smart Home Energy Savings Program" and it provides discounts on CFLs, LEDs, advanced power strips 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 F]***
98. Don't Know ***[SKIP TO SECTION F]***
99. Refused ***[SKIP TO SECTION F]***

E3. Where did you <u>most recently</u> hear about ***[INSERT UTILITY]'s watt***smart Home Energy Savings program**? [DO NOT READ LIST. RECORD FIRST RESPONSE. ONE ANSWER ONLY]**

1. Newspaper/Magazine/Print Media
2. Paper or Electronic Bill Inserts
3. Rocky Mountain Power/Pacific Power website
4. ***watt***smart Home Energy Savings website
5. Other website
6. Social media/internet Advertising/online ad
7. Family/friends/neighbor/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
17. Other **[RECORD VERBATIM]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

E4. ***[ASK ONLY IF E3<>3 AND E3<>4]*** Have you ever visited the ***watt***smart Home Energy Savings Website?

1. Yes
2. No

E5. ***[ASK ONLY IF E4=1]*** How often do you visit the ***watt***smart Home Energy Savings Website? Would you say you visit the website: **[READ RESPONSE OPTIONS]**

1. More frequently than once a month
2. About once a month
3. About once every six months
4. About once every year
5. Less frequently than once every year

E6. ***[ASK ONLY IF E4=1]*** When you visit the ***watt***smart Home Energy Savings Website, what is typically the purpose of your visit?

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

E7. ***[ASK ONLY IF E4 = 1 OR E3=3 OR 4, OTHERWISE SKIP TO SECTION F]*** 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

E8. 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

F. Nonparticipant Spillover

F1. ***[INSERT UTILITY]*'s** Home Energy Reports portal provides you with detailed information about your home's energy use and helps you discover ways to save money and make your home more energy efficient. Did you use the Home Energy Reports portal in 2015 or 2016?

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

F2. Now, I will read a list of household equipment and upgrades. Please say yes, if you have installed the equipment or upgrade mentioned in 2015 or 2016 and no, if you haven't. **[READ MEASURES AT STEADY PACE IF NO RESPONSE THEN PROBE: IS THAT YES OR NO?]**

Measure Name	1=Yes	2=No	98=Don't know	99= Refused
a) High-efficiency heat pump water heater				
b) High-efficiency Furnace with electronically commutated motor or ECM				
c) High-efficiency Air Source Heat Pump				
d) High-efficiency Ground Source Heat Pump				
e) High-efficiency Ductless Heat Pump				
f) High-efficiency Central Air Conditioner				
g) High-efficiency Evaporative Cooler				

Measure Name	1=Yes	2=No	98=Don't know	99= Refused
h) ENEGY STAR Room Air Conditioner				
i) ENERGY STAR Clothes Washer				
j) ENERGY STAR Dishwasher				
k) ENERGY STAR Freezer				
l) ENERGY STAR Refrigerator				
m) Attic insulation				
n) Wall insulation				
o) Floor insulation				
p) Air sealing **[IF NEEDED: THIS IS CAUKING OR SEALING GAPS TO MAKE THE HOME AIRTIGHT]**				
q) Duct insulation				
r) Duct sealing **[IF NEEDED: THIS IS SEALING ANY GAPS IN DUCT CONNECTIONS]**				
s) Windows				
t) Low flow showerhead				
u) Low flow faucet aerator				
v) Smart Thermostat				
w) Ceiling fan				
x) Any other energy-efficient				

Measure Name	1=Yes	2=No	98=Don't know	99= Refused
products? [SPECIFY]				

[IF F2.*=1 THEN RANDOMLY SELECT ONE MEASURE FROM F2.* = 1 AND CODE AS SELECTEDMEASURE1]

[IF F2.*= 1 AND MEASURE NAME <> SELECTEDMEASURE1 RANDOMLY SELECT ONE MEASURE FROM F2.* = 1 AND CODE AS SELECTEDMEASURE2]

[IF ALL F2.* = 2 THEN AUTO PUNCH F2 = 97 DID NOT INSTALL ANYTHING AND SKIP TO SECTION G]

[IF ALL F2.* = 98 OR 99 SKIP TO SECTION G]

F3. Did you receive a rebate or discount from ***[INSERT UTILITY]*** for the purchase of ***[SELECTEDMEASURE1]***?

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

F4. ***[IF SELECTEDMEASURE1=ATTIC INSULATION, OR WALL INSULATION, OR FLOOR INSULATION, OR AIR SEALING, OR DUCT INSULATION, OR DUCT SEALING, SAY "HOW MUCH" OTHERWISE SAY "HOW MANY"] [SELECTEDMEASURE1]*** did you install?

1. ***[RECORD QUANTITY OR AMOUNT WITH UNIT OF MEASUREMENT]***
98. Don't Know
99. Refused

F5. On a 1 to 4 scale, with 1 meaning "not at all influential," to 4, meaning the item was "highly influential," how influential was **[INSERT STATEMENT FROM TABLE BELOW]** on your decision to purchase the ***[SELECTEDMEASURE1]*** ?

Statement	Not at all influential	Not very influential	Somewhat influential	Highly influential	Don't know	Not applicable
	1	2	3	4	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.						

[SKIP F6 THROUGH F8 IF SELECTEDMEASURE2="NULL"]

F6. Did you receive a rebate or discount from ***[INSERT UTILITY]*** for the purchase of ***[SELECTEDMEASURE2]***?

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

F7. ***[IF SELECTEDMEASURE2=ATTIC INSULATION, OR WALL INSULATION, OR FLOOR INSULATION, OR AIR SEALING, OR DUCT INSULATION, OR DUCT SEALING, SAY "HOW MUCH" OTHERWISE SAY "HOW MANY"] [SELECTEDMEASURE2]*** did you install?

1. ***[RECORD QUANTITY OR AMOUNT WITH UNIT OF MEASUREMENT]***
98. Don't Know
99. Refused

F8. On a 1 to 4 scale, with 1 meaning "not at all influential," to 4, meaning the item was "highly influential," how influential was **[INSERT STATEMENT FROM TABLE BELOW]** on your decision to purchase the ***[SELECTEDMEASURE2]*** ?

Statement	Not at all influential	Not very influential	Somewhat influential	Highly influential	Don't know	Not applicable
	1	2	3	4	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.						

F9. ***[ASK IF F3= 2 OR F6 =2 OTHERWISE SKIP TO SECTION G]*** 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]**
9. Don't Know
10. Refused

G. Demographics

G1. Next are a few questions for statistical purposes only. Which of the following best describes your home? **[READ LIST]**

1. Single-family detached house
2. Townhouse or duplex
3. Mobile home or trailer
4. Apartment building with 4 or less units
5. Apartment building with 5 or more units
6. Other **[RECORD]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

G2. 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

G3. 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

G4. What is the primary heating system 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

G5. How old is the primary heating system? **[RECORD RESPONSE IN YEARS]**

1. **[RECORD 0-97]**
98. Don't Know
99. Refused

G6. What is the primary cooling system for 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

G7. ***[SKIP IF G6= 7,98 OR 99]*** How many years old is your primary cooling system? **[RECORD RESPONSE IN YEARS]**

1. **[RECORD 0-97]**
98. Don't Know
99. Refused

G8. 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

G9. Including yourself and any children, how many people currently live in your home?

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

G10. ***[ASK ONLY IF G9> 1*** AND <98,99***]*** 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. Do you have any additional feedback or comments regarding your household lighting or energy usage?

1. Yes **[RECORD VERBATIM]**
2. No
98. Don't Know
99. Refused

14. [SEX; DO NOT READ]

3. Female
4. Male
98. Don't Know

That concludes the survey. Thank you very much for your time and feedback.

CADMUS

PacifiCorp Home Energy Savings Participant Survey

Audience: This survey is designed for PacifiCorp residential customers in California, Utah, Idaho, Washington, and Wyoming that applied for an incentive through the incentive application process in the first half of 2016. 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: Aim for 60 completed surveys for each state (CA, UT, ID, WA, and WY)

	APPLIANCE	HVAC	Weatherization
	Sample (survey quota)	**Sample (survey quota)**	**Sample (survey quota)**
CA	20 (as many as possible)	86 (20)	3 (as many as possible)
ID	43 (20)	26 (as many as possible)	15 (as many as possible)
UT	400 (20)	400 (20)	400 (20)
WA	129 (20)	210 (20)	48 (20)
WY	58 (as many as possible)	56 (20)	9 (as many as possible)

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 ***watt***smart website (feedback)? Why did the customer purchase the program measure?	Section B
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 C
Net-to-Gross	Self-reported freeridership and spillover batteries	Section E and F
Demographics	Customer household information for statistical purposes	Section G

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

[UTILITY]
Washington and California: Pacific Power

Utah, Wyoming, and Idaho: Rocky Mountain Power

[MEASURE]

[YEAR OF PARTICIPATION]

[MEASURE QUANTITY]

["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
Heat Pump Best Practice Installation	SERVICE
Heat Pump 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	REFRIGERATOR
Room Air Conditioner	ROOM AC
Electric Water Heater	OTHER
Attic Insulation	INSULATION
Wall Insulation	INSULATION
Floor Insulation	INSULATION
Windows	WINDOWS
Smart Thermostat	OTHER

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 ***watt***smart 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 E5]***
2. No **[CONTINUE TO B5]**
98. Don't know ***[SKIP TO E5]***
99. Refused ***[SKIP TO E5]***

[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 E5]***

1. Failed or broken unit ***[SKIP TO E5]***
2. Removed because did not like it ***[SKIP TO E5]***
3. Have not had time to install it yet ***[SKIP TO E5]***
4. In-storage ***[SKIP TO E5]***
5. Back up equipment to install when other equipment fails ***[SKIP TO E5]***
6. Have not hired a contractor to install it yet ***[SKIP TO E5]***
7. Purchased more than was needed ***[SKIP TO E5]***
8. Other **[RECORD]** ***[SKIP TO E5]***
98. Don't Know ***[SKIP TO E5]***
99. Refused ***[SKIP TO E5]***

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 E5]***
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 2015, 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 E5]***
2. No **[CONTINUE TO B13]**
98. Don't know ***[SKIP TO E5]***
99. Refused ***[SKIP TO E5]***

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 E5]***

1. Failed or broken unit ***[SKIP TO E5]***
2. Removed because did not like it ***[SKIP TO E5]***
3. Have not had time to install it yet ***[SKIP TO E5]***
4. In-storage ***[SKIP TO E5]***
5. Back up equipment to install when other equipment fails ***[SKIP TO E5]***
6. Have not hired a contractor to install it yet ***[SKIP TO E5]***
7. Purchased more than was needed ***[SKIP TO E5]***
8. Other **[RECORD]** ***[SKIP TO E5]***
98. Don't Know ***[SKIP TO E5]***
99. Refused ***[SKIP TO E5]***

C. Program Awareness & Purchase Decisions

C1. How did you first hear about ***[INSERT UTILITY]***'s ***watt***smart 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. ***watt***smart Home Energy Savings website
18. Other **[RECORD VERBATIM]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C2. ***[ASK IF E5 <> 13 0R 17, OTHERWISE SKIP TO B3]*** Have you been to the ***[INSERT UTILITY]*** ***watt***smart Home Energy Savings program website? **[DO NOT READ RESPONSES]**

1. Yes
2. No

C3. ***[ASK IF E5 = 13 OR 17, OR IF B2 = 1, OTHERWISE SKIP TO E10]*** Was the website… **[READ]**

1. Very helpful ***[SKIP TO E10]***
2. Somewhat helpful
3. Somewhat unhelpful
4. Very unhelpful
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C4. ***[ASK IF B3= 2, 3, OR 4. OTHERWISE SKIP TO E10]*** 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 D10]***
98. Don't Know ***[SKIP TO D10]***
99. Refused ***[SKIP TO D10]***

D2. Approximately how many loads of clothes does your household wash in a typical week **[IF MEASURE TYPE = CLOTHES WASHER, SAY "WITH THE NEW CLOTHES WASHER"]**?

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

D3. ***[ASK IF MEASURE TYPE = CLOTHES WASHER, OTHERWISE SKIP TO D7]*** How does the number of wash loads you do now compare to the number that you did with your old clothes washer? Is it the same or different? **[DO NOT READ RESPONSES]**

1. Same ***[SKIP TO D7]***
2. Different **[CONTINUE TO D4]**
98. Don't Know ***[SKIP TO D7]***
99. Refused ***[SKIP TO D7]***

D4. ***[ASK IF D3 = 2]*** How many loads per week did your household do on average week before you installed the new clothes washer?

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

D5. Is your new washer smaller, bigger, or the same size as your older one?

1. Smaller
2. Bigger
3. Same Size
98. Don't Know
99. Refused

D6. Is your new washing machine top loading or front loading?

1. Top-Loading
2. Front-Loading
98. Don't Know
99. Refused

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

1. Never ***[SKIP TO B6]***
2. LESS THAN 25%
3. 25-50%
4. 50-75%
5. 75- 99%
6. Always or 100%
98. Don't know ***[SKIP TO B6]***
99. Refused ***[SKIP TO B6]***

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. Is your dryer powered by electricity or natural gas?

1. Electricity
2. Natural Gas
3. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't know
99. **[DO NOT READ]** Refused

[if MEASURE type= heating skip to B8 or heating/cooling skip toD20]

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 B8]***
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 TOD24]*** 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

IF MEASURE TYPE WINDOWS SKIP TO E1

D15. ***[ASK IF MEASURE TYPE = LIGHTING] [UTILTY]*** provides incentives for several different kinds of light fixtures. Were any of the light fixtures that you received an incentive for recessed ceiling or can light fixtures?

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

D16. ***[ASK IF MEASURE TYPE = LIGHTING AND D15 =1]*** What kind of lightbulb(s) did your recessed ceiling or can fixture(s) replace? Were they….[READ LIST]

1. Standard shaped bulbs **[IF NEEDED: THIS IS A TYPICAL HOUSEHOLD INCANDESCENT, CFL OR LED BULB, SOMETIMES REFERRED TO AS A-SHAPED AND SPREADS LIGHT IN ALL DIRECTION]**
2. Reflector or flood lightbulbs **[IF NEEDED: THIS IS A BULB THAT POINTS LIGHT IN ONE DIRECTION]**
3. No lightbulbs replaced
4. **[DO NOT READ]** Other **[SPECFICY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

[FOR QUESTIONS D17 - D25 USE THE FOLLOWING SKIP PATTERN
FOR MEASURE TYPES OTHER, CLOTHES WASHER, ROOM AC, AND LIGHTING: READ QUESTIONS D17 – D19 THEN SKIP TO E1;

FOR MEASURE TYPE REFRIGERATOR ASK D17 TO *ERROR! REFERENCE SOURCE NOT FOUND.* ***THEN SKIP TO E1***
FOR MEASURE TYPE HEATING: READ QUESTIONS D20 TO D23 THEN SKIP TO E1
FOR MEASURE TYPE COOLING: READ QUESTIONS D24 TO D25 THEN SKIP TO E1;
FOR MEASURE TYPE HEATING/COOLING: READ QUESTIONS D20 TO D22 AND D24 TO D25 THEN SKIP

TO E1;
FOR MEASURE TYPES WINDOWS, SEALING, INSULATION AND SERVICE: SKIP TO E1]

D17. Was the purchase of your new ***[INSERT MEASURE](S)*** intended to replace **[AN]** old ***[INSERT MEASURE TYPE]***?

1. Yes **[CONTINUE TO D18]**
2. No ***[SKIP TO E1]***
98. Don't Know ***[SKIP TO E1]***
99. Refused ***[SKIP TO E1]***

D18. ***[ASK IF MEASURE TYPE = REFRIGERATOR AND IF D17 = 1]*** Is your refrigerator bigger, smaller, or the same size as the one it may have replaced?

1. Smaller
2. Bigger
3. Same Size
4. Did not replace an existing unit
98. Don't Know
99. Refused

D19. ***[ASK IF D17 = 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]***

[Ask D20 to D23 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

D23. ***[ASK IF MEASURE TYPE = HEATING OTHERWISE SKIP TO D24]*** Did you also replace an air conditioner when you installed the new furnace?

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

[Ask D24 to D25 if MEASURE type = cooling or heating/cooling]

D24. 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

D25. 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 D1 = 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 ***watt***smart 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 ***watt***smart 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 ***watt***smart 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 E2]***

98. Don't Know ***[SKIP TO E2]***
99. Refused ***[SKIP TO E2]***

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

1. Yes
2. No ***[SKIP TO E2]***
98. Don't Know ***[SKIP TO E2]***
99. Refused ***[SKIP TO E2]***

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 E6]***
2. No
98. Don't Know
99. Refused

[IF F3= 1 SKIP TO E6]

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

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

[IF E2 = 1 THEN SKIP TO F6]

F5. ***[ASK IF E2 = 2, -98 OR -99]*** Help me understand, would you have purchased something without the ***watt***smart 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 E5]***
98. Don't Know ***[SKIP TO E6]***
99. Refused ***[SKIP TO E6]***

[IF F5 = 2 SKIP TO E5. IF F5 = -98 OR -99 SKIP TO E6]

F6. ***[ASK IF E2= 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 E2= 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 E2= 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 E6]

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 E5 = 1 SKIP TO E6]

F10. ***[ASK IF E5 = 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 E5= 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 E5 = 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 ***watt***smart Home Energy Savings Program?

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

[IF F1 = 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 F2 = 12 (ONLY), -98 OR -99 SKIP TO H1. REPEAT F3 THROUGH F5 FOR ALL RESPONSES TO F2]

G3. In what year did you purchase ***[INSERT MEASURE TYPE FROM F2]***?

1. 2015
2. 2016
3. Other ***[RECORD YEAR]***
98. Don't Know
99. Refused

G4. Did you receive an incentive for ***[INSERT MEASURE TYPE FROM F2]*****?**

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

G5. How influential would you say the ***watt***smart Home Energy Savings program was in your decision to add the ***[INSERT MEASURE FROM F2]*** to your home? Was it… **[REPEAT FOR EACH MEASURE LISTED IN F2]**

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.

Appendix B. Lighting Demand Elasticity Modeling

This appendix includes the analysis methodology and results of the lighting demand elasticity modeling that Cadmus conducted to estimate upstream lighting incentive freeridership for the HES program during the 2015-2016 evaluation period.

Bulb Lumens ENERGY STAR Linear Fits

For eight different lamp categories, Figure B1 through Figure B8 show lumens versus watts from the ENERGY STAR database. These include standard, reflector, and specialty LED and CFL lamps. When lumens could not be determined for a particular bulb model, these linear fits provided the bulb's lumen output.

Figure B1. Median Lumens vs. Wattage for ENERGY STAR-Qualified Standard CFLs

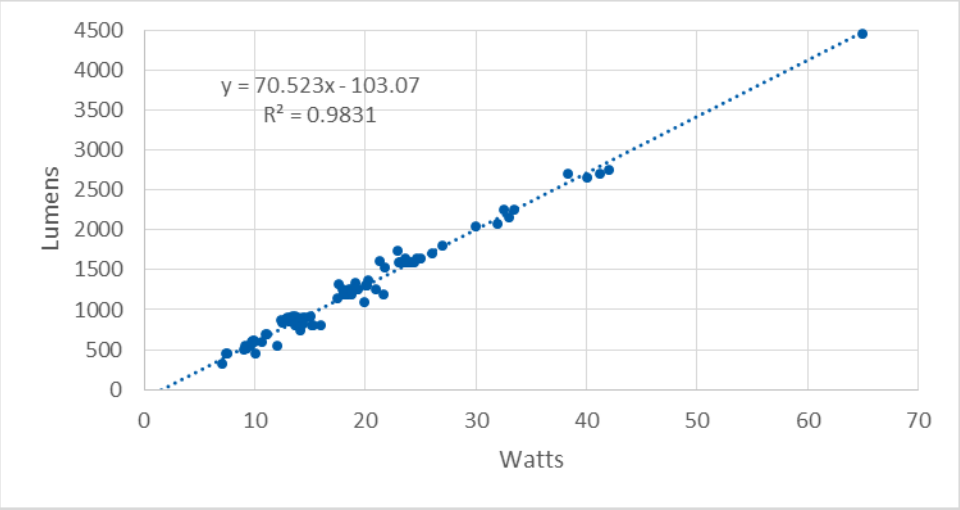


Figure B2. Median Lumens vs. Wattage for ENERGY STAR-Qualified Reflector CFLs

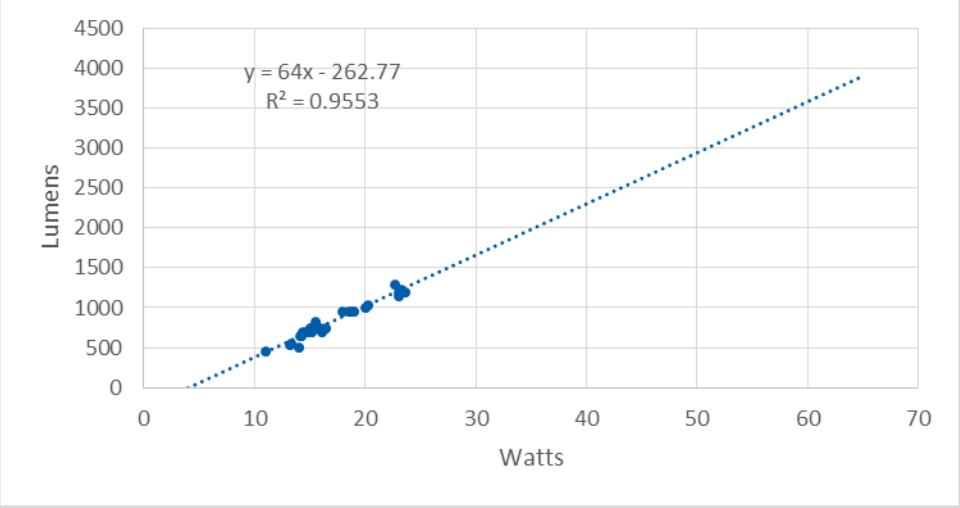


Figure B3. Median Lumens vs. Wattage for ENERGY STAR-Qualified Specialty CFLs

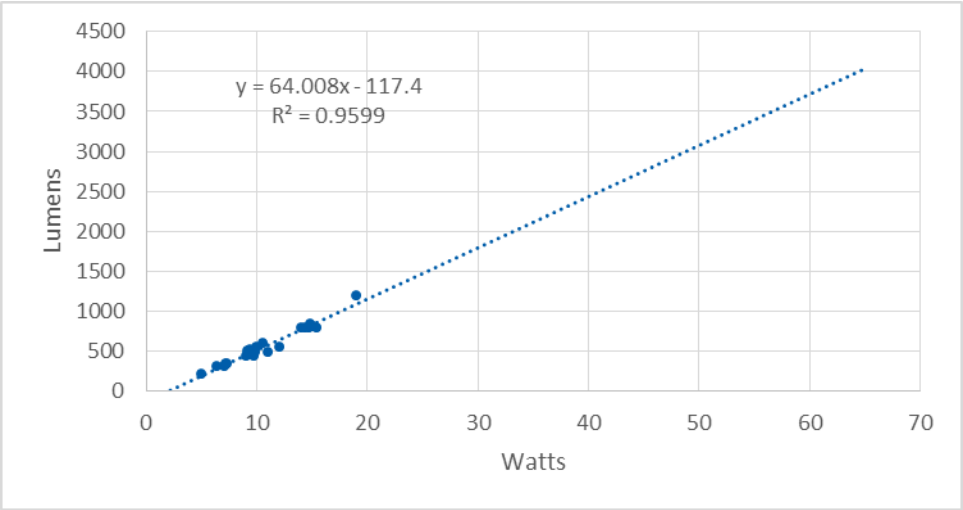


Figure B4. Median Lumens vs. Wattage for ENERGY STAR-Qualified CFL Fixtures

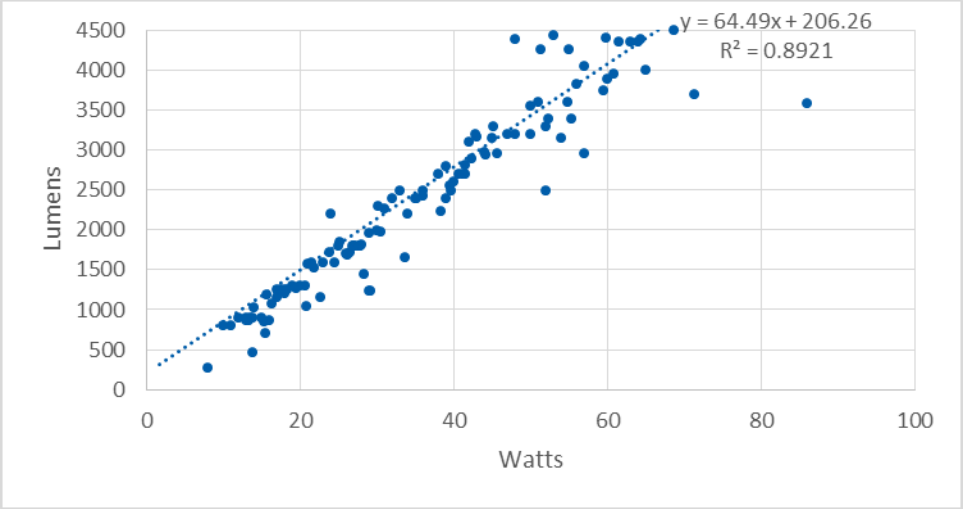


Figure B5. Median Lumens vs. Wattage for ENERGY STAR-Qualified Standard LEDs

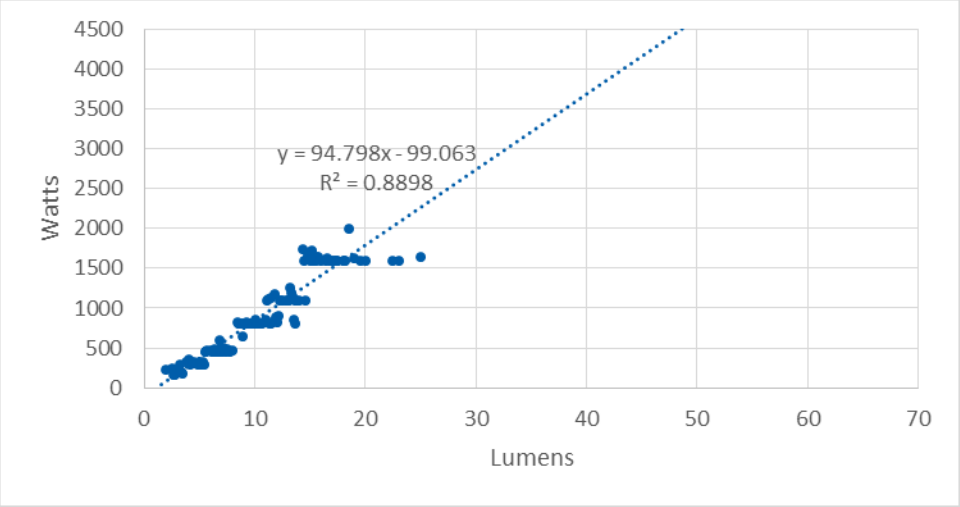


Figure B6. Median Lumens vs. Wattage for ENERGY STAR-Qualified Reflector LEDs

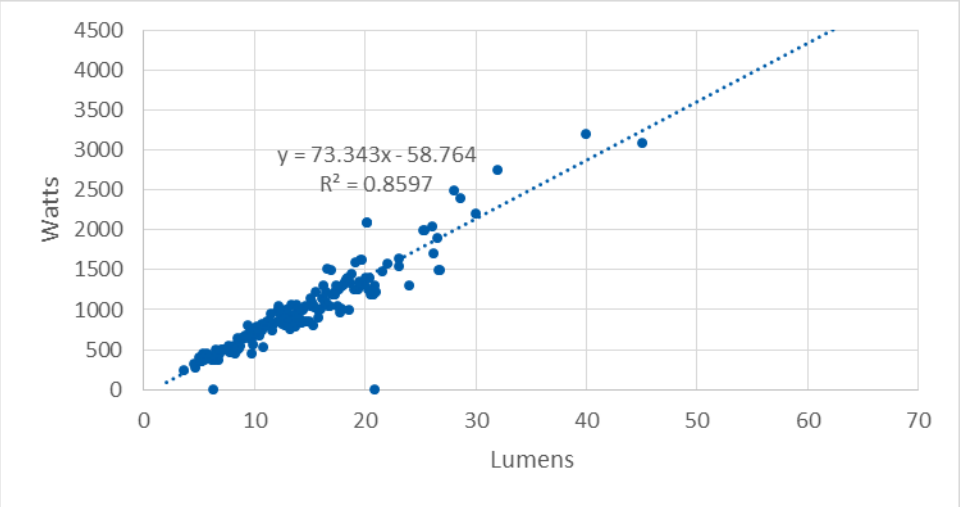


Figure B7. Median Lumens vs. Wattage for ENERGY STAR-Qualified Specialty LEDs

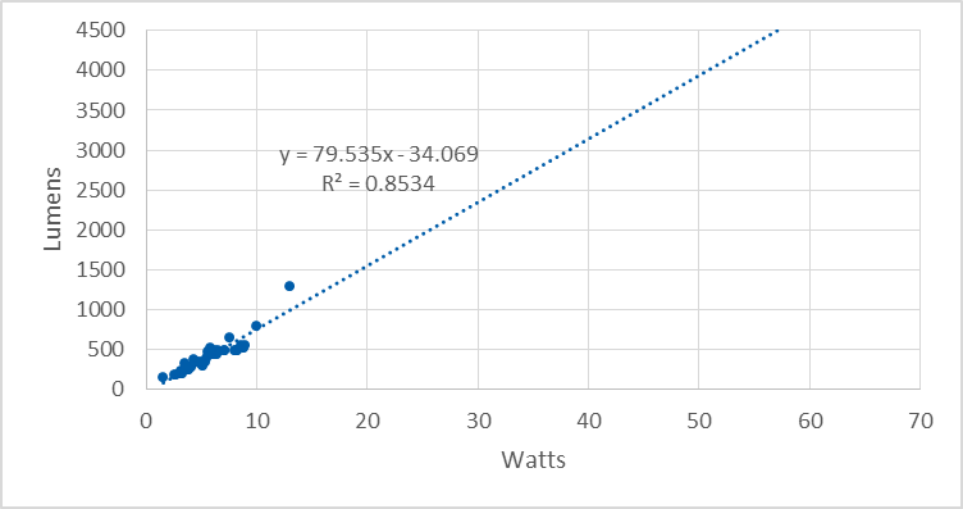
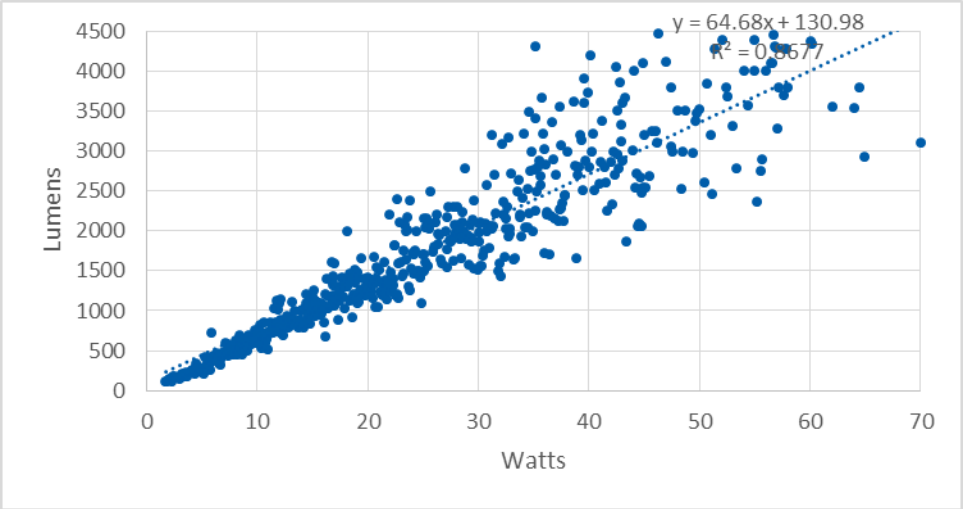


Figure B8. Median Lumens vs. Wattage for ENERGY STAR-Qualified LED Fixtures



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 2015 and 2016. The following description details 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)
- Estimate freeridership by comparing modeled baseline sales with predicted program sales

After estimating the variable coefficients, Cadmus used the resulting model to predict the following:

- Sales that would occur *without* the program's price impact
- 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, which this evaluation calculated 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. Improved from previous program years' sales, pricing data provided for the 2015 and 2016 program years proved sufficient for evaluation purposes.

Price Variation

Cadmus measured price and sales variations across all bulbs within a given retail location and bulb type category, taking the sales-weighted average price per bulb for all products within the retail location and bulb category, and the sum of bulb sales with the retailer/bulb category designations. For example, Cadmus combined all 60-watt incandescent-equivalent general purpose LEDs within a specific Wal-Mart storefront location into one category, regardless of manufacturers or pack sizes. Each month, observed data reflected the average price per-bulb and the total bulb sales within that specific location.

Defining model cross-sections this way increased the observed variation levels in price and sales by capturing more than changes in a product's price (i.e., for a given bulb model number); the data included changes in a bulb's average price due to changes in pack size (e.g., if an introduced three-pack displaced sales of a single pack bulb, thus lowering the average price per-bulb) or to introducing a new comparable product to the program.

Table B1 shows the representativeness of data included in the model for each year along with amounts combined for the evaluation cycle.

Table B1. Share of Sales Represented in Model

State	Year	Bulb Type	Total Sales	Share Represented by Year	Share Represented Combined

WA	2015	CFL	216,173	91%	86%
WA	2016	CFL	62,181	69%	
WA	2015	LED	138,031	69%	81%
WA	2016	LED	119,427	95%	

For both years and across both technologies, sales included in the model to estimate elasticities represented a majority (i.e., more than 2/3) of sales. CFLs achieved greater representativeness in 2015 (when CFLs accounted for a larger share of sales) than in 2016. Conversely, LED representation proved greater in 2016, when LEDs accounted for a larger share of total sales.

Promotional Displays

As the program administrator did not provide detailed data on product merchandising (e.g., clip strips, end caps, pallet displays), the model may not have captured all program impacts.[1]

Evaluations in other jurisdictions have found that product merchandising can generate 60% to 120% sales lift. Capturing and providing this detail level ensures the program receives credit for all activities. Cadmus recommends collecting these data for future evaluations.

Seasonality Adjustment

In economic analysis, separate data variations resulting from seasonality must be separated from those resulting from relevant external factors. For example, suppose umbrella prices had been reduced at the beginning of the rainy season. Skewed estimates of the price shift's impact would result if the analysis did not account for the natural seasonality of umbrella sales.

To adjust for seasonal sales variations, the model employed used time fixed-effects unique to each retail channel, representing differences from average monthly sales within each retail channel.

Historically, Cadmus has used a seasonal trend derived from a major lighting products manufacturer's national sales, comparing program sales with the expected share of annual sales occurring within each month. As shown in Figure B9 and Figure B10, however, neither LED nor CFL sales followed expected seasonal patterns (i.e., a small peak in March and a larger peak in October and November).

Both technologies experienced the highest sales in spring 2015, with sales tapering off and exhibiting much smaller peaks during fall 2015 and spring 2016.

[1] To the degree that product merchandising and prices co-vary, elasticity estimates may capture some sales lift generated by merchandising. As these data, however, could not be procured for incorporation into the model, separate impacts could not be estimated.

LEDs exhibited clearer relationships between price and sales than did CFLs, though a large drop in LED prices in late 2016 did not correspond with increased sales until November, when prices began to rise again.

For CFLs, prices and sales moved in the same direction during the first half of 2015: when prices increased, sales also increased. In 2016, however, CFL prices varied considerably, except for March 2016, and CFL sales did not appear at all responsive to price changes.

Ultimately, including seasonal sales trend from the national retailer produced positive elasticities for CFLs, leading to extremely negative net-to-gross estimates. Given this result and the atypical monthly sales pattern observed, the seasonal trend provided by the national retailer did not serve as an appropriate control in the model, and Cadmus opted for time fixed-effects.

In addition to the fixed-effects, Cadmus added dummy variables for specific months, retailers, and bulb types where anomalous changes in sales appeared. As these changes did not relate to program activity Cadmus observed through the data, the dummy variables absorbed these events' impacts, avoiding bias in price elasticities.

Figure B9. CFL Sales and Prices by Month

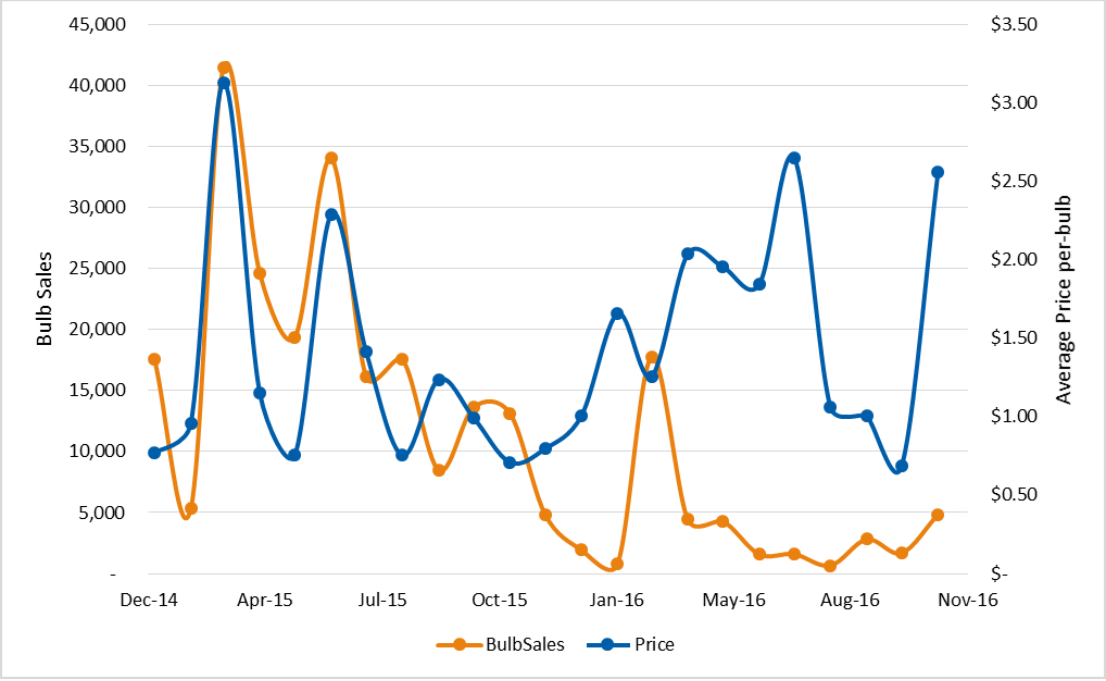
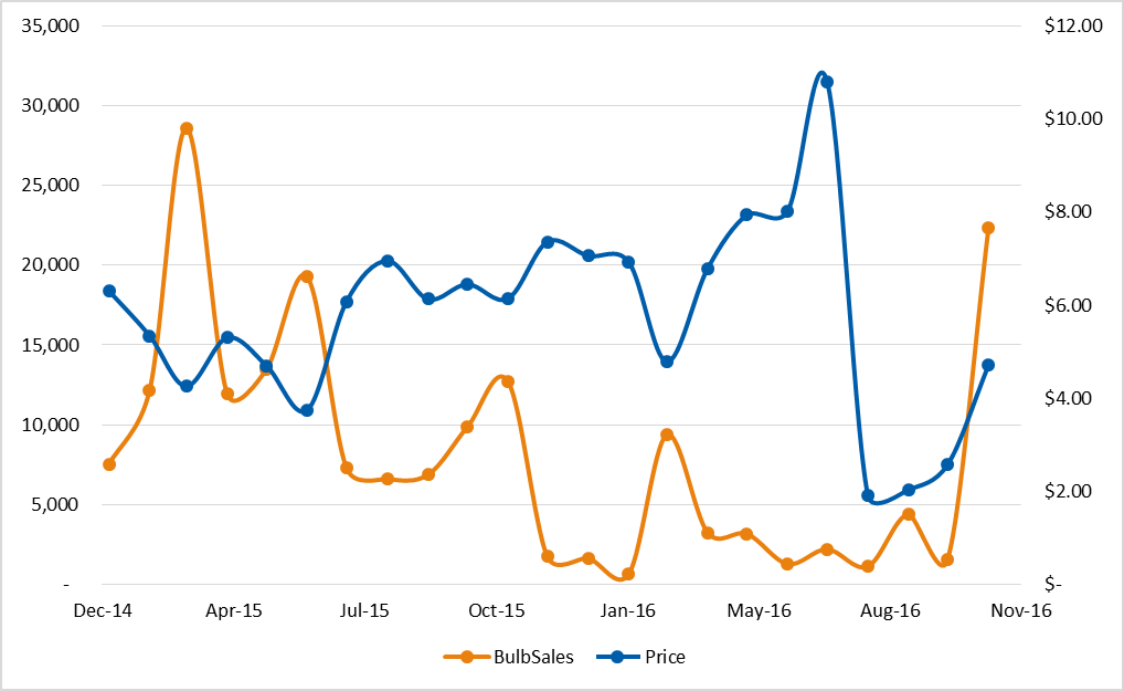


Figure B10. LED Sales and Prices by Month



Model Specification

Cadmus modeled bulb, pricing, and promotional data using an econometric model that addressed 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. Cadmus, however, analyzed the 2015 and 2016 data separately, producing two similar—though distinct—models. 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 2015 model (for bulb model *i*, in month *t*):

$$\ln(Q_{it}) = \sum_{\pi}(\beta_{\pi} ID_{\pi,\mathrm{i}}) + \sum_{\theta}\left(\beta_{\theta,i,j}\left[ln(P_{it}) * (Retail\ Channel_{\theta,\mathrm{i}}) * (Bulb\ Category_{\theta,\mathrm{j}})\right]\right) + \sum_{\theta}\left(\beta_{ti}\left[Sales\ Month_t * (Retail\ Channel_{\theta,\mathrm{i}})\right]\right) + \beta_3 * LED * \mathrm{Retailer}_i\mathrm{Month}_t + \varepsilon_i + \gamma_t$$

Where:

ln = Natural log

Q = Quantity of bulbs sold during month *t*

P = Sales-weighted retail price per-bulb (after markdown) in month *t*

Retail Channel	=	Retail category (Club, DIY, Mass Market)
$\text{Retailer}_i\text{Month}_t$	=	Dummy variable indicating an anomalous sales event for retailer *i* in month *t*; 0 otherwise
LED	=	Dummy variable equaling 1 if a product is an LED bulb; 0 otherwise
ID	=	Dummy variable equaling 1 for each unique retail channel, bulb technology, and bulb category; 0 otherwise
ε_i	=	Cross-sectional random-error term
γ_t	=	Time series random-error term

Due to slight differences in the 2016 model, Cadmus—rather than estimating price elasticities within each retail channel, technology, and bulb type combination separately—estimated elasticities within each retail channel separately. The evaluation added a partial slope term for LED bulbs and standard, general service bulbs. Partial slope terms measure the average incremental change in slope across all bulbs *across* retail channels rather than *within* them.

Cadmus estimated the following equation for the 2016 model (for bulb model *i*, in month *t*):

$$\ln(Q_{it}) = \sum_{\pi}(\beta_{\pi} ID_{\pi,\mathrm{i}}) + \sum_{\theta}\left(\beta_{\theta,i,j}\left[ln(P_{it}) * (Retail\ Channel_{\theta,\mathrm{i}})\right]\right) + \sum_{\theta}\left(\beta_{ti}\left[Sales\ Month_t * (Retail\ Channel_{\theta,\mathrm{i}})\right]\right) + \beta_{i,t} * Retailer_i Month_t + \beta_3\ ln(P_{it}) * LED + \varepsilon_i + \gamma_t$$

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)
LED	=	Dummy variable equaling 1 if a product is an LED bulb; 0 otherwise
Retailer*i*Month*t*	=	Dummy variable indicating an anomalous sales event for retailer i in month t; 0 otherwise[2]

[2] In 2016, four anomalous sales events produced sales much greater or fewer than expected and did not correspond with typical seasonality or program activity. Therefore, the dummy variables absorbed these effects rather than attributing them to the program.

ID = Dummy variable equaling 1 for each unique retail channel, bulb technology, and bulb category; 0 otherwise

ε_i = Cross-sectional random-error term

γ_t = Time series random-error term

The model specification assumed a negative binomial distribution, which provided accurate predictions for a small number of high-volume sale bulbs.

Using the following criteria, Cadmus ran numerous model scenarios to identify the best parsimony and explanatory power:

- Model coefficient p-values (keeping values less than <0.1)[3]
- Explanatory variable cross-correlation (minimizing where possible)
- Model Akaike's Information Criteria (AIC) (minimizing between models)[4]
- Minimizing multicollinearity
- Optimizing model fit

Overall, the model predicted sales within 1% of actual bulb sales over the evaluation period.

Findings

Cadmus estimated 50% combined CFL and LED freeridership levels over both 2015 and 2016. Table B2 shows the estimated freeridership ratio by technology, both within each program year and across.

Table B2. Modeling Results by Bulb Type

Year	Technology	Freeridership
2015	CFL	46%
	LED	54%
2016	CFL	54%
	LED	50%
Overall	CFL	47%
	LED	52%

In 2015, program sales were higher than 2016, therefore the overall freeridership estimates are weighted toward the 2015 estimates. LEDs produced slightly higher freeridership rates than CFLs.

[3] Where a qualitative variable had many states (such as bulb types), Cadmus did not omit variables if one state's proved insignificant; rather, the analysis considered the joint significance of all states.

[4] Cadmus used AIC to assess model fit, as nonlinear models did not define the R-square statistic. AIC also offered a desirable property, given it penalized overly complex models (similarly to the adjusted R-square).

Table B3 shows the incentive as a share of the original retail price and the estimated freeridership ratio by bulb type.

Table B3. Price and Discount by Bulb Type

Year	Technology	Final Price per Bulb	Original Price per Bulb	Markdown %
2015	CFL	$1.30	$2.37	45%
	LED	$4.56	$8.55	47%
2016	CFL	$1.28	$2.30	44%
	LED	$3.90	$6.22	37%

Typically, the proportional price reduction and the net of freeridership trend correlate: the higher the incentive, the lower the freeridership. However, CFL and LED markdowns did not differ significantly at 44% and 43%, respectively, across both 2015 and 2016. The difference in overall freeridership was driven by the slightly greater price elasticities estimated for CFLs in club store retailers (which accounted for a large share of total CFL sales), possibly because CFLs are still considerably cheaper than LEDs.

Elasticities

The freeridership ratios are derived from an estimate of price elasticities of demand. The price elasticity of demand measures the percentage change in the quantity demanded, given a percentage change in price. Due to the model's logarithmic functional form, the elasticities are simple the estimated coefficients for each price variable. In previous, similar analyses, elasticities typically ranged from -1 to -3 for both CFLs and LEDs, meaning a 10% drop in price led to a 10% to 30% increase in the quantity sold.

As shown in Table B4, elasticity estimates in 2015 fell a bit below the expected ranges, with some estimates less than one. Though elasticity estimates for the club store retail channel increased in 2016, elasticity estimates for Mass-market retailers decreased between 2015 and 2016.

Table B4. Elasticity Estimates by Retail Channel and Bulb Type

Year	Channel	Technology	Average Elasticity
2015	Club	CFL	-0.87
		LED	-1.06
	DIY	CFL	-0.74
		LED	-0.74
	Mass Market	CFL	-1.04
		LED	-0.98
2016	Club	CFL	-1.43
		LED	-1.71
	DIY	CFL	-0.58
		LED	-0.87
	Mass Market	CFL	-0.67
		LED	-0.96

Net of Freeridership Comparisons

Table B5 compares LED freeridership estimates, derived from several recent evaluations using the elasticity model approach. Many programs have phased out CFLs since 2015, so there are fewer recent points of comparison for CFLs.

Table B5. Comparisons of LED Freeridership Levels

Evaluation	Freeridership
Pacific Power Washington (2015-2016)	**52%**
Focus on Energy Wisconsin (2016)	38%
Focus on Energy Wisconsin (2015)	29%
Midwest Utility 1 (2016)	40%
Ameren Missouri (2015)	35%
Northeast Utility (2016)	39%
Mid-Atlantic (2015-2016)	39%

Freeridership estimates for Pacific Power were slightly higher than those observed in other programs across the 2015 and 2016 evaluation periods, and were slightly higher than estimates from the 2013–2014 evaluation cycle (i.e., 38%).

Overall sales in 2016 were also considerably lower than in 2015 and the peak months of program sales coincided with months when lighting sales typically peak regardless. Additionally, LED prices actually increased between October and November of 2016, when there was the largest increase in LED sales so this increase in sales is largely not attributable to the program according to the available data. If there was product merchandising or advertising that drove this increase in sales, we cannot account for that in the model.

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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 used and results achieved for each effort.

Insulation Billing Analysis

Cadmus conducted billing analysis to assess evaluated energy savings associated with insulation measure installations.[1] The analysis determined the savings estimate using a pooled, conditional savings analysis (CSA) regression model, which included the following groups:

- 2015–2016 insulation participants (combined attic, wall, and floor insulation)
- Nonparticipant homes, serving as the comparison group

The billing analysis resulted in a 162% 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 (e.g., account numbers, measure types, installation dates, square footage of insulation installed, heat sources, expected savings for the entire participant population).
- ***Control group data,*** collected by Cadmus from a census of approximately 164,000 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 achieve adequate coverage of the nonparticipating population, Cadmus included four times the number of nonparticipants as participants.
- ***Billing data***, provided by Pacific Power, included all Washington residential accounts. Cadmus matched 2015–2016 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 2014 through May 2017. The final sample used in the billing analysis consisted of 89 participants and 356 control customers.
- ***Washington weather data***, including daily average temperatures from January 2014 to May 2017 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 2014, before measure installations occurred. This meant defining the post-period as June 2016 through May 2017.[2]

Data Screening

To ensure the final model used complete pre- and post-participation and nonparticipant billing data, Cadmus selected accounts meeting the following criteria:

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 6,095 kWh per year or less than 44,019 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).
6. Participants installing other measures through the HES program.

Cadmus also examined individual monthly billing data to check for vacancies, outliers, and seasonal usage changes. If 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 2016 had less than 10 months of post-period data, the analysis excluded them. Similarly, the analysis excluded customers participating in 2015 with measure installation dates before November 2014 and 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			164,165	203
Match 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)	91,190	11	72,975	192
Reject accounts with less than 300 days in pre- or post-period	30,808	77	42,167	115
Reject accounts with less than 6,095 kWh or more than 44,019 kWh in pre- or post-period	4,250	0	37,917	115
Reject accounts with consumption changing by more than 50%	1,253	0	36,664	115
Reject accounts with expected savings over 70% of pre-period consumption	0	0	36,664	115
Reject participant accounts that also received other measures through HES program	0	13	36,664	102
Reject accounts with billing data outliers, vacancies, and seasonal usage	227	13	36,437	89
Nonparticipant sample selection (random sample of nonparticipants to match participant pre-period usage by quartile; four times more than participants)	36,081	0	356	89
Final Sample			**356**	**89**

Regression Model

After screening and matching accounts, the final analysis group consisted of 89 participants and 356 nonparticipants.

Of the final sample, 76% of participant homes installed attic insulation, 13% installed wall insulation, and 24% installed floor insulation. As separate wall or floor insulation savings could not be determined, Cadmus estimated a combined realization rate for all insulation measures.

Cadmus used the following CSA regression specification to estimate HES Program insulation savings:

$$ADC_{it} = \alpha_i + \beta_1 HDD_{it} + \beta_2 CDD_{it} + \beta_3 PARTHDD_{it} + \beta_4 PARTCDD_{it} + \beta_5 POST_t + \beta_6 POSTHDD_{it} + \beta_7 POSTCDD_{it} + \beta_8 PARTPOST_{it} + \beta_9 PARTPOSTHDD_{it} + \beta_{10} PARTPOSTCDD_{it} + \varepsilon_{it}$$

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)
PARTHDD_{it}	=	Interaction of the participant indicator and average daily HDDs (base 65)
$PARTCDD_{it}$	=	Interaction of the participant indicator and average daily CDDs (base 65)
$POST_t$	=	Indicator variable of 1 in the post-period for participants and nonparticipants, 0 otherwise
$POSTHDD_{it}$	=	Indicator variable of 1 in the post-period for participants and nonparticipants interacted with average daily HDDs (base 65), 0 otherwise
$POSTCDD_{it}$	=	Indicator variable of 1 in the post-period for participants and nonparticipants interacted with average daily CDDs (base 65), 0 otherwise
$PARTPOST_{it}$	=	Indicator variable of 1 in the post-period for participants, 0 otherwise
$PARTPOSTHDD_{it}$	=	Indicator variable of 1 in the post-period for participants interacted with average daily HDDs (base 65), 0 otherwise
$PARTPOSTCDD_{it}$	=	Indicator variable of 1 in the post-period for participants interacted with average daily CDDs (base 65), 0 otherwise

As the key coefficients determining average insulation savings, the $\beta_{8.}$ $\beta_{9,}$ β_{10} coefficients obtain insulation savings per program participant, normalizing heating and cooling savings to TMY3 normal weather after accounting for nonparticipant trends. This produces the final insulation savings estimate as follows:

$$\beta_8 * 365 + \beta_9 * 5485 + \beta_{10} * 655$$

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 2,027 kWh per participant. Expected averaged savings from insulation (1,249 kWh) translated to a 162% evaluated realization rate for insulation measures. With average participant pre-usage of 19,720 kWh, the savings represented a 10% reduction in total

[3] Due to the complexity of estimating a model with separate intercepts, Cadmus estimated a difference model, subtracting out customer-specific averages for dependent and independent variables. This method produced results identical to fixed effects models with separate intercepts. Using a difference model, however, proved simpler in estimating savings and presenting final model outputs.

energy usage from insulation measures installed. Table C2 presents 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 *	**89**	**1,249**	**2,027**	**162%**	**±24%**	**123%–202%**
Electric Heat	66	1,668	2,479	149%	±27%	149%–258%
Electric Heat (HP)	44	1,681	2,028	121%	±33%	81%–160%
Electric Heat (Non-HP)	22	1,642	3,442	210%	±27%	154%–265%

*The overall model includes electric and gas heat; gas heat could not split out due to its 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.

Overall, electrically heated homes achieved insulation savings of 2,479 kWh (per home), with average, electrically heated, expected insulation savings of 1,668 kWh—translating to a 149% realization rate. With average electrically heated participant pre-usage of 21,972 kWh, savings represented an 11% reduction in energy usage from insulation measures. Participants with heat pumps achieved savings of 2,028 kWh (9%); those without heat pumps achieved 3,442 kWh (16%).

Due to the small sample size (n=23), Cadmus could not obtain reliable savings estimates for gas-heated homes (as noted in Table C2).

Table C3, Table C4, Table C5, and Table C6 summarize model outputs for regression models Cadmus used to determine 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	10	2,149,869	214,987	803.16	<.0001
Error	10,807	2,892,774	267.676		
Corrected Total	10,817	5,042,643			
Root MSE		16.3608	R-Square		0.4263
Dependent Mean		0.0000	Adj. R-Square		0.4263
Coefficient of Variation		2.49E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.5042	0.0289	52.06	<.0001
AvgCDD	1	2.3799	0.0727	32.73	<.0001
PartHDD	1	0.3156	0.0627	5.04	<.0001
PartCDD	1	-0.0310	0.1540	-0.20	0.8405
Post	1	-1.9025	0.8025	-2.37	0.0178
PostHDD	1	0.0634	0.0401	1.58	0.1135
PostCDD	1	0.1110	0.1188	0.93	0.35
PartPost	**1**	**1.1255**	**1.7764**	**0.63**	**0.5264**
PartPostHDD	**1**	**-0.3991**	**0.0874**	**-4.57**	**<.0001**
PartPostCDD	**1**	**-0.3790**	**0.2318**	**-1.64**	**0.102**
Annual Normalized Savings	**1**	**2026.51**	**298.91**	**-6.78**	**<.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	10	2,278,295	227,829	863.67	<.0001
Error	10,266	2,708,105	263.794		
Corrected Total	10,276	4,986,399			
Root MSE		16.2417	R-Square		0.4569
Dependent Mean		0.0000	Adj. R-Square		0.4569
Coefficient of Variation		2.80E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.5042	0.0287	52.44	<.0001
AvgCDD	1	2.3799	0.0722	32.97	<.0001
PartHDD	1	0.7414	0.0693	10.70	<.0001
PartCDD	1	-0.0710	0.1760	-0.40	0.6866
Post	1	-1.9025	0.7967	-2.39	0.017
PostHDD	1	0.0634	0.0398	1.59	0.1108
PostCDD	1	0.1110	0.1179	0.94	0.3464
PartPost	**1**	**-0.3101**	**1.9929**	**-0.16**	**0.8764**
PartPostHDD	**1**	**-0.4020**	**0.0974**	**-4.13**	**<.0001**
PartPostCDD	**1**	**-0.1871**	**0.2600**	**-0.72**	**0.4717**
Annual Normalized Savings	**1**	**2479.41**	**337.31**	**-7.35**	**<.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	10	2,004,702	200,470	756.32	<.0001
Error	9,752	2,584,859	265.059		
Corrected Total	9,762	4,589,560			
Root MSE		16.2806	R-Square		0.4368
Dependent Mean		0.0000	Adj. R-Square		0.4368
Coefficient of Variation		5.59E+20			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.5042	0.0288	52.31	<.0001
AvgCDD	1	2.3799	0.0723	32.89	<.0001
PartHDD	1	0.6006	0.0823	7.30	<.0001
PartCDD	1	0.0961	0.2090	0.46	0.6457
Post	1	-1.9025	0.7986	-2.38	0.0172
PostHDD	1	0.0634	0.0399	1.59	0.1117
PostCDD	1	0.1110	0.1182	0.94	0.3476
PartPost	**1**	**0.0560**	**2.3743**	**0.02**	**0.9812**
PartPostHDD	**1**	**-0.3488**	**0.1162**	**-3.00**	**0.0027**
PartPostCDD	**1**	**-0.1788**	**0.3116**	**-0.57**	**0.566**
Annual Normalized Savings	**1**	**2028.07**	**401.28**	**-5.05**	**<.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	10	1,920,088	192,009	737.83	<.0001
Error	9,217	2,398,571	260.233		
Corrected Total	9,227	4,318,658			
Root MSE		16.1318	R-Square		0.4446
Dependent Mean		0.0000	Adj. R-Square		0.4446
Coefficient of Variation		-5.82E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.5042	0.0285	52.79	<.0001
AvgCDD	1	2.3799	0.0717	33.20	<.0001
PartHDD	1	1.0283	0.1131	9.09	<.0001
PartCDD	1	-0.4182	0.2883	-1.45	0.1469
Post	1	-1.9025	0.7913	-2.40	0.0162
PostHDD	1	0.0634	0.0395	1.61	0.1084
PostCDD	1	0.1110	0.1171	0.95	0.3432
PartPost	**1**	**-1.6648**	**3.2644**	**-0.51**	**0.6101**
PartPostHDD	**1**	**-0.4908**	**0.1581**	**-3.10**	**0.0019**
PartPostCDD	**1**	**-0.0632**	**0.4074**	**-0.15**	**0.8768**
Annual Normalized Savings	**1**	**3441.70**	**556.67**	**-6.18**	**<.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:

- 2015–2016 ductwork participants (combined duct sealing and duct insulation)
- Nonparticipant homes, serving as the comparison group

The billing analysis resulted in a 66% 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.

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

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 164,000 nonparticipating customers in Washington. This included matching energy use for the control group to quartiles of participants' pre-participation energy use to ensure the two groups' comparability. 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 2015–2016 participant program data to the census of billing data for the state (i.e., only for participants installing duct sealing and/or duct insulation measures).The data included meter-read dates and kWh consumption from January 2014 through May 2017. The final sample used in the billing analysis consisted of 471 participants and 1,884 control customers.
- ***Washington weather data***, including daily average temperatures from January 2014 to May 2017 for three 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 2014 (before any measure installations occurred) and defined the post-period as June 2016 through May 2017.[5]

Data Screening

To ensure the final model used complete pre- and post-participation and nonparticipation billing data, Cadmus selected accounts meeting the following criteria:

1. Participant addresses matching to 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 4,999 kWh per year or less than 49,672 kWh per year (i.e., the lowest and highest participant usage, designed 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] Cadmus removed participants from analysis if they installed measures in late 2016 as they had less than 10 months of post-period data. Similarly, customers participating in 2015, but with measure installation dates before November 2014 also were removed from analysis as they had less than 10 months of pre-period data.

5. Expected savings under 70% of household consumption (accounting for a mismatch between participant database and billing data or pre-period vacancies).
6. Participants installing other measures through the HES program.

Cadmus examined individual monthly billing data to check for vacancies, outliers, and seasonal usage changes. The analysis dropped the accounts if inconsistent usage patterns occurred between the pre- and post-periods. Table C7 shows participant and nonparticipant screening criteria used in the billing 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			163,647	721
Match billing data sample (reduced to nonparticipant, single-family/manufactured home residential accounts in participant zip codes; participant accounts that could be matched to billing data addresses)	59,524	14	104,123	707
Reject accounts with less than 300 days in pre- or post-period	59,970	148	44,153	559
Reject accounts with less than 4,999 kWh or more than 49,672 kWh in pre- or post-period	17,508	0	26,645	559
Reject accounts with consumption changing by more than 50%	1,202	0	25,443	559
Reject accounts with expected savings over 70% of pre-period consumption	0	0	25,443	559
Reject participant accounts that also received other measures through HES program	0	46	25,443	513
Reject accounts with billing data outliers, vacancies, and seasonal usage	771	42	24,672	471
Nonparticipant sample selection (random sample of nonparticipants to match participant pre-period usage by quartile: four times more than participants)	22,788	0	1,884	471
Final Sample			**1,884**	**471**

Regression Model

After screening and matching accounts, the final analysis group consisted of 471 participants and 1,884 nonparticipants. Cadmus used the following CSA regression specification to estimate HES program duct sealing and duct insulation savings:

$$ADC_{it} = \alpha_i + \beta_1 HDD_{it} + \beta_2 CDD_{it} + \beta_3 PARTHDD_{it} + \beta_4 PARTCDD_{it} + \beta_5 POST_t + \beta_6 POSTHDD_{it} + \beta_7 POSTCDD_{it} + \beta_8 PARTPOST_{it} + \beta_9 PARTPOSTHDD_{it} + \beta_{10} PARTPOSTCDD_{it} + \varepsilon_{it}$$

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)
PARTHDD_{it}	=	Interaction of the participant indicator and average daily HDDs (base 65)
$PARTCDD_{it}$	=	Interaction of the participant indicator and average daily CDDs (base 65)
$POST_t$	=	Indicator variable of 1 in the post-period for participants and nonparticipants, 0 otherwise
$POSTHDD_{it}$	=	Indicator variable of 1 in the post-period for participants and nonparticipants interacted with average daily HDDs (base 65), 0 otherwise
$POSTCDD_{it}$	=	Indicator variable of 1 in the post-period for participants and nonparticipants interacted with average daily CDDs (base 65), 0 otherwise
$PARTPOST_{it}$	=	Indicator variable of 1 in the post-period for participants, 0 otherwise
$PARTPOSTHDD_{it}$	=	Indicator variable of 1 in the post-period for participants interacted with average daily HDDs (base 65), 0 otherwise
$PARTPOSTCDD_{it}$	=	Indicator variable of 1 in the post-period for participants interacted with average daily CDDs (base 65), 0 otherwise

As the key coefficients determining average duct sealing and insulation savings, the $\beta_{8.}$ $\beta_{9,}$ β_{10} coefficients obtain duct sealing and insulation savings per program participant, normalizing the heating and cooling savings to TMY3 normal weather after accounting for nonparticipant trends. This produced the final duct sealing and insulation savings estimate:

$$\beta_8 * 365 + \beta_9 * 5336 + \beta_{10} * 678$$

Cadmus included individual customer intercepts (α_i) as part of a fixed-effects model specification to ensure participants or nonparticipants did not exert an undue influence over the final savings estimate; this resulted in a more robust model.[6]

[6] Due to the complexity of estimating the model with separate intercepts, Cadmus estimated a difference model, subtracting out customer-specific averages for dependent and independent variables. This method produced results identical to the fixed effects models with separate intercepts; using a difference model, however, proved simpler in estimating savings and presenting final model outputs.

Ductwork Results

Cadmus estimated overall duct sealing and duct insulation savings of 1,082 kWh per home. As expected average duct sealing and duct insulation savings were 1,645 kWh, this translated to a 66% evaluated realization rate for duct sealing and insulation measures. Average participant pre-usage of 16,434 kWh savings represented a 7% reduction in total energy usage from duct sealing and duct insulation measures installed. Table C8 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*	**471**	**1,645**	**1,082**	**66%**	**±14%**	**57%–75%**
Electric Heat	467	1,659	1,085	65%	±14%	56%–75%
Electric Heat (HP)	62	2,320	2,106	91%	±19%	74%–108%
Electric Heat (Non-HP)	405	1,557	933	60%	±17%	50%–70%

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

Though Cadmus used the overall Washington model results to apply a realization rate to multifamily duct sealing measures, the analysis provided results for electric heat, heat pump and non-heat pump participants.

Overall, electrically heated homes achieved duct sealing and duct insulation savings of 1,085 kWh per home. Expected average electrically heated duct sealing and duct insulation savings were 1,659 kWh, translating to a 65% evaluated realization rate. With average electrically heated participant pre-usage of 16,442 kWh, savings represented a 7% reduction in energy usage from duct sealing and duct insulation measures. Electrically heated participants with heat pumps achieved savings of 2,106 kWh (13%); those without heat pumps achieved 933 kWh (6%).

A separate savings estimate for gas heated homes could not be obtained due to small sample sizes (n=4).

Cadmus also estimated separate duct sealing and insulation savings and realization rates estimates for manufactured homes, estimating overall duct sealing and duct insulation savings of 974 kWh per manufactured home. Expected average duct sealing and duct insulation savings (1,543 kWh) translated to a 63% evaluated realization rate for manufactured home duct sealing and insulation measures. With average participant pre-usage of 16,134 kWh, savings represented a 6% reduction in total energy usage from duct sealing and duct insulation measures installed. Table C9 summarizes the results 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	**445**	**1,543**	**974**	**63%**	**±15%**	**53%–73%**
Electric Heat	445	1,543	974	63%	±15%	53%–73%
Electric Heat (HP)	42	1,536	948	62%	±49%	32%–92%
Electric Heat (Non-HP)	403	1,544	976	63%	±16%	53%–73%

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 948 kWh (6%); those without heat pumps achieved 976 kWh (6%).

Cadmus estimated separate duct sealing and insulation savings and realization rates estimates for single-family homes, estimating overall duct sealing and duct insulation savings of 3,069 kWh per single-family home. Expected average duct sealing and duct insulation savings of 3,394 kWh translated to a 90% evaluated realization rate for single-family duct sealing and insulation measures. With average participant pre-usage of 21,569 kWh, savings represented a 14% reduction in total energy usage from duct sealing and duct insulation measures installed. Table C10 summarizes the results for single-family homes.

Table C10. Single-Family 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*	**26**	**3,394**	**3,069**	**90%**	**±31%**	**63%–118%**
Electric Heat	22	3,990	3,721	93%	±27%	68%–118%
Electric Heat (HP)	20	3,966	3,503	88%	±30%	62%–115%

Cadmus used overall Washington single-family home model results for applying duct sealing and insulation savings for non-multifamily (i.e., where overall realization rate applied) or manufactured homes (where manufactured homes realization rate applied), but provided results for heat pump participants. Overall, electrically heated homes achieved duct sealing and duct insulation savings of 3,721 kWh per home. Expected average electrically heated duct sealing and duct insulation savings of 3,990 kWh translated to a 93% evaluated realization rate. With average electrically heated participant pre-usage of 22,677 kWh, savings represented a 16% reduction in energy usage from duct sealing and duct insulation measures. Electrically heated participants with heat pumps achieved savings of 3,503 kWh (15%).

Table C11, Table C12, Table C13, and Table C14 summarize model outputs for the regression models Cadmus used to determine the Washington overall duct sealing and duct insulation realization rates.

Table C11. Overall Ductwork Regression Model for Washington (Overall)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	15,826,556	1,582,656	11436.8	<.0001
Error	57,253	7,922,812	138.38		
Corrected Total	57,263	23,749,368			
Root MSE		11.7636	R-Square		0.6664
Dependent Mean		0.0000	Adj. R-Square		0.6664
Coefficient of Variation		2.36E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6907	0.0090	188.05	<.0001
AvgCDD	1	1.7915	0.0229	78.07	<.0001
PartHDD	1	0.2051	0.0197	10.43	<.0001
PartCDD	1	-0.1134	0.0494	-2.29	0.0218
Post	1	-0.0394	0.2521	-0.16	0.8758
PostHDD	1	0.0542	0.0125	4.35	<.0001
PostCDD	1	0.1151	0.0372	3.09	0.002
PartPost	**1**	**-1.0400**	**0.5598**	**-1.86**	**0.0632**
PartPostHDD	**1**	**-0.1098**	**0.0276**	**-3.97**	**<.0001**
PartPostCDD	**1**	**-0.1713**	**0.0773**	**-2.22**	**0.0267**
Annual Normalized Savings	**1**	**1081.92**	**92.27**	**-11.73**	**<.0001**

Table C12. Overall Ductwork Regression Model for Washington (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	15,854,093	1,585,409	11505.3	<.0001
Error	57,160	7,876,562	137.8		
Corrected Total	57,170	23,730,655			
Root MSE		11.7388	R-Square		0.6681
Dependent Mean		0.0000	Adj. R-Square		0.6681
Coefficient of Variation		2.31E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6907	0.0090	188.45	<.0001
AvgCDD	1	1.7915	0.0229	78.23	<.0001
PartHDD	1	0.2180	0.0197	11.07	<.0001
PartCDD	1	-0.1187	0.0495	-2.40	0.0164
Post	1	-0.0394	0.2516	-0.16	0.8755
PostHDD	1	0.0542	0.0124	4.36	<.0001
PostCDD	1	0.1151	0.0372	3.10	0.002
PartPost	**1**	**-0.9353**	**0.5607**	**-1.67**	**0.0953**
PartPostHDD	**1**	**-0.1151**	**0.0277**	**-4.16**	**<.0001**
PartPostCDD	**1**	**-0.1905**	**0.0776**	**-2.46**	**0.0141**
Annual Normalized Savings	**1**	**1084.60**	**92.37**	**-11.74**	**<.0001**

Table C13. Overall Ductwork Regression Model for Washington (Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	12,633,340	1,263,334	8541.67	<.0001
Error	47,441	7,016,641	147.9		
Corrected Total	47,451	19,649,981			
Root MSE		12.1615	R-Square		0.6429
Dependent Mean		0.0000	Adj. R-Square		0.6429
Coefficient of Variation		-5.08E+20			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6907	0.0093	181.90	<.0001
AvgCDD	1	1.7915	0.0237	75.51	<.0001
PartHDD	1	0.3673	0.0500	7.35	<.0001
PartCDD	1	0.5175	0.1274	4.06	<.0001
Post	1	-0.0394	0.2607	-0.15	0.8798
PostHDD	1	0.3673	0.0500	7.35	<.0001
PostCDD	1	0.1151	0.0385	2.99	0.0028
PartPost	**1**	**-2.4352**	**1.4432**	**-1.69**	**0.0915**
PartPostHDD	**1**	**-0.1970**	**0.0696**	**-2.83**	**0.0047**
PartPostCDD	**1**	**-0.1866**	**0.1976**	**-0.94**	**0.3451**
Annual Normalized Savings	**1**	**2106.04**	**241.91**	**-8.71**	**<.0001**

Table C14. Overall Ductwork Regression Model for Washington (Non-Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	15,311,315	1,531,131	11293.4	<.0001
Error	55,678	7,548,703	135.58		
Corrected Total	55,688	22,860,018			
Root MSE		11.6438	R-Square		0.6698
Dependent Mean		0.0000	Adj. R-Square		0.6698
Coefficient of Variation		2.65E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6907	0.0089	189.99	<.0001
AvgCDD	1	1.7915	0.0227	78.87	<.0001
PartHDD	1	0.1945	0.0207	9.39	<.0001
PartCDD	1	-0.2152	0.0519	-4.15	<.0001
Post	1	-0.0394	0.2496	-0.16	0.8745
PostHDD	1	0.0542	0.0123	4.40	<.0001
PostCDD	1	0.1151	0.0369	3.12	0.0018
PartPost	**1**	**-0.7459**	**0.5895**	**-1.27**	**0.2058**
PartPostHDD	**1**	**-0.1004**	**0.0292**	**-3.44**	**0.0006**
PartPostCDD	**1**	**-0.1880**	**0.0813**	**-2.31**	**0.0208**
Annual Normalized Savings	**1**	**933.40**	**96.98**	**-9.63**	**<.0001**

Table C15, Table C16, and Table C17 summarize the regression model outputs Cadmus used to determine the Washington manufactured home duct sealing and duct insulation realization rates.

Table C15. 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	10	15,047,889	1,504,789	11653.7	<.0001
Error	54,086	6,983,866	129.13		
Corrected Total	54,096	22,031,755			
Root MSE		11.3633	R-Square		0.6830
Dependent Mean		0.0000	Adj. R-Square		0.6830
Coefficient of Variation		2.77E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6924	0.0089	189.39	<.0001
AvgCDD	1	1.7500	0.0228	76.76	<.0001
PartHDD	1	0.1902	0.0196	9.72	<.0001
PartCDD	1	-0.1250	0.0491	-2.55	0.0109
Post	1	0.1274	0.2507	0.51	0.6113
PostHDD	1	0.0556	0.0124	4.49	<.0001
PostCDD	1	0.1203	0.0370	3.25	0.0012
PartPost	**1**	**-0.9742**	**0.5571**	**-1.75**	**0.0804**
PartPostHDD	**1**	**-0.0918**	**0.0276**	**-3.33**	**0.0009**
PartPostCDD	**1**	**-0.1908**	**0.0771**	**-2.47**	**0.0134**
Annual Normalized Savings	**1**	**973.63**	**91.61**	**-10.63**	**<.0001**

Table C16. Manufactured Home Ductwork Regression Model for Washington (Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	11,852,427	1,185,243	8566.32	<.0001
Error	44,415	6,145,293	138.36		
Corrected Total	44,425	17,997,720			
Root MSE		11.7627	R-Square		0.6586
Dependent Mean		0.0000	Adj. R-Square		0.6586
Coefficient of Variation		-5.57E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6924	0.0093	182.96	<.0001
AvgCDD	1	1.7500	0.0236	74.16	<.0001
PartHDD	1	0.2365	0.0591	4.00	<.0001
PartCDD	1	0.3652	0.1485	2.46	0.0139
Post	1	0.1274	0.2595	0.49	0.6235
PostHDD	1	0.0556	0.0128	4.33	<.0001
PostCDD	1	0.1203	0.0383	3.14	0.0017
PartPost	**1**	**-1.7934**	**1.7035**	**-1.05**	**0.2925**
PartPostHDD	**1**	**-0.0383**	**0.0838**	**-0.46**	**0.648**
PartPostCDD	**1**	**-0.1297**	**0.2349**	**-0.55**	**0.5809**
Annual Normalized Savings	**1**	**947.63**	**281.55**	**-3.37**	**0.0008**

Table C17. 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	10	14,714,054	1,471,405	11496.5	<.0001
Error	53,084	6,794,081	127.99		
Corrected Total	53,094	21,508,134			
Root MSE		11.3132	R-Square		0.6841
Dependent Mean		0.0000	Adj. R-Square		0.6841
Coefficient of Variation		1.58E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6924	0.0089	190.23	<.0001
AvgCDD	1	1.7500	0.0227	77.10	<.0001
PartHDD	1	0.1853	0.0203	9.14	<.0001
PartCDD	1	-0.1757	0.0508	-3.46	0.0005
Post	1	0.1274	0.2496	0.51	0.6098
PostHDD	1	0.0556	0.0123	4.51	<.0001
PostCDD	1	0.1203	0.0369	3.26	0.0011
PartPost	**1**	**-0.9044**	**0.5771**	**-1.57**	**0.1171**
PartPostHDD	**1**	**-0.0968**	**0.0286**	**-3.39**	**0.0007**
PartPostCDD	**1**	**-0.1942**	**0.0797**	**-2.44**	**0.0149**
Annual Normalized Savings	**1**	**976.40**	**94.90**	**-10.29**	**<.0001**

Table C18, Table C19, and Table C20 summarize model outputs for the regression models Cadmus used to determine the Washington single-family home duct sealing and duct insulation realization rates.

Table C18. Single-Family Ductwork Regression Model for Washington (Overall)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	833,922	83,392	297.92	<.0001
Error	3,157	883,691	279.915		
Corrected Total	3,167	1,717,613			
Root MSE		16.7307	R-Square		0.4855
Dependent Mean		0.0000	Adj. R-Square		0.4855
Coefficient of Variation		5.87E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6663	0.0543	30.68	<.0001
AvgCDD	1	2.5275	0.1398	18.08	<.0001
PartHDD	1	0.4372	0.1164	3.76	0.0002
PartCDD	1	0.0673	0.3015	0.22	0.8234
Post	1	-2.8032	1.5115	-1.85	0.0637
PostHDD	1	-0.0017	0.2243	-0.01	0.994
PostCDD	1	-0.0017	0.2243	-0.01	0.994
PartPost	**1**	**-2.9146**	**3.3313**	**-0.87**	**0.3817**
PartPostHDD	**1**	**-0.3502**	**0.1591**	**-2.20**	**0.0278**
PartPostCDD	**1**	**0.0638**	**0.4457**	**0.14**	**0.8862**
Annual Normalized Savings	**1**	**3069.37**	**571.08**	**-5.37**	**<.0001**

Table C19. Single-Family Ductwork Regression Model for Washington (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	860,341	86,034	314.36	<.0001
Error	3,064	838,559	273.681		
Corrected Total	3,074	1,698,900			
Root MSE		16.5433	R-Square		0.5064
Dependent Mean		0.0000	Adj. R-Square		0.5064
Coefficient of Variation		5.64E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6663	0.0537	31.03	<.0001
AvgCDD	1	2.5275	0.1382	18.29	<.0001
PartHDD	1	0.7188	0.1225	5.87	<.0001
PartCDD	1	0.0722	0.3178	0.23	0.8202
Post	1	-2.8032	1.4945	-1.88	0.0608
PostHDD	1	0.0263	0.0739	0.36	0.7221
PostCDD	1	-0.0017	0.2217	-0.01	0.994
PartPost	**1**	**-2.3733**	**3.5258**	**-0.67**	**0.5009**
PartPostHDD	**1**	**-0.4779**	**0.1668**	**-2.86**	**0.0042**
PartPostCDD	**1**	**-0.0734**	**0.4814**	**-0.15**	**0.8789**
Annual Normalized Savings	**1**	**3721.40**	**604.30**	**-6.16**	**<.0001**

Table C20. Single-Family Ductwork Regression Model for Washington (Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	824,034	82,403	300.07	<.0001
Error	3,016	828,227	274.611		
Corrected Total	3,026	1,652,261			
Root MSE		16.5714	R-Square		0.4987
Dependent Mean		0.0000	Adj. R-Square		0.4987
Coefficient of Variation		5.23E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
AvgHDD	1	1.6663	0.0538	30.98	<.0001
AvgCDD	1	2.5275	0.1385	18.25	<.0001
PartHDD	1	0.6283	0.1272	4.94	<.0001
PartCDD	1	0.1583	0.3326	0.48	0.6342
Post	1	-2.8032	1.4971	-1.87	0.0612
PostHDD	1	0.0263	0.0741	0.36	0.7226
PostCDD	1	-0.0017	0.2221	-0.01	0.994
PartPost	**1**	**-2.6493**	**3.6804**	**-0.72**	**0.4717**
PartPostHDD	**1**	**-0.4157**	**0.1726**	**-2.41**	**0.0161**
PartPostCDD	**1**	**-0.0911**	**0.5032**	**-0.18**	**0.8564**
Annual Normalized Savings	**1**	**3503.46**	**633.12**	**-5.53**	**<.0001**

Appendix D. Self-Reported Net-to-Gross Methodology

Net-to-gross (NTG) estimates play a critical part of demand-side management (DSM) program impact evaluations as they allow utilities to determine portions of gross energy savings influenced by and attributable to their DSM programs. This evaluation calculated two NTG components: freeridership and participant spillover. True freeriders would have purchased an incented appliance or equipment without any support from the program (e.g., taking the incentive). Participant spillover results from the amount of additional savings obtained by customers who, due to their program participation, invest in additional energy-efficient measures or activities. Though 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 gauged net effects for many measures at once, it enabled Cadmus to monitor freeridership and spillover over several evaluation efforts.

Survey Design

Direct questions (e.g., "Would you have installed measure X without the program incentive?") often result in exaggerated "yes" responses. Participants tend to provide answers that they believe surveyors seek; so a question becomes the equivalent of asking: "Would you have done the right thing on your own?" Per industry standards, asking questions in several different ways and checking for consistent responses provides an effective solution to avoiding bias.

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, the survey established decision makers' possible choices 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 used responses from three questions to estimate a freeridership score for each participant. Freeridership questions focused on whether participants already used the measure in their homes, and if they planned to purchase the measure before signing up to receive the kit. For participants receiving energy efficiency kits, Cadmus used the kit survey to establish decision makers' possible actions in the program's absence, per the following core questions:

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 prior to signing up for the kit?
3. If the participant planned to purchase the measure before signing up for the kit, in terms of timing, when would they have purchased the CFLs? (e.g., 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 evaluated program, did participants install additional energy-efficient equipment or services incented through a utility program?
2. How influential was the evaluated program on 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 that addressed 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 the following:

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 discussed, Cadmus used the spillover question results to determine whether program participants installed additional energy-saving measures since participating in the program. Savings participants received from additional measures could be classified as spillover if the program significantly influenced participants' decisions to purchase additional measures, provided they did not receive additional incentives for those measures.

The surveys specifically asked residential participants whether they installed the following measures:

- Clothes washers
- Refrigerators
- Dishwashers
- Windows
- Heat pumps
- Ceiling fans
- Electric water heaters
- CFLs
- Insulation

If the participant installed one or more of these measures, Cadmus asked additional questions about which year that participants purchased these measures, whether they received an incentive for the measure, and how influential (e.g., highly influential, somewhat influential, not at all influential) the HES Program was on their purchasing decisions.

Cadmus combined the freeridership and spillover questions into the same survey, conducted by telephone with randomly selected program participants. Prior to beginning the survey effort, Cadmus

pretested the survey to ensure all appropriate prompts and skip patterns were correct. Cadmus also monitored the survey company's initial phone calls to verify the following:

- Survey respondents understood the questions
- 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. Each question response pattern had a freeridership score assigned, and Cadmus calculated confidence and precision estimates based on the distribution of these scores.[1]

Cadmus used explicit response patterns and scoring weights; so these could be discussed and changed. Using a rules-based approach, Cadmus assigned scoring weights to each response from each freeridership question. This allowed instantaneously performing sensitivity analysis, testing the stability of response patterns and scoring weights. Scoring weights could be changed for a given response option to a given question. This also provided other important features, such as the following:

- Derivation of a partial freeridership score, based on the likelihood of a respondent taking similar actions in absence of incentives
- 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 via a "what if" exercise, testing the stability of the response patterns and scoring weights.

This method offered a key advantage by including partial freeridership. Cadmus' experience has shown that program participants do not fall neatly into freerider and non-freerider categories. Participants received partial freeridership scores if: they planned to install the measure before hearing about the program; and the program exerted some influence over their decisions. Further, by including partial freeridership, Cadmus could use "don't know" and "refused" responses rather than removing those respondents from the analysis.

The evaluation assessed rebated measure freeridership at three levels:

1. Cadmus converted each participant survey response into freeridership matrix terminology.
2. Cadmus gave each participant's response combination a score from the matrix.

[1] A specific approach cited in the National Action Plan for Energy Efficiency's *Handbook on DSM Evaluation*, 2007 edition, page 5-1.

3. Cadmus aggregated all participants into an average freeridership score for the entire program category.

Estimating up to two separate freeridership scores for each kit measure allowed freeridership assessment:

1. Cadmus estimated a *future intent* freeridership score from questions focusing 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, Cadmus estimated a *prior use* freeridership score from a question focusing on *prior use* of the examined kit measure in a respondent's 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 remained unsure whether they already purchased or planned to purchase the measure before learning about the incentive, Cadmus considered them an unlikely freerider.

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. In considering all combinations of survey question responses when creating the matrix and assigning each combination a freeridership score of 0% to 100%, Cadmus used this matrix to score every participants' combination of responses.

Kit Measure

If a respondent did not plan to purchase a kit measure within one year from the time they signed up to receive the kit, the evaluation automatically estimated them having 0% freeridership for that measure. If a respondent planned to purchase the measure at the time of signing up for the kit, their *future intent* freeridership score derived from the prescribed values in Table D2.

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.

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 have any of the measures installed in their home at the time of signing up for the kit, they received a *prior-use* freeridership score of 0%, with this *prior-use* freeridership estimate 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 purchased the measure at the same time they received the kit, but they also said that they were not using any of the measure in their home at the time of signing up for the kit, their *future intent* freeridership score of 100% was averaged with their *prior use* freeridership rating of 0%, using the arithmetic mean to arrive at the participant's final 50% freeridership score for the measure.

If a respondent said they would have purchased the measure at the same time they received the kit, and they used the measure in their home at the time they signed up for the kit, they received a 100% final freeridership score, incorporating 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. This individually weighted each respondent's freerider scores by the estimated savings from the equipment they installed, per 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. This individually weighted each respondent's final measure-level freeridership scores by estimated savings from equipment they installed, per 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 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 for use in calculating freeridership and to improve the consistency and quality of survey 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 program participants into program categories to calculate average freeridership scores.

The model incorporated the following inputs:

- Raw survey responses from each participant, along with 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
- Custom freeridership scoring matrices for each unique survey type

The model displayed each participant's response combinations and corresponding freeridership scores, producing 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

Cadmus developed a freeridership score for each survey respondent using a rules-based assignment of responses to survey items. This 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 scores focused on the participant's *future intent* to buy the kit measure within one year from signing up to receive the kit. In some instances, Cadmus estimated a second freeridership score from a question focused on *prior use* of the program measure in question. Where the respondent had *future intent* to buy the kit measure within one year and reported not having *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 served as the participant's final freeridership score for that measure.

By averaging individual measure-level participant freeridership scores, weighted by participants' evaluated savings, Cadmus calculated measure-level freerider scores. Averaging these scores calculated

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 (i.e., if they installed another efficient measure or undertook another energy efficiency activity due to their program participation). Cadmus also asked these respondents to rate the HES Program's (and incentive's) relative influence (e.g., highly, somewhat, 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. Analysis began with a data subset containing only survey respondents who indicated they installed additional energy-savings measures after participating in the HES Program. From this subset, Cadmus removed participants who said the program had little influence on their decisions to purchase additional measures, thus retaining only participants who rated the program as highly influential. Participants were also removed if they applied for an HES incentive for the additional measures 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:

$$Spillover\ \% = \frac{\sum Spillover\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}{\sum Program\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}$$

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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 the participant kit survey.

Further, Cadmus included a series of questions in the general population survey to estimate nonparticipant spillover (NPSO): savings generated by customers who were motivated by the program's reputation and marketing, conducting energy efficiency installations for which they did not receive incentives. Appendix F provides detailed NPSO 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 2015 and 2016 participants.

Freeridership, participant spillover, and NPSO 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) + Participant Spillover + Nonparticipant Spillover[1]

Methodology

Cadmus determined the freeridership amount for the appliance, HVAC, and weatherization measure categories based on an approach previously developed for Pacific Power; this ascertained freeridership using response patterns 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.[2]

Cadmus used a separate set of questions and scoring approach when estimating 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 already used the measure in their home and if they planned to purchase the measure before signing up to receive the kit.

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

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1 Appendix F presents nonparticipant spillover methodology, analysis, and results.

2 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.

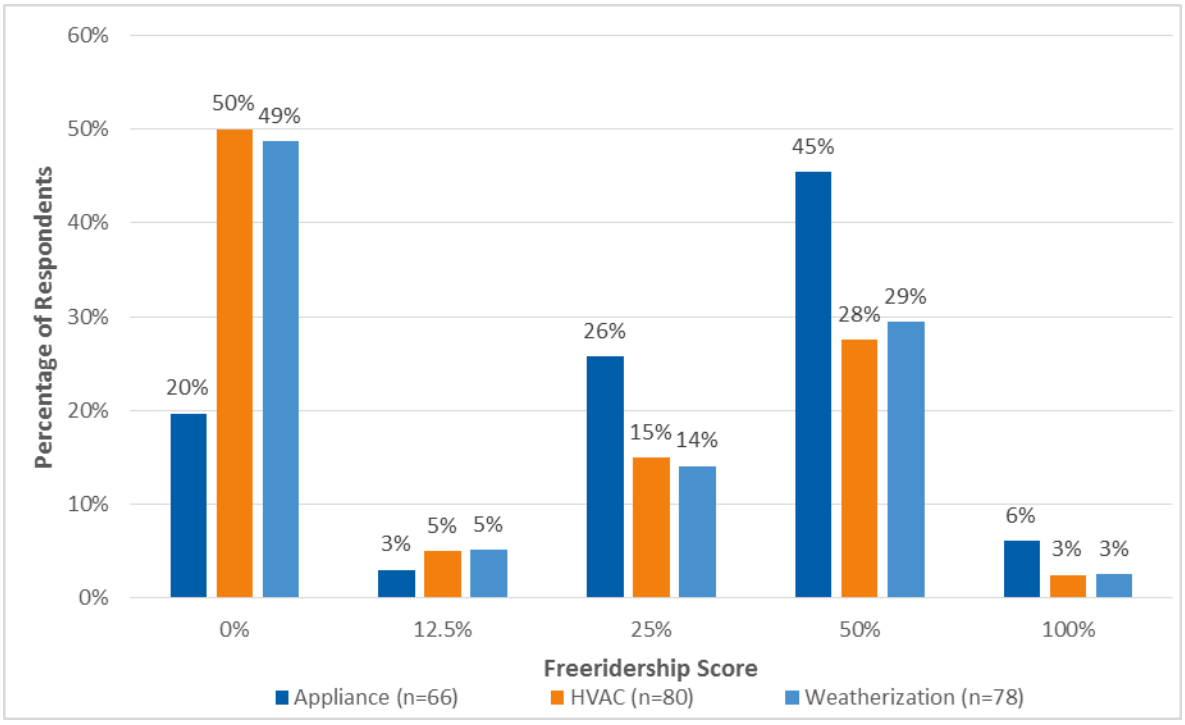
install additional measures. The spillover analysis included measures eligible for program incentives, provided respondents did not request or receive the incentive.

Using the measure category freeridership and spillover results, Cadmus calculated the program's NTG ratio. Appendix D provides a detailed explanation of the self-reported NTG methodology employed.

Appliance, HVAC, and Weatherization Freeridership

After conducting surveys with appliance, HVAC, and weatherization participants, Cadmus converted the responses to six freeridership questions into a score for each participant, using the scoring 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 20% of appliance respondents, 50% of HVAC measure respondents, and 49% of weatherization respondents did not indicate freeridership. That is, the respondents would not have purchased the efficient measure in the absence of Pacific Power's program. More appliance respondents indicated high freeridership rates (i.e., scores of 50% to 100%) than the other measure categories.

Kit Freeridership

Table E1 summarizes freeridership findings by measure for the kit measure category. Cadmus weighted the measure-level freeridership estimates by the evaluated program population kWh savings, arriving at an 11% 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	64	26%	410,289
LED	70	24%	49,848
Kitchen Faucet Aerator	78	5%	1,499,887
Bathroom Faucet Aerator	80	6%	750,113
Showerhead	92	15%	1,251,996
Overall		**11%***	**3,962,134**

*Weighted by evaluated program population kWh savings.

Participant Spillover

This section presents results from additional, energy-efficient measures that 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.[3]

Cadmus used evaluated savings values from the deemed savings analysis to estimate spillover measure savings. This involved estimating spillover percentages for measure categories by dividing the sum of additional spillover savings by total program savings achieved by all measure-category survey respondents. Table E2 shows the results.[4]

Table E2. Non-Lighting Rebate Spillover Responses

Measure Category	Spillover Measure Installed	Quantity	Total Electric Savings (kWh)	Surveyed Measure Category Savings	Spillover Ratio
Appliances	Clothes washer	1	136	8,382	1%
HVAC	Room air conditioner	1	66	113,866	0%
Kit	Clothes washer	2	263	64,844	3%
Kit	Electric heat pump water heater	1	1,036		
Kit	Refrigerator	1	66		
Kit	Room air conditioner	1	66		

[3] "Highly Influential" response for question "How influential would you say the ***watt***smart 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.

[4] No weatherization measure category respondents attributed additional energy efficient purchases to their participation on the HES program.

Non-Lighting NTG Findings

Cadmus conducted 66 surveys with appliance measure category participants, 80 with HVAC measure category participants, and 78 with weatherization measure category participants. Additionally, 137 surveys addressed customers who received energy efficiency kits. As shown in Table E3, Cadmus used these participant responses to generate the following NTG ratios: 66% for appliance measures; 84% for HVAC; 83% for weatherization; and 93% for kits.

Table E3. Non-Lighting NTG Ratio by Measure Category

Program Category	Responses (n)	Freeridership Ratio*	Participant Spillover Ratio*	NPSO Ratio	NTG*	Absolute Precision at 90% Confidence
Appliances	66	36%	1%	1%	66%	±5%
HVAC	79	16%	0%	1%	85%	±5%
Weatherization	78	18%	0%	1%	83%	±5%
Kit	137	11%	3%	1%	93%	±15%

*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 66% NTG, which indicates 66% 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 prior to 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 %	NPSO*** %	NTG
Appliances						
Pacific Power Washington 2015–2016 HES Evaluation: Appliances	**2017**	**66**	**36%**	**1%**	**1%**	**65%**
Pacific Power Washington 2013–2014 HES Evaluation: Appliances	2016	68	40%	0%	0%ł	60%
Northeast Utility—Appliances	2015	65	65%	3%	NA	38%
Northwest Utility—Appliances	2014	73	79%	2%	NA	23 %
HVAC						
Pacific Power Washington 2015–2016 HES Evaluation: HVAC	**2017**	**79**	**16%**	**0%**	**1%**	**85%**
Pacific Power Washington 2013–2014 HES Evaluation: HVAC	2016	68	26%	0%	0%ł	74%
Midwest Utility—HVAC	2015	73	51%	1%	NA	50%
Northwest Utility—HVAC	2014	48	72%	1%	NA	29%

Utility/Region	Reported Year	Responses (n)	FR** %	Spillover %	NPSO*** %	NTG
Weatherization						
Pacific Power Washington 2015–2016 HES Evaluation: Weatherization	**2016**	**78**	**18%**	**0%**	**1%**	**83%**
Pacific Power Washington 2013–2014 HES Evaluation: Weatherization	2016	61	20%	0%	0%ł	80%
Midwest Utility—Weatherization	2015	208	30%	2%	NA	72%
Midwest Utility—Weatherization	2015	79	36%	2%		66%
Kit						
Pacific Power Washington 2015–2016 HES Evaluation: Kit	**2017**	**137**	**11%**	**3%**	**1%**	**93%**
Pacific Power Washington 2013–2014 HES Evaluation: Kit	2016	130	12%	9%	0%ł	97%
Mideast Utility—Kit	2015	150	8%	1%	NA	93%

*NTG values derive from self-response surveys, though differences in analysis and scoring methodologies may vary across evaluations.

**FR = Freeridership

***NPSO = Nonparticipant spillover

ł NPSO of 1% of total 2015-2016 Pacific Power residential ***watt***smart program evaluated savings.

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. Generally, this is called nonparticipant spillover (NPSO)—energy savings results 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 30 customers who self-reported that they participated in a Pacific Power residential program during 2015 or 2016. By excluding these customers from analysis when estimating NPSO, Cadmus focused 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 (i.e., "like" spillover). Examples included installing a high-efficiency clothes washer and high-efficiency insulation that, for whatever reason, participants did not apply for or receive incentives. 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
- Respondents' experiences with past Pacific Power incentive programs

Cadmus estimated the NPSO savings for 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 2015–2016, residential ***watt***smart 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 2015–2016 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	Based on May 2017 Billing Data
E	NPSO kWh Savings Applied to Population	[(A÷B)×C)] × D
F	Total Gross Reported Savings	2015-2016 Evaluation
G	NPSO as a Percentage of Total residential Portfolio Reported Savings	E ÷ F

Results

Of 250 customers surveyed, four nonparticipant respondents reported installing five different measure types due to Pacific Power's influence. Table F2 presents measures and gross evaluated kWh savings that Cadmus attributed to Pacific Power, generating average savings of 107 kWh per NPSO measure.

Table F2. NPSO Response Summary

Reported Spillover Measures	Quantity	Unit Energy Savings (kWh)*	Total Savings (kWh)	Average Savings Per Spillover Measure (kWh)
Efficient Clothes Washer	1	136.6 per unit	137	
Efficient Showerhead	1	119.4 per unit	119	
Efficient Faucet Aerator	2	94.1 per unit	188	
Total	**4***		**444**	**111 (Variable C)**

*Cadmus generated unit energy savings (kWh) estimates for each measure, using average 2013–2014 HES evaluated gross savings by measure.

Table F3 presents variables used to estimate overall NPSO for the HES Program—a figure Cadmus estimates as 1% of Pacific Power's total residential ***watt***smart program reported savings. Cadmus applied the 1% NPSO % equally across the Pacific Power residential ***watt***smart program measures.

Table F3. NPSO Analysis Results

Variable	Metric	Value	Source
A	Number of Like Spillover Nonparticipant Measures	4	Survey data
B	Total Nonparticipant Customers Surveyed	220	Survey disposition
C	Weighted Average of Per Unit Measures Savings in kWh	111	Calculated in Table F2
D	Total Residential Customer Population	99,452	Based on May 2017 Billing Data
E	NPSO kWh Savings Applied to Population	200,838	((A÷B)×C)) × D
F	Total Gross Reported Savings	15,028,260	2015-2016 Residential ***watt***smart Reported Savings
G	NPSO as a Percentage of Total Residential Portfolio Reported Savings	1%	E ÷ F

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Appendix G. Measure Category Cost-Effectiveness

Completed at the measure-category level, the evaluation reported cost-effectiveness for evaluated savings and net savings. Net results are the results of applying the evaluated NTG ratio (consisting of spillover and nonparticipant spillover) to evaluated gross savings. Table G1 shows cost-effectiveness inputs for the evaluated results.

Table G1. Washington Measure Category Cost-Effectiveness Inputs

Input Description	2015	2016	Total
Average Measure Life*			
Appliance	12.9	14.0	13.3
HVAC	19.1	16.6	17.8
Lighting	10.0	11.2	10.5
Weatherization	45.0	44.8	44.9
New Homes	N/A	27.0	27.0
Kits	9.2	9.3	9.2
APS	N/A	5.0	5.0
Evaluated Energy Savings (kWh/year)**			
Appliance	39,815	24,223	64,038
HVAC	1,626,667	1,679,511	3,306,178
Lighting	3,954,816	3,283,748	7,238,564
Weatherization	440,087	179,310	619,396
New Homes	N/A	30,680	30,680
Kits	2,542,218	1,104,141	3,646,359
APS	N/A	25,800	25,800
Total Utility Cost (including incentives)***			
Appliance	$18,111	$15,779	$33,890
HVAC	$870,816	$1,433,735	$2,304,551
Lighting	$261,690	$338,280	$599,970
Weatherization	$111,142	$84,420	$195,562
New Homes	N/A	$22,231	$22,231
Kits	$334,955	$145,417	$480,372
APS	N/A	$18,695	$18,695
Incentives			
Appliance	$8,920	$7,742	$16,662
HVAC	$428,911	$703,501	$1,132,412
Lighting	$108,924	$143,061	$251,985
Weatherization	$54,742	$41,423	$96,165
New Homes	N/A	$10,908	$10,908
Kits	$112,346	$48,974	$161,320
APS	N/A	$3,775	$3,775
Retail Rate	**$0.09**	**$0.09**	**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

Table G2, 3, and 4 show cost-effectiveness results for evaluated savings, excluding non-energy impacts. The appliance measure category (again, excluding non-energy impacts) proved cost-effective from the UCT and PCT perspectives, as shown in Table G2. Table G5 provides annual program non-energy impacts. Table G6, Table G7, and Table G8 provide cost-effectiveness results, including non-energy impacts. The appliance measure category (including non-energy impacts) proved cost-effective from all perspectives except for the RIM, as shown in Table G6.

**Table G2. Washington Appliance 2015-2016 (Excluding Non-Energy Impacts)
(2015 IRP West Plug Loads 61% Preferred Decrement & 2015 IRP
West Residential Water Heating 53% Preferred Decrement)**

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.141	$88,096	$43,353	($44,744)	0.49
TRC	$0.141	$88,096	$39,411	($48,685)	0.45
UCT	$0.051	$32,254	$39,411	$7,158	1.22
RIM		$88,671	$39,411	($49,260)	0.44
PCT		$71,701	$72,275	$575	1.01
Lifecycle Revenue Impacts ($/kWh)					$0.000000974
Discounted Participant Payback (years)					14.84

**Table G3. Washington Appliance 2015 (Excluding Non-Energy Impacts)
(2015 IRP West Plug Loads 61% Preferred Decrement)**

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.148	$57,824	$25,486	($32,337)	0.44
TRC	$0.148	$57,824	$23,169	($34,654)	0.40
UCT	$0.045	$17,677	$23,169	$5,492	1.31
RIM		$52,421	$23,169	($29,252)	0.44
PCT		$48,853	$43,450	($5,403)	0.89
Lifecycle Revenue Impacts ($/kWh)					$0.000000590
Discounted Participant Payback (years)					N/A

Table G4. Washington Appliance 2016 (Excluding Non-Energy Impacts) (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.128	$32,406	$19,056	($13,350)	0.59
TRC	$0.128	$32,406	$17,324	($15,083)	0.53
UCT	$0.062	$15,779	$17,324	$1,545	1.10
RIM		$38,896	$17,324	($21,572)	0.45
PCT		$24,369	$30,859	$6,490	1.27
Lifecycle Revenue Impacts ($/kWh)					$0.000000434
Discounted Participant Payback (years)					9.09

Table G5. Washington Appliance Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Clothes Washer–2015	$6,787.32	PTRC, TRC, PCT
Clothes Washer–2016	$4,300.20	PTRC, TRC, PCT

Table G6. Washington Appliance 2015-2016 (Including Non-Energy Impacts) (2015 IRP West Plug Loads 61% Preferred Decrement & 2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.141	$88,426	$146,408	$57,981	1.66
TRC No Adder	$0.141	$88,426	$142,467	$54,040	1.61
UTC	$0.053	$32,904	$39,411	$6,507	1.20
RIM		$89,322	$39,411	($49,910)	0.44
PCT		$71,701	$175,651	$103,950	2.45
Lifecycle Revenue Impacts ($/kWh)					$0.000000987
Discounted Participant Payback (years)					4.03

Table G7. Washington Appliance 2015 (Including Non-Energy Impacts)
(2015 IRP West Plug Loads 61% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.148	$57,824	$90,109	$32,286	1.56
TRC No Adder	$0.148	$57,824	$87,792	$29,969	1.52
UTC	$0.045	$17,677	$23,169	$5,492	1.31
RIM		$52,421	$23,169	($29,252)	0.44
PCT		$48,853	$108,073	$59,220	2.21
Lifecycle Revenue Impacts ($/kWh)					$0.000000590
Discounted Participant Payback (years)					4.28

Table G8. Washington Appliance 2016 (Including Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.128	$32,406	$60,048	$27,642	1.85
TRC No Adder	$0.128	$32,406	$58,316	$25,909	1.80
UTC	$0.062	$15,779	$17,324	$1,545	1.10
RIM		$38,896	$17,324	($21,572)	0.45
PCT		$24,369	$71,851	$47,481	2.95
Lifecycle Revenue Impacts ($/kWh)					$0.000000434
Discounted Participant Payback (years)					2.69

Appliances—Net Savings

Table G9, Table G10, and Table G11 show cost-effectiveness results for net savings, excluding non-energy impacts. The appliance measure category (again, excluding non-energy impacts) proved cost-effective from the UCT and PCT perspectives, as shown in Table G9.

Table G12 provides the annual program non-energy impacts. Table G13, Table G14, and Table G15 provide cost-effectiveness results, including non-energy impacts. The appliance measure category (including non-energy impacts) proved cost-effective from all perspectives except for the RIM, as shown in Table G13.

Table G9. Washington Appliance 2015-2016 Net (Excluding Non-Energy Impacts) (2015 IRP West Plug Loads 61% Preferred Decrement & 2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.145	$86,743	$41,482	($45,261)	0.48
TRC	$0.145	$86,743	$37,711	($49,032)	0.43
UCT	$0.054	$32,254	$37,711	$5,458	1.17
RIM		$86,086	$37,711	($48,374)	0.44
PCT		$71,701	$72,275	$575	1.01
Lifecycle Revenue Impacts ($/kWh)					$0.000000957
Discounted Participant Payback (years)					14.84

Table G10. Washington Appliance 2015 Net (Excluding Non-Energy Impacts) (2015 IRP West Plug Loads 61% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.158	$56,303	$23,331	($32,972)	0.41
TRC	$0.158	$56,303	$21,210	($35,093)	0.38
UCT	$0.050	$17,677	$21,210	$3,533	1.20
RIM		$49,480	$21,210	($28,270)	0.43
PCT		$48,853	$43,450	($5,403)	0.89
Lifecycle Revenue Impacts ($/kWh)					$0.000000571
Discounted Participant Payback (years)					N/A

Table G11. Washington Appliance 2016 Net (Excluding Non-Energy Impacts) (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.127	$32,491	$19,302	($13,189)	0.59
TRC	$0.127	$32,491	$17,547	($14,944)	0.54
UCT	$0.062	$15,779	$17,547	$1,768	1.11
RIM		$39,192	$17,547	($21,646)	0.45
PCT		$24,369	$30,859	$6,490	1.27
Lifecycle Revenue Impacts ($/kWh)					$0.000000436
Discounted Participant Payback (years)					9.09

Table G12. Washington Appliance Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Clothes Washer – 2015	$6,923.07	PTRC, TRC, PCT
Clothes Washer – 2016	$4,386.20	PTRC, TRC, PCT

Table G13. Washington Appliance 2015-2016 Net (Including Non-Energy Impacts) (2015 IRP West Plug Loads 61% Preferred Decrement & 2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.146	$87,074	$146,582	$59,509	1.68
TRC No Adder	$0.146	$87,074	$142,811	$55,737	1.64
UTC	$0.055	$32,904	$37,711	$4,807	1.15
RIM		$86,736	$37,711	($49,025)	0.43
PCT		$71,701	$175,651	$103,950	2.45
Lifecycle Revenue Impacts ($/kWh)					$0.000000969
Discounted Participant Payback (years)					4.03

Table G14. Washington Appliance 2015 Net (Including Non-Energy Impacts) (2015 IRP West Plug Loads 61% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.158	$56,303	$89,246	$32,943	1.59
TRC No Adder	$0.158	$56,303	$87,125	$30,822	1.55
UTC	$0.050	$17,677	$21,210	$3,533	1.20
RIM		$49,480	$21,210	($28,270)	0.43
PCT		$48,853	$108,073	$59,220	2.21
Lifecycle Revenue Impacts ($/kWh)					$0.000000571
Discounted Participant Payback (years)					4.28

Table G15. Washington Appliance 2016 Net (Including Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.127	$32,491	$61,096	$28,605	1.88
TRC No Adder	$0.127	$32,491	$59,341	$26,850	1.83
UTC	$0.062	$15,779	$17,547	$1,768	1.11
RIM		$39,192	$17,547	($21,646)	0.45
PCT		$24,369	$71,851	$47,481	2.95
Lifecycle Revenue Impacts ($/kWh)					$0.000000436
Discounted Participant Payback (years)					2.69

HVAC—Evaluated Savings

Table G16, Table G17, and Table G18 show HVAC measure category cost-effectiveness results for evaluated savings, excluding non-energy impacts. The HVAC measure category proved cost-effective from all perspectives except for RIM, as shown in Table G16.

Table G19 provides the annual program non-energy impacts. Table G15 provides 2016 cost-effectiveness results, including non-energy impacts. The HVAC measure category (including non-energy impacts) proved cost-effective from all perspectives except for the RIM, as shown in Table G20.

Table G16. Washington HVAC 2015-2016 (Excluding Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.103	$3,935,756	$4,386,218	$450,462	1.11
TRC	$0.103	$3,935,756	$3,987,471	$51,715	1.01
UCT	$0.058	$2,215,678	$3,987,471	$1,771,793	1.80
RIM		$5,777,224	$3,987,471	($1,789,753)	0.69
PCT		$2,808,884	$4,650,351	$1,841,468	1.66
Lifecycle Revenue Impacts ($/kWh)					$0.000036929
Discounted Participant Payback (years)					7.35

Table G17. Washington HVAC 2015
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.084	$1,686,119	$2,303,526	$617,407	1.37
TRC	$0.084	$1,686,119	$2,094,114	$407,995	1.24
UCT	$0.043	$871,250	$2,094,114	$1,222,865	2.40
RIM		$2,739,348	$2,094,114	($645,234)	0.76
PCT		$1,243,994	$2,297,223	$1,053,229	1.85
Lifecycle Revenue Impacts ($/kWh)					$0.000013638
Discounted Participant Payback (years)					6.41

Table G18. Washington HVAC 2016 (Excluding Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.124	$2,399,345	$2,210,559	($188,786)	0.92
TRC	$0.124	$2,399,345	$2,009,599	($389,746)	0.84
UCT	$0.074	$1,433,735	$2,009,599	$575,864	1.40
RIM		$3,231,200	$2,009,599	($1,221,601)	0.62
PCT		$1,669,111	$2,500,966	$831,855	1.50
Lifecycle Revenue Impacts ($/kWh)					$0.000025767
Discounted Participant Payback (years)					7.34

Table G19. Washington HVAC Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Hybrid Heat Pump Clothes Dryer - 2016	$5.70	PTRC, TRC, PCT
Ductless Heat Pump - 2016	$7,868.07	PTRC, TRC, PCT

Table G20. Washington HVAC 2015-2016 (Including Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.103	$3,935,756	$4,464,246	$528,489	1.13
TRC	$0.103	$3,935,756	$4,065,498	$129,742	1.03
UCT	$0.058	$2,215,678	$3,987,471	$1,771,793	1.80
RIM		$5,777,224	$3,987,471	($1,789,753)	0.69
PCT		$2,808,884	$4,728,379	$1,919,495	1.68
Lifecycle Revenue Impacts ($/kWh)					$0.000036929
Discounted Participant Payback (years)					7.17

Table G21. Washington HVAC 2016 (Including Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.124	$2,399,345	$2,293,783	($105,562)	0.96
TRC	$0.124	$2,399,345	$2,092,823	($306,522)	0.87
UCT	$0.074	$1,433,735	$2,009,599	$575,864	1.40
RIM		$3,231,200	$2,009,599	($1,221,601)	0.62
PCT		$1,669,111	$2,584,190	$915,079	1.55
Lifecycle Revenue Impacts ($/kWh)					$0.000025767
Discounted Participant Payback (years)					6.93

HVAC—Net Savings

Table G22, Table G23, and Table G24 show HVAC measure category cost-effectiveness results for net savings. The HVAC measure category proved cost-effective from all perspectives, except for RIM, as shown in Table G22.

Table G25 provides the annual program non-energy impacts. Table G27 provides 2016 net cost-effectiveness results, including non-energy impacts. The HVAC measure category (including non-energy impacts) proved cost-effective from all perspectives except for the RIM, as shown in Table G26.

Table G22. Washington HVAC 2015-2016 Net (Excluding Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.102	$3,939,238	$4,401,424	$462,186	1.12
TRC	$0.102	$3,939,238	$4,001,294	$62,056	1.02
UCT	$0.058	$2,215,678	$4,001,294	$1,785,617	1.81
RIM		$5,789,485	$4,001,294	($1,788,191)	0.69
PCT		$2,808,884	$4,650,351	$1,841,468	1.66
Lifecycle Revenue Impacts ($/kWh)					$0.000036897
Discounted Participant Payback (years)					7.35

Table G23. Washington HVAC 2015 Net
(2015 IRP West Residential Heating 17% Preferred Decrement)

	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.083	$1,683,887	$2,311,594	$627,708	1.37
TRC	$0.083	$1,683,887	$2,101,450	$417,563	1.25
UCT	$0.043	$871,250	$2,101,450	$1,230,200	2.41
RIM		$2,745,863	$2,101,450	($644,413)	0.77
PCT		$1,243,994	$2,297,223	$1,053,229	1.85
Lifecycle Revenue Impacts ($/kWh)					$0.000013621
Discounted Participant Payback (years)					6.41

Table G24. Washington HVAC 2016 Net (Excluding Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.124	$2,404,687	$2,217,746	($186,941)	0.92
TRC	$0.124	$2,404,687	$2,016,133	($388,554)	0.84
UCT	$0.074	$1,433,735	$2,016,133	$582,398	1.41
RIM		$3,236,984	$2,016,133	($1,220,851)	0.62
PCT		$1,669,111	$2,500,966	$831,855	1.50
Lifecycle Revenue Impacts ($/kWh)					$0.000025752
Discounted Participant Payback (years)					7.34

Table G25. Washington HVAC Annual Net Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Hybrid Heat Pump Clothes Dryer - 2016	$3.76	PTRC, TRC, PCT
Ductless Heat Pump - 2016	$7,946.75	PTRC, TRC, PCT

Table G26. Washington HVAC 2015-2016 Net (Including Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.102	$3,939,238	$4,480,231	$540,993	1.14
TRC	$0.102	$3,939,238	$4,080,102	$140,864	1.04
UCT	$0.058	$2,215,678	$4,001,294	$1,785,617	1.81
RIM		$5,789,485	$4,001,294	($1,788,191)	0.69
PCT		$2,808,884	$4,728,379	$1,919,495	1.68
Lifecycle Revenue Impacts ($/kWh)					$0.000036897
Discounted Participant Payback (years)					7.17

Table G27. Washington HVAC 2016 Net (Including Non-Energy Impacts)
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.124	$2,404,687	$2,301,802	($102,884)	0.96
TRC	$0.124	$2,404,687	$2,100,189	($304,498)	0.87
UCT	$0.074	$1,433,735	$2,016,133	$582,398	1.41
RIM		$3,236,984	$2,016,133	($1,220,851)	0.62
PCT		$1,669,111	$2,584,190	$915,079	1.55
Lifecycle Revenue Impacts ($/kWh)					$0.000025752
Discounted Participant Payback (years)					6.93

Lighting – Evaluated Savings

Table G28, Table G29, and Table G30 show cost-effectiveness results for evaluated savings, excluding non-energy impacts. The lighting measure category proved cost-effective the UCT and PCT perspective, as shown in Table G28.

Table G31 provides the annual program non-energy impacts. Table G32, Table G33, and Table G34 provide cost-effectiveness results, including non-energy impacts. The Lighting measure category (including non-energy impacts) proved cost-effective from all perspectives except for the RIM, as shown in Table G32.

Table G28. Washington Lighting 2015-2016 (Excluding Non-Energy Impacts)
(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)	$0.075	$4,447,579	$4,152,562	($295,018)	0.93
TRC	$0.075	$4,447,579	$3,775,056	($672,523)	0.85
UCT	$0.010	$578,847	$3,775,056	$3,196,209	6.52
RIM		$5,855,612	$3,775,056	($2,080,556)	0.64
PCT		$4,111,784	$5,519,817	$1,408,033	1.34
Lifecycle Revenue Impacts ($/kWh)					$0.000049658
Discounted Participant Payback (years)					7.94

Table G29. Washington Lighting 2015 (Excluding Non-Energy Impacts)
(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)	$0.099	$3,192,513	$2,184,383	($1,008,130)	0.68
TRC	$0.099	$3,192,513	$1,985,802	($1,206,711)	0.62
UCT	$0.008	$261,690	$1,985,802	$1,724,112	7.59
RIM		$3,076,031	$1,985,802	($1,090,229)	0.65
PCT		$3,039,747	$2,923,265	($116,482)	0.96
Lifecycle Revenue Impacts ($/kWh)					$0.000027037
Discounted Participant Payback (years)					N/A

Table G30. Washington Lighting 2016 (Excluding Non-Energy Impacts)
(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)	$0.046	$1,338,654	$2,099,260	$760,606	1.57
TRC	$0.046	$1,338,654	$1,908,418	$569,764	1.43
UCT	$0.012	$338,280	$1,908,418	$1,570,138	5.64
RIM		$2,964,701	$1,908,418	($1,056,283)	0.64
PCT		$1,143,435	$2,769,482	$1,626,047	2.42
Lifecycle Revenue Impacts ($/kWh)					$0.000026143
Discounted Participant Payback (years)					3.58

Table G31. Washington Lighting Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Light Bulbs – CFL - 2015	$188,062.35	PTRC, TRC, PCT
Light Bulbs – LED - 2015	$188,902.56	PTRC, TRC, PCT
Light Bulbs – CFL -2016	$121,505.48	PTRC, TRC, PCT

Light Bulbs – LED - 2016	$120,833.34	PTRC, TRC, PCT

Table G32. Washington Lighting 2015-2016 (Including Non-Energy Impacts) (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)	$0.075	$4,447,579	$8,371,041	$3,923,461	1.88
TRC	$0.075	$4,447,579	$7,993,535	$3,545,955	1.80
UCT	$0.010	$578,847	$3,775,056	$3,196,209	6.52
RIM		$5,855,612	$3,775,056	($2,080,556)	0.64
PCT		$4,111,784	$9,738,295	$5,626,511	2.37
Lifecycle Revenue Impacts ($/kWh)					$0.000049658
Discounted Participant Payback (years)					3.77

Table G33. Washington Lighting 2015 (Including Non-Energy Impacts) (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)	$0.099	$3,192,513	$4,843,246	$1,650,733	1.52
TRC	$0.099	$3,192,513	$4,644,666	$1,452,153	1.45
UCT	$0.008	$261,690	$1,985,802	$1,724,112	7.59
RIM		$3,076,031	$1,985,802	($1,090,229)	0.65
PCT		$3,039,747	$5,582,129	$2,542,382	1.84
Lifecycle Revenue Impacts ($/kWh)					$0.000027037
Discounted Participant Payback (years)					4.43

Table G34. Washington Lighting 2016 (Including Non-Energy Impacts) (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)	$0.046	$1,338,654	$3,762,746	$2,424,092	2.81
TRC	$0.046	$1,338,654	$3,571,904	$2,233,250	2.67
UCT	$0.012	$338,280	$1,908,418	$1,570,138	5.64
RIM		$2,964,701	$1,908,418	($1,056,283)	0.64
PCT		$1,143,435	$4,432,968	$3,289,533	3.88
Lifecycle Revenue Impacts ($/kWh)					$0.000026143
Discounted Participant Payback (years)					1.91

Lighting—Net Savings

Table G35, Table G36, and Table G37 show cost-effectiveness results for net savings. The lighting measure category proved cost-effective from the UCT and PCT perspective, as shown in Table G35.

Table G38 provides the annual program non-energy impacts. Table G39, Table G40, and Table G41 provide cost-effectiveness results, including non-energy impacts. The Lighting measure category (including non-energy impacts) proved cost-effective from all perspectives except for the RIM, as shown in Table G39.

Table G35. Washington Lighting 2015-2016 Net (Excluding Non-Energy Impacts)
(2015 IRP West Residential Lighting 45% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.075	$4,488,697	$4,194,087	($294,610)	0.93
TRC	$0.075	$4,488,697	$3,812,807	($675,891)	0.85
UCT	$0.010	$578,847	$3,812,807	$3,233,959	6.59
RIM		$5,908,380	$3,812,807	($2,095,573)	0.65
PCT		$4,111,784	$5,519,817	$1,408,033	1.34
Lifecycle Revenue Impacts ($/kWh)					$0.000050016
Discounted Participant Payback (years)					7.94

Table G36. Washington Lighting 2015 Net (Excluding Non-Energy Impacts)
(2015 IRP West Residential Lighting 45% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.099	$3,222,910	$2,206,226	($1,016,684)	0.68
TRC	$0.099	$3,222,910	$2,005,660	($1,217,250)	0.62
UCT	$0.008	$261,690	$2,005,660	$1,743,970	7.66
RIM		$3,104,174	$2,005,660	($1,098,514)	0.65
PCT		$3,039,747	$2,923,265	($116,482)	0.96
Lifecycle Revenue Impacts ($/kWh)					$0.000027243
Discounted Participant Payback (years)					N/A

Table G37. Washington Lighting 2016 Net (Excluding Non-Energy Impacts) (2015 IRP West Residential Lighting 45% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.046	$1,350,088	$2,120,253	$770,164	1.57
TRC	$0.046	$1,350,088	$1,927,502	$577,414	1.43
UCT	$0.011	$338,280	$1,927,502	$1,589,222	5.70
RIM		$2,990,965	$1,927,502	($1,063,463)	0.64
PCT		$1,143,435	$2,769,482	$1,626,047	2.42
Lifecycle Revenue Impacts ($/kWh)					$0.000026320
Discounted Participant Payback (years)					3.58

Table G38. Washington Lighting Annual Net Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Light Bulbs – CFL - 2015	$189,942.97	PTRC, TRC, PCT
Light Bulbs – LED - 2015	$190,791.59	PTRC, TRC, PCT
Light Bulbs – CFL -2016	$122,720.53	PTRC, TRC, PCT
Light Bulbs – LED - 2016	$122,041.67	PTRC, TRC, PCT

Table G39. Washington Lighting 2015-2016 Net (Including Non-Energy Impacts) (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)	$0.075	$4,488,697	$8,454,751	$3,966,054	1.88
TRC	$0.075	$4,488,697	$8,073,470	$3,584,773	1.80
UCT	$0.010	$578,847	$3,812,807	$3,233,959	6.59
RIM		$5,908,380	$3,812,807	($2,095,573)	0.65
PCT		$4,111,784	$9,738,295	$5,626,511	2.37
Lifecycle Revenue Impacts ($/kWh)					$0.000050016
Discounted Participant Payback (years)					3.77

Table G40. Washington Lighting 2015 Net (Including Non-Energy Impacts)
(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)	$0.099	$3,222,910	$4,891,678	$1,668,768	1.52
TRC	$0.099	$3,222,910	$4,691,112	$1,468,202	1.46
UCT	$0.008	$261,690	$2,005,660	$1,743,970	7.66
RIM		$3,104,174	$2,005,660	($1,098,514)	0.65
PCT		$3,039,747	$5,582,129	$2,542,382	1.84
Lifecycle Revenue Impacts ($/kWh)					$0.000027243
Discounted Participant Payback (years)					4.43

Table G41. Washington Lighting 2016 Net (Including Non-Energy Impacts)
(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)	$0.046	$1,350,088	$3,800,373	$2,450,285	2.81
TRC	$0.046	$1,350,088	$3,607,623	$2,257,535	2.67
UCT	$0.011	$338,280	$1,927,502	$1,589,222	5.70
RIM		$2,990,965	$1,927,502	($1,063,463)	0.64
PCT		$1,143,435	$4,432,968	$3,289,533	3.88
Lifecycle Revenue Impacts ($/kWh)					$0.000026320
Discounted Participant Payback (years)					1.91

Weatherization—Evaluated Savings

Table G42, Table G43, and Table G44 show weatherization measure category cost-effectiveness results for evaluated savings. The weatherization measure category proved cost-effective from all perspectives, except for RIM, as shown in Table G42.

Table G42. Washington Weatherization 2015-2016
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.050	$501,885	$1,340,862	$838,977	2.67
TRC	$0.050	$501,885	$1,218,966	$717,081	2.43
UCT	$0.019	$190,291	$1,218,966	$1,028,675	6.41
RIM		$1,246,672	$1,218,966	($27,707)	0.98
PCT		$405,173	$1,149,960	$744,787	2.84
Lifecycle Revenue Impacts ($/kWh)					$0.000000443
Discounted Participant Payback (years)					6.80

Table G43. Washington Weatherization 2015
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.040	$291,802	$964,970	$673,168	3.31
TRC	$0.040	$291,802	$877,245	$585,444	3.01
UCT	$0.015	$111,142	$877,245	$766,103	7.89
RIM		$872,012	$877,245	$5,233	1.01
PCT		$235,402	$815,612	$580,211	3.46
Lifecycle Revenue Impacts ($/kWh)					($0.000000084)
Discounted Participant Payback (years)					5.08

Table G44. Washington Weatherization 2016
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.075	$224,075	$400,927	$176,852	1.79
TRC	$0.075	$224,075	$364,479	$140,404	1.63
UCT	$0.028	$84,420	$364,479	$280,059	4.32
RIM		$399,612	$364,479	($35,133)	0.91
PCT		$181,078	$356,615	$175,537	1.97
Lifecycle Revenue Impacts ($/kWh)					$0.000000562
Discounted Participant Payback (years)					10.67

Weatherization—Net Savings

Table G45, Table G46, and Table G47 show weatherization measure category cost-effectiveness results for net evaluated savings. The weatherization measure category proved cost-effective from all perspectives, except for RIM, as shown in Table G45.

Table G45. Washington Weatherization 2015-2016 Net
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.050	$497,234	$1,332,836	$835,602	2.68
TRC	$0.050	$497,234	$1,211,669	$714,435	2.44
UCT	$0.019	$190,291	$1,211,669	$1,021,378	6.37
RIM		$1,240,351	$1,211,669	($28,682)	0.98
PCT		$405,173	$1,149,960	$744,787	2.84
Lifecycle Revenue Impacts ($/kWh)					$0.000000458
Discounted Participant Payback (years)					6.80

Table G46. Washington Weatherization 2015 Net
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.040	$290,632	$962,371	$671,739	3.31
TRC	$0.040	$290,632	$874,882	$584,251	3.01
UCT	$0.015	$111,142	$874,882	$763,740	7.87
RIM		$869,963	$874,882	$4,919	1.01
PCT		$235,402	$815,612	$580,211	3.46
Lifecycle Revenue Impacts ($/kWh)					($0.000000079)
Discounted Participant Payback (years)					5.08

Table G47. Washington Weatherization 2016 Net
(2015 IRP West Residential Heating 17% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.075	$220,362	$395,138	$174,776	1.79
TRC	$0.075	$220,362	$359,217	$138,854	1.63
UCT	$0.029	$84,420	$359,217	$274,797	4.26
RIM		$395,056	$359,217	($35,839)	0.91
PCT		$181,078	$356,615	$175,537	1.97
Lifecycle Revenue Impacts ($/kWh)					$0.000000574
Discounted Participant Payback (years)					10.67

Kits—Evaluated Savings

Table G48, Table G49, and Table G50 show the kit measure category (excluding non-energy impacts) cost-effectiveness results for evaluated savings. The kit measure category proved cost-effective from all perspectives, except for RIM, as shown in Table G48.

Table G51 provides the annual program non-energy impacts. Table G52, Table G53, and Table G54 provide cost-effectiveness results, including non-energy impacts. The kit measure category (including non-energy impacts) proved cost-effective from all perspectives, except for RIM, as shown in Table G52.

Table G48. Washington Kits 2015-2016 (Excluding Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.017	$471,292	$1,876,471	$1,405,179	3.98
TRC	$0.017	$471,292	$1,705,882	$1,234,590	3.62
UCT	$0.017	$471,292	$1,705,882	$1,234,590	3.62
RIM		$2,924,799	$1,705,882	($1,218,916)	0.58
PCT		$155,658	$2,609,165	$2,453,507	16.76
Lifecycle Revenue Impacts ($/kWh)					$0.000033067
Discounted Participant Payback (years)					0.48

Table G49. Washington Kits 2015 (Excluding Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.017	$334,955	$1,314,010	$979,055	3.92
TRC	$0.017	$334,955	$1,194,555	$859,600	3.57
UCT	$0.017	$334,955	$1,194,555	$859,600	3.57
RIM		$2,068,573	$1,194,555	($874,019)	0.58
PCT		$112,346	$1,845,964	$1,733,618	16.43
Lifecycle Revenue Impacts ($/kWh)					$0.000024995
Discounted Participant Payback (years)					0.33

Table G50. Washington Kits 2016 (Excluding Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.017	$145,417	$599,921	$454,504	4.13
TRC	$0.017	$145,417	$545,382	$399,965	3.75
UCT	$0.017	$145,417	$545,382	$399,965	3.75
RIM		$913,250	$545,382	($367,868)	0.60
PCT		$46,197	$814,030	$767,833	17.62
Lifecycle Revenue Impacts ($/kWh)					$0.000010500
Discounted Participant Payback (years)					0.32

Table G51. Washington Appliance Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Kits – 2015	$211,319.18	PTRC, TRC, PCT
Kits – 2016	$91,481.66	PTRC, TRC, PCT

Table G52. Washington Kits 2015-2016 (Including Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.017	$468,688	$4,012,471	$3,543,783	8.56
TRC	$0.017	$468,688	$3,841,883	$3,373,195	8.20
UCT	$0.017	$471,292	$1,705,882	$1,234,590	3.62
RIM		$2,924,799	$1,705,882	($1,218,916)	0.58
PCT		$155,658	$4,747,769	$4,592,111	30.50
Lifecycle Revenue Impacts ($/kWh)					$0.000033067
Discounted Participant Payback (years)					0.35

Table G53. Washington Kits 2015 (Including Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.017	$334,955	$2,833,050	$2,498,095	8.46
TRC	$0.017	$334,955	$2,713,594	$2,378,639	8.10
UCT	$0.017	$334,955	$1,194,555	$859,600	3.57
RIM		$2,068,573	$1,194,555	($874,019)	0.58
PCT		$112,346	$3,365,004	$3,252,658	29.95
Lifecycle Revenue Impacts ($/kWh)					$0.000024995
Discounted Participant Payback (years)					0.20

Table G54. Washington Kits 2016 (Including Non-Energy Impacts)
(2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.016	$142,640	$1,257,971	$1,115,331	8.82
TRC	$0.016	$142,640	$1,203,433	$1,060,793	8.44
UCT	$0.017	$145,417	$545,382	$399,965	3.75
RIM		$913,250	$545,382	($367,868)	0.60
PCT		$46,197	$1,474,857	$1,428,660	31.93
Lifecycle Revenue Impacts ($/kWh)					$0.000010500
Discounted Participant Payback (years)					0.19

Kits—Net Savings

Table G55, Table G56, and Table G57 show the kit measure category (excluding non-energy impacts) cost-effectiveness results for net savings. The kit measure category proved cost-effective from all perspectives, except for RIM, as shown in Table G55, which **Error! Reference source not found.**provides the annual program non-energy impacts.

Table G58 provides the annual program non-energy impacts. Table G59, Table G60, and Table G61 provide net cost-effectiveness results, including non-energy impacts. The kit measure category (including non-energy impacts) proved cost-effective from all perspectives, except for RIM, as shown in Table G59.

Table G55. Washington Kits 2015-2016 (Excluding Non-Energy Impacts) Net (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.016	$471,292	$1,951,529	$1,480,238	4.14
TRC	$0.016	$471,292	$1,774,118	$1,302,826	3.76
UCT	$0.016	$471,292	$1,774,118	$1,302,826	3.76
RIM		$3,022,939	$1,774,118	($1,248,821)	0.59
PCT		$155,658	$2,615,391	$2,459,733	16.80
Lifecycle Revenue Impacts ($/kWh)					$0.000033878
Discounted Participant Payback (years)					0.48

Table G56. Washington Kits 2015 (Excluding Non-Energy Impacts) Net (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.016	$334,955	$1,366,570	$1,031,615	4.08
TRC	$0.016	$334,955	$1,242,337	$907,382	3.71
UCT	$0.016	$334,955	$1,242,337	$907,382	3.71
RIM		$2,137,918	$1,242,337	($895,581)	0.58
PCT		$112,346	$1,850,458	$1,738,112	16.47
Lifecycle Revenue Impacts ($/kWh)					$0.000025612
Discounted Participant Payback (years)					0.33

Table G57. Washington Kits 2016 (Excluding Non-Energy Impacts) Net (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.016	$145,417	$623,917	$478,500	4.29
TRC	$0.016	$145,417	$567,198	$421,781	3.90
UCT	$0.016	$145,417	$567,198	$421,781	3.90
RIM		$943,963	$567,198	($376,766)	0.60
PCT		$46,197	$815,878	$769,681	17.66
Lifecycle Revenue Impacts ($/kWh)					$0.000010754
Discounted Participant Payback (years)					0.32

Table G58. Washington Appliance Annual Non-Energy Impacts Net

Measure	Annual Value	Perspective Adjusted
Kits – 2015	$217,658.76	PTRC, TRC, PCT
Kits – 2016	$94,226.11	PTRC, TRC, PCT

Table G59. Washington Kits 2015-2016 (Including Non-Energy Impacts) Net (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.016	$470,167	$4,172,970	$3,702,803	8.88
TRC	$0.016	$470,167	$3,995,558	$3,525,391	8.50
UCT	$0.016	$471,292	$1,774,118	$1,302,826	3.76
RIM		$3,022,939	$1,774,118	($1,248,821)	0.59
PCT		$155,658	$4,752,517	$4,596,859	30.53
Lifecycle Revenue Impacts ($/kWh)					$0.000033878
Discounted Participant Payback (years)					0.35

Table G60. Washington Kits 2015 (Including Non-Energy Impacts) Net (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.016	$336,078	$2,946,372	$2,610,293	8.77
TRC	$0.016	$336,078	$2,822,138	$2,486,060	8.40
UCT	$0.016	$334,955	$1,242,337	$907,382	3.71
RIM		$2,137,918	$1,242,337	($895,581)	0.58
PCT		$112,346	$3,368,375	$3,256,028	29.98
Lifecycle Revenue Impacts ($/kWh)					$0.000025612
Discounted Participant Payback (years)					0.00

Table G61. Washington Kits 2016 (Including Non-Energy Impacts) Net (2015 IRP West Residential Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.016	$143,019	$1,308,290	$1,165,271	9.15
TRC	$0.016	$143,019	$1,251,570	$1,108,551	8.75
UCT	$0.016	$145,417	$567,198	$421,781	3.90
RIM		$943,963	$567,198	($376,766)	0.60
PCT		$46,197	$1,476,326	$1,430,129	31.96
Lifecycle Revenue Impacts ($/kWh)					$0.000010754
Discounted Participant Payback (years)					0.19

New Homes—Evaluated Savings

Table G62 shows the new homes measure category's cost-effectiveness results for evaluated savings. The new homes measure category proved cost-effective from the UCT and PCT perspectives.

Table G62. Washington New Homes 2016
(2015 IRP West Residential Whole House 65% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.103	$45,943	$33,658	($12,285)	0.73
TRC	$0.103	$45,943	$30,598	($15,345)	0.67
UCT	$0.050	$22,231	$30,598	$8,367	1.38
RIM		$66,155	$30,598	($35,557)	0.46
PCT		$34,620	$54,832	$20,212	1.58
Lifecycle Revenue Impacts ($/kWh)					$0.000000656
Discounted Participant Payback (years)					10.56

New Homes—Net Savings

Table G63 shows the new homes measure category's cost-effectiveness results for net savings. The new homes measure category proved cost-effective from the UCT and PCT perspectives.

Table G63. Washington New Homes 2016 Net
(2015 IRP West Residential Whole House 65% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.103	$45,943	$33,658	($12,285)	0.73
TRC	$0.103	$45,943	$30,598	($15,345)	0.67
UCT	$0.050	$22,231	$30,598	$8,367	1.38
RIM		$66,155	$30,598	($35,557)	0.46
PCT		$34,620	$54,832	$20,212	1.58
Lifecycle Revenue Impacts ($/kWh)					$0.000000656
Discounted Participant Payback (years)					10.56

Advanced Power Strip—Evaluated Savings

Table G64 shows the advanced power strip measure category's cost-effectiveness results for evaluated savings. The advanced power strip measure category proved cost-effective only from the PCT perspective.

Table G64. Washington Advanced Power Strip 2016
(2015 IRP West Residential Whole House 65% Preferred Decrement)

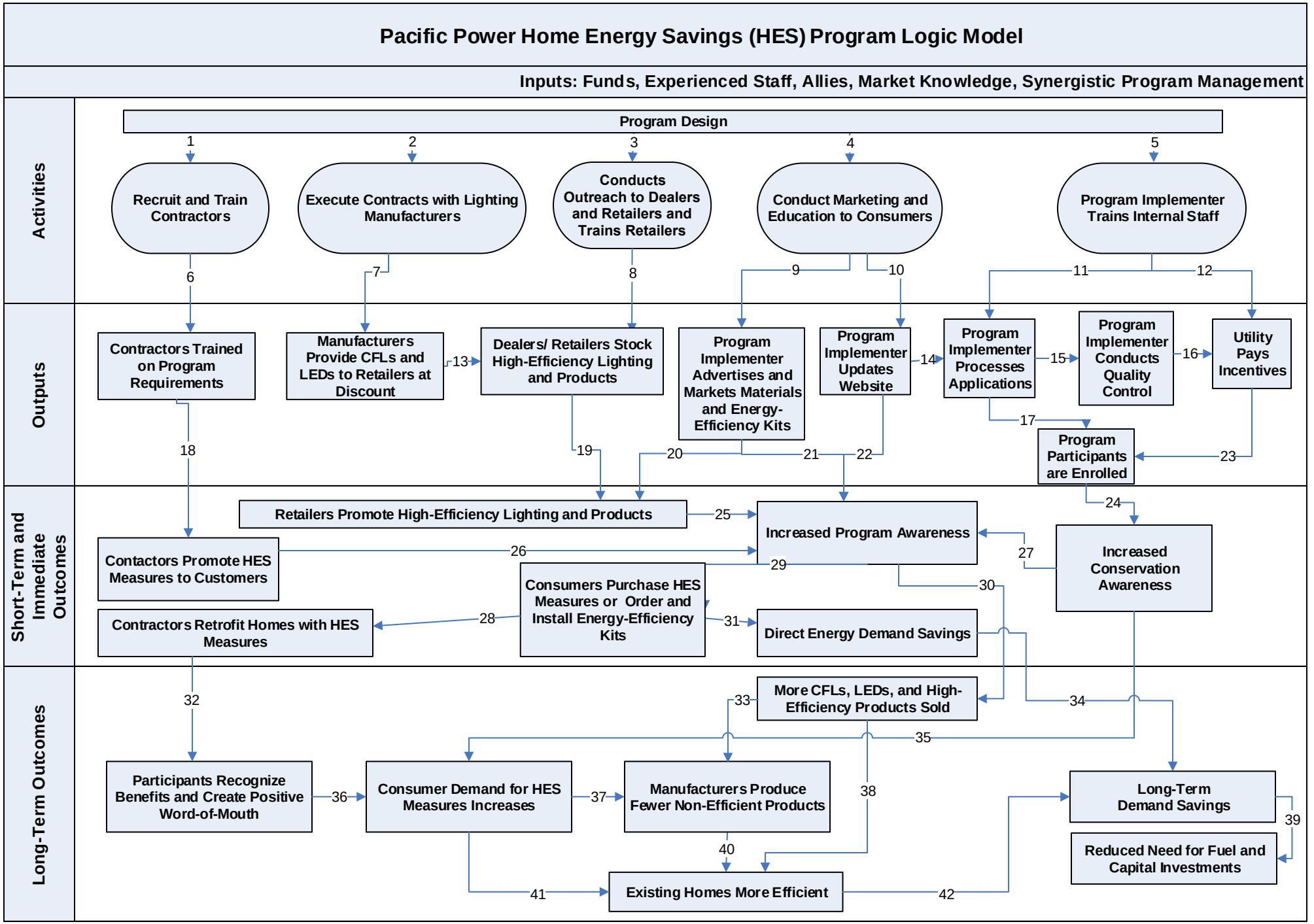
Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.150	$18,695	$7,313	($11,382)	0.39
TRC	$0.150	$18,695	$6,648	($12,047)	0.36
UCT	$0.150	$18,695	$6,648	($12,047)	0.36
RIM		$29,336	$6,648	($22,687)	0.23
PCT		$3,775	$14,416	$10,641	3.82
Lifecycle Revenue Impacts ($/kWh)					$0.000001272
Discounted Participant Payback (years)					0.62

Advanced Power Strip—Net Savings

Table G65 shows advanced power strip measure category cost-effectiveness results for net savings. The advanced power strip measure category proved cost-effective only from the PCT perspective.

Table G65. Washington Advanced Power Strip 2016 Net
(2015 IRP West Residential Whole House 65% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.176	$18,695	$6,216	($12,479)	0.33
TRC	$0.176	$18,695	$5,651	($13,044)	0.30
UCT	$0.176	$18,695	$5,651	($13,044)	0.30
RIM		$27,740	$5,651	($22,089)	0.20
PCT		$3,775	$13,850	$10,074	3.67
Lifecycle Revenue Impacts ($/kWh)					$0.000001238
Discounted Participant Payback (years)					0.62


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
Conducts Outreach to Dealers and Retailers and Trains 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
18
19
20
21
22
23
Program Participants are Enrolled
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
28
31
Contractors Retrofit Homes with HES Measures
Direct Energy Demand Savings
32
33
More CFLs, LEDs, and High-Efficiency Products Sold
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

Appendix I. Benchmark Detail

The tables in this appendix provide additional detail on the programs included in Cadmus benchmark review of residential lighting and non-lighting.

Table I1. Residential Upstream Lighting Programs

Utility/ PA, State	Program Name	Admini-strator	Measure Detail	Program Year	Unit Volume	Net MWh*	kWh/ Unit*	NTG	Notes
Pacific Power, WA	HES	CLEAResult	CFLs (Gen Purpose) CFLs (Specialty) LEDs (Gen Purpose) LEDs (Specialty) CFL, LED Fixtures	2015-2016	634,928	6,969**	11**	HES … realized 93% of reported savings	CLEAResult (RSAT, see p25 of manual) Retailers have to be rated as low leakage (stores inside service territory); Only residential customers are eligible. Mid-market incentives for CFL and LED bulbs apply to upstream, mail by request, and direct install. Mail by request and direct install are offered on an initiative basis and may not be available for the entire year.
Ameren, MO	Residential Lighting	ICF	10W General Purpose 15W General Purpose 20W General Purpose 4W Candelabra 8W Globe 12W Dimmable 10.5W Downlight 15W Flood (PAR 30) 18W Flood (PAR 38)	2016	917,013	24,418	27	59%	• ICF negotiated memorandums of understanding with 13 retail chains and franchise retailers in Ameren Missouri's territory, covering 177 storefront locations. Retailers fell into roughly four categories: Large Hardware, Large Mass-Merchandise, Specialty Electronics, and Discount Stores. Largest volume categories are 10W General Purpose (59% of total) and 15W Flood (23% of total) lamps • The Lighting program operates through a point-of-sale markdown system at major chain retailers and through an online website • Based on intercept surveys: sales-weighted average program leakage was 1.65% in PY16. Sales weighted residential installation 99.15%
EmPOWER, MD	Residential Lighting	ICF, Honeywell	CFL Lamps, LED Lamps and	1/1/2016-5/31/2016	2,442,683	47,519	20	60%	Utilities should continue to incent energy-efficient residential lighting

Utility/ PA, State	Program Name	Admini-strator	Measure Detail	Program Year	Unit Volume	Net MWh*	kWh/ Unit*	NTG	Notes
			Efficient Fixtures standard/specialty CFLs, standard/specialty LEDs, and ENERGY STAR fixtures						for the near future. The transition to an all-LED program has increased per-unit savings generated by the program, and net savings remain robust
SRP AZ	Retail Lighting	SRP	N/A	FY17	693,595	30,488	44	100%	SRP values based on NTG = 1.0
PPL, PA	Residential Retail	Ecova	N/A	6/1/2015-5/31/2016	1,211,953	42,219	30	69%	The upstream lighting component offers incentives to manufacturers to discount the price of energy-efficient screw-in LEDs sold in retail stores. The program also distributes information about energy-efficient lighting in brochures, online, and at participating retailers. The ICSP works directly with manufacturers and retail store channels to coordinate and track the sale of discounted bulbs. An additional quantity of bulbs was provided: Low-Income – Upstream Lighting 48,000 1,467 MWh savings

* Net MWh are values determined by evaluators and were taken from final evaluation reports.

** Cadmus determined the Pacific Power savings value using the RTF 4.2 market baseline. Other utility evaluations typically calculate gross values based on EISA requirements and net values adjusted for freeridership.

Table I2. Residential Non-Lighting Programs Measure and Participation Detail

Utility/PA, State	Program Name	Implementer	Measure Detail	Program Year	Participation	Gross MWh*	NTG
Ameren MO	Efficient Products Program	ICF International	ES room ACs ES HP water heaters ES room air purifiers ES pool pumps multi-speed ES pool pumps var speed Smart thermostats	2016	HPWHs 322 RACs 324 Room air purifiers 1,300 Multi speed pool pumps 147 Var speed pool pumps 550 Smart thermostats 8,200	6,671	HPWHs 84.8% RACs 59.8% Room air purifiers 50.2% Pool pumps 67.8%
EmPOWER, MD	Appliance Rebate Program	ICF Int'l for BGE, Pepco, Delmarva Power, and SMECO. Honeywell for PE	ES Cl Washer Tier 2 $75 ES Cl Washer Tier 3 $100 ES Refrig Tier 2 $100 ES Refrig Tier 3 $150 ES Room AC Tier 2 $30 ES Elec Cl Dryer $50 HP Water Heater $500 Pool Pump Multi-speed $150 Pool Pump Var-speed $400	1/1/2016-5/31/2016	CL Dryer 1,730 CL Washer Tier 2 1,789 CL Washer Tier 3 120 Pool Pump 344 Refrig Tier 2 215 Refrig Tier 3 1 HP Water Heater 424	1,548	68%
EmPOWER, MD	Residential HVAC Program	ICF Int'l for BGE, Pepco, Delmarva Power, and SMECO. Honeywell for PE	ASHP SEER 16-18 ASHP SEER 18+ CAC SEER 16-18 CAC SEER 18 Furnace GSHP Mini Split HP	1/1/2016-5/31/2016	ASHP SEER 16-18 1,631 ASHP SEER 18+ 1,029 CAC SEER 16-18 2,094 CAC SEER 18+ 540 Furnace 848 GSHP 336 Mini Split HP 374	5,380	60%
PPL, PA	Residential Retail	Ecova	Energy-efficient refrigerators and heat pump water heaters. Also includes efficient fossil-fuel water heaters eligible for rebates under the fuel-switching pilot	PY7	Refrigerators HPWHs Efficient fossil-fuel WHs 4417	3,053	64%
PSE, WA	Residential Single-Family Existing Dealer Channel & Low	N/A	Shell improvements/ wzn (insulation, air sealing, windows) HVAC (furnace, boiler, HPs), Water heat (equip. repl, SHs)	2013-2015	Ceiling Insulation 1,502 Floor Insulation 1,615 Wall Insulation 483 Air Sealing 190	N/A	N/A

Utility/PA, State	Program Name	Implementer	Measure Detail	Program Year	Participation	Gross MWh*	NTG
	Income Weatherization Programs		Lighting (CFLs, LEDs), appliances (refrigs.) Other direct install (power strips).		Windows 3,078 Duct Sealing, Insulation 1,922 Heat System Repl 7,404 Fireplace 1,163 Integ Space Water Heat 95 Showerheads 188		
EnergyTrust, OR	Exiting Homes	CLEAResult	1) Incentives for OR homes who install EE electric or gas measures 2) Incentives for NW Natural customers in SW WA who install gas measures 3) Energy Saver Kits: LED lightbulbs1, showerheads, and faucet aerators	2013-2015	Downstream/Midstream mix Recent effort to increase midstream engagement (Distrib. SPIFs, info sessions) Instant incentives through trade allies Specialized offers for Moderate income, rental properties	11,440	N/A
Ameren, MO	Efficient Products Program	ICF International	ES room ACs ES HP water heaters ES room air purifiers ES pool pumps multi-speed ES pool pumps var speed Smart thermostats	2016	HPWHs 322 RACs 324 Room air purifiers 1,300 Multi speed pool pumps 147 Var speed pool pumps 550 Smart thermostats 8,200	6,671	HPWHs 84.8% RACs 59.8% Room air purifiers 50.2% Pool pumps 67.8%
EmPOWER, MD	Appliance Rebate Program	ICF Int'l for BGE, Pepco, Delmarva Power, and SMECO. Honeywell for PE	ES Cl Washer Tier 2 $75 ES Cl Washer Tier 3 $100 ES Refrig Tier 2 $100 ES Refrig Tier 3 $150 ES Room AC Tier 2 $30 ES Elec Cl Dryer $50 HP Water Heater $500 Pool Pump Multi-speed $150 Pool Pump Var-speed $400	1/1/2016-5/31/2016	CL Dryer 1,730 CL Washer Tier 2 1,789 CL Washer Tier 3 120 Pool Pump 344 Refrig Tier 2 215 Refrig Tier 3 1 HP Water Heater 424	1,548	68%

Utility/PA, State	Program Name	Implementer	Measure Detail	Program Year	Participation	Gross MWh*	NTG
EmPOWER, MD	Residential HVAC Program	ICF Int'l for BGE, Pepco, Delmarva Power, and SMECO. Honeywell for PE	ASHP SEER 16-18 ASHP SEER 18+ CAC SEER 16-18 CAC SEER 18 Furnace GSHP Mini Split HP	1/1/2016-5/31/2016	ASHP SEER 16-18 1,631 ASHP SEER 18+ 1,029 CAC SEER 16-18 2,094 CAC SEER 18+ 540 Furnace 848 GSHP 336 Mini Split HP 374	5,380	60%
PPL, PA	Residential Retail	Ecova	Energy-efficient refrigerators and heat pump water heaters. Also includes efficient fossil-fuel water heaters eligible for rebates under the fuel-switching pilot	PY7	Refrigerators HPWHs Efficient fossil-fuel WHs 4417	3,053	64%
PSE, WA	Residential Single-Family Existing Dealer Channel & Low Income Weatherization Programs	N/A	Shell improvements/ wzn (insulation, air sealing, windows) HVAC (furnace, boiler, HPs), Water heat (equip. repl, SHs) Lighting (CFLs, LEDs), appliances (refrigs.) Other direct install (power strips).	2013-2015	Ceiling Insulation 1,502 Floor Insulation 1,615 Wall Insulation 483 Air Sealing 190 Windows 3,078 Duct Sealing, Insulation 1,922 Heat System Repl 7,404 Fireplace 1,163 Integ Space Water Heat 95 Showerheads 188	N/A	N/A
EnergyTrust, OR	Exiting Homes	CLEAResult	1) Incentives for OR homes who install EE electric or gas measures 2) Incentives for NW Natural customers in SW WA who install gas measures 3) Energy Saver Kits: LED lightbulbs1, showerheads, and faucet aerators	2013-2015	Downstream/Midstream mix Recent effort to increase midstream engagement (Distrib. SPIFs, info sessions) Instant incentives through trade allies Specialized offers for Moderate income, rental properties	11,440	N/A

* Gross MWh are values determined by evaluators and were taken from final evaluation reports.