2015–2016 Report: Utah Home Energy Savings Program Evaluation

December 21, 2017

Rocky Mountain Power
1407 W North Temple
Salt Lake City, UT 84116

This page left blank.

CADMUS

Prepared by:

Cadmus

This page left blank.

CADMUS

Table of Contents

Glossary of Terms

APS
Advanced Power Strips

CDD
Cooling Degree Days

CSA
Conditional Savings Analysis

CV
Coefficient of Variation

DOE
U.S. Department of Energy

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.

DSM
Demand-Side Management

DSMC
Demand-Side Management Central

ECM
Electronically Commutated Motors

EISA
Energy Independence and Security Act of 2007

Evaluated Savings
Evaluated savings represent the total program savings, based on 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:

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

HVAC
Heating, Ventilation, and Air Conditioning

HDD
Heating Degree Days

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.

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

NEEA
Northwest Energy Efficiency Alliance

NEI
Non-energy impact 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.

NPSO
Nonparticipant Spillover

NTG
Net-to-Gross

PCT
Participant Cost Test

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 resulted from 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
Savings that Rocky Mountain Power presented in its annual report for conservation acquisition.

RIM
Ratepayer Impact Measure

RSAT
Retail Sales Allocation Tool

SEEM
Simplified Energy Enthalpy Model

SKU
Stock Keeping Unit

SPIF
Sales Performance Incentive Funds

TRC
Total Resource Cost

TRM
Technical Reference Manual

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 that supply and install discounted light bulbs and fixtures, appliances, HVAC, or insulation through the program.

UCT
Utility Cost Test

UES
Unit Energy Savings

WHF
Waste Heat Factor

UMP
Uniform Methods Project

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.

This page left blank.

Executive Summary

In 2006, Rocky Mountain Power first offered the Home Energy Savings (HES) program in Utah. The program provides residential customers with incentives to facilitate their purchases of energy-efficient products and services through upstream (manufacturer), midstream (retailer), and downstream (customer) incentive mechanisms.

During the 2015 and 2016 program years, the HES program reported site gross electricity savings of 136,508,672 kWh. The largest of Rocky Mountain Power's Utah residential programs, the HES program contributed 52% of reported Utah residential energy efficiency savings and 23% of Utah's total portfolio of energy efficiency savings in 2015 and 2016.[1]

The 2015–2016 evaluation spans two HES program years. Though the HES program provided incentives for the following measure categories during the 2015–2016 period, the program did not offer all measures in both years:

- ***Appliances:*** efficient clothes washers, dishwashers (2015 only), refrigerators, freezers
- ***Building Shell:*** attic, wall, and floor insulation as well as high-efficiency windows and air sealing
- ***Electronics:*** advanced power strips (APS)
- ***Heating, ventilation, and air conditioning (HVAC):*** high-efficiency heating and cooling equipment and services, including central air conditioning, evaporative coolers, room air conditioners, gas furnace with electronically commutated motors (ECM), heat pumps, duct leakage testing and sealing, duct insulation, and air conditioner best practice installations and sizing
- ***Lighting:*** CFLs and LEDs bulbs, and light fixtures
- ***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
- ***Water Heating:*** high-efficiency electric water heaters (2015 only) and heat pump water heaters

Rocky Mountain Power contracted with Cadmus to conduct impact and process evaluations of the Utah 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, and opportunities for improvements. This document presents these evaluations' results. Cadmus also benchmarked HES against other similar programs around the country.

[1] Residential portfolio and total portfolio savings (at the customer site) sourced from the 2015 and 2016 Rocky Mountain Power Utah annual reports.

Key Findings

Cadmus' impact evaluation addressed 99% of the HES program savings. The evaluation included Cadmus 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

As summarized in Table 1, key evaluation findings include the following:

- ***Appliances:*** Overall, Cadmus estimated a gross realization rate of 84% of reported savings for the appliance measure category. Evaluated gross savings realization rates ranged from 100% for dishwashers, freezers, and refrigerators to 80% for clothes washers (which realized these savings primarily because 85% of participants had a non-electric water heating system). Incented appliances showed a 99% overall weighted average installation rate. From self-response surveys, appliance measures had a savings-weighted net-to-gross (NTG) of 65%.
- ***Building Shell:*** Overall, Cadmus estimated a 106% gross realization rate for the building shell measure category. Cadmus evaluated the insulation measures using a billing analysis that produced a net realization rate, therefore not applying a net adjustment (NTG = 100%) to those particular measures and producing the 100% NTG ratio for the entire measure category.
- ***Electronics:*** The electronics category achieved a 100% realization rate. Cadmus agreed with assumptions the program used to calculate APS reported savings. Electronics measures had an 85% NTG, based on a review of secondary sources.
- ***HVAC****:* Overall, the HVAC measure category realized 103% of reported gross savings. Evaluated gross savings realization rates ranged from 54% for premium ducted evaporative coolers to 112% for central air conditioners. HVAC measures had a savings-weighted NTG of 90% from self-response surveys.
- ***wattsmart Starter Kits: watt***smart kit products (e.g., lighting- and water-saving devices) were evaluated separately, but, when combined at the kit level, realized 61% of reported savings. Installation rates varied from 50% for bathroom aerators to 80% for LEDs, and 50% of survey respondents who received water-saving measures (e.g., faucet aerators, showerheads) reported having an electric water heater, hence savings could not be claimed for 50% of water-saving measures. Kits realized an 89%, savings-weighted NTG, derived from self-response surveys.
- ***Lighting:*** Overall, the lighting measure category realized 74% of reported gross savings. CFL and LED bulbs realized 70% and 79% installation rates, respectively, based on installation, storage, and removal practices reported through telephone surveys. The evaluation estimated lower-than-reported hours of use (HOU) for CFLs and lower-than-reported HOU and in-service rates (ISR) for LEDs. Lighting measures had a 71% weighted NTG (falling within the typical range for upstream lighting NTG).
- ***Water Heating:*** Cadmus assigned a 100% pass-through gross realization rate of reported savings to the water heating measure category. Due to the low savings contributed to the program,

Cadmus did not perform a detailed engineering review of measures in this category. Water heating measures had an 87% savings-weighted NTG ratio from self-response surveys.

Table 1. 2015 and 2016 HES Program Savings[1]

Measure Category	Reported Units[2]	Evaluated Units[2]	Reported Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Gross Realization Rate	Precision (at 90% Confidence)	Evaluated Net Savings (kWh)	NTG
Appliances	10,612	10,612	1,427,303	1,199,296	84%	±1.1%	779,542	65%
Building Shell	10,031,141	10,031,141	2,689,622	2,851,302	106%	±9.1	2,838,232	100%
Electronics	13,796	13,796	413,880	413,880	100%	NA	351,798	85%
HVAC	29,021	29,021	19,026,073	19,598,763	103%	±3.1%	17,589,951	90%
Energy Kits	16,240	16,240	2,990,780	1,810,585	61%	±12%	1,611,421	89%
Lighting	4,277,357	4,277,357	109,939,164	81,606,100	74%	±2.7%	57,554,537	71%
Water Heating	19	19	21,851	21,851	100%	NA	18,931	87%
Total	**14,378,186**	**14,378,186**	**136,508,672**	**107,501,778**	**79%**	**±2.1**	**80,744,412**	**75%**

[1]Totals in tables may not add exactly due to rounding.

[2]Cadmus counted each square foot of incented insulation or windows as one unit for the Building Shell category.

Table 2 and Table 3 show the breakout of impact evaluation findings by program year. Overall, realization rates exhibited small changes associated with changes in program measure offerings. Program savings, particularly in the lighting and energy kits categories, decreased significantly in 2016 from 2015. According to Rocky Mountain Power's annual report, manufacturers' reduced CFL production in 2016 and primarily drove the decrease, as the bulbs would no longer qualify under ENERGY STAR 2.0 specifications beginning in 2017. This reduction affected the ***watts***mart Starter Kit category as well, since the CFL-containing kits were the only kits that were available at no cost.

Cadmus consistently applied NTG ratios to each measure category across the program years, except for light bulbs (where Cadmus separately performed two rounds of demand elasticity modeling to estimate freeridership for CFL and LED bulbs incented in 2015 and 2016). Measure category realization rates exhibited small changes associated with changes in program measure offerings.

Table 2. 2015 HES Program Savings[1]

Measure Category	Reported Units[2]	Evaluated Units[2]	Reported Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Gross Realization Rate	Evaluated Net Savings (kWh)	NTG
Appliances	5,707	5,707	774,480	641,562	83%	417,016	65%
Building Shell	6,724,427	6,724,427	1,625,054	1,741,790	107%	1,736,484	100%
Electronics	13,796	13,796	413,880	413,880	100%	351,798	85%
HVAC	14,948	14,948	8,834,808	9,106,522	103%	8,187,872	90%
Energy Kits	15,158	15,158	2,777,043	1,688,263	61%	1,502,554	89%
Lighting	3,149,608	3,149,608	76,421,125	58,083,235	76%	42,252,008	73%
Water Heating	8	8	6,660	6,660	100%	5,715	86%
Total	**9,923,652**	**9,923,652**	**90,853,049**	**71,681,913**	**79%**	**54,453,446**	**76%**

[1]Totals in tables may not add exactly due to rounding.

[2]Cadmus counted each square foot of incented insulation or windows as one unit for the Building Shell category.

Table 3. 2016 HES Program Savings[1]

Measure Category	Reported Units[2]	Evaluated Units[2]	Reported Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Gross Realization Rate	Evaluated Net Savings (kWh)	NTG
Appliances	4,905	4,905	652,823	557,733	85%	362,527	65%
Building Shell	3,306,714	3,306,714	1,064,568	1,109,512	104%	1,101,748	99%
HVAC	14,073	14,073	10,191,265	10,492,241	103%	9,402,079	90%
Energy Kits	1,082	1,082	213,736	122,321	57%	108,866	89%
Lighting	1,127,749	1,127,749	33,518,040	23,522,865	70%	15,302,529	65%
Water Heating	11	11	15,191	15,191	100%	13,216	87%
Total	**4,454,534**	**4,454,534**	**45,655,623**	**35,819,864**	**78%**	**26,290,965**	**73%**

[1]Totals in tables may not add exactly due to rounding.

[2]Cadmus counted each square foot of incented insulation or windows as one unit for the Building Shell category.

Key Process Evaluation Findings

Key process evaluation findings include the following:

- Thirty-six percent of customers reported that they primarily learned of the upstream/midstream incentives through bill inserts. Similarly, forty-one percent of participants learned of the ***watt***smart Starter Kits through bill inserts. For downstream lighting fixtures incentives and non-lighting incentives, respondents primarily learned of the program through retailer marketing, cited by 44% and 31%, respectively.
- LED prices served as a motivating factor for 26% of LED purchasers in 2015–2016, up from 8% in 2013–2014. This corresponds to the steady decline in LED prices over the period.

- ***watt***smart Starter Kits participants primarily ordered the kit due to its good value (40%), followed by a desire to save on energy costs (30%). Those upgrading from CFLs to LEDs most often reported wanting the more efficient bulbs (47%) as well as bulbs that lasted longer (29%).
- In all participation categories, 97% or more of respondents were either very satisfied or somewhat satisfied. Downstream lighting fixtures participants most likely reported being very satisfied (81%), while Starter Kits participants least likely to report being very satisfied (65%). Among Starter Kit participants, those receiving kits with LEDs were very satisfied 82% of the time, compared to 67% for CFL recipients.
- Non-lighting incentive participants have reported increasing satisfaction levels with the HES program over time. The percentage of very satisfied respondents in 2015–2016 (71%) was significantly higher than the percentage of very satisfied respondents in 2011–2012.
- Downstream lighting fixtures participants were the most likely to live in single-family homes (98%), most likely to own their homes (100%), most likely to live in homes built after 1990 (64%), and most likely to live in homes larger than 2,000 square feet (79%). By comparison, 76% of general population respondents lived in single-family homes, 77% owned their homes, and 46% lived in homes built after 1990. General population respondents did not report on home size, but 52% and 54% of non-lighting and Starter Kit participants, respectively, lived in homes larger than 2,000 square feet.
- Approximately 60% of non-lighting applications were processed and incentives paid within the program's goal of 45 days. Of the 40% requiring more than 45 days to process and pay incentives, most addressed seven measures (i.e., windows, efficient clothes washers, central air conditioner best practice installation and proper sizing, duct sealing and insulation, efficient gas furnaces with ECM, evaporative coolers, attic insulation).

Benchmarking

- For CFL and LED lighting measures, Rocky Mountain Power exhibited a lower evaluated net savings-per-unit value than evaluated net savings reported by some utilities outside of the region. This resulted from lower ISRs and HOU.
- Rocky Mountain Power used a delivery channel strategy similar that used by other utilities. Lighting measures used an upstream and/or midstream incentive mechanism to provide a discount at the point of sale. Rocky Mountain Power (and other utilities) increasingly have used midstream channels (i.e., instant rebates available from contractors and retailers) as a strategy to encourage adoption of new technologies and big ticket items. Downstream incentives were paid post-purchase using mail-in or online incentive applications.
- The most effective new construction programs offered greater incentives for homes built to operate at substantially higher efficiency levels than code or ENERGY STAR minimum requirements. Rocky Mountain Power (which integrated its New Homes program into the Home Energy Savings program in Utah, effective December 1, 2016, renaming Home Energy Savings as Residential Energy Efficiency, and marketed as ***watt***smart Homes) addressed the new

construction market through its downstream incentives, including a whole-home, performance-based incentive.

Cost-Effectiveness Results

As shown in Table 4, the program proved cost-effective 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 Utility Cost Test (UCT) perspective, with a benefit/cost ratio of 2.48.

Table 4. 2015–2016 Evaluated Net HES Program Cost-Effectiveness Summary

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PacifiCorp Total Resource Cost Test (PTRC) (TRC + 10% Conservation Adder)	$0.076	$56,445,173	$78,602,218	$22,157,045	1.39
Total Resource Cost (TRC) No Adder	$0.076	$56,445,173	$71,456,562	$15,011,389	1.27
Utility Cost Test (UCT)	$0.039	$28,788,640	$71,456,562	$42,667,922	2.48
Ratepayer Impact Measure (RIM) Test		$112,441,593	$71,456,562	($40,985,032)	0.64
Participant Cost Test (PCT)		$53,916,662	$122,552,900	$68,636,238	2.27
Lifecycle Revenue Impacts ($/kWh)					$0.000813342
Discounted Participant Payback (years)					3.76

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

Table 5 and Table 6, respectively, show HES program cost-effectiveness for the 2015 and 2016 program years, based on evaluated net savings. The program proved cost-effective from the UCT perspective for both 2015 and 2016.

Table 5. 2015 Evaluated Net HES Program Cost-Effectiveness Summary

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.074	$36,116,855	$46,205,966	$10,089,110	1.28
TRC No Adder	$0.074	$36,116,855	$42,005,423	$5,888,568	1.16
UCT	$0.037	$17,837,946	$42,005,423	$24,167,477	2.35
RIM		$72,390,890	$42,005,423	($30,385,466)	0.58
PCT		$36,030,337	$80,179,746	$44,149,409	2.23
Lifecycle Revenue Impacts ($/kWh)					$0.000073197
Discounted Participant Payback (years)					3.20

Table 6. 2016 Evaluated Net HES Program Cost-Effectiveness Summary

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.080	$21,682,183	$34,553,842	$12,871,659	1.59
TRC No Adder	$0.080	$21,682,183	$31,412,584	$9,730,401	1.45
UCT	$0.043	$11,680,010	$31,412,584	$19,732,574	2.69
RIM		$42,718,081	$31,412,584	($11,305,497)	0.74
PCT		$19,077,555	$45,195,206	$26,117,652	2.37
Lifecycle Revenue Impacts ($/kWh)					$0.000225670
Discounted Participant Payback (years)					3.94

Summary and Recommendations

From impact and process evaluation interviews, surveys, and other analyses, Cadmus drew 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, Rocky Mountain Power filled in available data using its own customer database. While a small detail in terms of operating the program efficiently, this created additional strain on evaluation efforts and on Rocky Mountain Power to update program administrator data with kit participant phone numbers.

  Recommendation: Require that ***watt***smart kit program administrators collect kit participant phone numbers and e-mail addresses for kit program survey data collection activities. *[As of October 2017, the program administrator reported that customer e-mail addresses and phone numbers were mandatory online field entries for customers applying for kits.]*

- **Upstream Lighting Point-of-Sale Merchandizing Data:** Program tracking data did not include complete information about high-visibility product placements or merchandising within retail locations (only the last quarter of the evaluation period and only two retailers). Though decreasing the price of efficient lighting products primarily drives sales, merchandising can generate substantial sales lift. Without complete data, Cadmus could not attribute merchandising's effect on the program.

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

- **Non-Lighting Application Processing:** Participant-reported application processing times showed declining performance from the 2013–2014 program year evaluation. Although the program administrator moved most non-lighting measures applications online, streamlining the process in 2015–2016, and 69% of participants found the application very easy to complete, a small

percentage of customers cited confusing program requirements and the need to submit applications more than one time. In addition, approximately 40% of non-lighting incentive applications shown in the non-lighting participant database took longer to process and pay than the program's goal of 45 days.

Of the seven measures most frequently requiring more than 45 days for application processing and payment, four were retired from the program effective January 1, 2017 (i.e., windows, efficient clothes washers, central air conditioner best practice installation and proper sizing, and duct sealing and insulation). Two others—efficient gas furnaces with ECM, and evaporative coolers—were moved from downstream incentives to midstream and/or upstream (thus providing instant discounts) in 2017, leaving only attic insulation incentivized through a downstream mechanism that requires the customer or contractor to submit an application. Customers may apply online or through the mail.

> ***Recommendation:*** Review 2017 non-lighting application processing times to determine if the overall trend in application processing times improve. Continue training for HVAC and building shell contractors to help mitigate issues with the attic insulation applications by reviewing the criteria required for a complete application and the way to best support customers who chose to fill out the application.

Introduction

Program Description

During the 2015 and 2016 program years, Rocky Mountain Power contracted with CLEAResult to administer the Home Energy Savings (HES) Program and to provide prescriptive incentives to residential customers who purchased qualifying high-efficiency appliances; heating, ventilation, and air conditioning (HVAC); water heating; and building shell measures. The HES program included an upstream and/or midstream lighting component, providing high-efficiency lighting options by offering incentives for eligible CFLs and LED lamps. The program offered CFL or LED fixtures through a downstream incentive mechanism. The program also continued to offer low- and no-cost ***watt***smart Starter Kits. Further, in 2015 only, Rocky Mountain Power also offered upstream incentives for advanced power strips (APS).

The HES program offered the following measures for part or all of 2015–2016:

- Appliances:
  - Clothes washers
  - Dishwashers (2015 only)
  - Freezers
  - Refrigerators
- Building Shell:
  - Insulation (e.g., attic, floor, wall)
  - Windows
  - Air sealing
- Home Electronics: APS (2015 only)
- HVAC:
  - Air source heat pumps (e.g., upgrade and electric system to heat pump conversion)
  - Central air conditioners
  - Central air conditioner best practice installations
  - Central air conditioner best practice installations and sizing
  - Duct leakage testing for manufactured homes
  - Ductless heat pumps
  - Duct sealing
  - Duct sealing and insulation
  - Duct sealing for manufactured homes
  - Duct sealing with crossover for manufactured homes
  - Evaporative coolers (e.g., permanently installed, portable, premium, premium ducted, replacement)
  - Efficient gas furnaces with an electronically commutated motor (ECM)
  - Room air conditioners

- ***watt***smart Starter Kits (e.g., CFLs, LEDs, aerators, high-efficiency showerheads)
- Lighting:
  - CFLs
  - LEDs
  - Efficient light fixtures
- Water Heating:
  - Electric water heaters (2015 only)
  - Heat pump water heaters

Program Participation

During the 2015–2016 HES program years, Rocky Mountain Power provided prescriptive incentives to more than 35,000 residential customers, ***watt***smart Starter Kits to more than 16,000 customers, and upstream discounts for more than 4,000,000 products. Table 7 shows participation and savings by measures and measure categories for this period.

Table 7. HES Reported Quantity and Savings by Measure, 2015–2016*

Measure Category	Measure Name	Reported Quantity	Quantity Type	Reported kWh Savings
Appliances	Energy-Efficient Clothes Washer	8,379	Measures	1,121,335
	Energy-Efficient Dishwasher	222	Measures	10,137
	Energy-Efficient Freezer	538	Measures	35,799
	Energy-Efficient Refrigerator	1,473	Measures	260,032
Building Shell	Air Sealing	7,811	Square Feet	3,477
	Insulation-Attic	9,038,477	Square Feet	1,826,393
	Insulation-Floor	13,373	Square Feet	43,144
	Insulation-Wall	580,581	Square Feet	387,358
	Windows	390,898	Square Feet	429,250
Electronics	Advanced Power Strip	13,796	Measures	413,880
HVAC	Central Air Conditioner Best Practice Installation	201	Measures	16,201
	Central Air Conditioner Best Practice Installation and Sizing	1,707	Measures	544,533
	Central Air Conditioner Equipment	221	Measures	75,803
	Central Air Conditioner Equipment—Tier 1	2,812	Measures	958,892
	Central Air Conditioner Equipment—Tier 2	675	Measures	357,750
	Central Air Conditioner Equipment—Tier 3	394	Measures	292,348
	Central Air Conditioner Proper Sizing	102	Measures	24,480

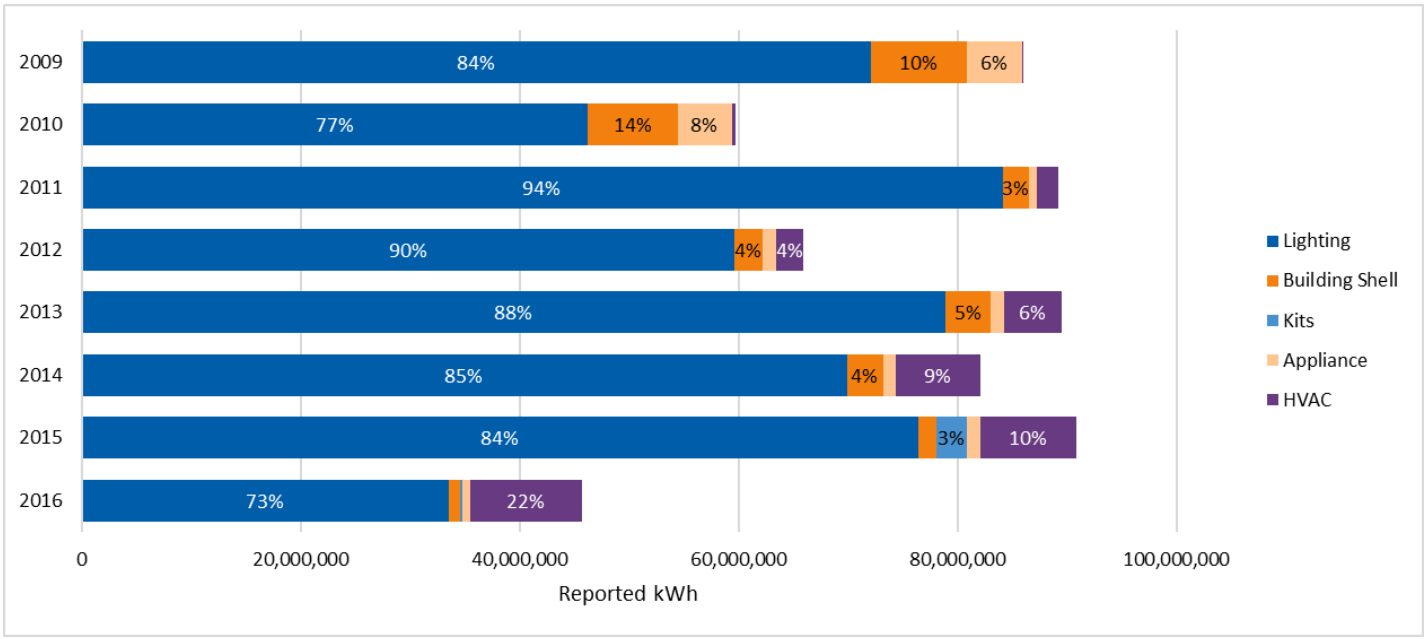
Measure Category	Measure Name	Reported Quantity	Quantity Type	Reported kWh Savings
	Duct Leakage Test—Manufactured Homes	8	Measures	0
	Duct Sealing	3	Measures	3,606
	Duct Sealing—Manufactured Homes	126	Measures	73,752
	Duct Sealing and Insulation	11,059	Measures	4,431,562
	Duct Sealing w/Crossover—Manufactured Homes	19	Measures	4,123
	ECM Retrofit, Gas Furnace	69	Measures	21,528
	Efficient Gas Furnace with ECM	4,441	Measures	2,322,643
	Electric System to Heat Pump Conversion—Tier 1	1	Measures	9,254
	Electric System to Heat Pump Conversion—Tier 2	5	Measures	48,430
	Energy Efficient Room Air Conditioner	231	Measures	21,239
	Evaporative Cooler—Permanently Installed	499	Measures	702,079
	Evaporative Cooler—Portable	100	Measures	80,417
	Evaporative Cooler—Premium	2,987	Measures	4,207,191
	Evaporative Cooler—Premium Ducted	72	Measures	101,523
	Evaporative Cooler—Replacement	3,183	Measures	4,477,044
	Heat Pump to Heat Pump Upgrade—Tier 2	3	Measures	3,675
	Heat Pump, Multi-Head, Ductless	30	Measures	169,620
	Heat Pump, Single-Head, Ductless	5	Measures	14,120
	Heat Pump, Supplemental, Ductless	68	Measures	64,260
Energy Kits	Basic Kit	2,263	Kits	1,484,038
	Best Kit	584	Kits	419,270
	Better Kit	87	Kits	56,664
	CFL Kit	10,274	Kits	713,838
	LED Kit	3,032	Kits	316,970
Lighting	Light Bulbs—CFL	2,039,187	Bulbs	40,950,268
	Light Bulbs—LED	2,045,922	Bulbs	62,408,698
	Light Fixtures—CFL	7,398	Fixtures	275,780
	Light Fixtures—LED	184,850	Fixtures	6,304,417

Measure Category	Measure Name	Reported Quantity	Quantity Type	Reported kWh Savings
Water Heating	Electric Water Heater	3	Measures	361
	Heat Pump Water Heater	16	Measures	21,490
Total				**136,508,672**

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

Historically, lighting savings have comprised the vast majority of HES program savings, as shown in Figure 1. The 2015 and 2016 program years proved not to be an exception, as lighting measures contributed 84% and 73% of 2015 and 2016, respectively, of HES annual reported gross program savings. In 2016, however, lighting savings decreased significantly from 2015, with the quantity of incented CFLs decreased by 93%, resulting in an overall decrease in program savings. According to Rocky Mountain Power's annual report, manufacturers' reducing CFL production in 2016 primarily drove the decrease, as the bulbs would no longer qualify under ENERGY STAR 2.0 specifications, beginning in 2017.

Figure 1. Reported Gross kWh Savings by Measure Category from 2009–2016[1,2]



[1]Percentages may not add to 100% due to rounding.

[2]Rocky Mountain Power categorized light fixtures under the "appliance" measure category in its 2013 and 2014 annual reports, and under the "lighting" measure category in its 2015–2016 annual reports. Figure 1 shows all light fixtures for 2013–2016 in the "lighting" category. As such, percentages in the corresponding figure from Cadmus' 2013–2014 program evaluation vary from those in the figure above.

Data Collection and Evaluation Activities

Table 8 summarizes evaluation activities that supported the impact and process evaluations.

Table 8. Summary of Evaluation Approach

Activities	Impact		Process
	Gross Savings	Net-to-Gross	
Program Staff and Program Administrator Interviews	-	-	X
Non-Lighting Participant Surveys	X	X	X
Lighting Participant Surveys (Fixtures)	X	X	X
Kit Participant Surveys	X	X	X
General Population Surveys	X	X*	X
Building Shell and HVAC Billing Analysis	X	X	-
Engineering Reviews	X	-	-
Demand Elasticity Modeling	-	X	-
Logic Model Review	-	-	X
Benchmarking Review	-	-	X

*This activity provided an estimate of nonparticipant spillover savings that was applied to program savings.

Appendix A provides the survey and data collection instruments used.

Sample Design and Data Collection Methods

For each measure category, Cadmus developed a representative sample of each surveyed population, designed to achieve precision of ±10% with 90% statistical confidence. Cadmus assumed a coefficient of variation (CV)[2] 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 9 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.[3]

[2] The CV equals the ratio of standard deviation (i.e., a measure of the dispersion of data points in a data series) to the series' mean.

[3] 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 9. Sample Disposition for Various Evaluation Data Collection Activities

Data Collection Activity	Population	Sampling Frame	Target Completes	Achieved Completes
Program Staff Interview	N/A	N/A	1	1
Program Administrator Interviews	N/A	N/A	2	2
Non-Lighting Participant Surveys[1]	35,053	34,038	240	240
Lighting Participant Surveys (Fixtures)	8,851	7,550	70	70
Kit Participant Surveys	16,240	12,592	140	139[2]
General Population Surveys[3]	875,130	98,801	250	250

[1]Non-lighting and kit participant populations represent all unique participants by account number, according to program tracking data from the program administrator.

[2]Due to limited available phone numbers for 2016 CFL kit participants, specifically, Cadmus could not attain the target number of completed surveys. All efforts were made to attain the target without placing an undue burden on customers; up to five attempts were made to reach each participant.

[3]Rocky Mountain Power provided the residential customer general population count to Cadmus. The available sample for the general population survey was capped at 100,000 customers, hence the survey's sampling frame was much smaller than the population of customers.

Non-Lighting Participant Telephone Surveys

Cadmus surveyed 240 non-lighting participants, gathering measure-level and measure-category level information on installations, freeridership, spillover, program awareness and satisfaction, and demographics.

In developing the targets by measure category, Cadmus used the measure mix from the 2015–2016 non-lighting database and randomly selected participants and measures within each measure category for the survey. Table 10 provides the population of non-lighting participants, targets, and achieved numbers of surveys.

Table 10. Non-Lighting Participant Survey Sample

Measure Category	Population	Sampling Frame	Targeted	Achieved
Appliances	10,243	9,182	80	80
HVAC	19,153	19,132	80	80
Building shell	7,294	7,291	80	80
Total	**36,690[1]**	**35,605**	**240**	**240**

[1]The total population here differs from the total population in Table 9 as some respondents participated in multiple measure categories.

Participant Kit Surveys

Cadmus surveyed 139 customers who received ***watt***smart Starter Kits in 2015 and 2016, and gathered measure-level information on kit product installations, freeridership, spillover, program awareness and satisfaction, and demographics.

Cadmus targeted samples to achieve statistically significant results for kits containing CFLs and kits 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 participants for the survey. Table 11 lists the population of kit participants, targets, and the number of surveys achieved.

Table 11. Participant Kit Survey Sample

Lighting Type	Population	Sampling Frame	Targeted	Achieved
CFL	12,624	9,149	70	69
LED	3,616	3,443	70	70
Total	**16,240**	**12,592**	**140**	**139***

*Cadmus conducted two rounds of kit participant surveys for 2015 and 2016 participants with 70 responses targeted in each round. Due to limited available sample for 2016 CFL kit participants, Cadmus fell slightly short of attaining the target number of completed surveys. All efforts were made to attain the target without placing an undue burden on customers; up to five attempts were made to reach each participant.

General Population Surveys

The 2015–2016 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 Utah customers. Cadmus drew the general population survey sample from a random list of Utah residential customers (provided by Rocky Mountain Power) and achieved 250 completed responses.

Lighting Participant Surveys (Fixtures)

Rocky Mountain Power administered the CFL and LED light fixture incentives downstream. Cadmus conducted participant surveys with 70 downstream lighting participants, gathering measure-level information on installations, freeridership, spillover, program awareness and satisfaction, and demographics, as shown in Table 12.

Table 12. Lighting Participant Survey (Fixtures) Sample

Measure Category	Population	Sampling Frame	Targeted	Achieved
Light Fixture	8,851	7,550	70	70
Total	**8,851**	**7,550**	**70**	**70**

Impact Evaluation

This chapter provides impact evaluation findings for the HES program, based on Cadmus' data analysis, which used the following activities:

- Participant surveys
- General population surveys
- Billing analysis
- Engineering reviews
- Demand elasticity modeling

This report presents two evaluated saving values: gross savings and net savings. Reported gross savings are electricity savings (kWh) that Rocky Mountain Power reported in the 2015 and 2016 Rocky Mountain Power Energy Efficiency and Peak Reduction Annual Reports.[4] To determine evaluated gross savings, Cadmus applied Step 1 through Step 3; to determine evaluated net savings, Cadmus applied Step 4:

- **Step 1** (verify participant database): This included reviewing the program tracking database to ensure participants and reported savings matched 2015 and 2016 annual reports.
- **Step 2** (adjust gross savings with the actual installation rate): Using telephone surveys, Cadmus determined the number of program measures installed and those remaining installed.
- **Step 3** (estimate gross 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 building shell and HVAC measures).
- **Step 4** (applying net adjustments): Cadmus calculated net saving adjustments using results from customer self-response surveys and demand elasticity modeling. Cadmus did not apply net savings adjustments to building shell measures as the billing analysis produced net savings through Step 3. Although HVAC measures (except efficient gas furnaces with ECM) were evaluated using billing analysis, the billing analysis produced gross savings through Step 3. Cadmus applied net savings adjustments to those HVAC measures.

Table 13 outlines the methodology for each gross and net savings step, by measure, in the 2015–2016 HES program.

[4] Rocky Mountain Power Utah Efficiency and Peak Reduction Annual Reports. Available online: 2015 report: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2016/UT_Energy_Efficiency_and_Peak_Reduction_Report.pdf. 2016 report: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2016/Energy_Efficiency_and_Peak_Reduction_Report_2016(6-30-17).pdf

Table 13. 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	Step 4: Net Adjustment
Appliances	Energy-Efficient Clothes Washer	0.8%	Non-Lighting Tracking Database Review	In-Service Rate (ISR): Non-Lighting Participant Survey	Engineering Review	Self-response net-to-gross (NTG)
	Energy-Efficient Dishwasher	Less than 0.1%			Reported	
	Energy-Efficient Freezer	Less than 0.1%				
	Energy-Efficient Refrigerator	0.2%				
Building Shell	Air Sealing	Less than 0.1%				
	Insulation-Attic	1.3%		Billing Analysis	Billing Analysis	No adjustment
	Insulation-Floor	Less than 0.1%				
	Insulation-Wall	0.3%				
	Windows	0.3%		ISR: Non-lighting Participant Survey	Engineering Review	Self-response NTG
Electronics	Advanced Power Strip	0.3%		ISR: General Population Survey	Engineering Review	NTG based on secondary sources
HVAC	Central Air Conditioner Best Practice Installation	Less than 0.1%		Billing Analysis	Billing Analysis	Self-response NTG
	Central Air Conditioner Best Practice Installation and Sizing	0.4%				
	Central Air Conditioner Equipment	0.1%				
	Central Air Conditioner Equipment—Tier 1	0.7%				
	Central Air Conditioner Equipment—Tier 2	0.3%				

Measure Category	Measure Name	Percentage of Savings	Method			
			Step 1: Database Review	Step 2: Verification	Step 3: Unit Energy Savings	Step 4: Net Adjustment
	Central Air Conditioner Equipment—Tier 3	0.2%				
	Central Air Conditioner Proper Sizing	Less than 0.1%				
	Duct Leakage Test—Manufactured Homes	0.0%		N/A	N/A	N/A
	Duct Sealing	Less than 0.1%		Billing Analysis	Billing Analysis	No adjustment[1]
	Duct Sealing—Manufactured Homes	0.1%				
	Duct Sealing & Insulation	3.2%				
	Duct Sealing w/Crossover—Manufactured Homes	Less than 0.1%				
	ECM Retrofit, Gas Furnace	Less than 0.1%		ISR: Non-lighting Participant Survey	Engineering Review	Self-response NTG
	Efficient Gas Furnace with ECM	1.7%				
	Electric System to Heat Pump Conversion—Tier 1	Less than 0.1%			Reported	
	Electric System to Heat Pump Conversion—Tier 2	Less than 0.1%				
	Energy Efficient Room Air Conditioner	Less than 0.1%				
	Evaporative Cooler—Permanently Installed	0.5%		Billing Analysis	Billing Analysis	Self-response NTG

Measure Category	Measure Name	Percentage of Savings	Method			
			Step 1: Database Review	Step 2: Verification	Step 3: Unit Energy Savings	Step 4: Net Adjustment
	Evaporative Cooler—Portable	0.1%		ISR: Non-lighting Participant Survey	Reported	
	Evaporative Cooler—Premium	3.1%		Billing Analysis	Billing Analysis	
	Evaporative Cooler—Premium Ducted	0.1%				
	Evaporative Cooler—Replacement	3.3%				
	Heat Pump to Heat Pump Upgrade—Tier 2	Less than 0.1%		ISR: Non-lighting Participant Survey	Reported	Self-response NTG
	Heat Pump, Multi-Head, Ductless	0.1%				
	Heat Pump, Single-Head, Ductless	Less than 0.1%				
	Heat Pump, Supplemental, Ductless	Less than 0.1%				
Kits	Basic Kit	1.1%	Kit Tracking Database Review	ISR: Kit Participant Survey	Engineering Review	
	Best Kit	0.3%				
	Better Kit	Less than 0.1%				
	CFL Kit	0.5%				
	LED Kit	0.2%				
Lighting	Light Bulbs—CFL	30.0%	Lighting Tracking Database Review	ISR: General Population Survey		Demand Elasticity Modeling
	Light Bulbs—LED	45.7%				
	Light Fixtures—CFL	0.2%		ISR: Lighting Participant Survey		Self-response NTG
	Light Fixtures—LED	4.6%				

Measure Category	Measure Name	Percentage of Savings	Method			
			Step 1: Database Review	Step 2: Verification	Step 3: Unit Energy Savings	Step 4: Net Adjustment
Water Heating	Electric Water Heater	Less than 0.1%	Non-Lighting Tracking Database Review	ISR: Non-lighting Participant Survey	Reported	Self-response NTG
	Heat Pump Water Heater	Less than 0.1%				

[1]Net adjustments were not applied to insulation and duct-sealing measures as the billing analysis conducted to generate savings produced a net result.

Evaluated Gross Savings

To calculate gross savings for HES program measures, Cadmus conducted tracking database reviews, measure verification, and, lastly, engineering reviews or billing analyses of measures that accounted for 99% of program savings. Table 14 presents the share of savings and gross savings evaluation method for measures evaluated during the 2015–2016 period.

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

Measure Category	Measure	Percentage of Reported kWh Savings	Step 3: Evaluation Method
Appliance	Clothes Washers	1%	Engineering Review
Building Shell	Attic, Floor, and Wall Insulation	2%	Billing Analysis
	Windows	Less than 1%	Engineering Review
Electronics	Advanced Power Strip	Less than 1%	Engineering Review
HVAC	Central Air Conditioner	1%	Billing Analysis
	Central Air Conditioner Best Practice Installation and Sizing	Less than 1%	Billing Analysis
	Duct Sealing and Insulation	3%	Billing Analysis
	Evaporative Coolers	7%	Billing Analysis
	Efficient Gas Furnace with ECM	2%	Engineering Review
Energy Kits	***watt***smart Starter Kits	2%	Engineering Review
Lighting	Light Bulbs—CFL	30%	Engineering Review
	Light Bubs—LED	46%	Engineering Review
	Fixtures	5%	Engineering Review
Sum % of Reported Savings Evaluated		**99%**	

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

Table 15. Reported and Evaluated Gross HES Program Savings for 2015–2016

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
Appliance	Energy-Efficient Clothes Washer	8,379	1,121,335	893,328	80%
	Energy-Efficient Dishwasher	222	10,137	10,137	100%
	Energy-Efficient Freezer	538	35,799	35,799	100%
	Energy-Efficient Refrigerator	1,473	260,032	260,032	100%
Building Shell[1]	Air Sealing	7,811	3,477	3,477	100%
	Insulation-Attic	9,038,477	1,826,393	2,095,874	115%
	Insulation-Floor	4,904	16,456	18,884	115%

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
	Insulation-Floor, Self-Installed	8,469	26,688	30,626	115%
	Insulation-Wall	472,710	279,240	320,441	115%
	Insulation-Wall, Self-Installed	107,871	108,118	124,070	115%
	Windows	390,898	429,250	257,930	60%
Electronics	Advanced Power Strip	13,796	413,880	413,880	100%
HVAC	Central Air Conditioner Best Practice Installation	201	16,201	18,100	112%
	Central Air Conditioner Best Practice Installation and Sizing	1,707	544,533	608,365	112%
	Central Air Conditioner Equipment	221	75,803	84,689	112%
	Central Air Conditioner Equipment—Tier 1	2,812	958,892	1,071,296	112%
	Central Air Conditioner Equipment—Tier 2	675	357,750	399,686	112%
	Central Air Conditioner Equipment—Tier 3	394	292,348	326,618	112%
	Central Air Conditioner Proper Sizing	102	24,480	27,350	112%
	Duct Leakage Test—Manufactured Homes	8	0	0	N/A
	Duct Sealing	3	3,606	3,450	96%
	Duct Sealing—Manufactured Homes	126	73,752	70,571	96%
	Duct Sealing and Insulation	11,059	4,431,562	4,240,427	96%
	Duct Sealing w/Crossover—	19	4,123	3,945	96%

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
	Manufactured Homes				
	ECM Retrofit, Gas Furnace	69	21,528	21,528	100%
	Efficient Gas Furnace with ECM	4,441	2,322,643	2,131,591	92%
	Electric System to Heat Pump Conversion—Tier 1	1	9,254	9,254	100%
	Electric System to Heat Pump Conversion—Tier 2	5	48,430	48,430	100%
	Energy Efficient Room Air Conditioner	231	21,239	21,239	100%
	Evaporative Cooler—Permanently Installed	499	702,079	753,307	107%
	Evaporative Cooler—Portable	100	80,417	80,417	100%
	Evaporative Cooler—Premium	2,987	4,207,191	4,514,176	107%
	Evaporative Cooler—Premium Ducted	72	101,523	108,931	107%
	Evaporative Cooler—Replacement	4,924	4,477,044	4,803,719	107%
	Heat Pump to Heat Pump Upgrade—Tier 2	3	3,675	3,675	100%
	Heat Pump, Multi-Head, Ductless	30	169,620	169,620	100%
	Heat Pump, Single-Head, Ductless	5	14,120	14,120	100%
	Heat Pump, Supplemental, Ductless	68	64,260	64,260	100%
Kits	Basic Kit	2,263	1,484,038	706,347	48%
	Best Kit	584	419,270	190,975	46%
	Better Kit	87	56,664	27,154	48%
	CFL Kit	10,274	713,838	667,745	94%
	LED Kit	3,032	316,970	218,364	69%

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated	
Lighting	Light Bulbs—CFL	2,039,187	40,950,268	33,453,170	82%
	Light Bulbs—LED	2,045,922	62,408,698	42,342,294	68%
	Light Fixtures—CFL	7,398	275,780	213,685	77%
	Light Fixtures—LED	184,850	6,304,417	5,596,951	89%
Water Heating	Electric Water Heater	3	361	361	100%
	Heat Pump Water Heater	16	21,490	21,490	100%
Total[2]			**136,508,672**	**107,501,778**	**79%**

[1]Quantities for building shell measures are in square feet.

[2]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 Utah data; these covered 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, building shell).

Cadmus' review of tracking databases 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 e-mails or phone numbers[5] from 2015 to 2016 (which were necessary for conducting surveys). Rocky Mountain Power provided participant phone numbers by mapping participant account numbers to its customer database.

Cadmus also reviewed the program administrator's tracking database of 2015 and 2016 non-lighting measures, which 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.

In addition to retailers, electric savings, purchase dates, models, and stock keeping units [SKUs],[6] the upstream lighting measures' database contained information on bulbs and fixtures incented. During the 2015–2016 evaluation cycle, Cadmus conducted lighting demand elasticity modeling to estimate freeridership for lighting incentives. In conducting 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 within each store location (i.e., end caps or pallet displays) along with the time frame for each

[5] At the time of this evaluation, the program administrator began collecting e-mails and phone numbers.

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

display. With these data, Cadmus could have estimated sales lift due to price effects as well as product merchandising conducted separately.

As the program administrator's merchandising and product placement data remained unavailable, Cadmus could only account for program price changes and not program merchandising. This could lead to bias in freeridership estimates. When unaccounted for in the demand elasticity model, any merchandising coinciding with price changes and leading to increased sales could potentially lead to upward bias in the price elasticity coefficients, with the model ultimately underestimating freeridership. Similarly, when unaccounted for in the model, merchandising that did not coincide with price changes would not be credited to the program, and the model would overestimate freeridership.

Step 2: Verification

Cadmus used the non-lighting participant survey to verify the non-lighting measures' in-service rate (ISR) (i.e., installation rate), and used the general population survey to verify upstream CFL and LED ISRs.

Non-Lighting In-Service Rate

For each measure category, Cadmus asked survey respondents a series of questions designed to determine whether they had installed products for which they had received incentives. Table 16 shows ISRs for each measure surveyed.

One respondent indicated that they installed the energy-efficient clothes washer in their camp trailer, resulting in a 99% ISR for clothes washers. Overall, the appliances measure category achieved a 99% ISR.

Due to the small quantity of participants, Cadmus could neither use non-lighting participant surveys to reach water-heating participants, nor to evaluate the APS measure's ISR, as the latter measure was offered upstream. Instead, Cadmus asked about the APS ISR through the general population survey. All other survey respondents reported installing all surveyed measures, resulting in a 100% ISR for building shell and HVAC measure categories. Table 16 shows the breadth and quantity of measures addressed by the survey.

Table 16. ISR by Measure Category, 2015–2016

Measure Category	Measure	2015 and 2016			
		Total Surveyed Measures	Installed Measures	Percentage Installed	Weighted Average ISR
Appliances	Clothes Washer	69	68	99%	99%
	Dishwasher	5	5	100%	
	Freezer	6	6	100%	
	Refrigerator	4	4	100%	
Building Shell	Attic Insulation*	55,574	55,574	100%	100%
	Floor Insulation*	1,500	1,500	100%	
	Wall Insulation*	2,293	2,293	100%	
	Windows*	4,478	4,478	100%	
HVAC**	Central Air Conditioner Equipment	9	9	100%	100%
	Evaporative Cooler	16	16	100%	
	Efficient Gas Furnace with ECM	19	19	100%	

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

**Cadmus surveyed 31 duct sealing measure participants and 6 central air conditioner best practice installation and sizing but did not ask ISR questions from these participants. One central air conditioner equipment participant answered the ISR question but did not complete the survey.

wattsmart Starter Kits In-Service Rate

Cadmus calculated ISRs for each kit product using data collected through a survey that Cadmus administered to 139 Utah kit recipients. The survey, conducted six months to one year after kit delivery, verified the number of kit products received and asked survey respondents how many products they had installed at the time of the survey. If respondents reported a measure not currently installed, the survey asked additional questions about why the measure had not been installed and what ultimately happened to the unit (e.g., stored, discarded).

Table 17 shows measure-level ISR results for kit products, along with total products surveyed and reported installed. The 2015–2016 kit participant survey's ISR results for aerators and showerheads were limited as 82% of kits sent to participants were lighting-only kits (only containing four CFL or LED bulbs). Specifically, the survey produced a limited number of responses for kitchen aerators (i.e., 23 responses, with only six confirming the aerator to be in-service), Cadmus calculated the kitchen aerator's ISR based on data combined from the 2015–2016 kit participant surveys in Utah, Idaho, and Wyoming (151 responses, of which 79 confirmed the kit aerator to be in-service).

Table 17. ISR by Kit Measure, 2015–2016

Measure	Total Surveyed Measures	Measures Reported to Be Installed	ISR
Bathroom Aerator	38	19	50%
CFLs[1]	236	185	78%
Kitchen Aerator[2]	151	79	52%
LEDs[1]	276	221	80%
Showerheads	47	25	53%

[1]Consistent with the upstream CFL and LED ISR analysis, bulbs removed due to burn outs were considered to have been installed.

[2]Due to the limited number of survey responses obtained in the 2015–2016 kit participant survey for kitchen aerators, Cadmus calculated the kitchen aerator's ISR based on data combined from the 2015–2016 kit participant surveys in Utah, Idaho, and Wyoming.

Cadmus compared ***watt***smart Starter Kit ISRs with those from two other utilities' residential energy efficiency kit programs, which included delivering free energy- and water-saving products to customers upon their request. As shown in Table 18, the ***watt***smart Starter Kit program produced CFL and LED ISRs similar to other kit programs. Aerator ISRs, however, appeared to be lower for Rocky Mountain Power Utah than for both benchmarked programs.

Table 18. Mail-by-Request Kit Program ISRs Comparison

Product	PPL Electric Utilities PA 2015[1]	Iowa Energy Wise IA 2016[2]	Utah HES 2015–2016
Kitchen Faucet Aerator	65%	74%	**52%**[3]
Bathroom Faucet Aerators	N/A	70%	**50%**
Showerheads	60%	74%	**53%**
CFLs	N/A	79%	**78%**
LEDs	97%	75%	**80%**

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

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

[3]Due to the limited number of survey responses obtained in the 2015–2016 kit participant survey for kitchen aerators, Cadmus calculated kitchen aerator's ISRs based on data combined from 2015–2016 kit participant surveys in Utah, Idaho, and Wyoming.

CFL and LED In-Service Rates

Cadmus calculated first-year ISRs for 2015–2016 using data collected through the general population survey of 250 Rocky Mountain Power Utah customers. Each survey asked participants about the number of bulbs they purchased, installed, removed, and stored within the prior 12 months. If respondents reported removing bulbs, the survey asked why these removals took place. For customers stating that they removed bulbs due to burnout, Cadmus adjusted the ISRs, based on the assumption that bulbs removed due to burn out would not have been removed had they remained functional. Additionally, the assumed effective useful life incorporated the burnout rate.

Surveys asked customers to consider bulbs purchased during the past 12 months rather than those purchased during the entire two-year evaluation period. This phrasing partially addressed Cadmus' concerns about a customer's ability to recall purchases that occurred more than two years prior to the survey. The calculated ISRs did not account for installations occurring after the first year of purchase.

The following formula calculated the lighting ISR:

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

To reflect the program's move away from CFL incentives in Utah, the 2015–2016 survey did not include questions related to CFL purchases. Therefore, the current evaluation based CFL's first-year ISR values on the program's 2013–2014 evaluation.

CFL In-Service Rates

As the general population survey did not include questions about CFL bulbs, Cadmus obtained CFL installation rates from telephone surveys conducted for the program's previous evaluation (i.e., 2013-2014).[7] Of 250 customers surveyed, 89 did not purchase CFLs, and six could neither estimate nor confirm how many they had purchased; the analysis, consequently, excluded these data. The analysis also removed an additional 21 responses for varying reasons, including not knowing how many bulbs were installed, removed, or stored, or reporting demonstrably inconsistent bulb quantities. In calculating the ISR, Cadmus used data from the remaining 134 respondents.

Table 19 provides ISR results for 2015–2016 CFLs.

Table 19. 2015 and 2016 First-Year CFL ISR (Based on 2013–2014 Upstream Lighting Survey)*

Bulb Status	Bulbs Reported	ISR
Purchased	**1,264**	70%
Installed	942	
Stored	322	
Removed	124	
Removed After Burning Out	73	
In-Service Bulbs (including burned out)	**891**	

*n = 134 respondents

Table 20 compares first-year ISRs evaluated for similar programs across the country (and for some past HES program evaluations in Utah).

[7] Cadmus. *Final Report: 2013–2014 Utah Home Energy Savings Program Evaluation.* Prepared for Rocky Mountain Power. April 25, 2016. Available at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2016/2013-2014_Utah_HES_Evaluation.pdf

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

Source	Data Collection Method	Reported Year	ISR
Midwest Utility 1	Self-reporting: determined by interview during home inventory site visits	2016	86%
Midwest Utility 2	Self-reporting: 301 customer surveys	2012	68%
Northeast Utility	Self-Reporting: 200 telephone surveys	2012	73%
Rocky Mountain Power Utah 2009–2010 HES Evaluation	Self-reporting: 250 in-territory lighting surveys	2011	69%
Rocky Mountain Power Utah 2011–2012 HES Evaluation	Self-reporting: 245 in-territory lighting surveys	2014	69%
Rocky Mountain Power Utah 2015–2016 HES Evaluation (Same as 2013–2014 Evaluation)	**Self-reporting: 134 in-territory upstream lighting surveys for 2013–2014 Evaluation**	**2016**	**70%**

LED In-Service Rates

Cadmus calculated the first-year LED ISR for 2015–2016 using data collected through the general population survey of 250 Utah Rocky Mountain Power customers. The survey asked participants about the number of LED bulbs they purchased, installed, removed, and stored within the previous 12 months. If respondents reported removing bulbs, the survey asked why removal took place and adjusted the ISR accordingly. The calculated ISR did not account for installations occurring after the first year of purchase.

After filtering survey results for those who purchased LEDs and provided reliable responses, 67 customers remained for inclusion in the LED ISR analysis. Table 21 lists the LED ISR results.

Table 21. 2015–2016 First-Year LED ISR*

Bulb Status	Bulbs Reported	ISR
Purchased	**981**	79%
Installed	788	
Stored	193	
Removed	30	
Removed After Burning Out	21	
In-Service Bulbs (including burned out)	**779**	

*n = 67 respondents

Table 22 compares LED ISR values to ISRs calculated for LEDs in other jurisdictions. As noted, Rocky Mountain Power's 2015–2016 LED ISR value was the lowest among other studies referenced. All but one study referenced using a multiyear ISR, assuming that bulbs currently in storage will be installed in the future. Only one other first-year ISR in Maryland was verified using site visits, which may indicate that site visits produce ISRs higher than those produced through self-report surveys.

Table 22. Comparison of Evaluated LED ISR Estimates

Utility or Program Administrator	Source	First-Year or Multiyear	Program Year	ISR
Ameren, MO	Site Visits	Multiyear	2016	88%
Salt River Project, AZ	The Uniform Methods Project*	Multiyear	2016	99%
EmPOWER, MD	Site Visits	First-Year	2016	90%
PPL Electric, PA	Pennsylvania 2015 Technical Reference Manual	Multiyear	2016	97%
Rocky Mountain Power, UT 2015–2016 HES Evaluation	**Phone Surveys**	**First-Year**	**2016**	**79%**

*National Renewable Energy Laboratory. *The Uniform Methods Project.* Chapter 21: Residential Lighting Evaluation Protocol. February 2015. Available online: http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf

Step 3: Unit Energy Savings Reviews

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

- Advanced power strips
- CFL and LED bulbs
- Clothes washers
- Efficient gas furnaces with ECMs
- Light fixtures
- Windows

Cadmus evaluated the following measures using billing analysis:

- Central air conditioners
- Evaporative coolers
- Attic, wall, and floor insulation
- Duct sealing and insulation

Further, Cadmus applied 100% realization rates to all measures not listed above (when combined, these contributed less than 1% of the program's savings). As shown in Table 23, UES realization rates for evaluated measures ranged between 70% for LEDs and 282% for clothes washers.

Table 23. 2015–2016 Evaluation Method and Gross[1] Unit Realization Rate Summary Table

Measure Category	Measure	Average UES (kWh/Unit)		UES Realization Rate[2]	UES Method
		Reported	Evaluated		
Appliance	Clothes Washer	134	108	81%	Engineering Review
Building Shell[3]	Attic, Floor, and Wall Insulation	0.2	0.3	115%	Billing Analysis
	Windows	1.1	0.7	60%	Engineering Review
Electronics	Advanced Power Strip	30	30	100%	Engineering Review
HVAC	Central Air Conditioner	411	459	112%	Billing Analysis
	Central Air Conditioner Best Practice Installation & Sizing	291	325	112%	Billing Analysis
	Duct Sealing and Insulation	401	383	96%	Billing Analysis
	Evaporative Cooler	1,407	1,510	107%	Billing Analysis
	Efficient Gas Furnace with ECM	520	477	92%	Engineering Review
Energy Kits	***watt***smart Starter Kits	184	111	61%	Engineering Review
Lighting	CFL Lamps	20	16	82%	Engineering Review
	LED Lamps	31	21	68%	Engineering Review
	Fixtures	34	30	88%	Engineering Review

[1]Gross savings values are net saving values derived from building shell billing analysis, but not for HVAC billing analysis.
[2]The UES realization rate may not calculate exactly due to rounding of reported and evaluated UES values.
[3]Insulation and window units are kWh/square foot.

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

CFL and LED Bulbs

During the 2015–2016 program years, Rocky Mountain Power provided incentives for 2,039,187 CFLs and 2,045,922 LEDs through 27 different Utah retailers, representing 230 stores. Table 24 shows quantities and savings for the 14 different bulb types. Overall, bulbs represented 76% of total HES reported savings.

Table 24. 2015–2016 Incented CFL and LEDs Bulbs by Type

Lighting Type	Bulb Type	Reported Quantity (Bulbs)	Reported Quantity % (Bulbs)	Reported Savings (kWh)
CFL	A-Lamp	31,879	0.8%	409,060
	Spiral	1,665,920	40.8%	32,888,462
	Candelabra	7,784	0.2%	146,194
	Globe	9,474	0.2%	160,437
	Reflector	99,408	2.4%	2,904,301
	Daylight	224,123	5.5%	4,422,054
	Outdoor	144	0.0%	3,836
	Dimmable	436	0.0%	15,038
	3-Way	19	0.0%	885

Lighting Type	Bulb Type	Reported Quantity (Bulbs)	Reported Quantity % (Bulbs)	Reported Savings (kWh)
CFL Total		**2,039,187**	**49.9%**	**40,950,268**
LED	A-Lamp	1,193,870	29.2%	28,442,430
	Candelabra	141,110	3.5%	3,799,660
	Globe	70,472	1.7%	1,900,472
	Downlight	640,124	15.7%	28,252,841
	3-Way	346	0.0%	13,295
LED Total		**2,045,922**	**50.1%**	**62,408,698**
Overall Total		**4,085,109**	**100.0%**	**103,358,967**

As noted in Table 24, LEDs made up 50% of the rebated lighting bulbs for the 2015–2016 evaluation period. From 2015 to 2016, this fraction increased from 36% to 88%, as shown in Table 25. In terms of quantity, however, CFL participation dropped precipitously in 2016, while LED participation held relatively steady. Rocky Mountain Power retired incentives for CFL bulbs and fixtures as of December 1, 2016.

Table 25. CFL and LED Upstream Lighting Participation, 2015–2016

Year	CFL Quantity	LED Quantity	Total	LED %	CFL %
2015	1,908,657	1,061,837	2,970,494	36%	64%
2016	130,530	984,085	1,114,615	88%	12%

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 difference between the evaluated baseline bulb wattage (W_{BASE}) and the evaluated efficient bulb wattage (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 with a home's heating and cooling systems

To calculate the various CFL and LED lighting component inputs, Cadmus conducted the primary and secondary data collection and analysis activities shown in Table 26.

Table 26. CFL and LED Bulb Evaluated Gross Savings Activities

Savings Variable	Lighting Type	Activity	Value
ΔWatts	CFL	Lumen Equivalency Method, via the Uniform Methods Project[2]	33.7[1]
	LED		37.7[1]
ISR	CFL	2013–2014 General Population Survey (n=133)	70.5%
	LED	2015–2016 General Population Survey (n=68)	79.4%
HOU	CFL	Multistate HOU Regression Model, 2013–2014 General Population Survey (n=63)	1.87
	LED	Multistate HOU Regression Model, 2015–2016 General Population Survey (n=195)	1.87
WHF	CFL + LED	2015–2016 General Population Survey (n=229)	1.014

[1]Weighted average value for all bulbs of each technology.

[2]National Renewable Energy Laboratory. *The Uniform Methods Project.* Chapter 21: Residential Lighting Evaluation Protocol. February 2015. Available online: http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf

Cadmus derived the annual savings algorithm from industry standard engineering practices, consistent with the methodology that the UMP prescribed for calculating residential lighting energy use and savings. The following sections discuss each equation component (except for ISR, discussed above in the CFL and LED In-Service Rates section).

Delta Watts

Delta watts represents the wattage difference between a baseline bulb and an equivalent CFL or LED bulb. Cadmus determined baseline wattages using the 2015–2016 upstream lighting tracking data, which included CFL and LED sales data by model numbers and bulb types for 4,085,109 bulbs sold through the program.

The lumen equivalency method produces delta watts for a given lamp by determining the lamp's lumen output and type. Each lamp type corresponds with a set of lumen bins, and each bin corresponds to an assumed baseline wattage. Delta watts equals the difference between this baseline wattage and the bulb's efficient wattage.

Whenever possible, Cadmus estimated each lamp's lumen output and efficient wattage by mapping these to the ENERGY STAR database. When this proved impossible, Cadmus interpolated lumen outputs from efficient wattage, based on a best-fit line derived from the ENERGY STAR database.

Cadmus used the UMP's latest methodology available to evaluate delta watts. Table 27 shows reported quantities for the five reported general lamp categories.

Table 27. 2015 and 2016 CFL Database Quantities by Bulb Types

Bulb Type	2015 Quantity	2015 Percentage	2016 Quantity	2016 Percentage	Overall Quantity	Overall Percentage
Standard	2,411,693	81.2%	705,394	63.3%	3,117,087	76.3%
Decorative	115,244	3.9%	33,311	3.0%	148,555	3.6%
Globe	69,133	2.3%	10,813	1.0%	79,946	2.0%
EISA-Exempt	212	0.0%	153	0.0%	365	0.0%
Reflector	374,212	12.6%	364,944	32.7%	739,156	18.1%
Total	**2,970,494**		**1,114,615**		**4,085,109**	

The majority of bulbs fell into the standard bulb category. Table 28 shows the lumen bins, UMP-specified baseline wattages, and 2015–2016 bulb quantities for standard lamps. Appendix B. Lighting Impacts provides lumen bins and quantities for the remaining bulb types, including a plot of baseline wattages compared to lumen outputs for various bulb types. Overall, for a given lumen output, standard lamps possessed a lower baseline wattage than reflector, globe, decorative, or Energy Independence and Security Act of 2007 (EISA)-exempt lamps. Notably, baselines for reflector lamps were set by a 2009 lamps ruling,[8] with reflector lamps divided into six separate categories, following the practice of the Mid-Atlantic Technical Reference Manual (TRM).[9]

Table 28. Lumen Bins for Standard Lamps and Lamp Quantities

Lumen Bin	Baseline Wattage	2015 Quantity	2016 Quantity	Total Quantity
0-309	25	0	0	0
310-449	25	2,549	777	3,326
450-799	29	169,846	117,032	286,878
800-1,099	43	1,716,257	545,184	2,261,441
1,100-1,599	53	160,708	17,069	177,777
1,600-1,999	72	362,333	25,332	387,665
2,000-2,600	72	0	0	0

ENERGY STAR-Qualified Product List Analysis

While all program bulbs *had* to be ENERGY STAR certified, 5% of bulbs (representing 121 models) could not be matched to the compiled ENERGY STAR-qualified product list that Cadmus used. This does not

[8] Energy Conservation Program. *Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps*. 74 FR 34080. https://www.gpo.gov/fdsys/pkg/FR-2009-07-14/pdf/E9-15710.pdf

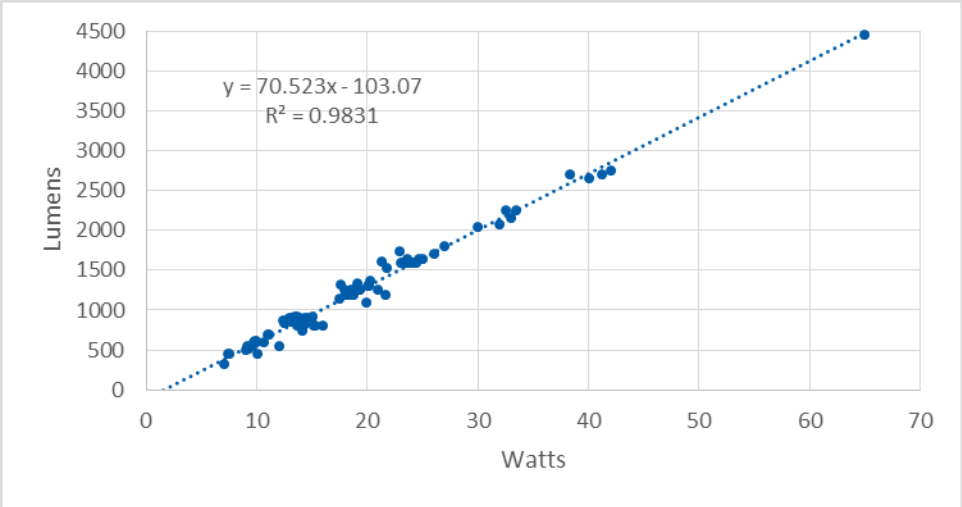
[9] The Mid-Atlantic TRM presents an analysis examining requirements and defining lumen bins for six different reflector categories, depending on the reflector type and diameter. Northwest Energy Efficiency Partnerships. *Mid-Atlantic Technical Reference Manual V5.* June 2015. Available online: http://www.neep.org/mid-atlantic-technical-reference-manual-v5

mean these models were not ENERGY STAR certified; rather, it means the 121 models (out of 718) did not automatically match to the ENERGY STAR database and consisted of too-few-to-warrant manual look-ups. To estimate lumen outputs for these bulbs, Cadmus created linear fits of lumens to wattage, based on the ENERGY STAR-qualified product list.

To determine the 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.[10] The database consisted of approximately 8,300 CFL products and 36,900 LED products, along with their associated wattages and lumens. 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 CFL wattages and lumen outputs. Cadmus used this linear relationship to determine lumen outputs for CFL lamps with model numbers that did not match the ENERGY STAR-qualified lamp product list.

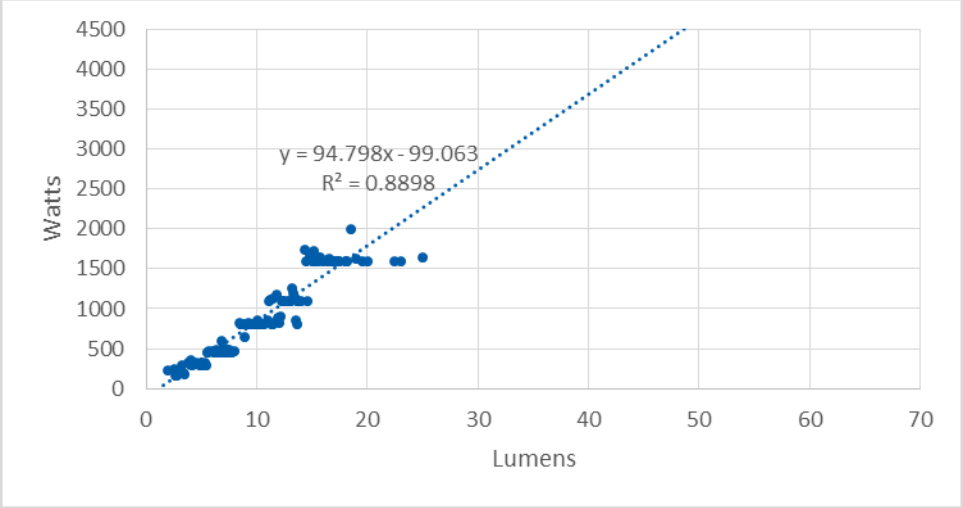
Figure 2. Median Lumens vs. CFL Wattage for ENERGY STAR-Qualified Standard CFLs



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

Figure 3 shows the same chart for LED standard lamps, indicating an even wider spread of efficacies, though the average efficacy was clearly higher than the average efficacy of CFLs (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. 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 computed the HOU using the bulb installation location from surveys of Rocky Mountain Power customers in Utah, combined with analysis of covariance model coefficients, drawn from combined, multistate, multiyear data, produced by two recent CFL HOU metering studies that Cadmus conducted in Maryland and Missouri during 2014. This model expressed average HOU as a function of room type. This method remains consistent with that used in the 2013–2014 program year evaluation.

Cadmus used the LED bulb installation location data from the 2015–2016 general population survey. As the 2015–2016 general population survey did not ask questions regarding CFLs, its data could not be used to derive HOU for CFL bulbs. Instead, Cadmus used CFL installation location data from the 2013–2014 evaluation upstream lighting survey.

Cadmus calculated an average of 1.87 HOU for both CFLs and LEDs. Table 29 compares the evaluations' HOU results.

Table 29. Rocky Mountain Power Utah Upstream Lighting HOU by Evaluation Period

Evaluation Period	Evaluated HOU
2009–2010	2.48 hours
2011–2012	2.27 hours
2013–2014 CFLs	1.87 hours
2015–2016 CFLs*	1.87 hours
2013–2014 LEDs	1.92 hours
2015–2016 LEDs	1.87 hours

*Used the same 2013–2014 evaluation upstream lighting survey data.

Cadmus estimated lighting installation location using response data from the general population surveys, as shown in Table 30.

Table 30. Survey-Reported CFL and LED Installation Locations[1]

Bulb Location	Percentage of Total CFLs			Percentage of Total LEDs	
	2009–2010	2011–2012	2013–2014 (also used in 2015–2016 evaluation)	2013–2014	2015–2016
Living Space	31%	28%	15%	17%	15%
Bedroom	21%	32%	17%	16%	17%
Kitchen	15%	11%	19%	19%	17%
Bathroom	14%	12%	11%	9%	10%
Outdoor	7%	5%	4%	8%	7%
Basement	5%	5%	5%	4%	5%
Other	7%	7%	29%	27%	29%
Total[2]	**100%**	**100%**	**100%**	**100%**	**100%**

[1]n=250 for the 2009 and 2010 program years; n=245 for the 2011 and 2012 program years; n = 250 for the 2015–2016 program years.

[2]Percentages may not total to 100% due to rounding.

The reported proportion of bulbs installed in some room types changed markedly between evaluation cycles. For example, the proportion of efficient bulbs installed in living space fixtures dropped in recent years, from 28% in 2011–2012 (combined CFL/LED evaluation) to 15% for CFLs and 15% for LEDs in 2015–2016. This represents a significant drop, given that living space fixtures have an average HOU of 2.2 hours per day. The "Other" category (e.g., closets, hallways, garages, dining, home office, utility or storage rooms) exhibited a large increase (from 7% in previous evaluations to 29% for CFLs and LEDs in 2015–2016). As many room types in the "Other" category had a lower average HOU, an increase in the proportion of bulbs installed in these room types lowered the overall average HOU.

Waste Heat Factor

A waste heat factor (WHF) adjustment to energy savings accounts for the lighting measures' effects on operations of heating and cooling equipment. As lower-wattage bulbs produce less waste heat, their use requires more heating and less cooling to maintain a room's setpoint temperature.

The evaluation used Simplified Energy Enthalpy Model (SEEM) results from the RTF Residential Lighting Workbook v4.2 as a foundation for LED bulbs' WHF analysis.[11,12]

Table 31 and Table 32 show the RTF's SEEM results and evaluation weightings. Cadmus determined saturation weightings for heating and cooling systems, based on the 2015–2016 general population surveys of Rocky Mountain Power residential customers in Utah, cooling zone weightings from Typical Meteorological Year 3 (TMY3) weather data, and census population data for Utah counties.

Table 31. WHF Heating Inputs Summary[1]

WHF Component	Heating System Type	SEEM Results (kWh/kWh Saved)[2]	Cadmus Saturation Weighting
Heating Impact	Electric Zonal	-0.440	6.3%
	Electric Forced Air	-0.479	0.5%
	Heat Pump	-0.258	2.4%
	Non-Electric	0.000	90.8%

[1]Percentages may not add to 100% due to rounding.

[2]Regional Technical Forum. "Simplified Energy Enthalpy Model." Accessed May 2016: http://rtf.nwcouncil.org/measures/support/seem/

Table 32. WHF Cooling Inputs Summary

WHF Component	System Type	SEEM Results (kWh/kWh Saved)	Cadmus Zone Weighting*	Cadmus Saturation Weighting
Cooling Impact	Cooling Zone 1	0.033	0.5%	**76%**
	Cooling Zone 2	0.053	0.7%	
	Cooling Zone 3	0.074	98.8%	

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

Calculating the weighted averages of values in Table 31 and Table 32 provided the impacts from heating and cooling of a bulb installed in a conditioned space, as shown in Table 33. Summing the heating and cooling impacts produced an estimated combined impact of 0.019 kWh per kWh of lighting savings.

11 SEEM is a building simulation model that the RTF calibrated for residential homes, providing the magnitude of interaction between lighting and HVAC systems. Additional background information for SEEM may be found at: Regional Technical Forum. "Simplified Energy Enthalpy Model." Accessed September 2017: http://rtf.nwcouncil.org/measures/support/seem/

12 RTF's savings workbook for residential, screw-in, CFL, and LED lamps: ResLighting_Bulbs_v4_2.xlsm.

Table 33. WHF Weighted Average Impact, Conditioned Space

Component	kWh/kWh Savings*
Heating	-0.036
Cooling	0.056
Combined	**0.019**

*Table may not sum to total due to rounding.

Cadmus also considered the location of bulbs in determining the appropriate WHF to account for bulbs not installed in conditioned spaces. As shown in Table 34, Cadmus used bulb allocations by space type from the 2015–2016 Rocky Mountain Power general population survey data to determine the overall thermal coupling factor.

Table 34. Thermal Coupling by Space Type

Space Type	RTF Thermal Coupling Correction Factor	Bulb Allocation*
Basement	50%	7.6%
Main House	75%	87.9%
Outdoor	0%	4.4%
Weighted Average		**69.8%**

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

Multiplying the combined impacts from Table 33 with the weighted thermal coupling in Table 34 and adding 1 provided the final WHF, shown in Table 35.

Table 35. Utah CFL and LED Bulb WHF, Average Installation Location

Fuel	Value	Units
Electric	1.014*	kWh/kWh Saved

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

CFL and LED Bulbs Total Savings

Table 36 shows reported and evaluated savings inputs and input sources for CFL lamps, in addition to reported and evaluated UES. Cadmus determined evaluated savings and inputs using assumptions provided by Rocky Mountain Power along with information drawn from the tracking database. Reported and evaluated delta watts inputs varied widely across and within bulb categories.

As such, values for W_{EFF}, W_{BASE}, and ΔWatts in Table 36 represent weighted averages. The far-right column shows the fraction produced by dividing evaluated savings or inputs by reported savings or inputs. Its UES value equals the CFL bulb realization rate. This also serves as an approximate "partial realization rate" for each of the other inputs—delta watts, WHF, HOU, and ISR.

Table 36. 2015–2016 Reported and Evaluated CFL Bulb Savings and Inputs

Input[1]	Reported		Evaluated		Evaluated/ Reported
	Value	Source	Value	Source	
UES (kWh/bulb)	20.09[1]	Tracking database	16.41[1]	Calculated from factors below	82%
W_{EFF}	15.4[1]	UES values split and set by assigned integer efficient wattages	15.7[1]	Tracking database, with some verification. Values used were binned for each model.	102%
W_{BASE}	49.7[1]	Lumen equivalence via EISA bins and baselines, special reflector bins	49.4[1]	Lumen equivalence via UMP, Mid-Atlantic TRM	99%
ΔWatts (W)	34.3[1]	W_{BASE} - W_{EFF}	33.7[1]	W_{BASE} - W_{EFF}	98%
WHF	1.007	PacifiCorp HES 2011-2012 Evaluation[2]	1.014	2015–2016 General Population Survey (n=229)	101%
HOU (hr/day)	2.27		1.87	Multistate HOU Regression Model, 2013–2014 General Population Survey	82%
ISR	69.4%		70.5%	2013–2014 General Population Survey (n=133)	102%

[1]Weighted average values.

[2]Cadmus. *Final Report: 2011-2012 Utah Residential Home Energy Savings Evaluation.* January 21, 2014. Available online: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2014/Utah_Final_2011-2012_HES_Evaluation_Report.pdf

These weighted average input values could be used to discern general drivers of differences between CFLs' evaluated and reported savings. As shown in the UES Evaluated/Reported column, CFL bulbs achieved an 82% overall realization rate. A difference in reported and evaluated HOU primarily drove this difference in evaluated and reported values. The reported 2.27 HOU came from the Cadmus 2011–2012 evaluation, though the HOU value from the 2013–2014 evaluation—used again this year—was 1.87. Reported and evaluated W_{EFF}, W_{BASE}, and ΔWatts were all extremely close. Smaller differences occurred between reported and evaluated WHF and ISR, but HOU served as the primary driver of realization rates for CFL bulbs.

Table 37 shows reported and evaluated savings inputs and input sources for LED bulbs, with wattage values again representing weighted averages. Two factors largely contributed to the 68% overall realization rate for LED bulbs. As with CFLs, reported HOU was notably higher than evaluated HOU. In addition, the reported LED ISR followed an RTF version that assumed a 100% LED installation rate, but the 2015–2016 participant survey revealed a first year LED bulb installation rate of 79%. Both factors combined to produce the 68% overall LED realization rate.

Table 37. 2015–2016 Reported and Evaluated LED Bulb Savings and Inputs

Input[1]	Reported		Evaluated		Evaluated/ Reported
	Value	Source	Value	Source	
UES (kWh/bulb)	30.50[1]	Tracking database	20.70[1]	Calculated from factors below	68%
W_{EFF}	9.8[1]	Tracking database, UES values split and set by integer wattages	9.8[1]	Tracking database, with some verification. Values used were binned for each model.	100%
W_{BASE}	46.4[1]	Lumen equivalence via EISA bins and baselines, special reflector bins	47.5[1]	Lumen equivalence via UMP, Mid-Atlantic TRM	102%
ΔWatts (W)	34.3[1]	W_{BASE} - W_{EFF}	33.7[1]	W_{BASE} - W_{EFF}	103%
WHF	1.007	PacifiCorp HES 2011-2012 Evaluation[2]	1.014	2015–2016 General Population Survey (n=229)	101%
HOU (hr/day)	2.27		1.87	Multistate HOU Regression Model, 2015–2016 General Population Survey	82%
ISR	100.0%	RTF storage and removal rate	79.4%	2015–2016 General Population Survey (n=68)	79%

[1]Weighted average values.

[2] Cadmus. *Final Report: 2011-2012 Utah Residential Home Energy Savings Evaluation.* January 20, 2014. Available online: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2014/Utah_Final_2011-2012_HES_Evaluation_Report.pdf

Table 38 provides evaluated CFL and LED savings in addition to realization rates by bulb types.

Table 38. 2015–2016 Evaluated and Reported HES Program CFL and LED Savings

Bulb Type	Reported		Evaluated		Realization Rate		
	CFL	LED	CFL	LED	CFL	LED	Overall
Standard	37,743,992	28,459,843	31,111,389	20,520,106	82%	72%	78%
Decorative	140,654	3,799,502	118,297	2,632,949	84%	69%	70%
Globe	160,437	1,900,472	222,021	1,244,894	138%	65%	71%
EISA-Exempt	885	13,295	883	15,420	n/a	116%	115%
Reflector	2,904,301	28,235,586	2,000,581	17,928,925	69%	63%	64%
Overall	**40,950,268**	**62,408,698**	**33,453,170**	**42,342,294**	**82%**	**68%**	**73%**

Light Fixtures

During the 2015–2016 program period, Rocky Mountain Power provided incentives for 192,248 ENERGY STAR light fixtures, representing 5% of reported program savings. Cadmus grouped and analyzed the fixtures' savings, divided into three categories:

1. Downlight fixtures
2. Fluorescent fixtures
3. Miscellaneous fixtures

These categories respectively contributed 94.3%, 0.3%, and 3.9% of program fixtures by quantity (with 1.6% unidentifiable). Generally, fixture savings calculations used the same methodology as that employed for light bulbs, though the three fixture types required slight variations in their energy savings calculations. Again, the general equation for lighting gross saving evaluation follows:

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

To calculate the various light fixture component inputs, Cadmus conducted the primary and secondary data collection activities shown in Table 39.

Table 39. Light Fixture Evaluated Gross Savings Activities and Results

Savings Variables	Lighting Technology	Activity	Value
ΔWatts	CFL	Downlights: UMP[2], recessed can average baseline. Miscellaneous: UMP[2], standard lamp baseline. Unknown: Weighted average of known categories.	43.7[1]
	LED		
ISR	CFL	2015–2016 Lighting Fixture Rebate Survey	98.6%
	LED		
HOU	CFL	Multistate HOU Regression Model, 2013–2014 General Population Survey (n=63)	1.866
	LED	Multistate HOU Regression Model, 2015–2016 General Population Survey (n=195)	1.869
WHF	CFL + LED	2015–2016 General Population Survey (n=229)	1.014

[1]Weighted average value for all bulbs.

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

Downlight Fixtures

Figure 4 depicts a downlight fixture, designed for installation into recessed ceiling or "can" light receptacles (i.e., intended to accept reflector lamps). This fixture type differs from other fixtures in that each purchase replaces a particular lamp, meriting the application of the lumens equivalence method to calculate delta watts.

Figure 4. Example of a Downlight Fixture

Calculating baseline wattages for LED downlights requires determining the lamp types typically replaced by LED downlight fixtures. Although recessed ceiling fixtures are usually designed to accommodate reflector lamps that point light down to maximize the lamp's output, other lamp types may be installed at times. Using data compiled from household lighting inventories conducted in four other jurisdictions across the United States, Cadmus calculated a weighted baseline wattage for LED downlight fixtures to account for the mix of bulb types typically installed in recessed ceiling receptacles.[13]

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

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

As shown in Table 40, respondents installed reflector lamps in 85.6% of ceiling receptacles, with the rest drawing upon various other categories. For both 2015 and 2016, Cadmus used these saturation values to create an average set of lumen bins and baseline wattages for recessed ceiling receptacles. Appendix B provides plots of weighted reflector and final recessed can lumen bins and baseline wattages. As with reflector baseline wattages in general, recessed can baseline wattage values were generally higher than those for standard lamps.

[13] This data is not published.

Table 40. Lamp Type Saturation in Recessed Ceiling Receptacles

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

Fluorescent Fixtures

The UMP did not specify a lumens equivalence approach for fluorescent lamps (i.e., 0.3% of fixtures), and EISA legislation did not provide discrete lumen bins or baseline wattages for 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.[14] As the installation locations for these fixtures remained 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

Just 3.9% of fixtures sold could not be classified as downlights or fluorescents. These constituted a mix of fixture types (e.g., single- and multi-bulb sconce lights, motion sensors, track lighting), with a majority serving as replacements for one- and two-lamp fixtures of various types. Cadmus applied the lumens equivalence approach to evaluate these fixtures.

Unknown Fixtures

The database included 1.6% of fixtures falling within unknown categories. These listed models did not match the ENERGY STAR database or online resources. Cadmus applied weighted average UES values for the downlight and miscellaneous fixture categories.

[14] RTF's savings workbook for residential High Performance 4-foot and 8-foot T8 Lamps: ResLightingHPT8Lamps_v1_1.xlsm, Nov 1, 2013. available at: https://nwcouncil.box.com/s/d7yr2079fbu22n8c55nssyxoeqlnuaik (RTF deactivated this measure as of September 20, 2016)

Lighting Fixture Findings

In 2015–2016, the HES program provided incentives for 192,248 light fixtures. Table 41 provides lamp quantities, savings, and realization rates by each fixture type for 2015–2016.

Table 41. 2015–2016 Light Fixture Quantity and Gross Savings

Fixture Category	CFL/LED	Quantity	Reported Savings (kWh)	Evaluated Savings (kWh)	Evaluated UES (kWh/unit)	Realization Rate
Downlight	CFL	4,909	161,094	148,671	30.3	92%
Downlight	LED	176,337	6,011,743	5,373,470	30.5	89%
Fluorescent	N/A	525	19,035	15,196	28.9	80%
Miscellaneous	CFL	1,908	93,826	48,068	25.2	51%
Miscellaneous	LED	5,501	188,399	145,041	26.4	77%
Unknown	N/A	3,068	106,100	80,190	26.1	76%
Total		**192,248**	**6,580,198**	**5,810,637**	**30.2**	**88%**

For UES, fixtures generally have one of three reported values, with 90% having a 34.62 kWh UES, 8% having a 28 kWh UES, and the reset having a 50.2 kWh UES value. Fixtures with a 34.62 kWh UES value contributed most to the disparity between evaluated and reported savings. For most of these fixtures, while reported ΔWatts were 11% higher than evaluated ΔWatts on average, reported HOU was 18%—lower than evaluated HOU on average. These factors combined to form an overall 88% realization rate for these fixtures, which drove the overall fixture realization rate.

wattsmart Starter Kits

Rocky Mountain Power's HES program provides incentives for eight varieties of ***watt***smart Starter Kits, which contain unique combinations of 13-watt CFLs, 10-watt LEDs, kitchen aerators, bathroom aerators, and showerheads.

Table 42 shows the components for each of the eight kits available in 2015 and 2016.

Table 42. 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 provide a handheld showerhead in the kit with the same flow rate as the fixed showerhead in the Basic kits.

Kit CFLs and LEDs

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

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

Table 43 defines and provides values and sources for the key variables in the equation.

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

Parameter	Definition	CFL	LED	Unit	Source(s)
W_{Base}	Baseline wattage	43	43	W	Lumens equivalence method
W_{EE}	Measure wattage	13.0	10.5	W	Program materials
ISR	In-service rate	78.4	80.1	%	2015–2016 kit participant surveys (n=59 - CFL, 69 - LED)
HOU	Hours of use	1.866	1.869	$\frac{hours}{year}$	2015–2016 HES light bulb room and HOU analysis
WHF	Waste heat factor	1.014	1.014		2015–2016 HES light bulb WHF analysis
ΔkWh	**Energy Savings**	**16.2**	**18.0**	**$\frac{kWh}{year}$**	**Calculated**

Cadmus determined CFL and LED reported savings by dividing the reported savings for CFL- and LED-only kits (as deemed by Rocky Mountain Power) by the number of bulbs in each kit (four). Cadmus derived baseline wattage assumptions using ENERGY STAR's lumens equivalence method and ISRs from 2015–2016 kit participant surveys. Cadmus conducted HOU and WHF analyses specifically for HES to derive HOU and WHF assumptions. Table 44 shows reported and evaluated savings as well as realization rates for each bulb type.

Table 44. Kit Lighting Reported and Evaluated Per-Unit Savings

Kit Product	Reported Savings Per Unit (kWh)	Evaluated Savings Per Unit (kWh)	Realization Rate
CFL	17.4	16.2	93%
LED	26.1	18.0	69%

CFLs and LEDs did not realize 100% of reported savings, most likely due to different HOU values used in reported and evaluated calculations.

Kit Aerators

Cadmus estimated energy savings for bathroom and kitchen faucet aerators distributed through ***watt***smart Starter Kits using the following equation:

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

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

Table 45 defines and provides values and sources for the equation's key variables.

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

Parameter	Definition	Kitchen Aerator	Bathroom Aerator	Unit	Source(s)[1]
ISR	In-service rate	52.3	50.0	%	2015–2016 kit participant surveys (n=23 - kitchen, 20 - bathroom)
GPM_{Base}	Baseline flow rate	2.2	2.2	$\frac{gal}{min}$	Federal rated maximum flow rate (10CFR430.32)
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	Min/person/ day	2013 Cadmus Study[2]
PH	People per household	3.3	3.3	People	2015–2016 kit participant survey (n=128)
FH	Faucets per household	1	2.84	Faucets	Bathroom: 2015–2016 kit participant survey (n=139). Kitchen: One per household.
T_{Mix}	Usage water temperature	93	86	$°F$	2013 Cadmus Study[2]
T_{In}	Inlet water temperature	58.9	58.9	$°F$	U.S. Department of Energy Hot Water Scheduler, 2015 National Climatic Data Center, 2016 U.S. Census Bureau
RE	Recovery efficiency of electric water heater	98	98	%	NREL, "Building America Research Benchmark Definition"[3]
$\%DHW$	Households with electric hot water	50.0	50.0	%	2015–2016 kit participant survey (n=22)
ΔkWh	**Energy Savings**	**85.3**	**19.7**	**$\frac{kWh}{year}$**	**Calculated**

[1]Survey results reflect averages only for those who received water-saving measures.

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

3National Renewable Energy Laboratory. *Building America Research Benchmark Definition*. December 2009. pg. 12. Available online: http://www.nrel.gov/docs/fy10osti/47246.pdf

Rocky Mountain Power derived several reported savings values for kit aerators using a 2013 Cadmus potential study.[16] Rocky Mountain Power derived its ISR value (76%)—a figure higher than Cadmus' values (52% for kitchen aerators, 50% for bathroom aerators)—from Version 2.1 of the Residential DHW Showerhead RTF workbook,[17] in addition to deriving HOU and percentage of homes with electric hot water (64%) from the RTF workbook. The calculations assumed kitchen and bathroom faucet aerators would be used identically in terms of annual HOU.

For its evaluated savings values, Cadmus assumed a baseline flow rate of 2.2 GPM, as specified by the U.S. Department of Energy (DOE). This derived values for people per household and fixtures per household (for bathroom aerators), drawn from the 2015–2016 kit participant survey. Cadmus assigned energy savings solely to the 50% of households with electric water heaters, and calculated the change in water temperature using calculations from a 2013 Cadmus metering study,[18] and using data from the Census Bureau and the DOE's hot water scheduler. Due to concerns about small sample sizes, Cadmus calculated the kitchen faucet aerator ISR as the weighted average of the kit participant survey results in Utah, Idaho, and Wyoming 2015-2016 evaluations.

Table 46 shows reported and evaluated savings as well as realization rates for each faucet aerator type.

Table 46. Kit Aerator Reported and Evaluated Per-Unit Savings

Kit Product	Reported Savings Per Unit (kWh)	Evaluated Savings Per Unit (kWh)	Realization Rate
Kitchen Aerator	25.8	85.3	331%
Bathroom Aerator	62.6	19.7	31%

Each kit aerator product produced discrepant realization rates due to very different assumptions belying the reported and evaluated savings calculations, such as those for water temperature differences (75°F versus 58.9°F) and the percentage of homes with electric water heat (64% versus 50%).

Kit Showerheads

Using the following equation, Cadmus estimated energy savings for high-efficiency showerheads distributed through ***watt***smart Starter Kits:

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

[16] Cadmus. *Assessment of Long-Term, System-Wide Potential for Demand-Side and Other Supplemental Resources, 2013-20132 Volume I and II.* Prepared for PacifiCorp, March 2013. Available online: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/DSM_Potential_Study/PacifiCorp_DSMPotential_Vol-II_Mar2013.pdf

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

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

Table 47 defines and provides values and sources for the key variables in the equation.

Table 47. *watt*smart Starter Kit Showerhead Key Evaluation Variables and Assumptions

Parameter	Definition	Value	Unit	Source[1]
MPS	Shower duration	7.8	$\frac{min}{shower}$	2013 Cadmus Study[2]
GPM_{Base}	Baseline flow rate	2.5	$\frac{gal}{min}$	Federal-rated maximum flow rate for showerheads (10CFR430.32 (p)
GPM_{EE}	Efficient flow rate	1.5	$\frac{gal}{min}$	Program Materials
EV	Showers per person per year	219	Showers	2013 Cadmus Study[2]
PH	People per household	3.3	People	2015–2016 kit participant survey (n=128)
SH	Showerheads per household	2.22	Shower-heads	2015–2016 kit participant survey (n=130)
T_{Mix}	Usage water temperature	101	$°F$	2013 Cadmus Study[2]
T_{In}	Inlet water temperature	58.9	$°F$	U.S. Department of Energy Hot Water Scheduler, 2015 National Climatic Data Center, 2016 U.S. Census Bureau
RE	Recovery efficiency	98	%	Constant
ISR	In-service rate	53.2	%	2015–2016 kit participant survey (n=25)
$\%DHW$	Households with electric hot water	50.0	%	2015–2016 kit participant survey (n=22)
ΔkWh	**Energy Savings**	**71.7**	**$\frac{kWh}{year}$**	**Calculated**

[1]Survey results reflect averages only for those receiving water-saving measures.

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

Rocky Mountain Power derived its reported savings values, including people per household (2.51), showers per person per year (193), percentage of homes with electric water heat (62%), and the difference between usage and inlet water temperatures (75°F), from Version 2.3 of the Residential DHW Showerhead RTF workbook.[19]

As with kit faucet aerators, Cadmus derived its evaluated values from the following sources:

- Cadmus' 2015–2016 kit participant survey (for showerheads per household, people per household, and the percentage of homes with electric hot water)
- DOE (for baseline flow rate)
- A 2013 Cadmus metering study (for shower events per person per year and water temperature changes)

[19] Regional Technical Forum. "Residential: DHW – Showerheads." ResShowerheads_v2_3.xlsm. Feb. 1, 2016. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=126

Table 48 shows reported and evaluated savings as well as realization rates for kit showerheads.

Table 48. Kit Showerhead Reported and Evaluated Per-Unit Savings

Kit Product	Reported Savings Per Unit (kWh)	Evaluated Savings Per Unit (kWh)	Realization Rate
Showerhead	234.0	71.7	31%

Showerheads did not realize 100% of reported savings, most likely due to very different assumptions belying the reported and evaluated savings calculations, such as those for water temperature differences (75°F versus 58.9°F) and the percentage of homes with electric water heat (84% versus 50%).

*watt*smart Starter Kits Summary

Using the evaluated savings shown above for CFLs, LEDs, aerators, and showerheads, Cadmus calculated savings for each kit variety. Table 49 shows the percentage of evaluated savings attributable to each kit product.

Table 49. Percent of Evaluated Savings by Kit Product

Kit Name	Percent of Kit Evaluated Savings				
	CFL Bulbs	LED Bulbs	Kitchen Aerators	Bathroom Aerators	Showerheads
Basic 1	27%	0%	35%	8%	30%
Basic 2	20%	0%	26%	12%	43%
Better 1	27%	0%	35%	8%	30%
Better 2	20%	0%	26%	12%	43%
Best 1	0%	29%	34%	8%	29%
Best 2	0%	21%	25%	12%	42%
CFL Only	100%	0%	0%	0%	0%
LED Only	0%	100%	0%	0%	0%

For kits that included water-saving products, showerheads and CFLs accounted for the greatest share of evaluated savings. Bathroom aerators consistently accounted for the least savings in kits. LEDs accounted for slightly more savings in kits, both for those that included and excluded water-saving products.

For each of the eight ***watt***smart Starter Kits, Table 50 shows the quantity of each product making up the kit, the quantity of kits installed in 2015 and 2016, the reported and evaluated savings per kit, and the realization rates.

Table 50. 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	Shower-head				
Basic 1	4	0	1	1	1	520	408	242	59%
Basic 2	4	0	1	2	2	1,743	730	333	46%
Better 1	4	0	1	1	1	20	409	242	59%
Better 2[1]	4	0	1	2	2	67	724	333	46%
Best 1	0	4	1	1	1	84	445	249	56%
Best 2	0	4	1	2	2	500	764	340	45%
CFL Only	4	0	0	0	0	10,274	69	65	94%
LED Only	0	4	0	0	0	3,032	105	72	69%
Total	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**16,240**	**2,990,780[2]**	**1,810,585[2]**	**61%**

[1]Better kits provide the same products as Basic kits, but they replace the fixed showerhead with a handheld showerhead. The difference does not affect reported or evaluated savings per kit.

[2]Total savings from all installed kits equals the sum-product of the quantity installed and savings per kit.

Clothes Washers

Cadmus estimated clothes washers' energy savings using Version 5.4 of the RTF workbook for residential clothes washers. Published on December 2, 2016, the RTF workbook compared energy consumption of efficient clothes washers to a baseline of average non-ENERGY STAR-compliant clothes washers. With the change in federal standards for energy-efficient clothes washers in 2015, the Integrated Modified Energy Factor (IMEF) and the Integrated Water Factor (IWF) replaced the program-tracked parameters of the Modified Energy Factor (MEF) and Water Factor (WF) as best practices for estimating clothes washers' energy consumption.

Cadmus used the ENERGY STAR Clothes Washer database to find the IMEF and IWF for 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) as noted in the program tracking data. Cadmus adjusted the RTF savings to use program-specific results from participant surveys for the expected number of loads per year. The participant surveys indicated 364[20] average loads expected per year—a result 33% greater than that predicted by the RTF (i.e., 273 average loads). Cadmus estimated an average evaluated savings value of 107 kWh per unit, yielding an 80% realization rate for program years 2015–2016. The low realization rate was driven by lower estimated energy savings reported for homes with non-electric domestic hot water.

[20] The 2013–2014 Utah HES Program Evaluation used 307 loads per year, and the 2011–2012 Utah HES Program Evaluation used 286 loads per year.

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

Table 51 shows the quantity of measures incented, reported and evaluated savings, realization rates, and percentages of reported savings for each combination of DHW and dryer fuel at each efficiency level during 2015 and 2016.

As shown, a clothes washer, paired with a non-electric dryer and a non-electric water heater, offered lower savings than a measure paired with an electric dryer and/or water heater. In 2015 and 2016, the tracking database indicated that measures combining natural gas dryers and water heaters accounted for 4% of all incented measures.

Table 51. Clothes Washer Savings by Performance Level and DWH/Dryer Fuel

Efficiency Level	IMEF Low	IMEF High	DHW Fuel	Dryer Fuel	Quantity Evaluated		Reported UES		Evaluated UES		Realization Rate[1]		Percentage of Reported Savings[2]	
					2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
ENERGY STAR	2	2.37	Electric	Electric	25	0	156	n/a	294	n/a	189%	n/a	1%	0%
			Electric	Other	1	0	51	n/a	68	n/a	136%	n/a	0%	0%
			Other	Electric	84	0	46	n/a	133	n/a	291%	n/a	2%	0%
			Other	Other	18	0	1	n/a	25	n/a	2,061%	n/a	0%	0%
CEE Tier 1	2.38	2.73	Electric	Electric	124	194	226	227	480	480	212%	212%	6%	7%
			Electric	Other	7	12	47	94	76	305	161%	326%	0%	0%
			Other	Electric	606	950	142	149	202	202	143%	135%	18%	23%
			Other	Other	150	191	13	16	26	26	204%	161%	0%	0%
CEE Tier 2	2.74	2.91	Electric	Electric	322	396	113	227	137	500	121%	220%	15%	14%
			Electric	Other	21	20	47	47	89	89	189%	190%	0%	0%
			Other	Electric	1,552	1,669	148	149	210	210	141%	141%	46%	40%
			Other	Other	530	444	8	16	-3	27	-39%	166%	2%	1%
CEE Tier 3	2.92	N/A	Electric	Electric	49	52	113	114	151	151	133%	133%	2%	2%
			Electric	Other	1	5	47	47	97	97	208%	208%	0%	0%
			Other	Electric	243	232	72	75	50	50	69%	67%	7%	6%
			Other	Other	80	83	7	8	-3	-3	-51%	-41%	0%	0%
All Levels														
All Levels	2	N/A	Electric	Electric	520	642	224	227	267	292	119%	129%	24%	25%
			Electric	Other	30	37	94	94	169	190	179%	204%	1%	1%
			Other	Electric	2,485	2,851	145	149	91	108	63%	73%	73%	72%
			Other	Other	778	718	15	16	-5	1	-35%	8%	2%	2%
Weighted Average[3]					**3,813**	**4,248**	**129**	**138**	**96**	**119**	**74%**	**86%**	**100%**	**100%**

[1]Realization rates may not calculate exactly due to rounding of evaluated UES values. Percent of reported savings may not add to 100% due to rounding.
[2]Percentage of reported savings may not add to 100% due to units with no match in ENERGY STAR database.
[3]"Quantity" and "Percent of Report Savings" values are summations, not average values.

As Table 51 indicates, a clothes washer, paired with a non-electric dryer and a non-electric water heater, offered lower savings than measures with an electric dryer and/or water heater. Rocky Mountain Power allowed this measure's installation, considering it: "extremely rare and as such has minimal impact on the measure's cost-effectiveness."[21] In 2015 and 2016, however, measures combining natural gas dryers and water heaters accounted for 4% of all incented measures. Effective December 1, 2016, Rocky Mountain Power retired the clothes washer measure offering. Table 52 shows the percentage of measures installed in homes using electrically heated DHW and dryers.

Table 52. Clothes Washer Percent of Electric DHW and Dryer Fuel as Reported in Program Tracking Database

Input Categories		2015–2016 Saturation of Fuel Types	2013–2014 Saturation of Fuel Types	Source
DHW Fuel	Electric	15.2%	12.9%	2013–2014 and 2015–2016 Non-Lighting Tracking Databases
	Other	84.8%	87.1%	
Dryer Fuel	Electric	80.6%	81.3%	
	Other	19.4%	18.7%	

Advanced Power Strips

In 2015, the HES program provided incentives for 13,796 APS. Cadmus evaluated APS savings using Version 2.4 of the RTF workbook for APS.[22] The program incented master/periphery APS, which cut power to peripheral devices while master devices remained inactive.

The RTF estimated annual savings of 20 kWh for measures with a desktop as the master device (Home Office), and 40 kWh for measures with a television as the master device (Home Entertainment Center). This resulted in 30 kWh average savings per measure after rounding to one significant digit per RTF decision, assuming 39% of APS units used a desktop computer as the master device and that 61% of units used a television as the master device.

To better estimate master devices used by program participants, Cadmus included questions about APS use in the 2015–2016 general population survey of Rocky Mountain Power customers, but only eight survey respondents reported purchasing an APS, and none surveyed reported being aware of purchasing the measure as part of a utility-sponsored sale. Cadmus also surveyed the general population on how they would use an APS if they bought one, but, of 250 surveyed, only 19 respondents knew of APS before the survey. Of those responding, 54% said they would use the device for their home entertainment center, 37% said they would use it for their home office, and 9% said they would use it

---

21 Public Service Commission of Utah, Advice No. 14-07. *Proposed Changes to Schedule 111 Home Energy Saving Incentive Program.* July 9, 2014. Page 6.

22 RTF. "Residential: Advanced Power Strips." ResAdvancedPowerStrips_v2.4.xlsm. Available online: https://rtf.nwcouncil.org/measure/advanced-power-strips

somewhere other than a home entertainment center or home office. These findings closely matched the RTF placement assumptions.

Due to the lack of participant survey responses, Cadmus used the RTF assumed savings for APS units, resulting in annual savings of 30 kWh and a realization rate of 100%.

Efficient Gas Furnace with ECM

Cadmus estimated evaluated gross savings for furnace ECMs, based on metered data collected in 2013 for an ECM study in Wisconsin and Utah weather data.[23] This study provided the best available savings estimate for this technology. No other comparable metering study exists within the PacifiCorp regions.

The 2013 Wisconsin study involved collecting, over a two-year period, fan-use data from 67 single-family homes. Cadmus calculated gross electric savings for gas furnaces with ECMs within Rocky Mountain Power's territory by applying a linear ratio adjustment, using typical heating degree days (HDDs) and cooling degree days (CDDs) in Wisconsin and HDDs and CDDs of the actual installed units based on their zip codes in Utah.

Cadmus used the following equations to estimate savings:

$$kWh_{savings\ total} = kWh_{savings\ cool} + kWh_{savings\ heat} + kWh_{savings\ circ}$$

$$kWh_{savings\ cool} = tons \times EFLH_{cooling} \times 12 \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ECM}}\right) \times \%AC$$

$$kWh_{savings\ heat} = hours_{heat} \times \Delta kW_{heat}$$

$$kWh_{savings\ circ} = hours_{circ} \times \Delta kW_{circ}$$

Table 53 outlines values used in the above equations, the sources for these values, and the resulting energy savings.

[23] Cadmus. *Focus on Energy Evaluated Deemed Savings Changes*. Prepared for the Public Service Commission of Wisconsin. November 14, 2014. Available online: https://focusonenergy.com/sites/default/files/FoE_Deemed_WriteUp%20CY14%20Final.pdf.

Table 53. Efficient Gas Furnace with ECM Evaluation Assumptions and Calculated Savings

Parameter	Definition	Value	Unit	Source
$tons$	Air conditioner capacity	2.425	$tons$	Focus on Energy Evaluation, Residential Programs: CY09 Deemed Savings Review. March 26, 2010
$EFLH_{cooling}$	Effective full load cooling hours	963	$hours$	Cadmus Wisconsin 2013 metering study scaled using CDD ratios between install locations in UT, and average CDDs in Wisconsin*
12	Unit conversion	12	$\frac{kBtu}{ton}$	Constant
$SEER_{base}$	Baseline SEER	12	$\frac{kBtu}{kWh}$	2013 Cadmus Wisconsin ECM metering study
$SEER_{ECM}$	Efficient SEER	13	$\frac{kBtu}{kWh}$	2013 Cadmus Wisconsin ECM metering study
$\%AC$	Percentage of furnaces with air conditioning	95%	%	Utah 2015–2016 non-lighting participant survey.
$\boldsymbol{kWh_{savings\ cool}}$	**Cooling mode energy savings**	**170**	$\boldsymbol{\frac{kWh}{year}}$	**Calculated**
$hours_{heat}$	Hours of heating operation	851	$\frac{hours}{year}$	Cadmus metering study, scaled using HDD ratios between install locations i UT, and average HDDs in Wisconsin*
ΔkW_{heat}	Power savings in heating	0.116	kW	2013 Cadmus Wisconsin ECM metering study
$\boldsymbol{kWh_{savings\ heat}}$	**Heating mode energy savings**	**99**	$\boldsymbol{\frac{kWh}{year}}$	**Calculated**
$hours_{circ}$	Hours of fan-only operation	1,020	$\frac{hours}{year}$	2013 Cadmus Wisconsin ECM metering study
ΔkW_{circ}	Power savings in fan-only mode	0.207	kW	2013 Cadmus Wisconsin ECM metering study
$\boldsymbol{kWh_{savings\ circ}}$	**Circulation mode energy savings**	**211**	$\boldsymbol{\frac{kWh}{year}}$	**Calculated**
$\boldsymbol{kWh_{savings\ total}}$	**Total Savings**	**480**	$\boldsymbol{\frac{kWh}{year}}$	**Calculated**

*Website for HDDs and CDDs: http://www.climate-zone.com/climate/united-states/

The 2013 Cadmus metering study used a baseline SEER of 12—rather than the federal standard baseline SEER of 13—as the study found: "many air conditioners were not replaced when the furnace was replaced and were installed before the minimum efficiency standard increased to 13 SEER."[24]

Table 54. 2015-2016 Reported and Evaluated Efficient Gas Furnace with ECM Savings

Measure	Quantity 2015	Quantity 2016	Reported Per Unit Savings	Evaluated Per Unit Savings	Realization Rate
Efficient Gas Furnace with ECM	1,781	2,729	520	480	92%

During the 2015–2016 participant survey, Cadmus found that only 95% of homes receiving the gas furnace measure used air conditioning whereas air-conditioning was a measure eligibility requirement. In 2017, this measure is moving to a mid-stream delivery channel (which reduces Rocky Mountain Power's ability to screen participants for measure eligibility) but the expected savings should perhaps be adjusted for the expected number of measures that will be installed in homes without air conditioning.

Attic, Wall, and Floor Insulation

Cadmus conducted billing analyses to assess actual net energy savings associated with insulation measure installations.[25] 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

Cadmus used program participants, a control group, billing consumption, and Utah weather data specific to participants' zip codes 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.[26]

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

---

[24] Cadmus. *Focus on Energy Evaluated Deemed Savings Changes*. Prepared for the Public Service Commission of Wisconsin. November 14, 2014. Available online: https://focusonenergy.com/sites/default/files/FoE_Deemed_WriteUp%20CY14%20Final.pdf.

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

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

Insulation Results

Cadmus estimated average insulation savings of 343 kWh per participant, translating to a 115% net realization rate for insulation measures. This analysis resulted in net (rather than gross) savings as it compared participant usage trends to a nonparticipant group, accounting for market conditions outside of the program.

With an average participant pre-usage of 11,295 kWh, savings represented a 3% reduction in total energy usage from insulation measures installed. Table 55 presents the overall net savings estimate for wall, floor, and attic insulation.

Table 55. Insulation Net Realization Rates

Model	Billing Analysis Participants (n)	Reported kWh Savings per Premise	Evaluated Net kWh Savings per Premise	Net Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall	**1,454**	**299**	**343**	**115%**	**±17%**	**95%–135%**
Electric Heat	64	1,432	1,366	95%	±19%	78%–113%
Gas Heat	1,390	247	296	120%	±20%	96%–144%

*Overall model includes electric and gas heat.

Cadmus only used overall model results (including electric and gas heat) to determine measure-level net savings, but provided results by space heating fuel: electric and gas.

Duct Sealing and Insulation

Cadmus conducted billing analysis to assess net energy savings associated with duct sealing and duct insulation measure installations.[27] The analysis determined the savings estimate using 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

Using program participants, a control group, billing consumption, and Utah weather data specific to participants' zip codes, Cadmus created the final database to conduct 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.[28]

---

[27] Billing analysis performed for customers that installed only duct sealing and/or duct insulation measures.

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

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

Duct Sealing and Insulation Results

Cadmus estimated average duct sealing and duct insulation savings of 321 kWh per home, translating to a 96% net realization rate for these measures. As with insulation results, this produced net (rather than gross) savings as it compared participant usage trends to a nonparticipant group, accounting for market conditions outside of the program.

With average participant pre-usage of 10,788 kWh, savings represented a 3% reduction in total energy usage from duct sealing and duct insulation measures installed. Table 56 presents the overall savings estimate for duct sealing and duct insulation.

Table 56. Ductwork Net Realization Rates

Model	Billing Analysis Participant (n)	Reported kWh Savings per Premise	Evaluated Net kWh Savings per Premise	Net Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall*	**1,962**	**336**	**321**	**96%**	**±16%**	**80%–111%**
Electric Heat	82	1,473	1,166	79%	±20%	63%–95%
Gas Heat	1,880	286	284	99%	±19%	81%–118%

*Overall model includes both electric and gas heat.

Cadmus only used overall model results (electric and gas heat combined) to determine measure-level net savings, but provided results by space heating fuel: electric and non-electric. Overall, electrically heated homes achieved duct sealing and duct insulation savings of 1,166 kWh per home.

Central Air Conditioners and Evaporative Coolers

Cadmus conducted billing analyses to assess gross energy savings associated with high-efficiency air conditioners and evaporative coolers. The analysis required construction of three regression models (Appendix C provides further details on the regression model):

- A central air conditioner and sizing and installation measures (SEER 15+) model[29]
- An evaporative cooling model
- A model of SEER 13 nonparticipant units (to serve as a baseline)[30]

[29] This model, which contained sizing + TXV (thermal expansion valve) and proper installation of central air-conditioning measures, calculated a realization rate applying to all of these measures.

[30] This assessment adopted a central assumption: participants would have installed a base-efficiency (13 SEER) unit had they not participated in the program. Given this, Cadmus used a control group composed of 2005 Cool Cash Program participants known to have received a 13 SEER air-conditioning unit—without sizing + TXV

Cadmus used program participants, billing consumption, Utah weather specific to participants' zip codes, and square footage data to create the final database for conducting the billing analysis, the results of which provided gross realization rates for central air conditioners and evaporative cooler equipment types across both years. This billing analysis resulted in gross savings (as opposed to net savings estimated through the billing analysis for ductwork and insulation) due of the nature of the comparisons group used. The central air conditioner and evaporative cooler comparison group did not reflect average market conditions (as did the other billing analyses) as it consisted of a group of customers who purchased a SEER 13 model in a prior HES program year. As SEER 13 served as the federal baseline during 2015 and 2016 (and not as a market baseline), the comparison yielded a gross result.

Table 57 shows the regression model results.

Table 57. Utah HVAC Measure Billing Data Regression Results

Group	Consumption per CDD (kWh)	Annual Consumption Based on 1,385 Average CDD (kWh)	Evaluated Gross Savings (kWh)
SEER 13	1.330	1,842	N/A
Evaporative Cooling	0.240	332	1,509
Central Air Conditioner	0.900	1,246	596

SEER 13 units' average consumption per CDD, estimated at 1.330 kWh, represented the baseline or consumption level occurring in the program's absence.[31] Cadmus used this baseline to estimate savings from each participating central air conditioner and evaporative cooler measure.

Central Air Conditioners and Evaporative Cooler Results

Table 58 presents overall gross savings estimates and realization rates for 2015–2016 cooling equipment.

or proper installation incentives—as their primary cooling system. SEER 13 air-conditioning equipment represents the federal minimum efficiency level for residential central air conditioners manufactured after January 2006.

[31] Cadmus considered SEER 13 as the baseline, given it met the federal minimum efficiency level for residential central air conditioners manufactured after January 2006 and could be assumed to represent the efficiency of cooling equipment purchased in the program's absence.

Table 58. Cooling Equipment Gross Realization Rates

Measure	Billing Analysis Participants (n)	Reported kWh Savings per Premise	Evaluated Gross kWh Savings per Premise	Gross Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Evaporative Coolers	3,936	1,406	1,509	107%	±7%	100% - 115%
Central Air Conditioners	3,008	533	596	112%	±18%	92% - 131%

Cadmus estimated overall evaporative cooler savings of 1,509 kWh per participant. Given the average evaporative cooler had expected savings of 1,406 kWh, this translated to a 107% gross realization rate.

Further, Cadmus estimated average central air conditioner savings of 596 kWh per measure. Given the average central air conditioner had expected savings of 533 kWh, this translated to a 112% gross realization rate.

Windows

Cadmus evaluated savings for five window measures for which Rocky Mountain Power offered incentives, dividing window efficiency incentives between two tiers, with each tier containing options for zonal heat, gas heat with central air-conditioning, or heat pumps. Cadmus estimated savings for all window measures using Version 3.4 of the RTF residential single-family weatherization savings workbook,[32] and incorporating participant-specific climate information. In its reported savings, Rocky Mountain Power used EnergyGauge models to simulate performance savings and applied the resulting per-unit savings to each measure.

Table 59 shows the quantity of each window measure incented in 2015 and 2016, the reported and evaluated savings, and the realization rates. The variances in reported and evaluated numbers resulted from different per-unit savings values applied using the RTF methodology. The savings values determined by EnergyGauge were greater than the savings values deemed in the RTF. The reported values overestimated savings for all heating types.

[32] Regional Technical Forum. "Residential: Single Family Weatherization." ResSFWx_v3_4.xlsx. June 30, 2015. Available online: https://rtf.nwcouncil.org/measure/single-family

Table 59. 2015–2016 Reported and Evaluated Window Savings

Measure	Quantity 2015	Quantity 2016	Reported Per Unit Savings (kWh/unit)	Evaluated Per Unit Savings (kWh/unit)	Realization Rate
Tier 1					
Heat Pump	125,792	138,588	1.06	0.32	30%
Gas Heat with Central Air Conditioner (CAC)	35,487	0	1.06	0.8	75%
Tier 2					
Heat Pump	787	695	2.20	0.93	42%
Zonal Heat	21,044	66,214	1.17	1.58	136%
Gas heat with CAC	2,292	0	1.11	0.93	84%
Weighted Average			**1.09**	**0.65**	**60%**

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

Evaluated Net Savings

Cadmus tailored the net savings adjustment analysis to each measure and measure category, and developed NTG analysis methods prioritized by the highest-saving measures. For CFL and LED bulbs, Cadmus conducted demand elasticity modeling to estimate freeridership for a discounted bulb's price. For non-lighting measure categories (including kits), Cadmus conducted freeridership and participant spillover analysis using responses from the non-lighting and participant kit surveys.

Further, Cadmus included a series of questions from the 2015–2016 general population survey of Utah Rocky Mountain Power customers to estimate nonparticipant spillover (NPSO), consisting of savings generated by customers motivated by the program's reputation and marketing to conduct energy efficiency installations without receiving an incentive. Cadmus estimated NPSO as 3% of the HES program's total evaluated savings, applying the 3% NPSO equally across HES program measures.

Table 60 provides the net savings evaluation results: evaluated gross savings, evaluated net savings, and NTG by measure type, as well as the NTG methodology utilized.

Table 60. HES Program NTG Methods and Results for 2015–2016

Measure Category	Measure Name	Program Savings (kWh)		NTG	NTG Methodology
		Evaluated Gross	Evaluated Net		
Appliance	Clothes Washer	893,328	580,663	65%	Self-Response NTG
	Dishwasher	10,137	6,589	65%	
	Freezer	35,799	23,269	65%	
	Refrigerator	260,032	169,021	65%	

Measure Category	Measure Name	Program Savings (kWh)		NTG	NTG Methodology
		Evaluated Gross	Evaluated Net		
Home Electronics	Advanced Power Strip	413,880	351,798	85%	Deemed NTG Used[1]
HVAC	Central Air Conditioner Equipment	1,882,289	1,637,591	87%	Self-Response NTG
	Central AC Best Practice Installation and Sizing	653,814	568,818	87%	Self-Response NTG
	Duct Sealing and Insulation	4,243,878	4,243,878	100%	No Adjustments[2]
	Duct Sealing—Manufactured Homes	74,516	74,516	100%	No Adjustments[2]
	Efficient Gas Furnace with ECM	2,153,119	1,873,213	87%	Self-Response NTG
	Evaporative Cooler	10,180,133	8,856,716	87%	Self-Response NTG
	Evaporative Cooler—Portable	80,417	52,271	65%	Self-Response NTG
	Heat Pump System Conversion	57,684	50,185	87%	Self-Response NTG
	Heat Pump	3,675	3,197	87%	Self-Response NTG
	Ductless Heat Pump	14,120	12,284	87%	Self-Response NTG
	Multi Head Ductless Heat Pump	169,620	147,569	87%	Self-Response NTG
	Supplemental Ductless Heat Pump	64,260	55,906	87%	Self-Response NTG

Measure Category	Measure Name	Program Savings (kWh)		NTG	NTG Methodology
		Evaluated Gross	Evaluated Net		
	Room Air Conditioner	21,239	13,805	65%	Self-Response NTG
Energy Kits	***watt***smart Starter Kit	1,810,585	1,611,421	89%	Self-Response NTG
Lighting	CFL Bulb	33,453,170	20,740,965	62%	Demand Elasticity Modeling
	LED Bulb	42,342,294	31,990,743	76%	
	CFL Fixture	213,685	177,359	83%	Self-Response NTG
	LED Fixture	5,596,951	4,645,470	83%	
Water Heating	Heat Pump Water Heater	21,490	18,696	87%	Self-Response NTG
	Water Heater	361	235	65%	Self-Response NTG
Building Shell	Air Sealing	3,477	3,303	95%	Self-Response NTG
	Attic Insulation	2,095,874	2,095,874	100%	No Adjustments [2]
	Floor Insulation	49,510	49,510	100%	
	Wall Insulation	444,512	444,512	100%	
	Windows	257,930	245,034	95%	Self-Response NTG
Total		**107,501,778**	**80,744,412**	**75%**	

[1]Deemed NTG from California work paper: San Diego Gas & Electric. *Tier 2 Audio Visual (AV) Advanced Power Strip.* Work Paper WPSDGEREHE0004 Revision 0.3. August 25, 2015. Available at: http://www.embertec.com/assets/pdf/CPUC%20Approval.pdf

[2]No net adjustments applied to measures as the billing analysis conducted to generate net savings produced a net result.

The following sections outline the NTG methodology used and present detailed results for lighting and non-lighting.

Lighting Evaluated Net Savings

To estimate HES program freeridership for CFLs and LEDs, Cadmus performed demand elasticity modeling, a method for estimating net lighting savings based on actual observed sales. Cadmus used information from the tracking database (provided by the program administrator) to predict bulb sales in the absence of program incentives.

The model expressed sales as a function of price (including incentives), seasonality, retail channels, and bulb characteristics. Appendix B provides the equation for the elasticity model. To predict freerider sales at program-incented prices, Cadmus used model coefficients to predict sales as though prices had remained at their original levels. Cadmus then multiplied the predicted sales at the incented program price and at the price-absent program incentives by the evaluated gross kWh savings per bulb.[33] The difference in savings between the hypothetical original price scenario and actual price scenario produced CFL and LED bulb savings attributable to the program.

Table 61 shows the net savings results.

Table 61. Lighting Freeridership and NTG

Bulb Type	Freeridership	Net of Freeridership	NTG*
CFLs	41%	59%	62%
LEDs	28%	72%	76%**

*Includes a 3% NPSO.

**Appears to be larger than a 3% increase due to rounding.

Cadmus estimated higher freeridership rates for CFL bulbs (41%) than for LED bulbs (28%) due to lower observed price elasticities of demand for CFL bulbs. That is, CFL sales did not increase as much as LEDs due to price reductions, indicating program activities influenced CFL sales less than LED sales.

As shown in Table 62, Cadmus also estimated freeridership by the distribution channel. Upon predicting monthly savings for each individual bulb model (described above), Cadmus aggregated the results by the retail channel and bulb type. Taking the difference between predicted savings with the program and those without the program provided freeridership estimates by retail channels and bulb types.

[33] Though statistical models over- or under-predict to some degree, predicted program sales should be close to actual sales when using a representative model. Utilizing predicted program sales rather than actual sales mitigates bias by comparing predicted program sales to predicted non-program sales.

Table 62. Per-Bulb Price and Freeridership by Retail Channel and Bulb Type

Retail Channel	Bulb Type	Average Original Price Per Bulb	Average Final Price Per Bulb	Markdown %	Freeridership
2015	CFL	$0.79	$2.03	61%	41%
	LED	$4.59	$8.58	47%	17%
2016	CFL	$0.68	$1.27	46%	41%*
	LED	$1.93	$3.08	37%	38%

*As CFLs did not sell through all of 2016, they were not included in the 2016 elasticity model. Rather, the estimated freeridership from 2015 was applied to 2016 CFL sales.

Table 63 shows the estimated price elasticities used to predict program sales.

Table 63. Estimated Price Elasticities by Year, Retail Channel, and Technology

Year	Channel	Technology	Average Elasticity
2015	Club	CFL	-0.55
		LED	-3.33
	DIY	CFL	-1.04
		LED	-2.05
	Mass Market	CFL	-1.13
		LED	-1.59
2016	Club	LED	-2.29
	DIY	LED	-1.46
	Mass Market	LED	-1.90

The two primary freeridership drivers were the price elasticities and the markdown. The price elasticity measured the average change in sales in response to the program's markdown, and it cannot be manipulated by the program (though a program could be designed to focus on products with greater average elasticities). The markdown provided the easiest method for manipulating the program to achieve its goals.

Though CFL demand remained relatively inelastic in 2015, it proved more elastic for LEDs. LED elasticities decreased slightly in 2016, with LED demand most elastic at club stores across both years. Cadmus typically observes greater price elasticities in club stores than other channels, likely due to club stores building a business model that encourages customers to stock up and take advantage of price discounts.

In 2016, sales at club stores accounted for the largest share of program savings, with nearly one-half of program bulbs sold through club stores. This focus on channels with the least elastic demand helped to minimize freeridership.

Appendix B provides detailed information on the price response modeling methodology and results.

Freeridership Comparisons

Table 64 shows LED freeridership estimates from five other recent evaluations that also used elasticity models to estimate freeridership. Rocky Mountain Power Utah's program experienced estimated freeridership comparable to the other utilities.

Table 64. Comparison of LED Freeridership

Utility (Program Year)	Freeridership
Rocky Mountain Power Utah (2015–2016)	**28%**
Focus on Energy Wisconsin (2016)	38%
Focus on Energy Wisconsin (2015)	29%
Midwest Utility 1 (2016)	40%
Ameren Missouri (2015)	35%
Connecticut (2016)	39%

Non-Lighting Evaluated Net Savings

For 2015 and 2016 participants, Cadmus relied on the non-lighting participant surveys to determine the NTG for appliances, HVAC, building shell, and kit product categories. Freeridership, participant spillover, and NPSO constituted 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

Methodology

Cadmus determined freeridership amounts for the appliance, HVAC, and building shell measure categories, based on a previously developed approach for Rocky Mountain Power that determined 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, allowing Cadmus to calculate confidence and precision estimates based on score distributions.[34]

When estimating the freeridership for the kit product category, Cadmus used a separate set of questions and scoring approach. After conducting participant surveys with ***watt***smart Starter Kit recipients, Cadmus studied responses from three questions, used to estimate a freeridership score for each participant, and adopting 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.

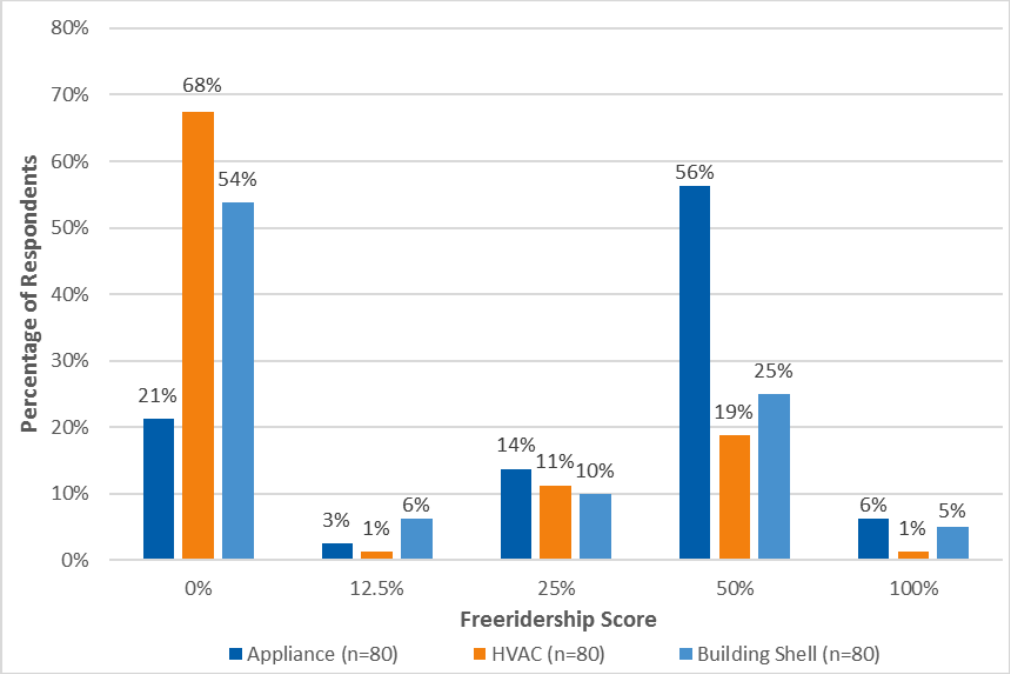
[34] This approach was outlined in Schiller, Steven, et al. "National Action Plan for Energy Efficiency." *Model Energy Efficiency Program Impact Evaluation Guide*. 2007. Available online: https://www.epa.gov/sites/production/files/2015-08/documents/evaluation_guide.pdf.

Cadmus determined participant spillover by estimating savings derived from additional measures installed and whether respondents credited Rocky Mountain Power with influencing their decisions to install additional measures. Cadmus included measures eligible for program incentives (provided the respondent did not request or receive the incentive), and then used the measure category's freeridership and spillover results to calculate the program's NTG ratio. Appendix D provides a detailed explanation of Cadmus' self-reported NTG methodology.

Freeridership

After conducting surveys with appliance, HVAC, and building shell participants, Cadmus converted the responses from six freeridership questions to a score for each participant, using the Excel-based matrix approach described in Appendix D. Cadmus derived each participant's freerider score by translating these responses into a matrix value and applying a rules-based calculation. Figure 5 shows freeridership score distributions for appliances, HVAC, and building shell survey respondents.

Figure 5. Distribution of Freeridership Scores by Measure Category*



*Total may not sum to 100% due to rounding.

**This figure is not weighted by measure savings and does not reflect final freeridership rates.

Approximately 21% of appliance respondents, 68% of HVAC measure respondents and 54% of building shell respondents indicated no freeridership. That is, they would not have purchased the efficient measure in the absence of Rocky Mountain Power's program. More appliance respondents indicated high freeridership (scores of 50%–100%) than respondents did for the other measure categories.

Kit Freeridership

For the kit product category, Table 65 summarizes freeridership findings by measure. Cadmus weighted measure-level freeridership estimates by the evaluated gross program population's kWh savings to determine a 18% freeridership estimate for the kit product category.

Table 65. HES Kit Measure Category Freeridership by Measure

Measure	Responses (n)	Freeridership Ratio	Evaluated Program Population kWh Savings
CFL	65	24%	820,480
LED	63	21%	260,423
Kitchen Faucet Aerator	8	0%	250,323
Bathroom Faucet Aerator	19	11%	103,291
Showerhead	20	19%	376,067
Overall		**18%***	**1,810,585**

*Weighted by evaluated program population kWh savings.

Spillover

This section presents the results from additional, energy-efficient measures that customers installed after participating in the HES program. While many participants installed such measures after receiving incentives from Rocky Mountain Power, Cadmus only attributed program spillover to additional purchases significantly influenced by HES program participation and not claimed through the program. Four rebate program respondents and two kit program respondents fit this category.

Cadmus used evaluated savings values from the deemed savings analysis to estimate spillover measure savings. This involved estimating the spillover percentage for measure categories by dividing the sum of the additional spillover savings by the total incentivized gross savings achieved by all respondents within a measure category. Table 66 shows the results.

Table 66. Non-Lighting Spillover Responses

Measure Category	Spillover Measure Installed	Quantity	Total Electric Spillover Savings (kWh)	Surveyed Measure Category Savings (kWh)	Spillover Ratio
HVAC	Central Air Conditioning	1	689	181,974	0%
	Refrigerator	2			
Building shell	Attic Insulation	1,100 square feet	838	24,127	4%
Kit	Clothes Washer	1	858	20,183	4%
	Smart Thermostat	1			

Non-Lighting NTG Findings

Cadmus conducted 80 surveys with appliance-measure category participants, 80 with HVAC-measure category participants, and 80 with building shell measure category participants. Additionally, 128 surveys addressed customers receiving ***watt***smart Starter Kits. Cadmus used these participant responses to generate the NTG ratios that follow: 65% for appliance measures; 87% for HVAC; 95% for building shell; and 89% for kits. Table 67 lists these findings.

Table 67. Non-Lighting NTG Ratio by Measure Category

Program Category	Responses (n)	Freeridership Ratio[1]	Participant Spillover Ratio	NPSO Ratio	NTG	Absolute Precision at 90% Confidence
Appliance	80	38%	0%	3%	65%	±5%
HVAC	80	17%	0%	3%	87%	±6%
Building shell	80	12%	4%	3%	95%	±6%
Kit	128	18%	4%	3%	89%	±19%

[1]Weighted by evaluated program savings.

The NTG column indicates the percentage of gross savings attributable to the program. For example, participants that purchased an appliance measure received an 65% NTG, indicating that 65% of gross savings for appliance measures could be attributed to the HES program.

Table 68 shows freeridership, spillover, and NTG estimates for appliance and HVAC rebate programs reported for prior Rocky Mountain Power program years as well as for other utilities with similar programs and measure offerings.

Table 68. Non-Lighting NTG Comparisons*

Utility/Region	Evaluation Publication Year	Responses (n)	Percentage FR[2]	Participant Spillover	NPSO	NTG
Appliances						
Rocky Mountain Power Utah 2015–2016 HES Evaluation: Appliances	**2017**	**80**	**38%**	**0%**	**3%**	**65%**
Rocky Mountain Power Utah 2013–2014 HES Evaluation: Appliances	2016	68	19%	0%	0%[3]	81%
Northeast Utility—Appliance	2015	65	65%	3%	NA	38%
Northwest Utility—Appliance	2014	73	79%	2%	NA	23 %
HVAC						
Rocky Mountain Power Utah 2015–2016 HES Evaluation: HVAC	**2017**	**80**	**17%**	**0%**	**3%**	**87%**
Rocky Mountain Power Utah 2013–2014 HES Evaluation: HVAC	2016	68	31%	1%	0%[3]	70%
Midwest Utility—HVAC	2015	73	51%	1%	NA	50%
Northwest Utility—HVAC	2014	48	72%	1%	NA	29%
Building Shell						
Rocky Mountain Power Utah 2015–2016 HES Evaluation: Building shell	**2017**	**80**	**12%**	**4%**	**3%**	**95%**
Rocky Mountain Power Utah 2013–2014 HES Evaluation: Building shell	2016	68	18%	0%	0%[3]	82%
Midwest Utility—Weatherization	2015	208	30%	2%	NA	72%
Midwest Utility—Weatherization	2015	79	36%	2%	NA	66%
Energy Kits						
Rocky Mountain Power Utah 2015–2016 HES Evaluation: Kit	**2017**	**128**	**18%**	**4%**	**3%**	**89%**
Mideast Utility—Kit	2015	150	8%	1%	NA	93%

[1]NTG values derived from self-response surveys, though differences in analysis and scoring methodologies may have varied across evaluations.

[2]FR = Freeridership

[3]Cadmus did not use NPSO in the 2013–2014 evaluation of the program.

Process Evaluation

This section presents detailed findings 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's design, marketing, and process
- Customer satisfaction and participation barriers
- HES upstream/midstream/downstream delivery channels vs. those used by similar utility programs

Cadmus focused the research activities on key research topics, identified during the evaluation kick-off, as well as on topics of interest identified by program stakeholders. Table 69 lists the study's primary research questions.

Table 69. 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 Rocky Mountain Power programs? If so, how did they learn about the programs?
Satisfaction	How satisfied are customers with their LEDs, APS, lighting fixtures, ***watt***smart Starter Kits, incented non-lighting measures, or contractors? Why?
Motivations	What actions have customers taken to save energy, and what 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
- Downstream lighting fixture participant survey
- Non-lighting participant survey
- Benchmarking of selected program components

Program Materials Review

Cadmus reviewed program documentation to understand the program model and compared field activities to the expected implementation plan. The program materials review focused on critical

program documents, including past evaluation reports, the program implementation manual, and Rocky Mountain Power's annual reports for 2015 and 2016. As discussed in Appendix G, Cadmus also reviewed the HES program logic model, noting only minor changes.

To document and evaluate marketing activity in 2015–2016, Cadmus reviewed the ***watt***smart Homes 2015–2016 Marketing Activities workbook provided by CLEAResult, in addition to Rocky Mountain Power's annual reports for 2015 and 2016.

Utility and Administrator Staff Interviews

Cadmus developed stakeholder interview guides and collected information about key topics from program management staff. The evaluation involved three interviews: one with program staff at Rocky Mountain Power; and two with program staff at CLEAResult, 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 experiences
- Barriers and areas for improvement
- Data tracking

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

Participant Survey

Cadmus conducted a telephone survey with non-lighting, downstream lighting, ***watt***smart Starter Kits participating customers, designing the survey instrument to collect data regarding the following process topics:

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

General Population Survey

Cadmus' telephone survey with customers addressed LED lighting and APS purchases, with the survey instrument designed to collect data regarding the following process topics:

- ***Program process***. Details to inform the following performance indicators:

- Upstream/midstream lighting and APS incentive awareness
- Lighting purchase decisions and barriers to purchasing energy-efficient lighting
- APS purchase decisions and barriers to purchasing the units
- Customer satisfaction with products purchased

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

Downstream Lighting

Cadmus' telephone survey with customers explored CFL and LED lighting fixture purchases, with the survey instrument designed to collect data regarding the following process topics:

- ***Program process***. Details to inform the following performance indicators:
  - HES Program incentive awareness
  - Lighting fixture purchase decisions and barriers to purchasing energy-efficient lighting
  - Customer satisfaction with products purchased, installation contractors, and the incentive application process
- ***Customer information***. Demographic information and household statistics

Benchmarking

In conversations with Rocky Mountain Power, Cadmus chose to benchmark the HES upstream/ midstream/downstream delivery channels and the measures offered through each channel against similar utility programs across the country. In conducting this benchmarking, Cadmus utilized its ESource data resource as well as a library of Cadmus' current and past utility program evaluations.[35]

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, Rocky Mountain Power offered energy efficiency measures in three primary categories (e.g., lighting/APS, non-lighting, and ***watt***smart Starter Kits). The lighting component (except fixtures), APS, and room air conditioners used an upstream and/or midstream incentive mechanism with a discount applied at the point of sale, whereas the non-lighting and lighting fixture components used a downstream, post-purchase mechanism, using mail-in or online incentive applications.

Customers could order ***watt***smart Starter Kits through Rocky Mountain Power's website, with delivery by mail. Rocky Mountain Power offered eight kit types that contained a mix of measures, depending on a participant's bulb preferences (e.g., CFLs, LEDs) and on whether the participant used an electric water heater.

[35] Data from DSM Insights, used with permission from E Source.

Rocky Mountain 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). For $4.99, the 2015 and 2016 program offered a kit upgrade option that moved from CFLs to LEDs.

Tariff Changes

Each year, Rocky Mountain Power files program modifications (i.e., tariff changes) with the Utah Public Utilities Commission. Key changes during 2015 and 2016 included the addition of the following:

- APS
- Air sealing
- Central air conditioner best practice installation and sizing
- Duct leakage testing and duct sealing for manufactured homes
- Efficient gas furnaces with electrically commutated motors
- Ductless heat pumps
- Smart thermostats (added December 1, 2016)

In 2016, the program no longer incentivized electric water heaters, efficient dishwashers, or central air conditioner best practices installation. Effective December 1, 2016, the program retired incentives for CFL bulbs and fixtures.

Delivery Structure and Processes

In 2016, Rocky Mountain Power renamed and restructured HES, marketing it as the ***watt***smart Homes program. Rocky Mountain Power also consolidated the New Homes program under the ***watt***smart Homes program. Program staff continued to coordinate with participating distributors, retailers, and trade allies to deliver the program's different components. In 2016, Rocky Mountain Power's *Utah Energy Efficiency and Peak Reduction Annual Report* showed 696 participating retailers and trade allies.

For most program-qualifying, non-lighting measures, customers received post-purchase, cash-back incentives directly from the program, allowing Rocky Mountain Power to verify recipients were their customers. Rocky Mountain Power offered its lighting incentives through retailers, identifying these retailers using the Retail Sales Allocation Tool (RSAT), developed in partnership with the Bonneville Power Administration. RSAT helped Rocky Mountain 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 enabling the program to stop incentivizing measures as funds became exhausted for the year.

The program administrator also maintains an account manager who reaches out directly to property managers or property owners of multifamily properties in Utah—particularly electrically heated properties—to help them engage with the program incentives, pairing them with a choice of contractors providing non-lighting equipment.

Looking forward, Rocky Mountain Power program staff will continue to evaluate measures to be moved to midstream from downstream, based on market saturation, participation levels, and the measures' cost-effectiveness.

Data Tracking

The program administrator, CLEAResult, provides the program tracking data to Rocky Mountain Power through a Demand-Side Management Central (DSMC) data entry spreadsheet. This report, known as the project upload, also serves as CLEAResult's invoice to Rocky Mountain Power. For downstream rebates, CLEAResult hand-keys the application information into its program tracking database, using a software control mechanism to ensure all application data are present and customers are eligible. The program administrator submits project uploads to the DSMC on a weekly basis, with the DSMC serving as Rocky Mountain Power's project management and reporting database.

The program administrator also provides monthly reports to Rocky Mountain Power; these highlight the program's actual performance compared to forecasts, and updates the forecast for the remainder of the year. In late 2016, the administrator began providing this report via an online dashboard.

Application Processing

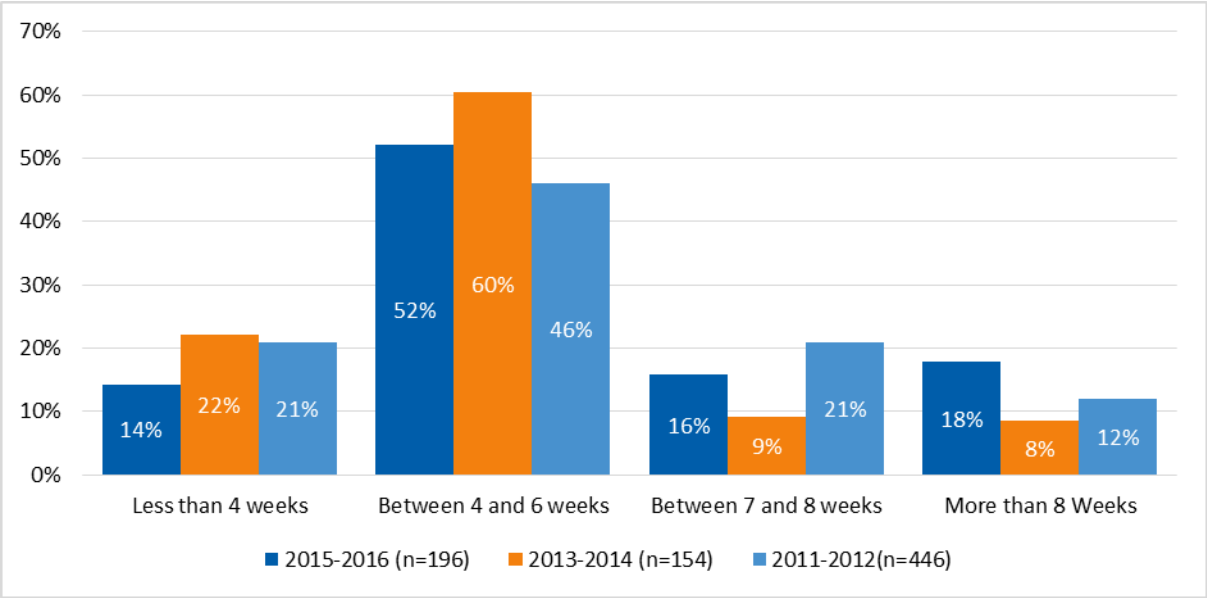
By the end of 2016, CLEAResult provided almost all applications online, hoping these applications would streamline the submittal process and reduce missing information required for processing applications. CLEAResult also launched an online portal in 2016, allowing customers to enter their account numbers and track the status of their applications and incentives.

As shown in Figure 6, during the 2015–2016 evaluation period, 14% of non-lighting customers reported receiving their incentives in less than four weeks (a rate significantly down from 22% in 2013–2014), while those reporting incentives received in seven to eight weeks or in more than eight weeks—were significantly more than those reporting through 2013–2014 survey (i.e., 16% vs 9%, and 18% vs 8%, respectively).[36] The number of customers reporting that they received incentives in four to six weeks (52%) were similar to those reporting this in 2013–2014.

Notably, this question gauged participants' perceptions of the time required to receive the rebate, and their responses probably included the time required to resubmit their applications to address missing or incorrect information. Actual payment times for all customers in the 2015 and 2016 non-lighting participant data files showed 59% and 62% of incentives (2015 and 2016 respectively) were paid in 45 days or less (45 days being the program goal). Most applications requiring more than 45 days, were for central air conditioner best practice installation and sizing, efficient gas furnaces with ECM, duct sealing and insulation, evaporative coolers, attic insulation, efficient clothes washers and windows.

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

Figure 6. Time Between Application Submissions and Incentive Receipt (2011–2016)



Source: Rocky Mountain Power Utah HES Residential Non-Lighting Survey (QF6, 2011–2012; QE7, 2015–2016). "Don't know", "refused", and "have not received the incentive yet" responses removed.

Retailers and Trade Allies

The program administrator continued its use of a tiered system for trade allies, reflecting savings that trade allies delivered to the HES Program and the attention level provided by the administrator. Tier 1 trade allies—those delivering 80% of program savings—received individual support from the administrator, including training on the program, measures, and incentives. Tier 2 trade allies received a program newsletter, along with site visits and phone calls from the account manager (although this occurred less frequently than support provided to Tier 1 trade allies). Tier 3 trade allies remain new to the program.

The program administrator employed four account managers (two for trade allies and two for retailers) in Rocky Mountain Power's Utah-based network, and noted well-established relationships with Utah trade allies (though trade allies, per the administrator, expressed dissatisfaction with some decreased incentive levels, and, at the end of 2016, the loss of central air conditioner best practice installations.

Rocky Mountain Power program staff felt the administrator did a good job of recruiting sufficient trade allies in Utah; Rocky Mountain Power's 2016 annual report showed 160 HVAC trade allies, 101 building shell trade allies, and one trade ally providing duct sealing and insulation to manufactured homes.

Marketing

Approach

In 2016, Rocky Mountain Power began shifting emphasis in marketing to renewables and business solutions more than the residential program. HES, however, continued using a variety of channels to communicate with customers, retailers, and trade allies. The administrator marketed the HES program using combined tactics, including bill inserts, Opower ads, and content in Rocky Mountain Power's customer newsletters and social media channels. Rocky Mountain Power also distributed printed materials, and, at home shows, offered free Starter Kits to qualified customers.

In executing these tactics, the program sought to teach customers how to reduce consumption and save money on their own or through the program. Marketing campaigns adopted several key 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 communications through direct mail, e-mail, and social media

The administrator also provided trade allies with some marketing collateral, such as general program fact sheets.

Effectiveness

In the month of deploying a marketing tactic, the program administrator measured the HES landing pages' web traffic, comparing this to prior and subsequent months to determine the tactic's effectiveness in increasing traffic to the site. The program administrator pointed out that other Google Analytics (e.g., session lengths, bounce rates) did not provide particularly valuable metrics. Visitors used the website to gain quick information about available rebates and to provide a path to the online application website.

Table 70, provides several direct-to-customer tactics Rocky Mountain Power deployed in 2015–2016 and the subsequent increases in website visits.

Table 70. Examples of Direct-to-Customer Tactics 2015–2016

Tactic	Date	Increase in Website Visits
LED/Starter Kit Bill Insert	April 2015	7.3%
Evaporative Cooler/Central Air Conditioner Bill Insert	June 2015	178%
Opower LED Advertisement	July 2015	1%

Source: CLEAResult provided this table's data in response to follow-up questions submitted by Cadmus.

The administrator noted that bill inserts featuring specific equipment measures—such as those shown in Table 70—continued to serve as effective vehicles for increasing customer awareness about program incentives and measure benefits.

The administrator added that, while articles in Rocky Mountain Power's newsletters and social media did not notably increase website traffic, they maintained baseline awareness of energy efficiency offerings from Rocky Mountain Power at a very low cost to the program. Further, when customers purchased qualified products offline, the administrator could not tie the marketing to actual purchases and installations.

One primary HES website objective, as the administrator noted, was to drive customers toward applying for incentives online. The administrator reported an increase in the number of year-over-year visits to the application landing page from 2014 to 2015 (6,410 vs. 25,512), but the site experienced a decrease in 2016 (13,234). The administrator attributed the decrease to minimal marketing activity in general and to limited marketing in promoting the online application due to measure changes and updates to the online platform.

Program Challenges and Successes

The program administrator reported application processing delays during "rush times," but otherwise "did pretty well." Customers' perceptions of the response times between submitting the application and receiving the incentive were slower for three of the four categories.

The administrator also noted the program's challenges with administration accuracy and forecasting. Though these challenges resulted from several factors, key issues included the following:

- Staff and system changes resulting from CLEAResult's purchase of Portland Energy Conservation, Inc.
- Aligning data management systems with Rocky Mountain Power's newly implemented DSMC.

The administrator, however, reported decreasing errors by early 2017, and staff and system alignment improved.

The administrator also cited successes in migrating applications online and strong relationships with Utah retailers and trade allies.

Customer Response

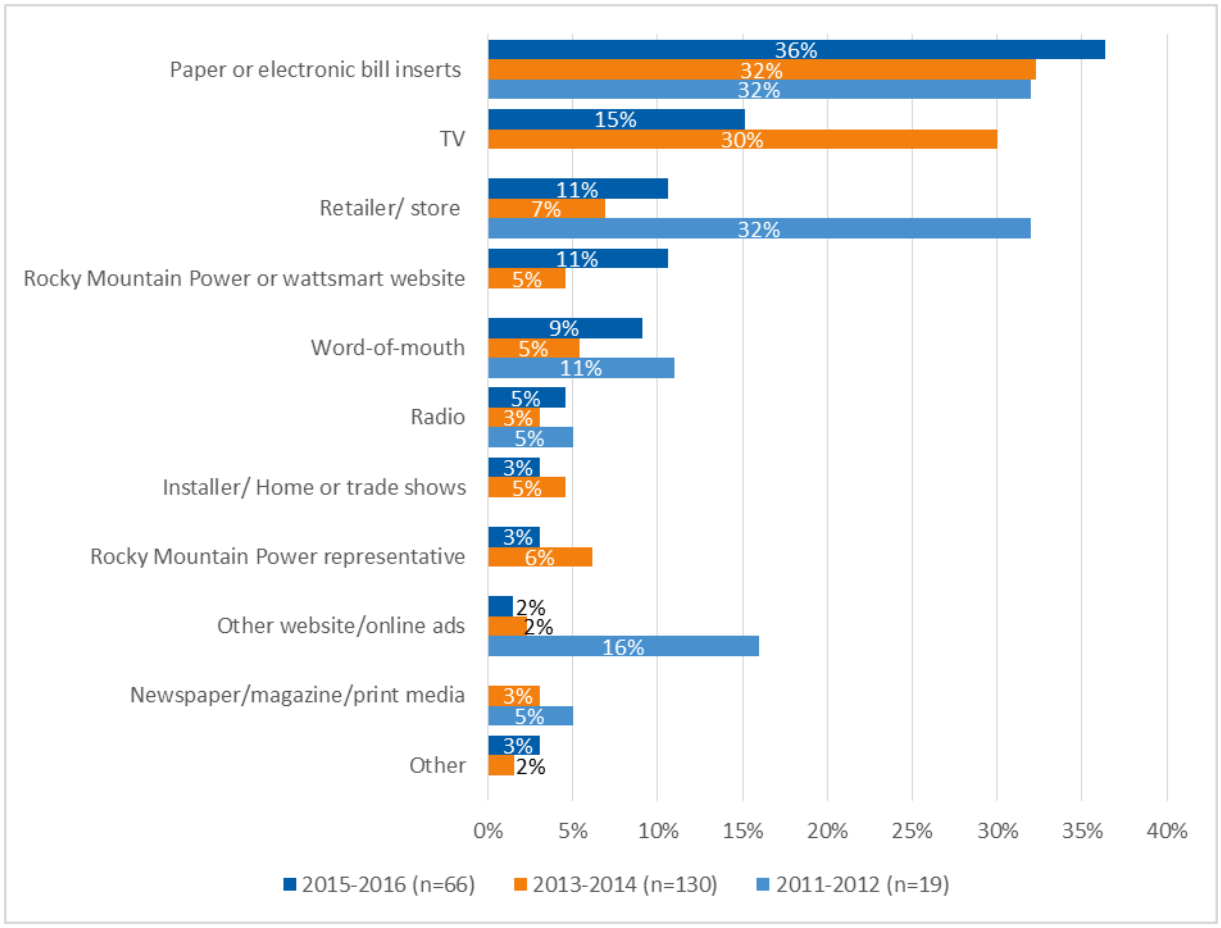
Awareness

About 43% (n=250) of the general population knew that Rocky Mountain Power provided incentives for equipment and home improvements to reduce energy bills, and 61% (n=114) of those respondents familiar with the incentives also knew of the ***watt***smart HES program. Respondents aware of the program reported learning of it through a variety of means.

As in 2013–2014, respondents most commonly learned of the program through bill inserts in 2015-2016, cited by 36% of respondents. Also (as in 2013–2014), respondents second-most commonly learned of the program through television, though just 15% of respondents cited television in 2015–2016, compared to 30% in 2013–2014.[37]

Figure 7 presents all awareness sources noted in 2015-2016 and compares those responses to 2013–2014 and 2011–2012 results. Although only 11% of general population respondents indicated most recently hearing about the ***watt***smart program through the Rocky Mountain Power ***watt***smart website, 31% (n=65) visited the website, and, of those, 96% found the website very or somewhat helpful.

Figure 7. General Population Survey Source of *watt*smart Awareness



Source: Rocky Mountain Power Utah HES Residential General Population Survey (QB2, 2011–2012; QD3, 2013–2014; QE3 2015-2016). Don't know and refused responses removed.

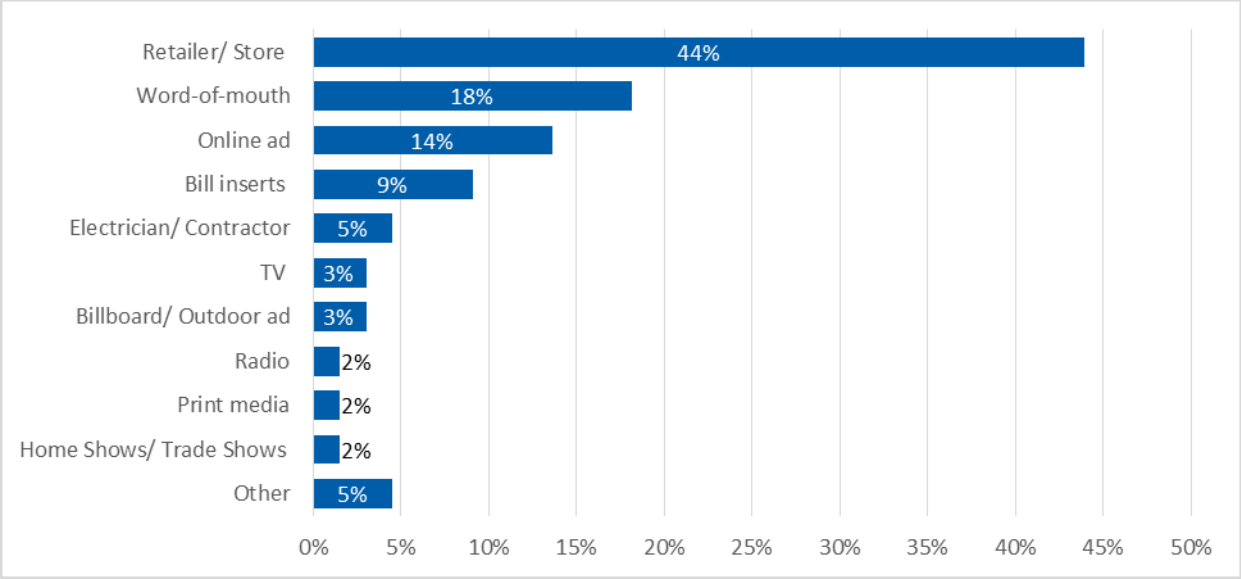
Downstream lighting fixture participants reported learning about the program primarily through retailers. Figure 8 shows other awareness sources, including word-of mouth (18%) and online ads (14%). Although respondents did not indicate they learned about the rebates on the ***watt***smart website, 51%

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

(n=70) of respondents reported visiting the website. Of those, the majority (56%, n=36) found the website somewhat helpful, while 39% found it very helpful; the remaining 3% considered it somewhat unhelpful. Most respondents did not provide suggestions for improving the website, though four respondents suggested the following:

- Making the website easier to navigate
- Providing easier access to customer support and FAQs (two respondents)
- Making the information more clear and concise (one respondent)

Figure 8. Downstream Lighting Fixtures Participants' Sources of Awareness



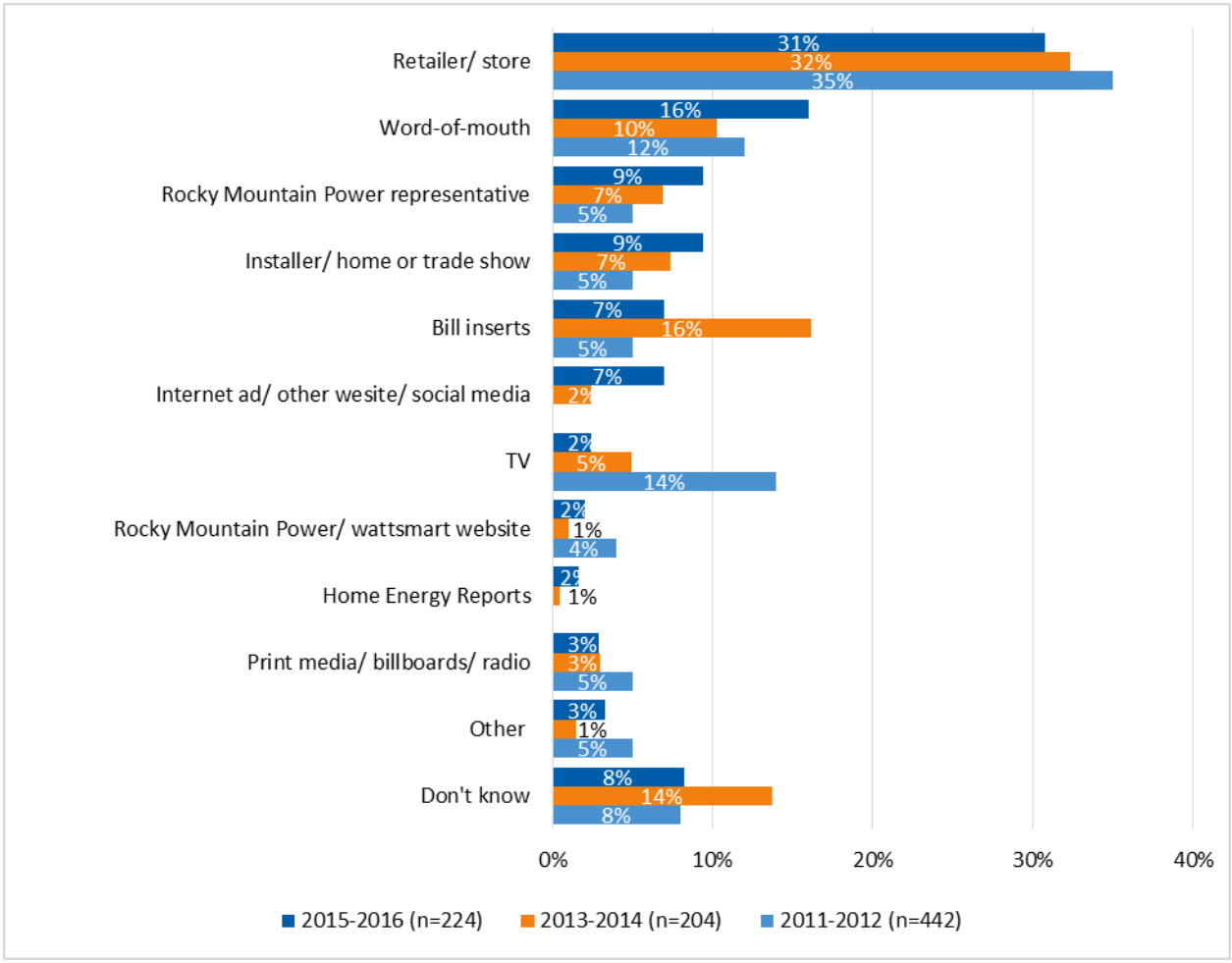
Source: Rocky Mountain Power Utah HES Residential Downstream Lighting Fixtures Survey (QC1, n=66). Don't know and refused responses removed.

As shown in Figure 9, non-lighting participants most commonly reported learning of the program through a retailer (31%), followed by word of mouth (16%). Overall, in 2015–2016, non-lighting participants learned of the program through sources similar to those in the 2013–2014 evaluation, excepting bill inserts. Bill inserts exhibited a significant decrease, falling from 16% of respondents in 2013–2014 to 7% in 2015–2016.[38] The percentage of respondents who did not know how they learned of the ***watt***smart program also changed significantly, falling from 14% in 2013–2014 to 8% in 2015–2016.[39]

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

[39] Ibid.

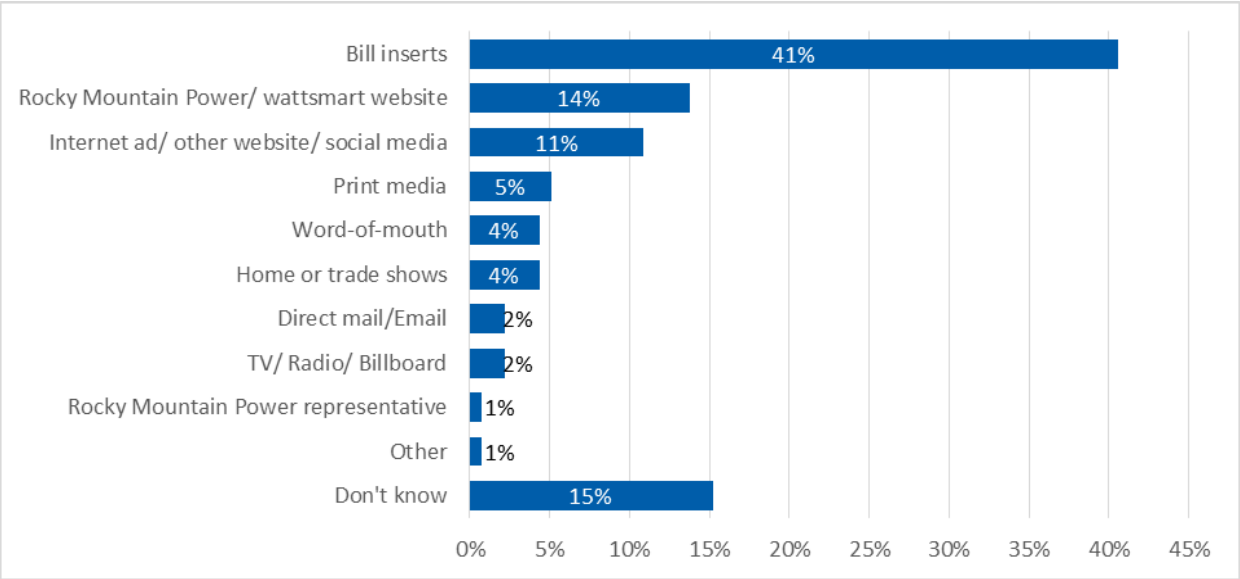
Figure 9. Non-Lighting Participant Sources of Awareness



Source: Rocky Mountain Power Utah HES Residential Non-lighting Survey (QM1, 2011–2012; QC1, 2013–2014 and 2015–2016). Refused responses removed.

Starter kit participants most commonly learned of the program through the bill insert (41%). The next most commonly cited sources included the Rocky Mountain Power or ***watt***smart websites, and other online sources (14% and 11%, respectively). Fifteen percent of respondents did not know how they first heard of the Starter Kit program. Figure 10 shows other awareness sources.

Figure 10. Starter Kits Participant Source of Awareness



Source: Rocky Mountain Power Utah HES Starter Kits Survey, QE5 (n=138). Refused responses removed.

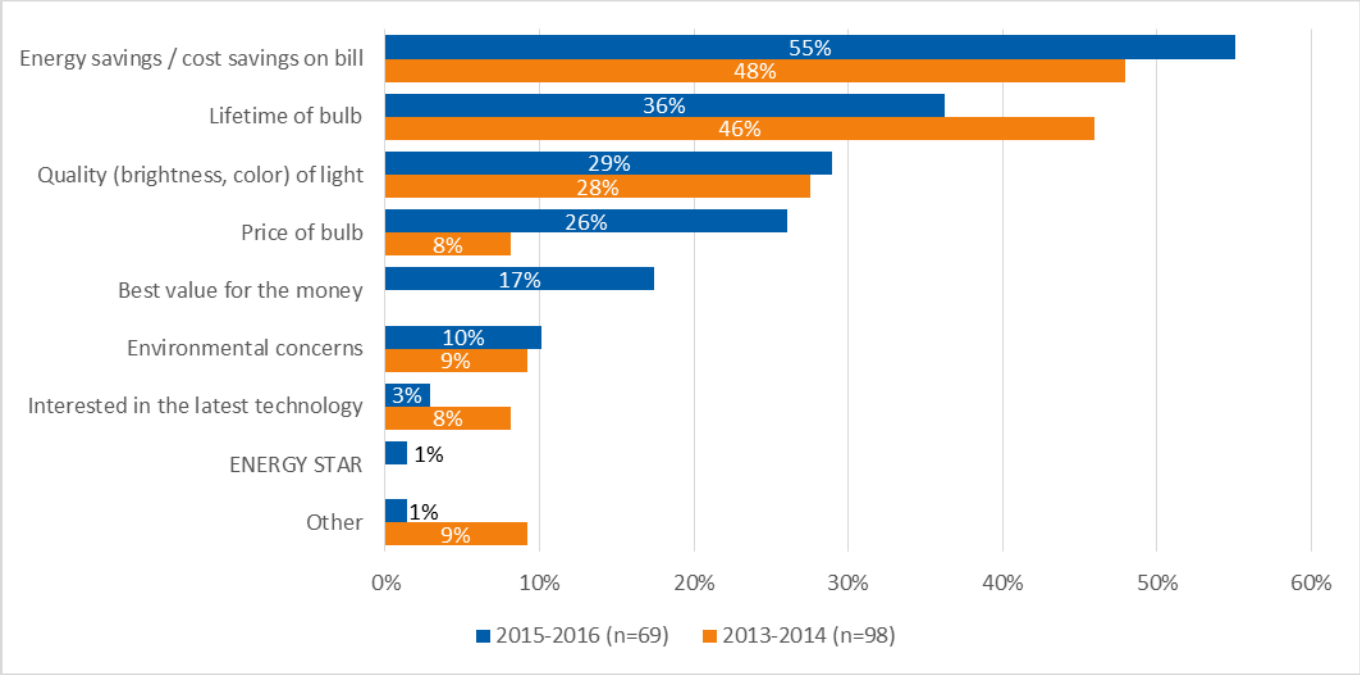
Purchasing Decisions

Lighting

Among the general population purchasing LEDs, 55% of respondents said energy or utility bill cost savings motivated them. The second most common reason was the bulb lifetime, followed by the quality of the light. Participants motivations did not significantly change 2013–2014 to 2015–2016, except for bulb price, which was cited by 8% of respondents in 2013–2014, significantly less than the 26% that citing this in 2015–2016.[40] The increase was not surprising, given the overall decline in LED bulb prices over the 2015–2016 time period. (Best value for the money was not a response option in the 2013–2014 survey, and therefore cannot be compared across years.)

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

Figure 11. General Population Reasons for Purchasing LEDs

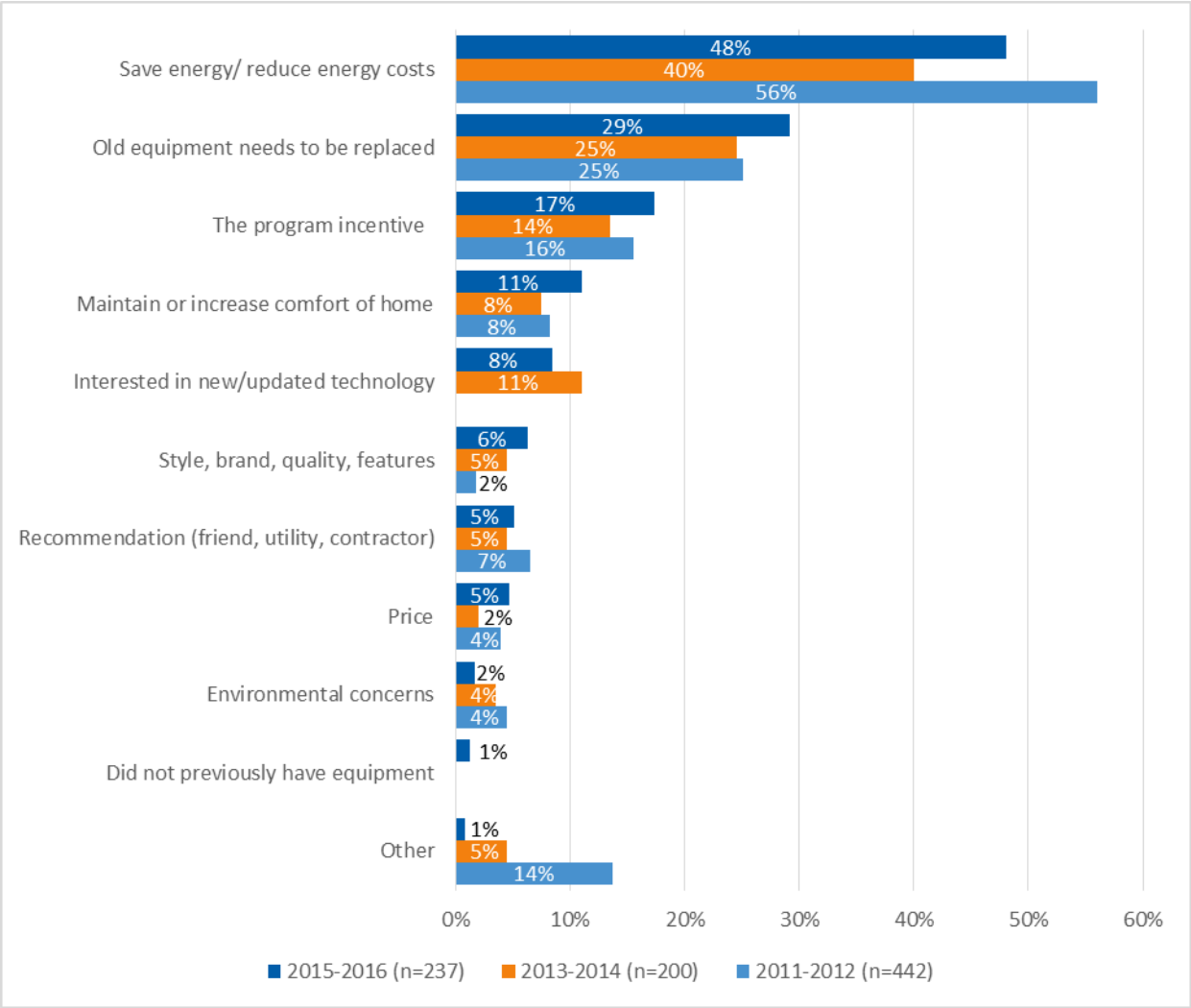


Source: Rocky Mountain Power Utah HES Residential General Population Survey (QC7, 2013–2014; QE7 2015–2016). Don't know and refused responses removed.

Non-Lighting Participation Decisions

Similar to the general population respondents' motivations for purchasing LEDs, about one-half (48%, n=237) of non-lighting participants participated in the ***watt***smart HES program to save energy or energy costs. The second most common reason for participating was to replace aging or broken equipment, cited by 29% of respondents, followed by the desire to receive the program incentive, cited by 17%. Motivations reported by non-lighting participants have remained fairly consistent since 2011, as shown in Figure 12.

Figure 12. Non-Lighting Reasons for Participation

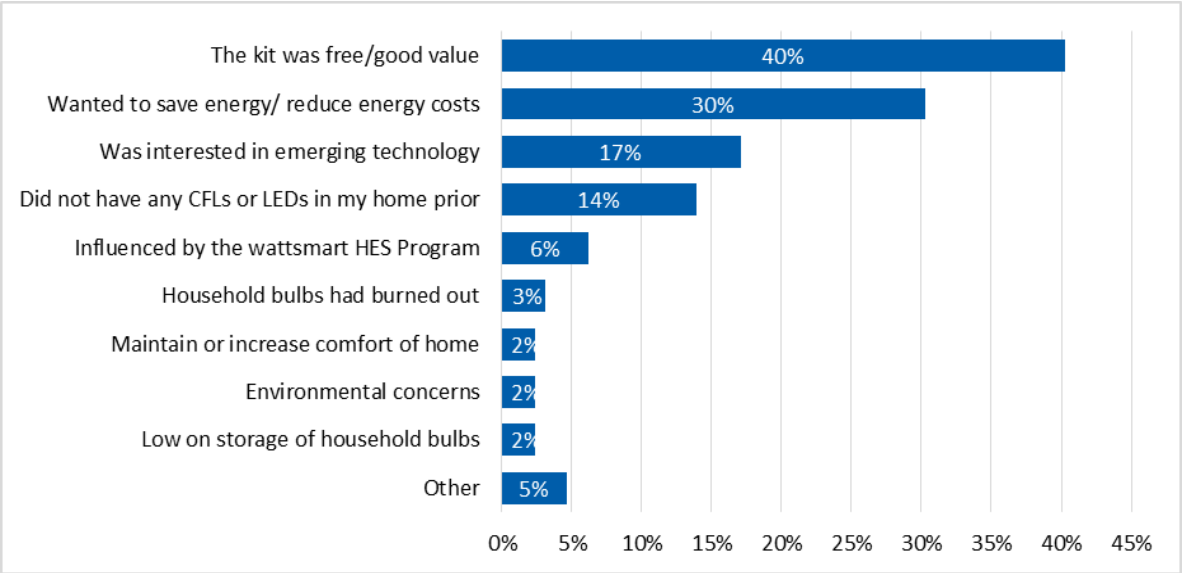


Source: Rocky Mountain Power Utah HES Residential Non-lighting Survey (QM4, 2011-2012; QC5, 2013–2014 and 2015–2016). Don't know and refused responses removed.

wattsmart Starter Kits

Starter kit participants primarily ordered the kit for economic or financial reasons, with 40% of respondents indicating they ordered the kit because it was free or a good value, and 30% reporting that they ordered to save energy or money on their bills. Curiosity about the technology included in the kits also served as a common motivation, cited by 17% of respondents. Respondents' comments indicated that, while most people were curious to try LEDs, some people also were interested in the CFLs or the showerheads. Figure 13 shows other factors influencing people to order a kit.

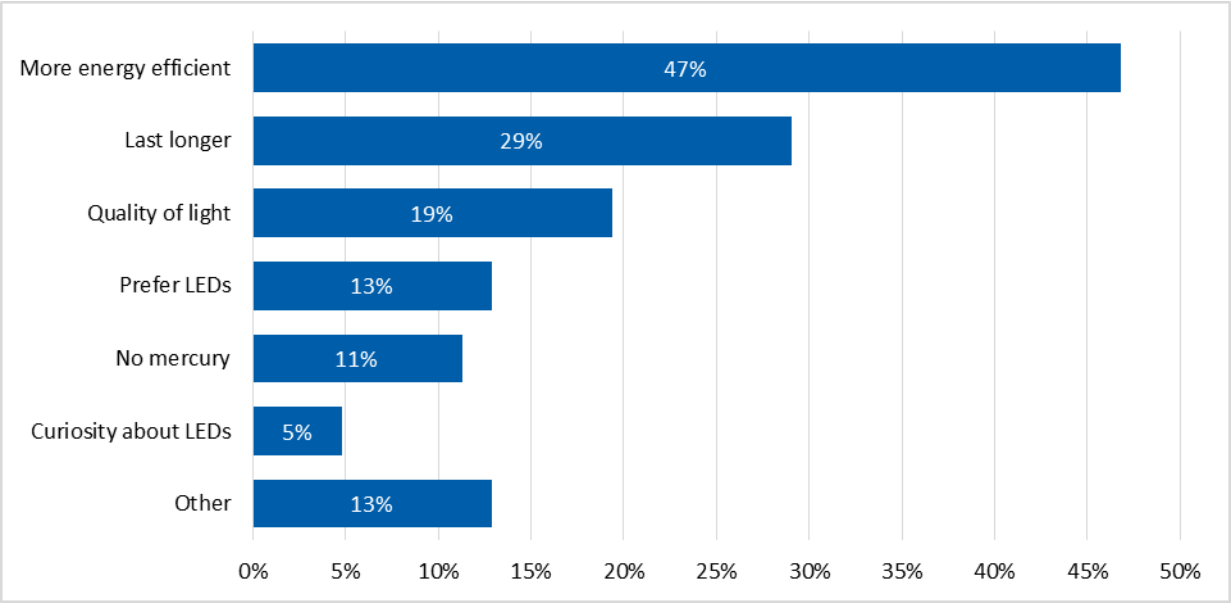
Figure 13. Motivation to Order a *watt*smart Starter Kit



Source: Rocky Mountain Power Utah HES Starter Kits Survey, QE10 (n=129).
Don't know and Refused responses removed.

During the application process, customers could upgrade their kits from CFLs to LEDs for $4.99. Nearly one-half (47%) of those choosing to upgrade reported doing so due to LEDs' higher efficiency. Customers' other common reasons for upgrades included LEDs lasting longer (29%) or having better light quality (19%). Participants also reported a general preference for LEDs, LEDs' lack of mercury, and the respondent's curiosity about LEDs as motivating factors for upgrading their kits. Figure 14 shows reasons that customers upgraded their kits to include LEDs rather than CFLs.

Figure 14. Reasons for LED Upgrades



Source: Rocky Mountain Power Utah HES Residential Energy Kit Survey (QB20 2015–2016, n=62). This was asked as an open-ended question, multiple response allowed.

Those ordering CFL kits were equally likely to have installed CFLs in their homes (55%, n=69) as LED kit participants were to have LEDs installed (55%, n=70), though 47% of CFL participants reported already planning to buy CFLs at the time they ordered the kit, compared to 28% of LED participants already planning to buy LEDs.

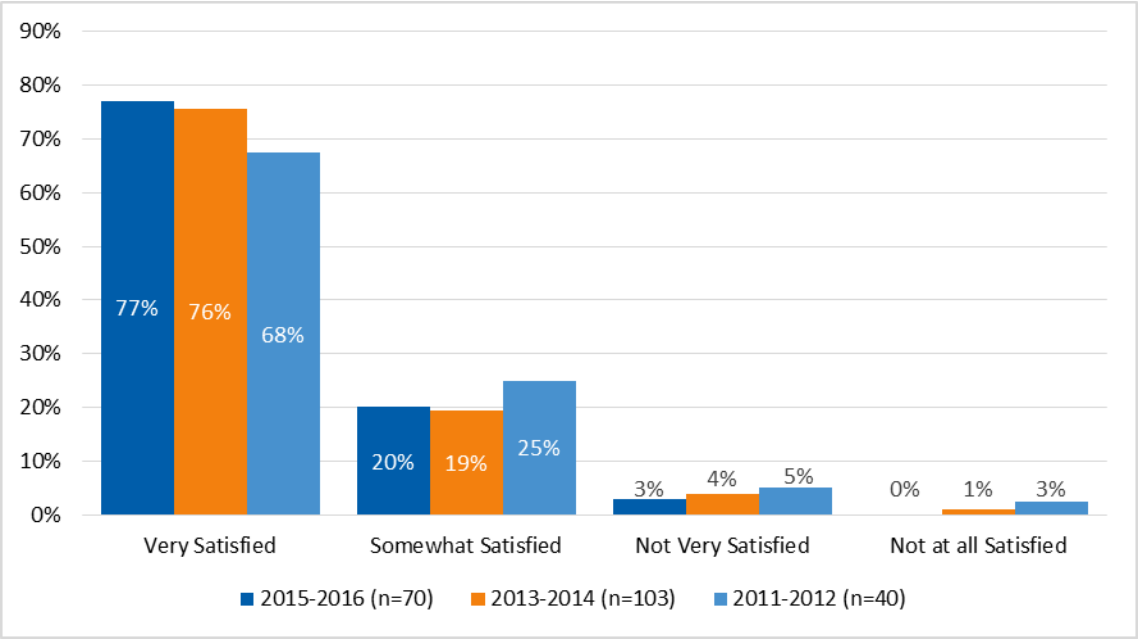
Thirty-eight percent of CFL kit participants (n=58) reported knowing of the option to upgrade to LEDs. Of 18 respondents answering the question, nine chose not to upgrade to LEDs due to cost; the remainder cited other reasons, including not being familiar with LEDs, preferring CFLs, and not understanding the difference between CFLs and LEDs. Of 36 customers not aware of the option, 19 would have upgraded had they known.

Satisfaction

Lighting

As in prior surveys, respondents were highly satisfied with their LEDs, with 97% of respondents very satisfied or somewhat satisfied, as shown in Figure 15.

Figure 15. General Population LED Satisfaction



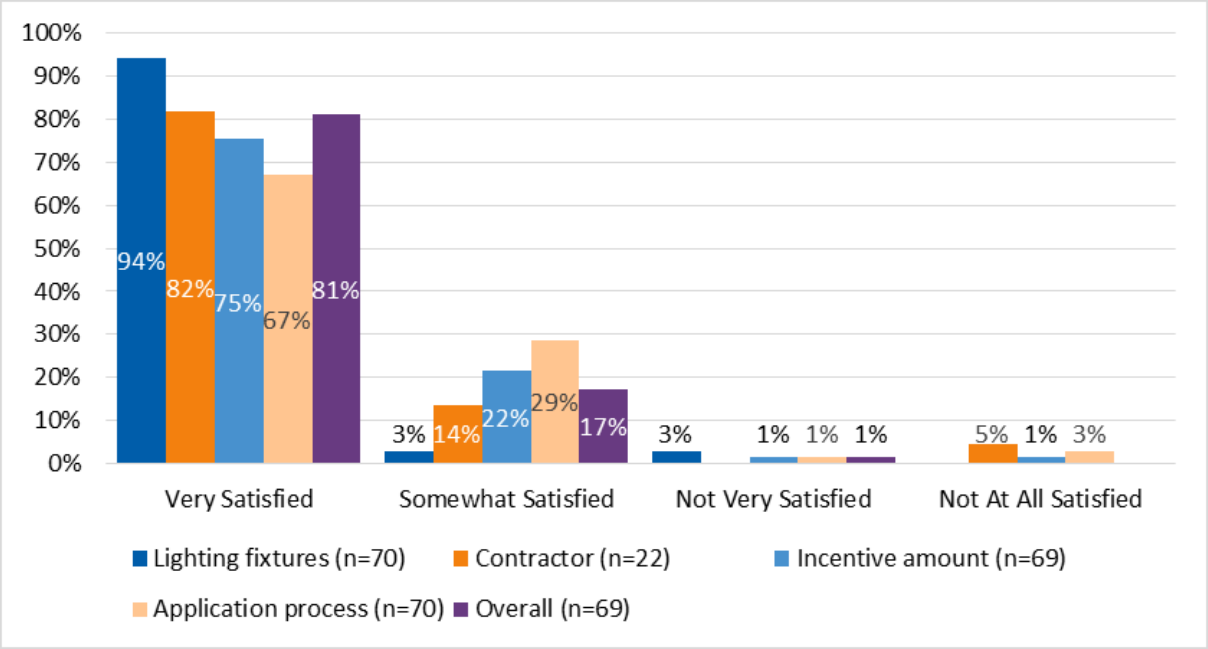
Source: Rocky Mountain Power Utah HES Residential General Population Survey (QG1, 2011–2012, QC14, 2013–2014, QC16 2015–2016). Don't know and refused responses removed.

Downstream Lighting Fixtures

Downstream lighting fixtures participants reported high satisfaction levels across various program components, with at least 95% of respondents very satisfied or somewhat satisfied with each component, as shown in Figure 16. Respondents were significantly more likely to be satisfied with the measures or with the contractor that installed the measure (32% of respondents) than with the application process, which earned the lowest satisfaction level.[41] Only two respondents who were less than satisfied commented on their responses, saying the process was too confusing and too time intensive.

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

Figure 16. Downstream Lighting Fixtures Participants Satisfaction



Source: Rocky Mountain Power Utah HES Residential Downstream Lighting Fixtures Survey (QD1, D3, D6, D9 and D10). Don't know and refused responses removed.

Non-lighting

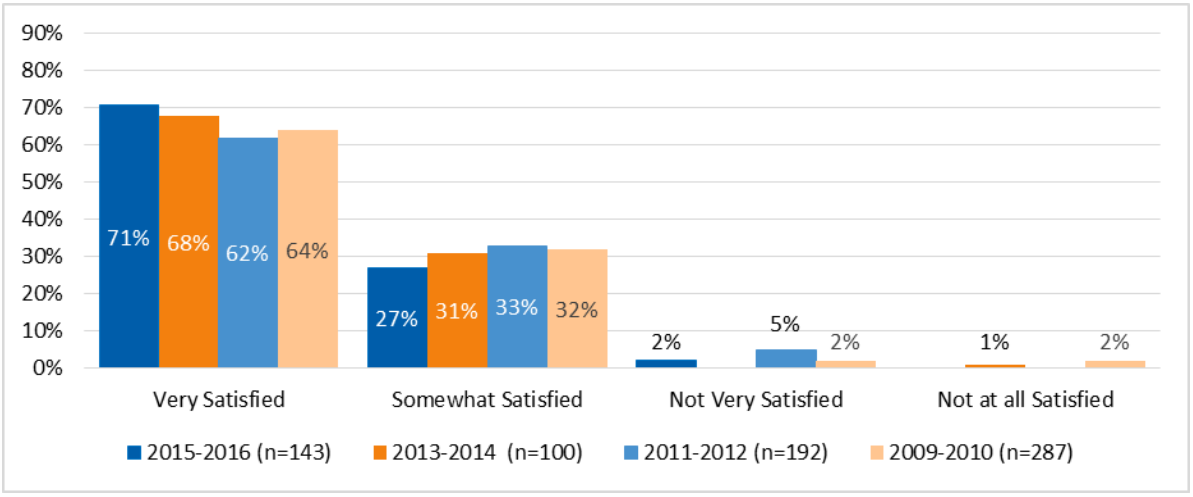
The great majority of non-lighting customers expressed satisfaction with the HES program experience, with 71% reporting they were very satisfied and 27% reporting they were somewhat satisfied. Only 2% of respondents were not satisfied. These latter respondents offered the following comments:

- "The dealer was telling me I was going save so much energy, and that was not true."
- "Because Rocky Mountain didn't offer that much of a rebate."

Satisfaction levels have increased over time, with the percentage of very satisfied respondents in 2015–2016 (71%) significantly higher than the percentage of very satisfied respondents in 2011–2012, as shown in Figure 17.[42]

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

Figure 17. Non-Lighting Satisfaction with the *watt*smart HES Program



Source: Rocky Mountain Power Utah HES Residential Non-lighting Survey (QF9, 2011–2012, QE10, 2013–2014 and 2015–2016). Don't know and refused responses removed.

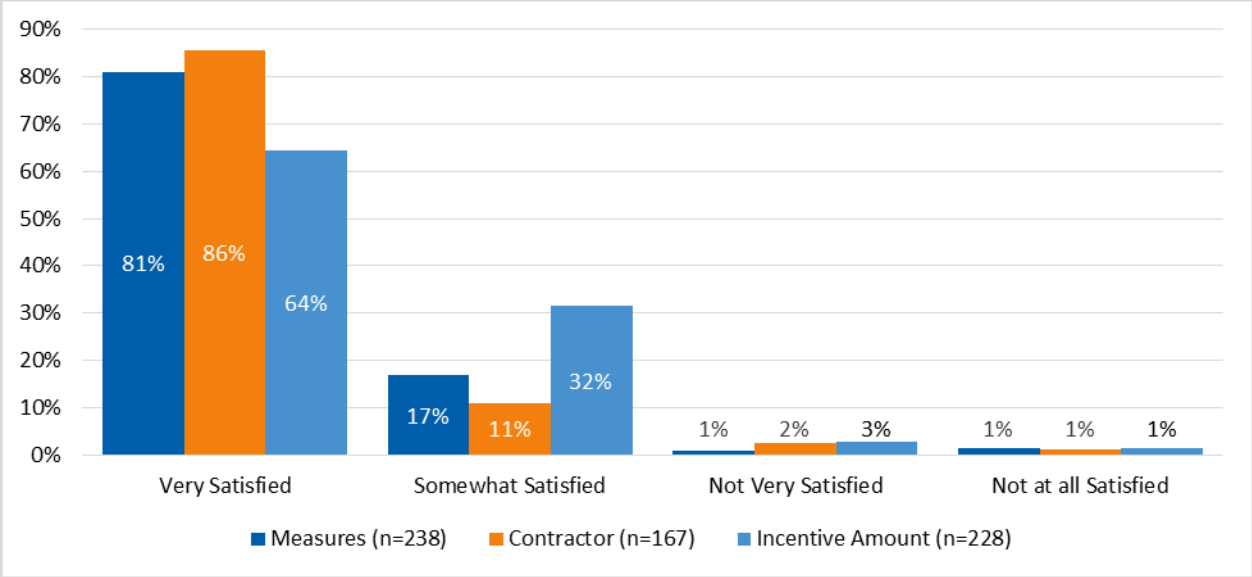
When asked whether their HES program participation changed their satisfaction levels with Rocky Mountain Power, 44% (n=240) of non-lighting customers said it increased their satisfaction, 52% said it stayed the same, and 4% said it decreased.

In addition to their overall satisfaction levels with the HES program, non-lighting customers expressed high satisfaction levels with the measures they installed, the contractor installing the measure (used by 71%), and the incentive amounts they received. Customers, however, were significantly more likely to be very satisfied with the measure or installer than with the incentive amount, as shown in

Figure 18.[43] Eighty-one percent and 86% of non-lighting customers said they were very satisfied with measures installed or the installer, respectively, compared to 64% of respondents that were very satisfied with the incentive amount.

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

Figure 18. Non-Lighting Satisfaction with Measures, Contractors, Incentive Amounts



Source: Rocky Mountain Power Utah HES Residential Non-lighting Survey (QE1, E3, E6 2015–2016). Don't know and refused responses removed.

Non-lighting customers also found the HES program incentive application easy to fill out, with 69% (n=241) of respondents reporting it very easy to fill out, 25% reporting it somewhat easy, 4% reporting it not very easy, and 2% reporting it not at all easy—satisfaction levels roughly equivalent to the 2013–2014 survey. Participants experiencing difficulty with filling out the application (including some reporting they were somewhat satisfied with their experience overall) reported the following challenges:

- The application requirements were not clear.
- The application required too much information.
- They had to submit the application several times.
- They ultimately had to submit different information than that indicated on the website or the application form to get the application processed.
- They never received the incentive or received less than the amount they expected.

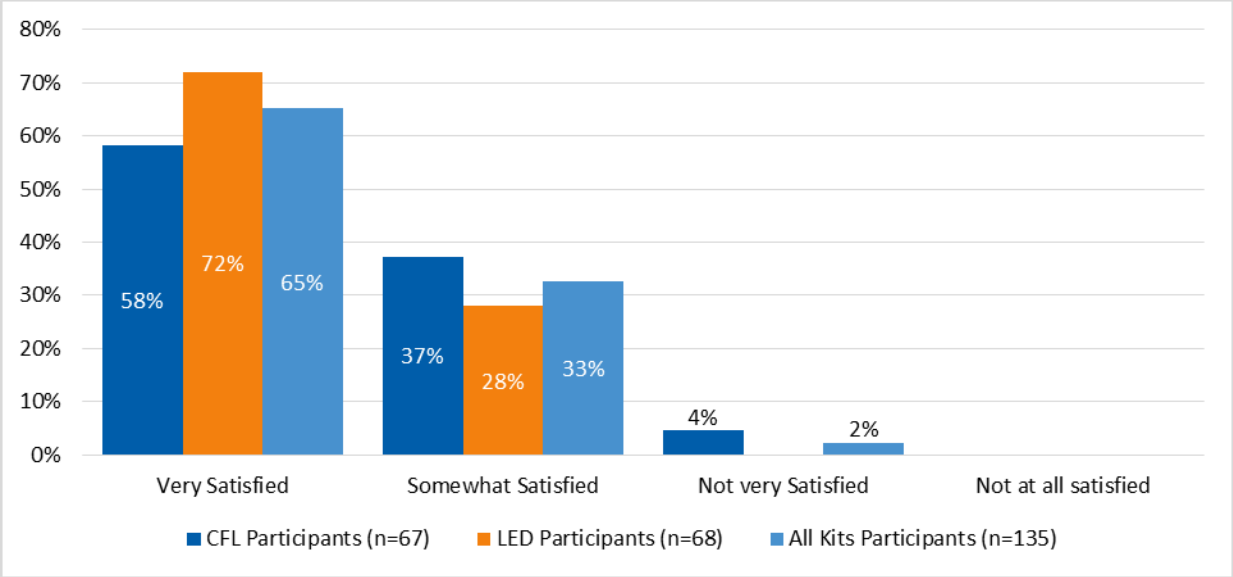
The majority of participants, 82% (n=193) were satisfied with the time required to receive their incentive after submitting their application.

wattsmart Starter Kits

Program Satisfaction

The great majority of CFL kit and LED kit participants expressed satisfaction with their kit experience: 98% reporting they were very or somewhat satisfied. LED participants, however, were more likely than CFL participants to be very satisfied, with 72% of LED participants reporting they were very satisfied compared to 58% of CFL participants.

Figure 19. CFL and LED Starter Kit Participants Overall Satisfaction



Source: Rocky Mountain Power Utah HES Starter Kits Survey, QE10 (n=129). Don't know and Refused responses removed.

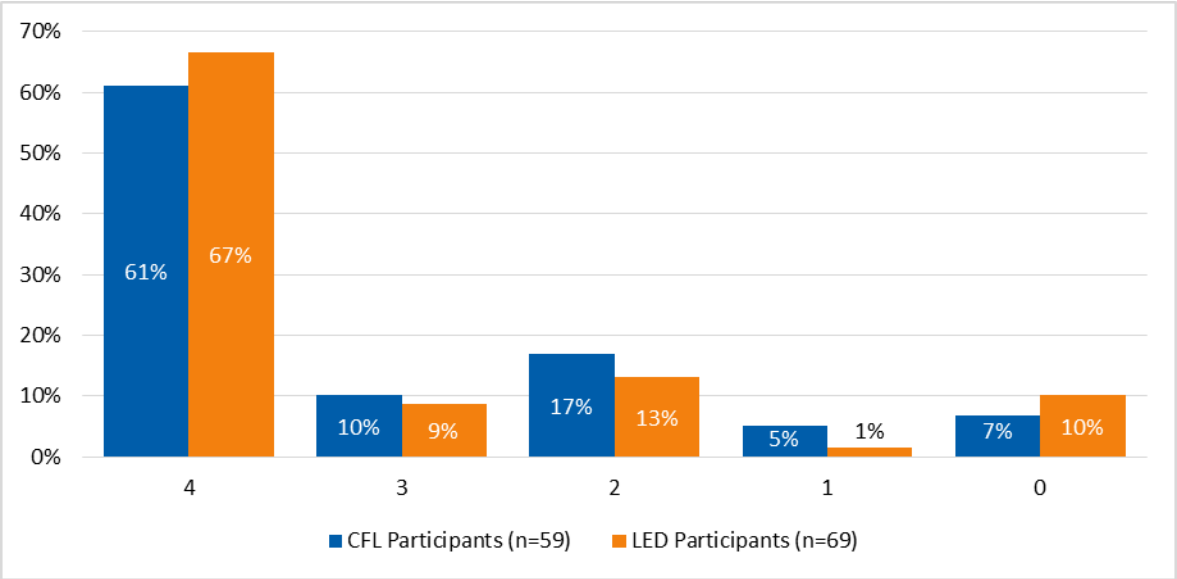
Customers found the kit applications easy to fill out, with 81% (n=129) of respondents reporting the process very easy and 19% reporting it somewhat easy. Fifty-nine percent (n=106) of respondents received their kits within four weeks of submitting the application, while the remaining 41% received it within four to eight weeks.

Satisfaction with Kit Measures

Kit recipients also reported high satisfaction levels with kit components. As Rocky Mountain Power offered eight kit variations, including either CFLs or LEDs and water measures (depending on whether the customer used electric water heating), survey respondents only answered questions pertaining to their specific kit's contents.

Figure 20 shows the percentage of CFL and LED kits participants installing 4, 3, 2, 1, or none of the four bulbs they received in their kit. Most kit participants (61% of CFL participants, and 67% of LED participants) installed all bulbs received. Only 12% of CFL participants and 11% of LED participants installed fewer than two of the kits bulbs. Little difference emerged in the number of bulbs installed between CFL and LED bulb recipients.

Figure 20. Participants Installing Kits Bulbs by Number of Bulbs Installed

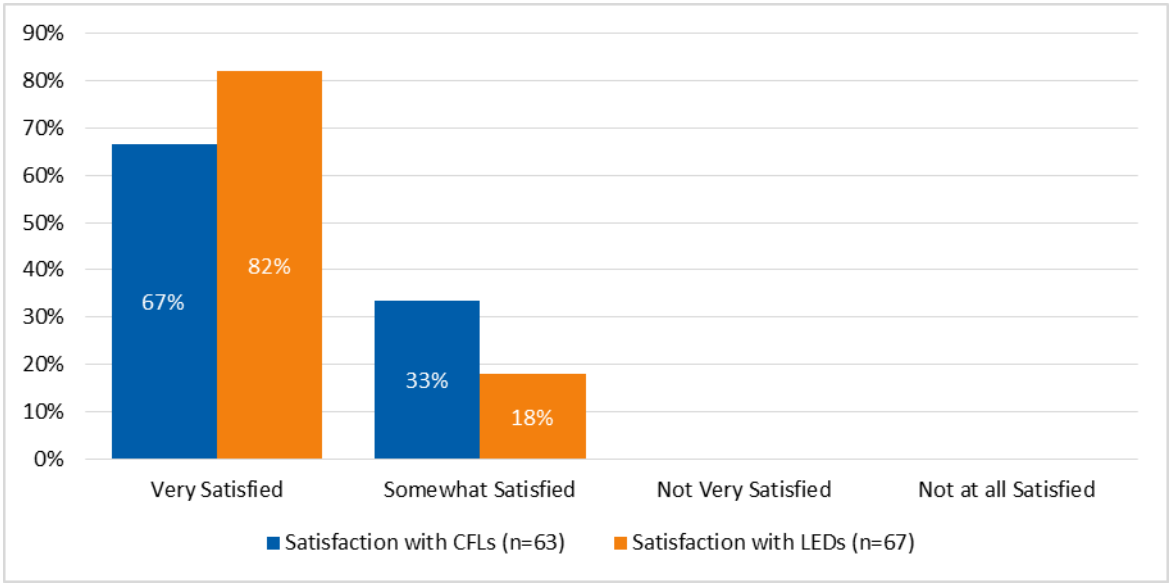


Source: Rocky Mountain Power Utah HES Starter Kits Survey, QB1 and QB15.
Don't know and refused responses removed.

All respondents were very or somewhat satisfied with lighting measures in the kits, as shown in Figure 21. LED kit participants, however, were significantly more likely to be very satisfied, with 82% of LED recipients reporting they were very satisfied compared to 67% of CFL recipients.[44] CFL recipients and LED recipients were similarly satisfied with the number of bulbs received, with 72% (n=137) of respondents indicating they were very satisfied overall.

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

Figure 21. Satisfaction with *watt*smart Starter Kit CFLs and LEDs

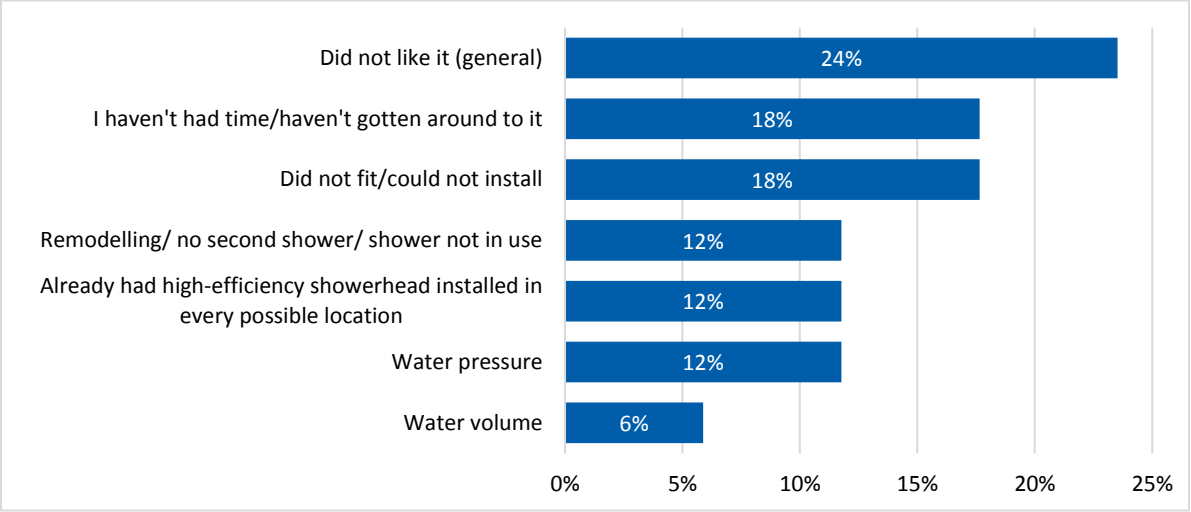


Source: Rocky Mountain Power Utah HES Residential Kit Survey (QB6 and B21, 2015–2016).
Don't know and refused responses removed.

Kits contained zero, one, or two showerheads; zero, one or two bathroom faucet aerators; and zero or one kitchen faucet aerator. Of 139 kit participants surveyed, 19% reported receiving at least one showerhead, 18% received at least one bathroom aerator, and 18% received a kitchen faucet aerator.

Customers reported lower installation rates for showerheads than for CFLs or LEDs, with 36% (n=25) of showerhead recipients installing all showerheads provided, and another 40% installing one of the two showerheads they received. Respondents most commonly reported not installing all showerheads provided as they did not like the high-efficiency showerhead without specifying why (24%). Other common reasons included they had yet to do so or the unit did not fit. Figure 22 shows all responses.

Figure 22. Reasons for Not Installing High-Efficiency Showerheads

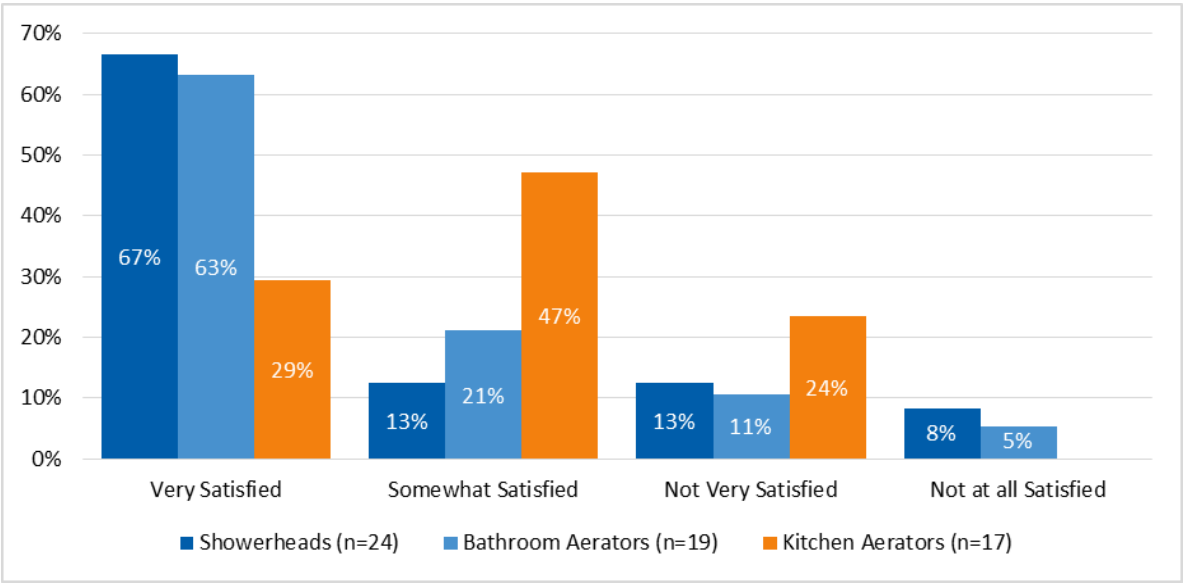


Source: Rocky Mountain Power Utah Residential Kit Survey (QC2 2015–2016, n=17). Don't know removed. Multiple responses allowed.

Customers also reported lower installation rates for kitchen and bathroom faucet aerators, with bathroom aerator recipients equally likely to install all aerators received (40%, n=20) as to install none of them. The remaining 20% installed one of two aerators received. Respondents not installing all bathroom aerators received as they had yet to do so (4 of 12), or the aerators did not fit (3 of 12). Only 6 of 23 respondents reported installing the kitchen faucet aerator. Those not installing the aerators most commonly report it did not fit (6 of 15 respondents).

Despite the lower installation rates for water measures than for lighting measures, customers expressed similar satisfaction levels for showerheads and bathroom aerators: 67% and 63% of respondents, respectively, were very satisfied with their showerheads or bathroom aerators. Only 29% (n=17) of respondents were very satisfied with the kitchen aerator, while 47% were somewhat satisfied. Figure 23 shows satisfaction levels with each water measure.

Figure 23. Water Measure Satisfaction



Source: Rocky Mountain Power Utah HES Residential Kit Survey (QC4, QD4, QD12 2015–2016).

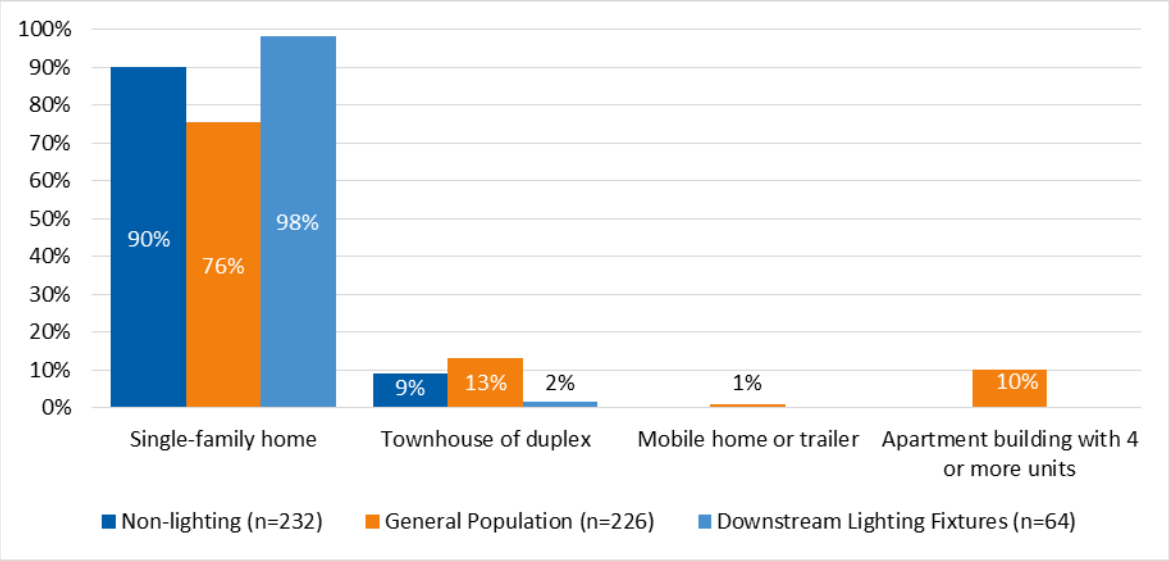
Customer Demographics

Housing Characteristics

As shown in Figure 24, most participants lived in single-family homes, with a small percentage of customers residing in townhomes, apartments, or mobile homes. Downstream lighting fixtures and non-lighting participants were more likely than the general population to live in a single-family home.[45]

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

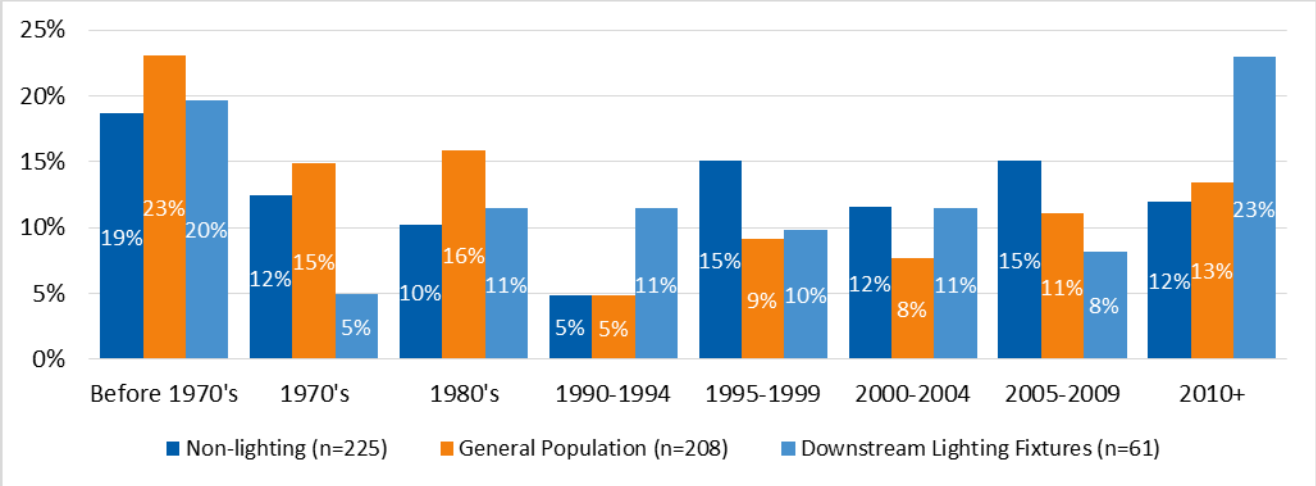
Figure 24. General Population and Non-Lighting Residence Types



Source: Rocky Mountain Power Utah HES Residential General Population (QG1) Non-lighting (QH1) and Downstream Lighting Fixtures Surveys (QG6). Don't know and refused responses removed.

Ninety-five percent (n=230) of non-lighting participants and 100% (n=64) of downstream lighting fixture participants owned their own homes, compared to 77% (n=230) of general population participants. Non-lighting and downstream lighting fixture participants tended to have newer homes: 59% of non-lighting participants and 64% of downstream lighting fixtures participants lived in homes built in the 1990s or later, compared to 46% of the general population, as shown in Figure 25.

Figure 25. General Population, Non-Lighting and Downstream Fixtures Home Age



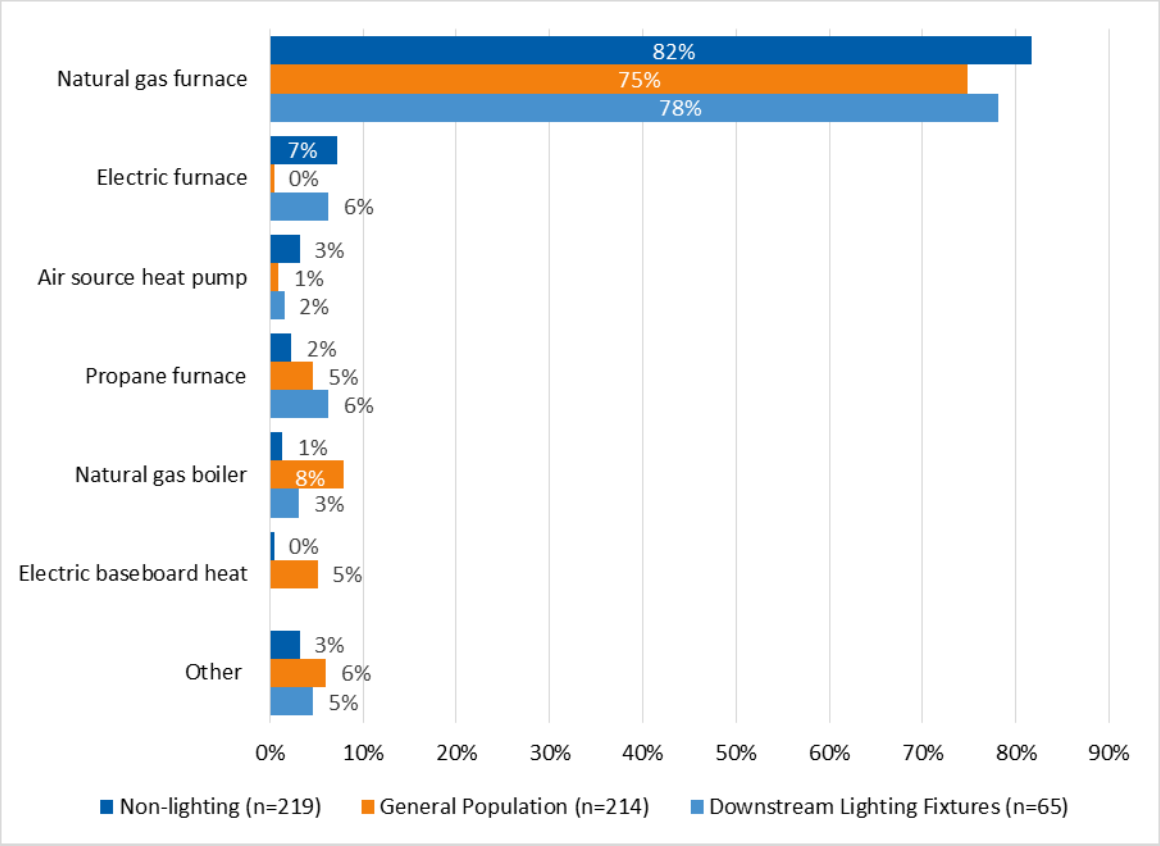
Source: Rocky Mountain Power Utah HES Residential Non-lighting (QH4), General Population (G3) and Downstream Lighting Fixtures Surveys (G9). Don't know and refused responses removed.
Totals may not sum due to rounding.

Non-lighting and ***watt***smart Starter kit participants reported a similar distribution of home sizes, with 54% (n=216) and 52% (n=116), respectively, living in homes over 2,000 square feet. Downstream lighting fixtures participants were more likely to live in larger homes, with 79% (n=58) living in a home larger than 2,000 square feet, and 67% living in a home larger than 2,500 square feet.

Fuel and Equipment Characteristics

All respondents reported primarily using forced air natural gas furnaces for space heating, as shown in Figure 26. Other heating sources included electric and propane furnaces, air source heat pumps, and gas boilers. Non-lighting respondents reported heating equipment at an average age of 8.0 years, relative to 10.8 years for general population respondents, and 8.9 years on average for downstream lighting fixture participants.

Figure 26. Space Heating Fuel and Equipment

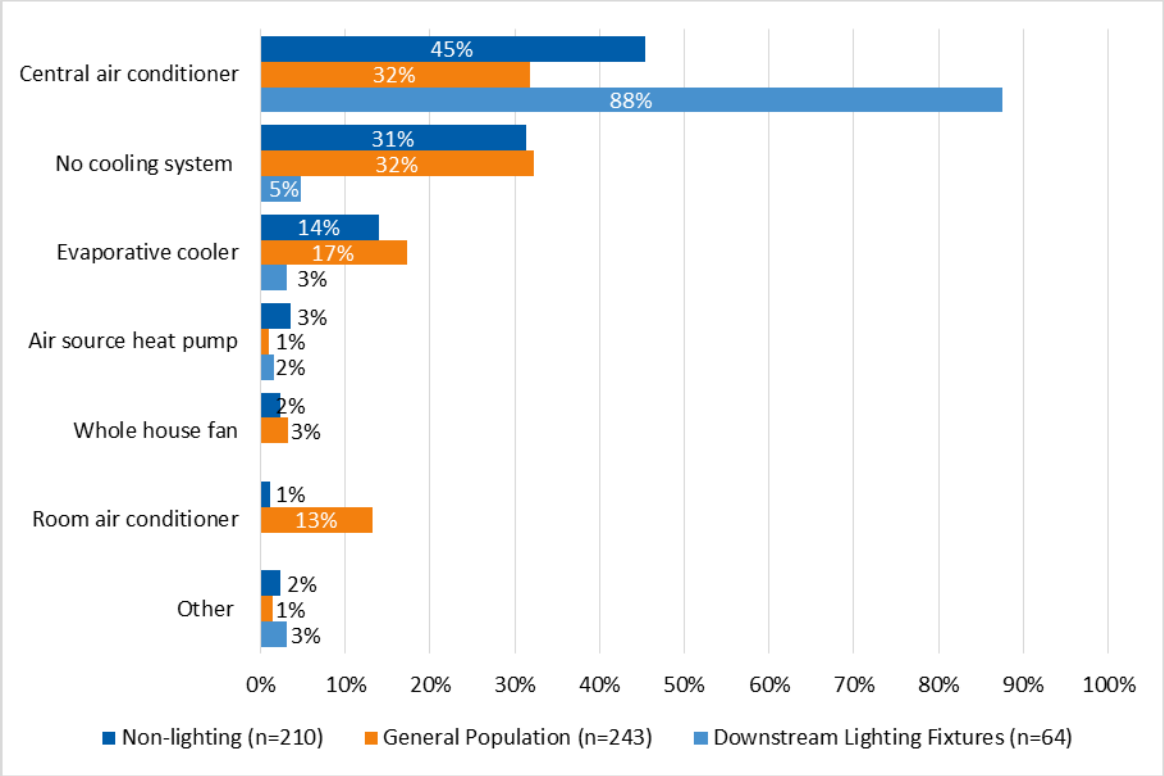


Source: Rocky Mountain Power Utah HES Non-lighting, General Population and Downstream Lighting Fixtures Rebates Surveys (QD10 and QD12 Non-lighting, G3 General Population, QG1 and QG3 Downstream Lighting Fixtures). Don't know and refused responses removed.

Figure 27 shows common cooling equipment used by non-lighting, general population respondents and downstream lighting fixtures participants. All respondents most commonly used a central air conditioner: 45%, 32%, and 88% of non-lighting, general population, and downstream lighting respondents, respectively. Just under one-third of non-lighting and general population respondents

reported not having a cooling system (31% and 32%, respectively). Downstream lighting fixture participants were more likely than the other two groups to have a central air conditioner and were less likely to have no cooling system.

Figure 27. Cooling Equipment



Source: Rocky Mountain Power Utah HES Non-lighting, General Population and Downstream Lighting Fixtures Rebates Surveys (QD13 Non-lighting, QG4 General Population and Downstream Lighting Fixtures). Don't know and refused responses removed.

The majority of non-lighting, general population, and starter kits respondents reported using natural gas for water heating (87%, 82%, and 77%, respectively), followed by electricity (12%, 16%, and 20%, respectively).

Benchmarking

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

Though the main report presents findings at a high level, Appendix H provides additional detail on programs, channels, and measures.

Definitions

As Rocky Mountain Power specifically expressed interest in delivery channels used to implement residential programs, Cadmus developed definitions of descriptive terms used consistently in this report to characterize program delivery. Summarizes of these definitions follow:

- **Upstream Programs**: Implemented as agreements between the program and the product's manufacturer. Through these agreements, specific products (lighting for 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 (e.g., use in a residence, use within a service territory). Consequently, product use outside of 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 a 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, and intermediaries may receive a separate SPIF or bonus for their program role. Unlike upstream programs, however, midstream programs sometimes enforce program requirements (e.g., use of the measure in a residence, use of the measure in the service territory) to reduce the potential for leakage or cross-sector participation. Midstream program examples 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:** Offered 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.

Midstream programs offer an advantage over downstream programs in enabling program administrators to wield greater influence on products stocked by distributors, retailers, and contractors. 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).

Further, for new home programs, homebuilders serve as the primary participant. As the builder retains the incentive payment (i.e., no adjustment required to the home's price), these meet Cadmus' definitions for downstream programs.

Upstream: Lighting

As shown in Table 71, Cadmus reviewed residential lighting programs offered by four other utilities, comparing these to Rocky Mountain Power's program.

Table 71. Summary of Upstream Lighting Programs

Utility/PA, State	Administrator	Measures	Program Year	Participation Measures	Net MWh[1]	kWh/ Measure[2]
Rocky Mountain Power, UT	CLEAResult	CFLs, LEDs, Fixtures	2015–2016	4,277,357	57,555	13
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	20
Salt River Project, 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	39,278	28

[1] Net MWh—values determined by evaluators—derived from final evaluation reports.

[2] Differences in net kWh per measure between HES and other benchmarked programs result from variances in engineering algorithm inputs (e.g., ISR, HOU, WHF, NTG) in each evaluation. See appendix H for more detail.

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 72 summarizes these programs' key aspects.

Table 72. 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 application approval.
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 the primary channel for HPWHs, and pool pumps are 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.

Utility/PA, State	Year	Measures	Delivery Notes
Energy Trust, OR	2015	Smart T-stats, Energy Reports, Kits, Heat Pumps, Pool pumps, HPWHs Insulation, Air/Duct Sealing	**Downstream/Midstream Mix:** Recent efforts to increase midstream engagement (distributor SPIFs, 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 73.

Note: Effective December 1, 2016, Rocky Mountain Power does not operate a dedicated new construction program in this service territory. Instead, Rocky Mountain Power integrated its New Homes program into the HES program in Utah, renaming Home Energy Savings as ***watts***mart Homes, and addressing the new construction market through its downstream incentives, including a whole-home, performance-based incentive.

Table 73. Summary of New Construction Programs

Utility/PA, State	Admin.	Measure(s)	Program Year	Homes	Gross MWh[1]	kWh/ Home[1]	Notes
SRP, AZ	SRP	ES V3	FY17	6,613	32,079	4,851	ENERGY STAR Homes have over a 70% market share in the 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[2]	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%

Utility/PA, State	Admin.	Measure(s)	Program Year	Homes	Gross MWh[1]	kWh/ Home[1]	Notes
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 2015; the program attained its electric and gas savings goals for both 2014 and 2015.

[1]Gross MWh—values determined by evaluators—derived from final evaluation reports and were used to calculate kWh/home.

[2]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. No verified net savings were attributed to this program in PY 2016.

ENERGY STAR certification alone did not ensure savings. A recent evaluation of an ENERGY STAR homes program offered by Wisconsin's Focus on Energy did not achieve electric savings and achieved only small gas savings. Consequently, Focus on Energy is redesigning that program to incent construction to energy neutral, with varying levels of percent better than code. This approach is expected to deliver greater savings while pushing the residential construction market towards more efficient building strategies.

Generally, program participation depends on factors more likely to occur in urban areas (e.g., the presence of high-volume "production" builders, access to an efficiency raters pool, available inventories of efficient equipment, and subcontractors—such as HVAC technicians, insulation specialists, electricians, and plumbers—skilled in efficient home construction).

Cost-Effectiveness

In assessing HES program cost-effectiveness, Cadmus analyzed program costs and benefits from five different perspectives, using Cadmus' DSM Portfolio Pro[46] model. The California Standard Practice Manual for assessing DSM program cost-effectiveness describes the benefit/cost ratios Cadmus used for the following five tests:

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

Table 74 summarizes the five tests' components.

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

Table 74. 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 75 provides selected cost analysis inputs for each year, including evaluated energy savings, discount rated, line loss, inflation rated, and total program costs.

Table 75. Selected Cost Analysis Inputs

Input Description	2015	2016	Total
Evaluated Gross Energy Savings (kWh/year)*	71,681,913	35,819,864	107,501,778
Discount Rate	6.66%	6.66%	N/A
Line Loss	9.32%	9.32%	N/A
Inflation Rate**	1.9%	1.9%	N/A
Total Program Costs	$17,873,946	$11,680,011	$29,517,956

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

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

HES program benefits included energy savings and their associated avoided costs. For the cost-effectiveness analysis, Cadmus used this study's evaluated energy savings and measure lives from sources such as the RTF.[47] For all analyses, Cadmus used avoided costs associated with Rocky Mountain Power's 2015 *IRP Eastside Decrement Values*.[48]

Cadmus analyzed HES program cost-effectiveness for net savings with evaluated freeridership and spillover incorporated.

Table 76 presents the 2015–2016 program cost-effectiveness analysis results, including the evaluated NTG (but not accounting for non-energy impacts). For this scenario, the HES program proved cost-

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

[48] 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

effective from all perspectives, except the RIM test. The primary criterion for assessing cost-effectiveness in Utah is the UCT, which achieved a 2.48 benefit/cost ratio for the combined years' net savings.

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

Table 76. HES Program Cost-Effectiveness Summary for 2015–2016 (Evaluated Net)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.076	$56,445,173	$78,602,218	$22,157,045	1.39
TRC No Adder	$0.076	$56,445,173	$71,456,562	$15,011,389	1.27
UCT	$0.039	$28,788,640	$71,456,562	$42,667,922	2.48
RIM		$112,441,593	$71,456,562	($40,985,032)	0.64
PCT		$53,916,662	$122,552,900	$68,636,238	2.27
Lifecycle Revenue Impacts ($/kWh)					$0.000813342
Discounted Participant Payback (years)					3.76

Table 77 presents the 2015 program cost-effectiveness analysis results, including the evaluated NTG, but not accounting for non-energy impacts. For this scenario, the HES program proved cost-effective from all perspectives except for RIM.

Table 77. HES Program Cost-Effectiveness Summary for 2015 (Evaluated Net)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.074	$36,116,855	$46,205,966	$10,089,110	1.28
TRC No Adder	$0.074	$36,116,855	$42,005,423	$5,888,568	1.16
UCT	$0.037	$17,837,946	$42,005,423	$24,167,477	2.35
RIM		$72,390,890	$42,005,423	($30,385,466)	0.58
PCT		$36,030,337	$80,179,746	$44,149,409	2.23
Lifecycle Revenue Impacts ($/kWh)					$0.000073197
Discounted Participant Payback (years)					3.20

Table 78 presents the 2016 program cost-effectiveness analysis results, including evaluated NTG, but not accounting for non-energy impacts. For this scenario, again, the HES program proved cost-effective from all perspectives except the RIM test.

Table 78. HES Program Cost-Effectiveness Summary for 2016 (Evaluated Net)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.080	$21,682,183	$34,553,842	$12,871,659	1.59
TRC No Adder	$0.080	$21,682,183	$31,412,584	$9,730,401	1.45
UCT	$0.043	$11,680,010	$31,412,584	$19,732,574	2.69
RIM		$42,718,081	$31,412,584	($11,305,497)	0.74
PCT		$19,077,555	$45,195,206	$26,117,652	2.37
Lifecycle Revenue Impacts ($/kWh)					$0.000225670
Discounted Participant Payback (years)					3.94

Conclusions and Recommendations

Based on findings previously presented, 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, Rocky Mountain Power filled in available data using its own customer database. While a small detail in terms of operating the program efficiently, this created additional strain on evaluation efforts and on Rocky Mountain Power to update program administrator data with kit participant phone numbers.

  Recommendation: Require that ***watt***smart kit program administrators collect kit participant phone numbers and e-mail addresses for kit program survey data collection activities. *[As of October 2017, the program administrator reported that customer e-mail addresses and phone numbers have become mandatory online field entries for customers applying for kits.]*

- **Upstream Lighting Point-of-Sale Merchandizing Data:** Program tracking data did not include complete information about high-visibility product placements or merchandising within retail locations (only the last quarter of the evaluation period and only two retailers). Though decreasing the price of efficient lighting products primarily drives sales, merchandising can generate substantial sales lift. Without complete data, Cadmus could not attribute merchandising's effect on the program.

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

- **Non-Lighting Application Processing**: Participant-reported application processing times showed declining performance over participant-reported processing times in 2013–2014. Although the program administrator moved most non-lighting measures applications online, streamlining the process in 2015–2016, and 69% of participants found the application very easy to complete, a small percentage of customers cited confusing program requirements and the need to submit applications more than one time. In addition, approximately 40% of non-lighting incentive applications shown in the non-lighting participant database took longer to process and pay than the program's goal of 45 days.

  Of the seven measures most frequently requiring more than 45 days for application processing and payment—windows, efficient clothes washers, central air conditioner best practice installation and proper sizing, and duct sealing and insulation—were retired from the program effective January 1, 2017. Two others—efficient gas furnaces with ECM, and evaporative coolers—were moved from downstream incentives to midstream and/or upstream (thus providing instant discounts) in 2017, leaving only attic insulation incentivized through a downstream mechanism that requires the customer or contractor to submit an application. Customers may apply online or through the mail.

Recommendation: Review 2017 non-lighting application processing times to determine if the overall trend in application processing times improve. Continue training for HVAC and building shell contractors to help mitigate issues with the attic insulation applications by reviewing the criteria required for a complete application and the way to best support customers who chose to fill out the application.

Appendices

A separate volume contains the following appendices:

Appendix A. Survey and Data Collection Forms

Appendix B. Lighting Impacts

Appendix C. Billing Analysis

Appendix D. Self-Report NTG Methodology

Appendix E. Nonparticipant Spillover

Appendix F. Measure Category Cost-Effectiveness

Appendix G. Logic Model

Appendix H. Benchmarking

CADMUS

Appendix A. Survey Instruments and Data Collection Tools

This page left blank.

CADMUS

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!

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.

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				
h) ENEGY STAR Room Air Conditioner				
i) ENERGY STAR Clothes Washer				
j) ENERGY STAR Dishwasher				
k) ENERGY STAR Freezer				
l) ENERGY STAR Refrigerator				

Measure Name	1=Yes	2=No	98=Don't know	99= Refused
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 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 1970s
2. 1970s
3. 1980s
4. 1990-1994
5. 1995-1999
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 **Error! Reference source not found.**
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 **Error! Reference source not found.**
Net-to-Gross	Self-reported freeridership and spillover batteries	Section **Error! Reference source not found.** and **Error! Reference source not found.**
Demographics	Customer household information for statistical purposes	Section **Error! Reference source not found.**

- 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

wattsmart Home Energy Savings program. We're talking with customers about their experiences with the incentive program. Are you the best person to talk with about this?

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

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

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

1. Yes
2. No **[REQUEST TO SPEAK TO THE PRIMARY DECISION MAKER, IF AVAILABLE START OVER, IF NOT, SCHEDULE TIME TO CALL BACK]**

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

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

1. Yes **[THANK AND TERMINATE]**
2. No **[CONTINUE]**

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

B. Measure Verification

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

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

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

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

1. Yes ***[SKIP TO B4]***
2. No, quantity is incorrect **[CONTINUE TO B2]**
3. No, measure is incorrect ***[SKIP TO B3]***
4. No, both quantity and measure are incorrect ***[SKIP TO B3]***

98. Don't Know ***[SKIP TO B3]***
99. Refused **[TERMINATE]**

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

1. **[RECORD]** ***[SKIP TO B4]***

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

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

1. **[RECORD VERBATIM] [IF RESPONSE = SAME MEASURE, GO BACK TO B1]**

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

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

1. Yes ***[SKIP TO 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*** *ERROR! REFERENCE SOURCE NOT FOUND.**]*** 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*** *ERROR! REFERENCE SOURCE NOT FOUND.* ***= 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** ERROR! REFERENCE SOURCE NOT FOUND.**= 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*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
2. LESS THAN 25%
3. 25-50%
4. 50-75%
5. 75- 99%
6. Always or 100%
98. Don't know ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
99. Refused ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***

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 ERROR! REFERENCE SOURCE NOT FOUND. 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*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
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** ERROR! REFERENCE SOURCE NOT FOUND. **= 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*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***

98. Don't Know ***[SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*
99. Refused ***[SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*

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** ERROR! REFERENCE SOURCE NOT FOUND.]*
98. Don't Know ***[SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*
99. Refused ***[SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*

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** ERROR! REFERENCE SOURCE NOT FOUND.]*
2. No
98. Don't Know
99. Refused

***[IF F3= 1 SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*

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** ERROR! REFERENCE SOURCE NOT FOUND. **= 1 THEN SKIP TO F6]

F5. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND. **= 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** ERROR! REFERENCE SOURCE NOT FOUND.]*
98. Don't Know ***[SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*
99. Refused ***[SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*

***[IF F5 = 2 SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.**. IF F5 = -98 OR -99 SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.]*

F6. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND.**= 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** ERROR! REFERENCE SOURCE NOT FOUND.**= 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** ERROR! REFERENCE SOURCE NOT FOUND.**= 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** ERROR! REFERENCE SOURCE NOT FOUND.**]

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** ERROR! REFERENCE SOURCE NOT FOUND. **= 1 SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.**]

F10. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND. **= 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** ERROR! REFERENCE SOURCE NOT FOUND.**= 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** ERROR! REFERENCE SOURCE NOT FOUND. **= 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.

CADMUS

PacifiCorp Home Energy Savings Downstream Lighting Participant Survey

Audience: This survey is designed for PacifiCorp residential customers in Utah and Wyoming that received a rebate for the purchase of one or more lighting fixtures in 2015 and 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.

Note that a light fixture is not the same as a light bulb. Light fixture refers to the body and the light socket that hold the lamp/light bulb (s) and allow for its/their replacement. The fixtures rebated through the program are designed to work specifically with energy efficient CFLs or LED light bulbs. Aside from the program-incented downlights or ceiling cans, which were sold without the bulb, the other incented fixtures came with integrated energy efficient bulbs. Some participants purchased both LED and CFL light fixtures but we are asking about only one kind or the other in this survey.

Quota: Aim for the survey quota listed below for UT and WY

	Lighting
	Sample (survey quota)
UT	1080 (70)
WY	160 (as many as possible)

Topics	Researchable Questions	Survey Questions
Measure Verification	Did program measure(s) get installed in the household? What was replaced when the new measure was installed?	Section B
Program Awareness and Purchase Decisions	How did the customer learn about the program? Has the customer been to the wattsmart website (feedback)? Why did the customer purchase the program measure?	Section **Error! Reference source not found.**
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 **Error! Reference source not found.**
Net-to-Gross	Self-reported freeridership and spillover batteries	Section **Error! Reference source not found.** and **Error! Reference source not found.**
Demographics	Customer household information for statistical purposes	Section **Error! Reference source not found.**

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

[UTILITY]
Utah, Wyoming: Rocky Mountain Power

[MEASURE]

[YEAR OF PARTICIPATION]

[MEASURE QUANTITY]

Measure Name	Measure Type
LED Light Fixture	**LIGHT FIXTURE**
CFL Light Fixture	**LIGHT FIXTURE**

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 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 YOUR EXPERIENCES WITH THE [INSERT MEASURE NAME] INCENTIVE 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 NAME] INCENTIVE 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 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 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.)

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](S)*** through the wattsmart Home Energy Savings program. We're talking with customers about their experiences with the incentive program. Are you the best person to talk with about this?

A2. **[IF NEEDED: LIGHT FIXTURE REFERS TO THE BODY AND THE LIGHT SOCKET THAT HOLD THE LIGHT BULB AND ALLOW FOR ITS REPLACEMENT. THE FIXTURES REBATED THROUGH THE WATTSMART HOME ENERGY SAVINGS PROGRAM WERE DESIGNED TO WORK SPECIFICALLY WITH ENERGY EFFICIENT CFLS OR LED LIGHT BULBS.]**

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 NAME](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.

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 NAME](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 [INSERT MEASURE NAME] PURCHASED DURING THE YEAR MENTIONED."]

[IF NEEDED SAY: "THE LIGHT FIXTURE INCENTIVE WAS FOR DOWNLIGHTS OR CEILING CAN LIGHTS, CANDELABRA, GLOBE, OR OMNIDIRECTIONAL LIGHT FIXTURES THAT WERE SPECIFICALLY DESIGNED TO WORK WITH ENERGY EFFICIENT CFLS OR LED BULBS."]

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 B4]***
5. No, year is incorrect ***[SKIP TO B5]***

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

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

1. **[RECORD 0-200]** ***[IF QUANTITY IS ZERO THANK AND TERMINATE OTHERWISE, SET MEASURE QUANTITY AS B2.1 SKIP TO B7]***

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

B3. ***[ASK IF B1 = 3]*** Please tell me for what type of equipment you applied for an incentive in ***[YEAR OF PARTICIPATION]***?

1. CFL Light Fixture ***[SET [NEW MEASURE NAME] AS 'CFL LIGHT FIXTURE' AND SKIP TO B6 AND INSERT [NEW MEASURE NAME], USE [NEW MEASURE NAME] FOR THE REMAINDER OF THE SURVEY]***
2. LED Light Fixture ***[SET [NEW MEASURE NAME] AS 'LED LIGHT FIXTURE' AND SKIP TO B6 AND INSERT [NEW MEASURE NAME], USE [NEW MEASURE NAME] FOR THE REMAINDER OF THE SURVEY]***
3. Other **[THANK AND TERMINATE]**
4. Don't Know **[THANK AND TERMINATE]**

99. Refused **[THANK AND TERMINATE]**

B4. ***[ASK IF B1 = 4]*** Please tell me for what type of equipment you applied for an incentive:

1. CFL Light Fixture ***[SET [NEW MEASURE NAME] AS 'CFL LIGHT FIXTURE' AND ASK B4A]***
   B4a. For how many ***[NEW MEASURE NAME]*** did you apply for an incentive?

   [RECORD 0 - 200] ***[SET AS [NEW MEASURE QUANTITY] IF MEASURE QUANTITY = 0 THANK AND TERMINATE OTHERWISE SKIP TO B6 AND INSERT [NEW MEASURE NAME] AND [NEW MEASURE QUANTITY], USE FOR THE REMAINDER OF THE SURVEY]***

   Don't Know **[THANK AND TERMINATE]**

2. LED Light Fixture ***[SET [NEW MEASURE NAME] AS 'LED LIGHT FIXTURE' AND ASK B4B]***
   B4b. For how many ***[NEW MEASURE NAME]*** did you apply for an incentive?

   [RECORD 0 - 200] ***[SET AS [NEW MEASURE QUANTITY] IF MEASURE QUANTITY =0 THANK AND TERMINATE OTHERWISE SKIP TO B6 AND INSERT [NEW MEASURE NAME] AND [NEW MEASURE QUANTITY] , USE FOR THE REMAINDER OF SURVEY]***
   Don't Know **[THANK AND TERMINATE]**

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

B5. ***[ASK IF B1= 5]*** What year did you apply for the incentive?

1. 2015 ***[SET [NEW YEAR OF PARTICIPATION] AS '2015' AND ASK B6 AND INSERT [NEW YEAR OF PARTICIPATION], USE FOR THE REMAINDER OF THE SURVEY]***
2. 2016 ***[SET [NEW YEAR OF PARTICIPATION] AS '2016' AND ASK B6 AND INSERT [NEW YEAR OF PARTICIPATION], USE FOR THE REMAINDER OF THE SURVEY]***
3. Other **[THANK AND TERMINATE]**
98. Don't Know **[THANK AND TERMINATE]**
99. Refused **[THANK AND TERMINATE]**

B6. Just to confirm, you applied for an incentive for [MEASURE QUANTITY/NEW MEASURE QUANTITY] {MEASURE NAME/NEW MEASURE NAME] in [YEAR OF PARTICIPATION/NEW YEAR OF PARTICIPATION] is that correct?

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

B7. **DID [IF MEASURE QUANTITY >1 SAY "ALL OF"]** the ***[INSERT MEASURE NAME](S)*** get installed? **[DO NOT READ RESPONSES]**

1. Yes ***[SET MEASURE QUANTITY AS INSTALLED QUANTITY AND SKIP TO B10]***
2. No **[CONTINUE TO B5]**
98. Don't know ***[SKIP TO B10]***
99. Refused ***[SKIP TO B10]***

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

B8. **HOW MANY** ***[INSERT MEASURE NAME](S)*** got installed?

1. **[RECORD 0-200] [SET B8.1 AS INSTALLED QUANTITY AND CONTINUE TO B6]**
98. Don't Know **[CONTINUE TO B6]**
99. Refused **[CONTINUE TO B6]**

B9. ***[ASK IF B4 = 2]*** Why haven't you installed **[IF MEASURE QUANTITY >1 SAY "ALL OF"]** the ***[INSERT MEASURE NAME](S) [MULTIPLE RESPONSE UP TO 3; DO NOT READ]***

1. Failed or broken unit
2. Because did not like it
3. Have not had time to install it yet
4. In-storage
5. Back up equipment to install when other equipment fails
6. Have not hired a contractor to install it yet
7. Purchased more than was needed
8. Other **[RECORD]**
98. Don't Know
99. Refused

B10. ***[ASK IF B4=1 OR B8.1>0]*** Was/were **[IF INSTALLED MEASURE QUANTITY >1 SAY "ALL OF"]** the ***[INSERT MEASURE NAME](S), INSTALLED IN THE HOME THAT YOU RESIDE IN?***

1. ***YES***
2. ***NO*** **[PROBE: "WHERE WERE THEY INSTALLED?" RECORD RESPONSE VERBATIM]**
98. Don't know
99. Refused

B11. Were any of the ***[INSERT MEASURE NAME]*** that you received an incentive for, recessed ceiling can light fixtures? **[IF NEEDED: A RECESSED CEILING CAN LIGHT FIXTURE REPLACES THE ENTIRE CAN, NOT JUST THE BULB THAT WAS PREVIOUSLY INSTALLED IN THE CAN.]**

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

B12. Were any of the ***[INSERT MEASURE NAME](S)*** that you received an incentive for, intended to replace **[AN]** old light fixture(s)?

1. Yes **[CONTINUE TO B13]**
2. No ***[SKIP TO E5]***
98. Don't Know ***[SKIP TO E5]***
99. Refused ***[SKIP TO E5]***

B13. ***[ASK IF B11=1]*** What kind of light bulb(s) did your new recessed ceiling 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 floodlight bulbs **[IF NEEDED: THIS IS A BULB THAT POINTS LIGHT IN ONE DIRECTION]**
3. Both standard shaped bulbs and reflector/floodlight bulbs
4. No light bulbs were replaced **[I.E. THERE DID NOT USE TO BE A LIGHT BULB WHERE I INSTALLED THE RECESSED CEILING OR CAN LIGHT FIXTURE)**
5. **[DO NOT READ]** Other **[SPECFICY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

B14. ***[ASK IF B12 = 1]*** What did you do with the old light fixture(s) ***AFTER YOU GOT YOUR NEW [INSERT MEASURE NAME](S)***? **[READ CATEGORIES IF NEEDED]**

1. Still in home they were originally installed in, but permanently removed and stored
2. Sold or gave it/them away
3. Recycled it/them
4. Installed it/them in another location/home
5. Threw it/them away
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

C. Program Awareness & Purchase Decisions

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

1. Bill Inserts
2. Billboard/outdoor ad
3. Family/friends/word-of-mouth
4. Home Energy Reports
5. Home Shows/Trade Shows (Home and Garden Shows)
6. Internet Advertising/Online Ad
7. Newspaper/Magazine/Print Media
8. Northwest Energy Efficiency Alliance (NEEA)
9. Another website
10. Radio
11. Retailer/Store
12. Rocky Mountain Power/Pacific Power Representative
13. Rocky Mountain Power/Pacific Power website
14. Social Media
15. Sporting event
16. TV
17. wattsmart Home Energy Savings website
18. Other **[RECORD VERBATIM]**

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

C2. ***[ASK IF E5 <> 13 0R 17, OTHERWISE SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.**]*** Have you been to the ***[INSERT UTILITY]*** wattsmart Home Energy Savings program website? **[DO NOT READ RESPONSES]**

1. Yes
2. No

C3. ***[ASK IF E5 = 13 OR 17, OR IF*** *ERROR! REFERENCE SOURCE NOT FOUND.* ***= 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** ERROR! REFERENCE SOURCE NOT FOUND.**= 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 light fixture(s). What factors motivated you to purchase the ***[INSERT MEASURE NAME](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 DEALER/RETAILER?" 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. Satisfaction

D1. ***O***verall, how satisfied are you with your ***[INSERT MEASURE NAME](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

D2. ***DID A CONTRACTOR INSTALL THE [INSERT MEASURE NAME](S) FOR YOU?***

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

D3. ***[ASK IF E2=1] HOW SATISFIED WERE YOU WITH THE CONTRACTOR THAT INSTALLED THE [INSERT MEASURE NAME](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

D4. **[IF** ERROR! REFERENCE SOURCE NOT FOUND. **= 3 OR 4]** Why were you not satisfied with the contractor that installed the ***[INSERT MEASURE NAME](S)***?

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

D5. How easy did you find filling out the wattsmart Home Energy Savings Program incentive application? **[READ CATEGORIES; RECORD FIRST RESPONSE ONLY]**

1. Very Easy
2. Somewhat Easy
3. Not Very Easy **[PROBE: WHY DO YOU SAY THAT?]**
4. Not At All Easy **[PROBE: WHY DO YOU SAY THAT?]**
5. Did not fill out an application
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D6. How satisfied were you with the amount of the incentive you received for the ***[INSERT MEASURE NAME](S)*****?**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE: WHY DO YOU SAY THAT?]**
4. Not At All Satisfied **[PROBE: WHY DO YOU SAY THAT?]**
98. Don't Know
99. Refused

D7. ***[ASK IF D5<>5] 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
6. Did not fill out an application
98. **[DO NOT READ]** Don't Know ***[SKIP TO E9]***
99. **[DO NOT READ]** Refused ***[SKIP TO E9]***

D8. ***[ASK IF*** *ERROR! REFERENCE SOURCE NOT FOUND.* ***<> 5 OR D7<> 5]*** Were you satisfied with how long it took to receive the incentive?

1. Yes
2. No **[PROBE: WHY DO YOU SAY THAT?]**
98. Don't Know
99. Refused

D9. ***[ASK IF D5<>5 OR D7<>6]*** How satisfied were you with the entire application process?

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied **[PROBE: WHY DO YOU SAY THAT?**
4. Not At All Satisfied **[PROBE: WHY DO YOU SAY THAT?**

D10. Overall, how satisfied are you with the wattsmart Home Energy Savings program? **[READ CATEGORIES; RECORD ONLY FIRST RESPONSE]**

1. Very Satisfied **[PROBE: WHY DO YOU SAY THAT?**
2. Somewhat Satisfied **[PROBE : WHY DO YOU SAY THAT?**
3. Not Very Satisfied **[PROBE: WHY DO YOU SAY THAT?**
4. Not At All Satisfied **[PROBE: WHY DO YOU SAY THAT?]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

D11. Did your participation in ***[INSERT UTILITY]***'s wattsmart Home Energy Savings Program cause your satisfaction with ***[INSERT UTILITY]*** to…

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

E. Freeridership

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

E1. When you first heard about the incentive from ***[INSERT UTILITY]***, had you already been planning to purchase the ***[INSERT MEASURE NAME](S)***?

1. Yes
2. No ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
98. Don't Know ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
99. Refused ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***

E2. Ok. Had you already purchased or installed the new ***[INSERT MEASURE NAME](S)*** before you learned about the incentive from the wattsmart Program?

1. Yes
2. No ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
98. Don't Know ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
99. Refused ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***

E3. Just to confirm, you learned about the ***[INSERT UTILITY]*** rebate program after you had already purchased or installed the ***[INSERT MEASURE NAME](S)***?

1. Yes ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
2. No
98. Don't Know
99. Refused

[IF F3= 1 SKIP TO *ERROR! REFERENCE SOURCE NOT FOUND.****]***

E4. Would you have purchased the same light fixture (S) without the incentive from the wattsmart Home Energy Savings program?

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

[IF *ERROR! REFERENCE SOURCE NOT FOUND.* ***= 1 THEN SKIP TO F6]***

E5. ***[ASK IF*** *ERROR! REFERENCE SOURCE NOT FOUND.* ***= 2, 98 OR 99]*** Help me understand, would you have purchased something without the wattsmart Home Energy Savings program incentive? **[DO NOT READ RESPONSES]**

1. Yes, I would have purchased something
2. No, I would not have purchased anything ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
98. Don't Know ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***
99. Refused ***[SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***

[IF F5 = 2 SKIP TO *ERROR! REFERENCE SOURCE NOT FOUND.****. IF F5 = 98 OR 99 SKIP TO*** *ERROR! REFERENCE SOURCE NOT FOUND.****]***

E6. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND.**= 1 OR F5 = 1]*** Let me make sure I understand. When you say you would have purchased **[A]** light fixture (s) without the program incentive, would you have purchased a CFL or LED light fixture ?

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

E7. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND.**= 1 OR F5 = 1 AND MEASURE QUANTITY >1]*** Without the program incentive would you have purchased the same amount of light fixtures?

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

E8. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND.**= 1 OR F5 = 1]*** Without the program incentive would you have purchased the light fixture(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** ERROR! REFERENCE SOURCE NOT FOUND.**]

E9. ***[ASK IF F5=2]*** To confirm, when you say you would not have purchased the same light fixture without the program incentive, do you mean you would not have purchased the light fixtures <u>at all</u>?

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

[IF** ERROR! REFERENCE SOURCE NOT FOUND. **= 1 SKIP TO** ERROR! REFERENCE SOURCE NOT FOUND.**]

E10. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND. **= 2, 98, 99]*** Again, help me understand. Without the program incentive, would you have purchased the same type of light fixture(s) but a light fixture that was not designed specifically to work with CFLs or LED light bulbs?

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

E11. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND.**= 2,98, 99 AND QTY MEASURE>1]*** Without the program incentive would you have purchased the same amount of light fixtures?

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

E12. ***[ASK IF** ERROR! REFERENCE SOURCE NOT FOUND. **= 2, 98, 99]*** And, would you have purchased the light fixtures**… [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

E13. In your own words, please tell me the influence the Home Energy Saving incentive had on your decision to purchase ***[INSERT MEASURE NAME](S)*****?**

1. _____ **[RECORD RESPONSE]**

F. Spillover

F1. Since participating in the program, have you added any other energy efficient equipment or services in your home that were not incentivized through the wattsmart Home Energy Savings Program?

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

[IF F1 = 2, 98 OR 99 SKIP TO H1]

F2. What high-efficiency energy-saving equipment or services have you purchased since applying for the incentive, not including the ***[INSERT MEASURE NAME]*** that we have been discussing today? ***[READ LIST] .***

PROMPT: WE ARE ONLY INTERESTED IN HIGH –EFFICIENCY ENERGY-SAVING EQUIPMENT OR SERVICES

[READ 1-18 BEFORE ENTERING 19, 98, OR 99]

1. Clothes Washer: **RECORD QUANTITY [NUMERIC]**
2. Refrigerator: **RECORD QUANTITY [NUMERIC]**
3. Dishwasher: **RECORD QUANTITY [NUMERIC]**
4. Windows: **RECORD NUMBER OF WINDOWS [NUMERIC]**
5. Light Fixtures: **RECORD QUANTITY [NUMERIC]**
6. Heat Pump: **RECORD QUANTITY [NUMERIC]**
7. Central Air Conditioner: **RECORD QUANTITY [NUMERIC]**
8. Room Air Conditioner: **RECORD QUANTITY [NUMERIC]**
9. Ceiling Fans: **RECORD QUANTITY [NUMERIC]**
10. Electric Storage Water Heater: **RECORD QUANTITY [NUMERIC]**
11. Electric Heat Pump Water Heater: **RECORD [NUMERIC]**
12. CFLs: RECORD **QUANTITY [NUMERIC]**
13. LED bulbs: **RECORD QUANTITY [NUMERIC]**
14. Insulation: **RECORD QUANTITY IN SQ FT [NUMERIC]**
15. Air Sealing: **[PROBE: WHERE DID YOU INSTALL IT? RECORD LOCATION OF AIR SEALING]**
16. Duct Sealing: **[PROBE: WHERE WAS THE DUCT SEALING APPLIED? RECORD LOCATION OF DUCT SEALING]**
17. Programmable thermostat: **[RECORD QUANTITY[NUMERIC]**
18. Any other energy efficient equipment or measures? **[RECORD EQUIPMENT OR MEASURE PROBE: HOW MANY OR WHERE WAS IT INSTALLED? RECORD QUANTITY/LOCATION]**
19. None
98. Don't Know
99. Refused

[IF F2 = 19 (ONLY), 98 OR 99 SKIP TO H1. 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
3. 2017
4. Other ***[RECORD YEAR]***
98. Don't Know
99. Refused

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

1. Yes **[PROBE: WHO PAID THE INCENTIVE?]**
2. No
98. Don't Know
99. Refused

F5. How influential would you say the wattsmart Home Energy Savings program was in your decision to add the energy efficient ***[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 your household. Again, all your answers will be strictly confidential.

G1. 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 G4]***
9. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

G2. How many years old is the heating system?

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

G3. 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

G4. What type of cooling system do you primarily use? 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 G6]***
8. Other **[SPECIFY]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

G5. ***[ASK IF G4 <> 7]*** How many years old is your current cooling system?

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

G6. 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 more units
5. Other **[RECORD]**
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** refused

G7. Do you rent or own your home?

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

G8. Including yourself and any children, how many people currently live in your home?

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

G9. 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

G10. 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

H. Conclusion

H1. That concludes the survey. Do you have any additional feedback or comments?

1. Yes **[RECORD VERBATIM]**
2. No
98. Don't know
99. refused

Thank you very much for your time and feedback. Have a great day.

CADMUS

Appendix B. Lighting Impacts

This appendix contains further details on the following lighting topics, as introduced in the report's main body:

1. Delta Watts
2. Demand Elasticity Modeling

Where applicable, Cadmus followed the Uniform Methods Protocol for lighting impact evaluations.[1]

Delta Watts Lumen Bins

Table B1 through Table B7 provide lumen bins by lamp types applied in the gross evaluated lighting evaluation (e.g., CFLs, LEDs, light fixtures). The tables include evaluated baseline wattages by year and total lamp quantities sold in 2015–2016.

Table B1. Lumen Bins and Quantities for Standard Lamps

Lumen Bin	Baseline Wattage	Lamp Quantity
0–309	25	0
310–449	25	3,326
450–799	29	286,878
800–1,099	43	2,261,441
1,100–1,599	53	177,777
1,600–1,999	72	387,665
2,000–2,600	72	0

Table B2. Lumen Bins and Quantities for Globe Lamps

Lumen Bin	Baseline Wattage	Lamp Quantity
250–349	25	2,842
350–499	29	57,384
500–574	43	13,100
575–649	53	1,305
650–1,099	72	5,315
1,100–1,300	72	0

[1] Available online at: http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf

Table B3. Lumen Bins and Quantities for Decorative Lamps

Lumen Bin	Baseline Wattage	Lamp Quantity
70–89	10	1
90–149	15	12
150–299	25	14,839
300–499	29	130,928
500–699	43	2,775

Table B4. Lumen Bins and Quantities for EISA-Exempt Lamps

Lumen Bin	Baseline Wattage	Lamp Quantity
310–449	25	0
450–799	40	0
800–1,099	60	0
1,100–1,599	75	0
1,600–1,999	100	356
2,000–2,600	150	9

Table B5. Lumen Bins and Quantities for D > 20 Reflector Lamps

Lumen Bin	Baseline Wattage	Lamp Quantity
300–639	30	16,048
640–739	40	9,664
740–849	45	368
850–1,179	50	483
1,180–1,419	65	3,605
1,420–1,789	75	0
1,790–2,049	90	0
2,050–2,579	100	0
2,580–3,429	120	0

Table B6. Lumen Bins and Quantities for BR30, BR40, ER40 Reflector Lamps

Lumen Bin	Baseline Wattage	Lamp Quantity
300–399	30	1,204
400–449	40	0
450–499	45	59,179
500–649	50	20,591
650–1,179	65	623,281
1,180–1,419	65	2,721
1,420–1,789	75	541
1,790–2,049	90	0
2,050–2,579	100	0
2,580–3,429	120	0

Table B7. Lumen Bins and Quantities for R20 Reflector Lamps

Lumen Bin	Baseline Wattage	Lamp Quantity
300–399	30	0
400–449	40	41
450–719	45	1,430
720–999	50	0
1,000–1,199	65	0
1,200–1,519	75	0
1,520–1,729	90	0
1,730–2,189	100	0
2,190–2,899	120	0
2,900–3,850	150	0

Watts vs. Lumen ENERGY STAR Linear Fits

Figure B1 through Figure B8 show watts versus lumens from the ENERGY STAR database for eight different lamp categories, representing standard, reflector, and specialty LED and CFL lamps. When lumens could not be determined for a particular bulb model, Cadmus used these linear fits to obtain that bulb's lumen output.

Figure B1. Median Lumens vs. Wattage for ENERGY STAR-Qualified Standard CFLs

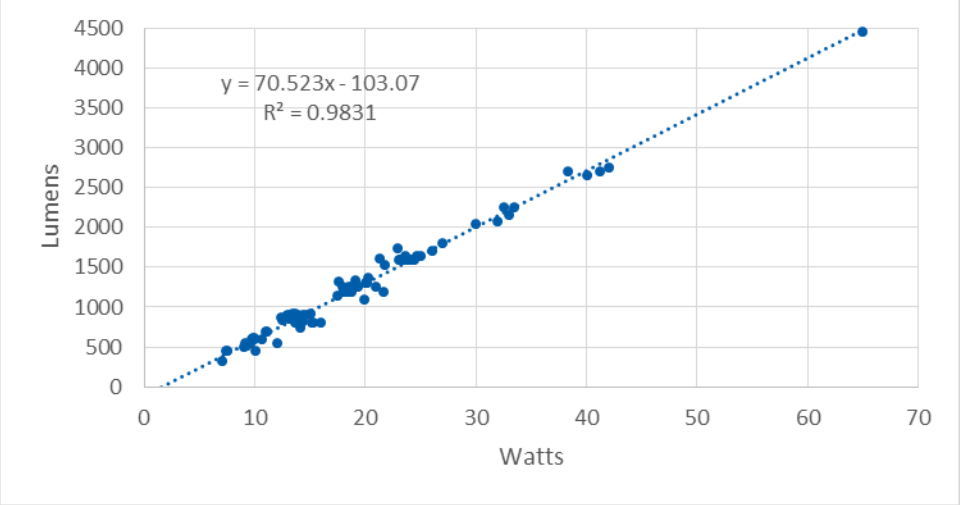


Figure B2. Median Lumens vs. Wattage for ENERGY STAR-Qualified Reflector CFLs

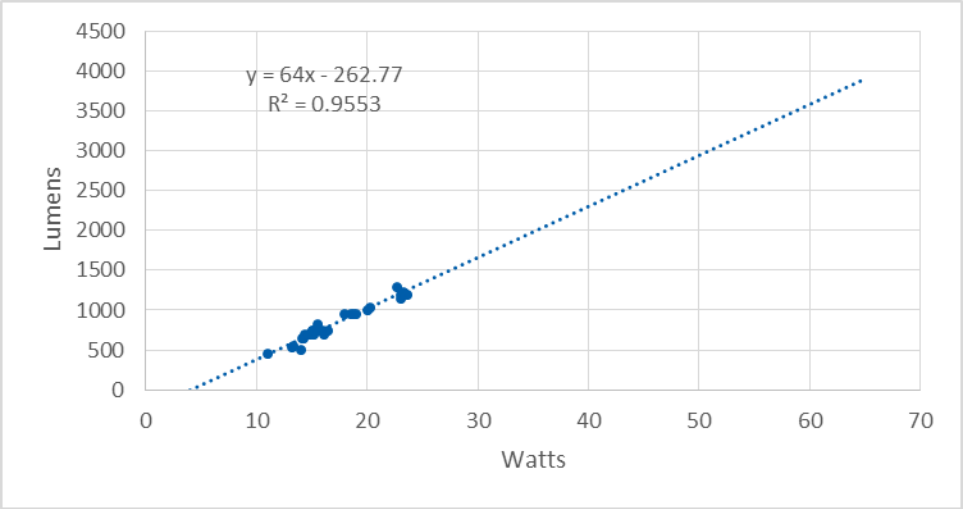


Figure B3. Median Lumens vs. Wattage for ENERGY STAR-Qualified Specialty CFLs

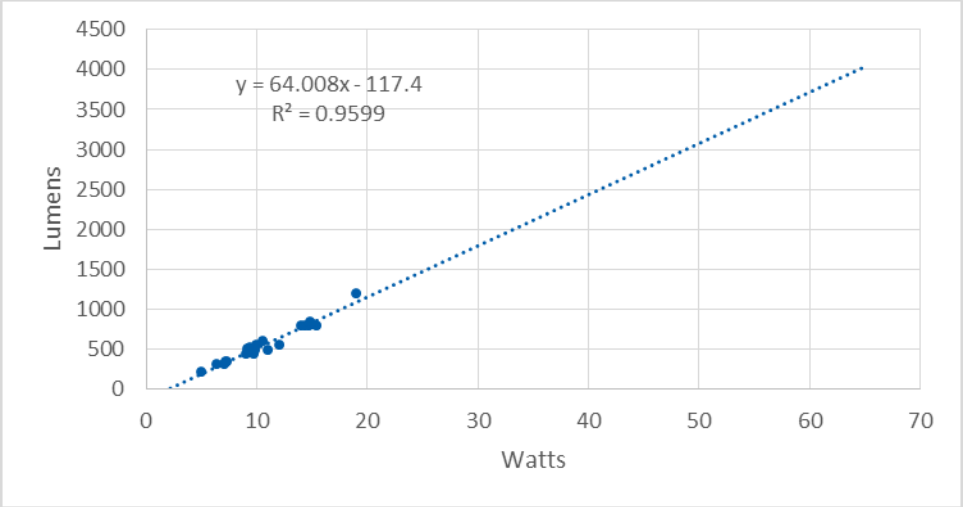


Figure B4. Median Lumens vs. Wattage for ENERGY STAR-Qualified CFL Fixtures

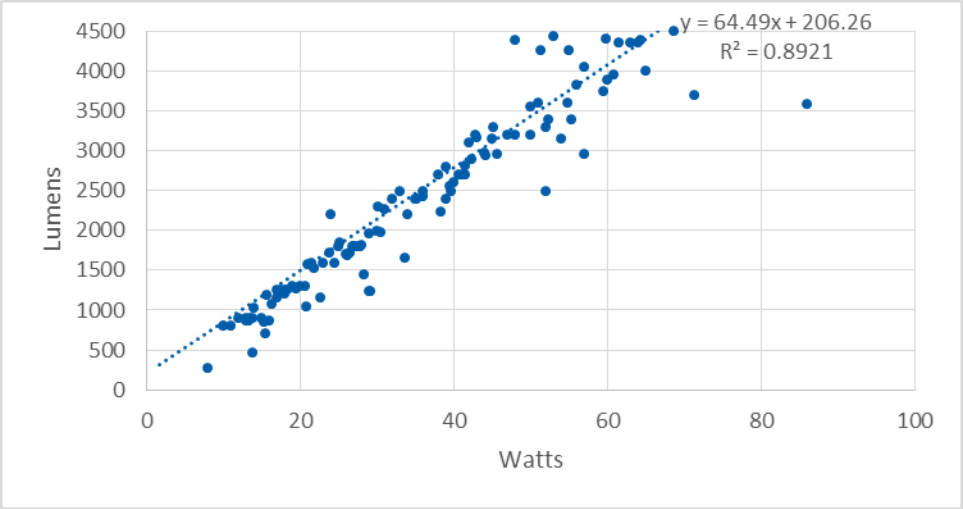


Figure B5. Median Lumens vs. Wattage for ENERGY STAR-Qualified Standard LEDs

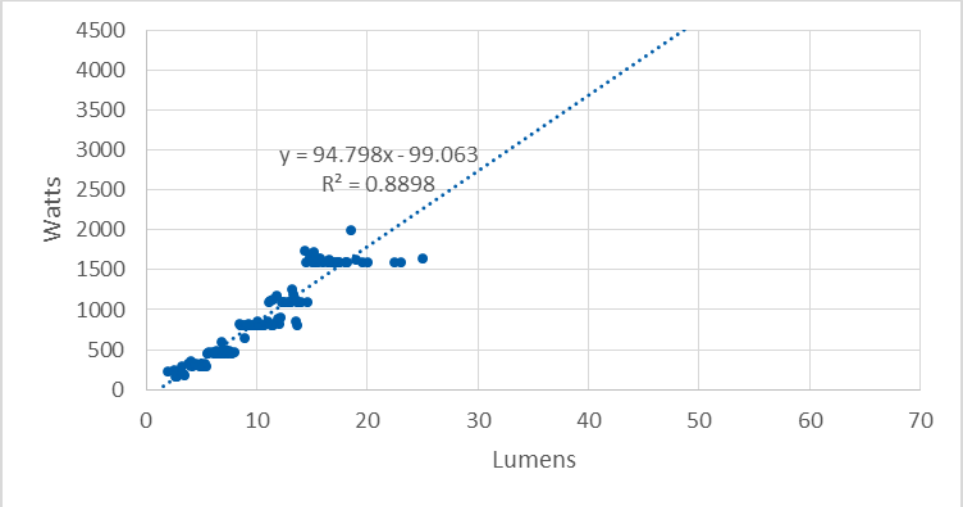


Figure B6. Median Lumens vs. Wattage for ENERGY STAR-Qualified Reflector LEDs

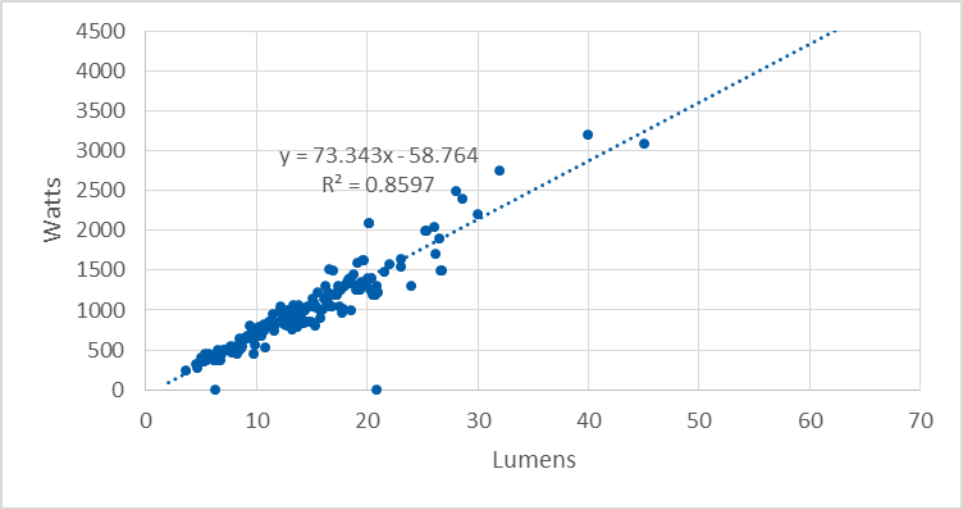


Figure B7. Median Lumens vs. Wattage for ENERGY STAR-Qualified Specialty LEDs

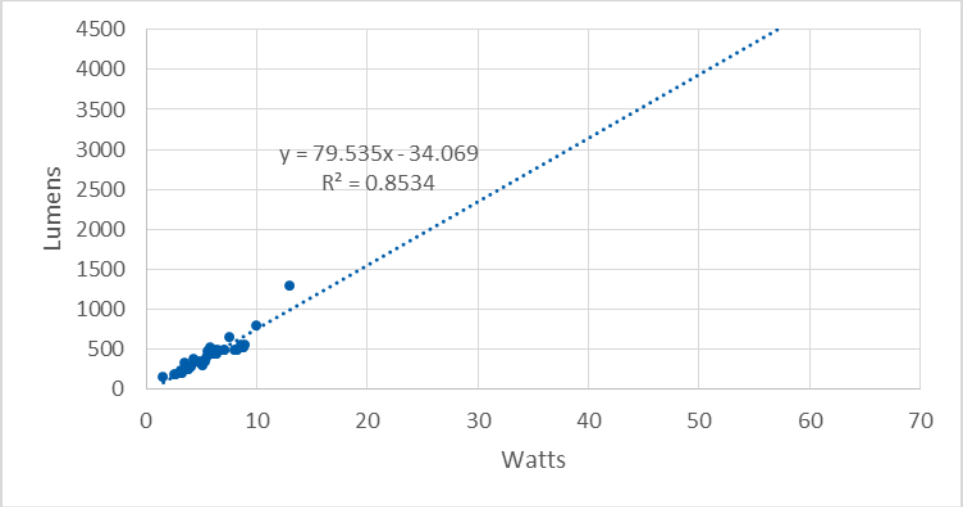
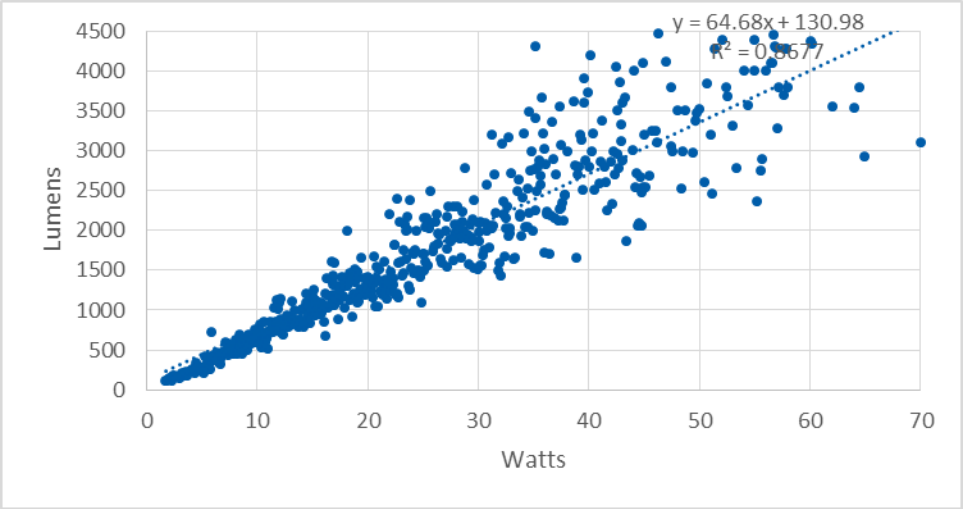


Figure B8. Median Lumens vs. Wattage for ENERGY STAR-Qualified LED Fixtures



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 buydown 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 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 by evaluated savings values, calculated through this evaluation to estimate program savings and savings without the program's price impact.

Input Data

As the demand elasticity approach relies exclusively on program data, a model's robustness depends on data quality. The sales and pricing data provided for the 2015 and 2016 program years were sufficient and improved from previous program years.

Price Variation

Price and sales variations were measured across all bulbs within a given retail location and bulb type category by taking the sales-weighted average price per bulb for all products within the retail location and the bulb category and the sum of bulb sales with the retailer/bulb category designations. For example, all 60 watt incandescent-equivalent general purpose LEDs within a specific Wal-Mart storefront location were combined into one category, regardless of manufacturer or pack size. Each monthly observation in the data reflected the average price per-bulb and the total bulb sales within that specific location.

Defining cross-sections for the model this way increased the observed variation levels in price and sales by not only capturing changes in a product's own price (for a given bulb model number) but also changes in the bulb's average price due to changes in pack size (e.g., a three-pack is introduced and displaces single pack bulb sales, thus lowering the average price per bulb) or the introduction of new, comparable products to the program.

Table B8 shows the representativeness of data included in the model for each year as well as data combined for the evaluation cycle.

Table B8. Share of Sales Represented in Model

Year	Bulb Type	Total Sales	Share Represented by Year	Share Represented Combined
2015	CFL	1,751,277	85%	81%
2016	CFL	86,340	0%	
2015	LED	940,991	70%	80%
2016	LED	886,688	92%	

Sales included in the model used to estimate elasticities represented a majority of sales for both technologies in 2015. LEDs representativeness increased in 2016 to over 90%. CFL sales, however, decreased sharply in 2016, with only 2% of 2016 CFLs sales occurring after April. Because of this, Cadmus did not model CFL sales in 2016, instead applying the freeridership estimate from 2015 directly to 2016 CFL sales.

Promotional Displays

The program administrator did not provide complete detailed data on product merchandising (e.g., clip strips, end caps, pallet displays). Therefore, the model may not have captured all program impacts.[2]

Evaluations in other jurisdictions have found that product merchandising can generate sales lift between 60% and 120%. Capturing and providing this detail level ensures that the program receives credit for all activities. Cadmus recommends collecting and providing these data for future evaluations.

Seasonality Adjustment

In economic analysis, it is critical to separate data variations resulting from seasonality from those resulting from relevant external factors. For example, suppose prices had been reduced on umbrellas at the beginning of the rainy season. Any estimate of this price shift's impact would be skewed if the analysis did not account for the natural seasonality of umbrella sales.

To adjust for seasonal variations in sales, Cadmus used time fixed-effects in the model. These fixed effects were unique to each retail channel and represented differences from average monthly sales within each retail channel.

Historically, Cadmus has used a seasonal trend derived from national sales from a major lighting products manufacturer for comparing program sales with the expected share of annual sales to occur within each month. As shown in Figure 9 and Figure 10, however, neither LED nor CFL sales followed the expected seasonal pattern, with a small peak in March and a larger peak in October and November.

Both technologies exhibited the highest sales in June and July 2015, with sales tapering off. CFL sales dropped sharply in 2016, essentially ending after April as LED sales picked up.

LED sales also dropped at the end of 2015 and remained relatively low in early 2016 while prices were high. When prices dropped in the second half of 2016, sales responded and increased considerably.

Ultimately, including the seasonal sales trend from the national retailer produced positive elasticities for CFLs, leading to extreme negative net-to-gross estimates. Given this result and the atypical monthly pattern of sales observed, the seasonal trend provided by the national retailer did not serve as an appropriate control in the model, and Cadmus opted for the 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 were observed. These changes were unrelated to any program activity Cadmus observed in the data. Therefore, these dummy variables absorbed impacts from these events, as to not bias the price elasticities.

---

[2] To the degree that product merchandising and prices co-vary, elasticity estimates may capture some sales lift generated by merchandising. As data, however, were not available for incorporation into the model, separate impacts could not be estimated.

Figure 9. CFL Sales and Prices by Month

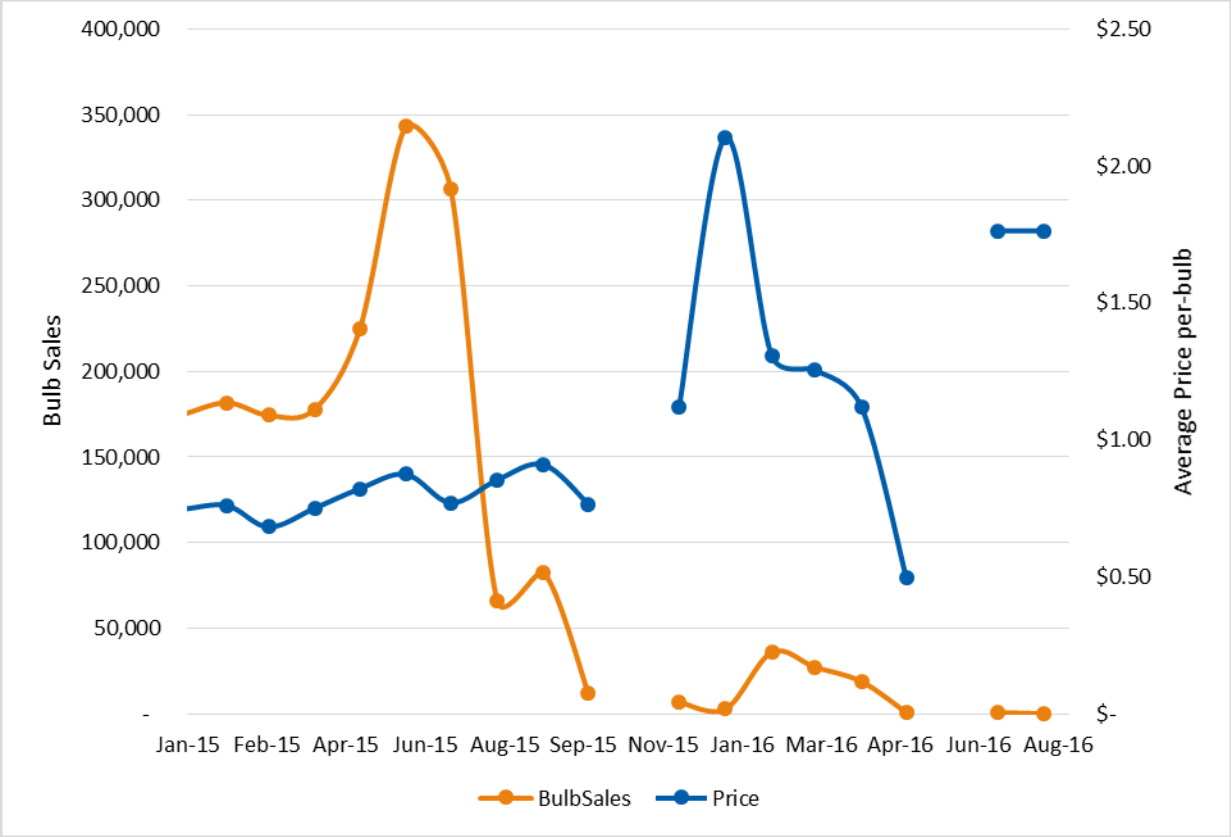
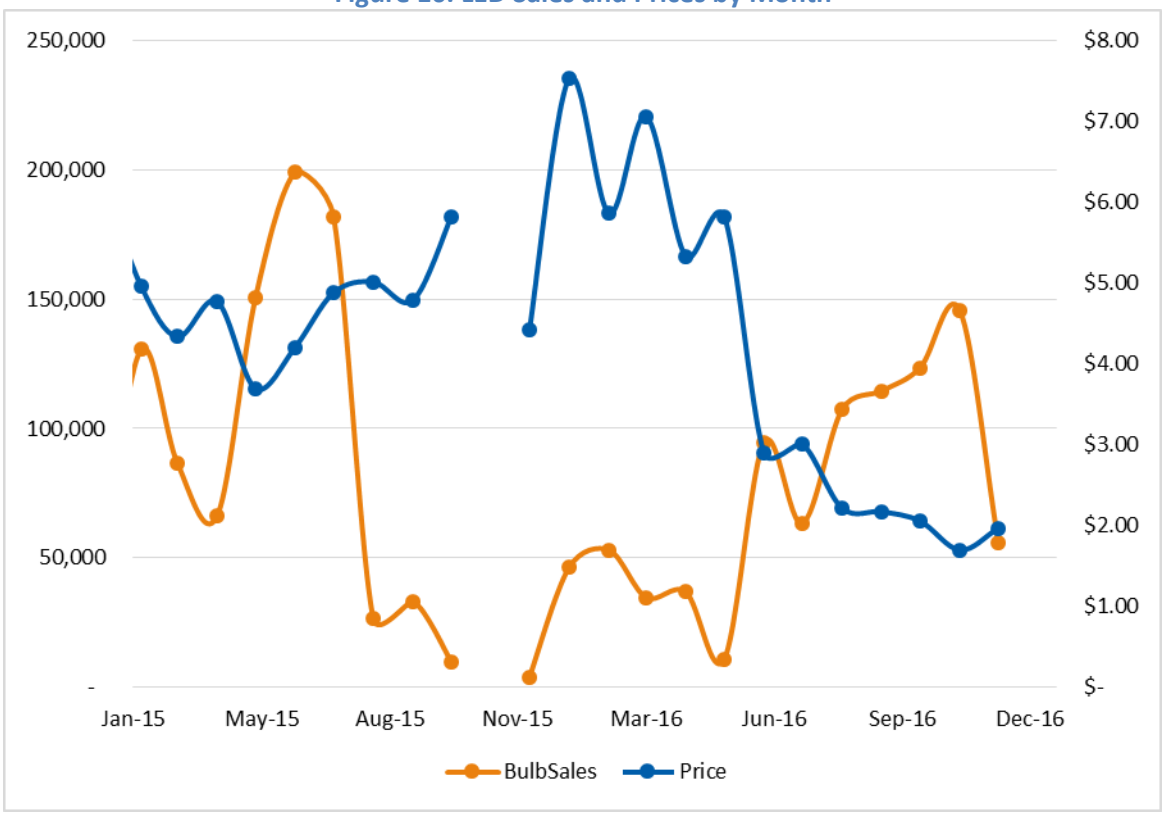


Figure 10. LED Sales and Prices by Month



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 (i.e., 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*):

$$\ln(Q_{it}) = \sum_{\pi}(\beta_{\pi} ID_{\pi,i}) + \sum_{\theta}\left(\beta_{\theta,i,j}\left[ln(P_{it}) * (Retail\ Channel_{\theta,i}) * (Bulb\ Technology_{\theta,j})\right]\right) + \sum_{\theta}\left(\beta_{ti}\left[Sales\ Month_t * (Bulb\ Technology_{\theta,j}) * (Retail\ Channel_{\theta,i})\right]\right) + \beta_3 * Specialty * ln(P_{it}) + \beta_4 * Reflector * ln(P_{it}) + \varepsilon_i + \gamma_t$$

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)
Bulb Technology	=	CFL or LED
Specialty	=	Dummy variable equaling 1 if a product is a specialty bulb; 0 otherwise
Reflector	=	Dummy variable equaling 1 if a product is a reflector 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

In the 2016 model, sufficient data and price variation occurred to allow Cadmus to estimate elasticities within each retail channel and bulb category separately.

Cadmus estimated the following equation for the 2016 model (for bulb model *i*, in month *t*):

$$\ln(Q_{it}) = \sum_{\pi}(\beta_{\pi} ID_{\pi,\mathrm{i}}) + \sum_{\theta}\left(\beta_{\theta,i,j}\left[ln(P_{it}) * (Retail\ Channel_{\theta,\mathrm{i}}) * (Bulb\ Category_{\theta,\mathrm{j}})\right]\right) + \sum_{\theta}\left(\beta_{ti}\left[Sales\ Month_t * (Retail\ Channel_{\theta,\mathrm{i}})\right]\right) + \varepsilon_i + \gamma_t$$

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)
Bulb Category	=	Style of bulb (A-line, reflector, specialty)
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 1.6% of actual bulb sales over the evaluation period.

Findings

Cadmus estimated a combined CFL and LED freeridership of 29%. Table B9 shows the estimated freeridership ratio by bulb type. LEDs had slightly lower freeridership than CFLs.

Table B9. Modeling Results by Bulb Type

Bulb Type	Freeridership
CFLs	41%
LEDs	28%
All Bulbs	**29%**

Table B10 shows the incentive as a share of the original retail price and the estimated freeridership ratio, by bulb type. Typically, the proportional price reduction and the net of freeridership trend correlate: the higher the incentive, the lower the freeridership. This is particularly evident in this case. The markdown was greater in 2015 and freeridership was less than half of estimated freeridership in 2016.

In addition to markdown levels being greater in 2015 for LEDs, the observed price elasticities were considerably greater in club stores in 2015 (-3.33) than in 2016 (-2.29). This could be due to LED prices declining generally. Price elasticities tend to decline when consumers come to expect lower prices.

[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 B10. Modeling Results by Bulb Type

Year	Technology	Final Price per Bulb	Original Price per Bulb	Markdown %	Freeridership
2015	CFL	$0.79	$2.03	45%	41%
	LED	$4.59	$8.58	47%	17%
2016	CFL	$0.68	$1.27	46%	41%
	LED	$1.93	$3.08	37%	38%

Elasticities

Freeridership ratios derive 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 were simply 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 B11, elasticity estimates for both 2015 and 2016 fell a bit below the expected ranges, with most estimates less than one.

Table B11. Elasticity Estimates by Retail Channel and Bulb Type

Year	Channel	Technology	Average Elasticity
2015	Club	CFL	-0.55
		LED	-3.33
	DIY	CFL	-1.04
		LED	-2.05
	Mass Market	CFL	-1.13
		LED	-1.59
2016	Club	LED	-2.29
	DIY	LED	-1.46
	Mass Market	LED	-1.90

CADMUS

Appendix C. HES Billing Analysis

Cadmus conducted three billing analyses to estimate gross and net savings for the following measures:

- Insulation (attic, wall, or floor)
- Ductwork (duct sealing and/or duct insulation)
- Cooling Equipment (central air conditioners and evaporative coolers)

The following sections outline the methodology and results for each effort.

Insulation Billing Analysis

Cadmus conducted billing analysis to assess actual net energy savings associated with insulation measure installations.[1] Cadmus determined the savings estimate using a pooled, conditional savings analysis (CSA) regression model, which included the following groups:

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

The billing analysis resulted in a 115% net realization rate for insulation measures (a net result rather than gross as it compares participant usage trends to a nonparticipant group, accounting for market conditions outside of the program).

Insulation Program Data and Billing Analysis Methodology

Cadmus used the following sources to create the final database for conducting the billing analysis:

- ***Participant program data,*** collected and provided by the program administrator (including account numbers, measure types, installation dates, square footage of insulation installed, heat sources, and expected savings for the entire participant population).
- ***Control group data,*** which Cadmus collected from a census of approximately 1,200,000 nonparticipating customers in Utah. Cadmus matched energy use for the control group to quartiles of the participants' pre-participation energy use to ensure comparability of the two groups. To ensure adequate coverage of the nonparticipating population, Cadmus included four times the number of nonparticipants than participants.
- ***Billing data***, provided by Rocky Mountain Power, which included all Utah residential accounts. Cadmus matched the 2015–2016 participant program data to the census of Utah'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 1,454 participants and 5,816 control customers.

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

- ***Utah weather data***, including daily average temperatures from January 2014 to May 2017 for 8 weather stations, corresponding with HES participant locations.

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 with the following:

1. Participant addresses matching to the billing data provided.
2. A minimum of 300 days in each of the pre- and post-periods (i.e., before the earliest installation, and after the latest reported installation in 2016).
3. More than 1,667 kWh per year or less than 65,120 kWh per year (the lowest and highest participant usage to remove very low- or high-usage nonparticipants).
4. Gas-heated accounts (99% of homes in Utah) showing a consumption change of less than 30% of pre-program usage, ensuring a better match between participants and the control group; electrically heated accounts with consumption up to 50%.
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 the usage patterns remained inconsistent between pre- and post-periods, the analysis dropped accounts.

Table C1 shows participant and nonparticipant screening criteria used for the insulation billing analysis.

[2] As participants installing measures mid-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 had less than 10 months of pre-period data.

Table C1. Screen for Inclusion in Billing Analysis

Screen	Attrition		Remaining	
	Nonparticipant	Participant	Nonparticipant	Participant
Original measures database (insulation installations only) and nonparticipant population	N/A	N/A	1,218,205	4,356
Matched billing data sample (reduced to nonparticipant, single-family residential accounts in participant zip codes; participant accounts that could be matched to the billing data addresses)	718,750	426	499,455	3,930
Reject accounts with less than 300 days in pre- or post-period	206,804	2,041	292,651	1,889
Reject accounts with less than 1,667 kWh or more than 65,120 kWh in pre- or post-period	609	-	292,042	1,889
Reject accounts with consumption changing by more than 30% from pre- to post-period for gas-heated homes and more than 50% for electrically heated homes	36,611	231	255,431	1,658
Reject accounts with expected savings over 70% of pre-period consumption	-	9	255,431	1,649
Reject participant accounts that also received other measures through HES program	-	5	255,431	1,644
Reject accounts with billing data outliers, vacancies, and seasonal usage	18,118	190	237,313	1,454
Nonparticipant sample selection (random sample of nonparticipants to match participant pre-period usage by quartile; four times more than participants)	231,497	-	5,816	1,454
Final Sample			***5,816***	***1,454***

Regression Model

After screening and matching accounts, the final analysis group consisted of 1,454 participants and 5,816 nonparticipants.

Of the final sample, 95% of participant homes installed attic insulation, 6% installed wall insulation, and none of the participant home installed floor insulation. As determining separate wall or floor insulation savings proved impossible, Cadmus estimated a combined realization rate for all insulation measures.

Cadmus used the following CSA regression specification to estimate HES Program insulation savings:

$$ADC_{it} = \alpha_i + \beta_1 HDD_{it} + \beta_2 CDD_{it} + \beta_3 POST_t + \beta_4 PARTPOST_{it} + \varepsilon_{it}$$

Where for customer (i) and month (t):

ADC_{it}	=	Average daily kWh consumption
HDD_{it}	=	Average daily HDDs (base 65)
CDD_{it}	=	Average daily CDDs (base 65)
$POST_t$	=	Indicator variable of 1 in the post-period for participants and nonparticipants, 0 otherwise
$PARTPOST_{it}$	=	Indicator variable of 1 in the post-period for participants, 0 otherwise

β_4 served as the key coefficient determining average insulation savings. The coefficient averaged daily insulation savings per program participant, after accounting for nonparticipant trends. Cadmus included individual customer intercepts (α_i) as part of a fixed-effects model specification to ensure no participants or nonparticipants exerted an undue influence over the final savings estimate; this resulted in a more robust model.[3]

Insulation Results

Cadmus estimated overall insulation savings of 343 kWh per participant. Average insulation had expected savings of 299 kWh, translating to a 115% net realization rate for insulation measures. With average participant pre-usage of 11,295 kWh, savings represented a 3% reduction in total energy usage from insulation measures installed. Table C2 presents the overall net savings estimate for wall, floor, and attic insulation.

Table C2. Insulation Net Realization Rates

Model	Billing Analysis Participants (n)	Reported kWh Savings per Premise	Evaluated Net kWh Savings per Premise	Net Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall	**1,454**	**299**	**343**	**115%**	**±17%**	**95%–135%**
Electric Heat	64	1,432	1,366	95%	±19%	78%–113%
Gas Heat	1,390	247	296	120%	±20%	96%–144%

Cadmus only used overall model results to determine the measure-level net savings, while also providing results by space heating fuel: electric and non-electric.

[3] Due to the complexity of estimating the model with separate intercepts, Cadmus estimated a difference model, subtracting out the customer-specific averages for both the dependent and independent variables. This method produced results identical to the fixed effects models with separate intercepts; however, using a difference model proved simpler in estimating savings and presenting final model outputs.

Overall, electrically heated homes achieved insulation savings of 1,432 kWh per home. Average electrically heated expected insulation savings were 1,366 kWh, translating to a 95% realization rate. With average electrically heated participant pre-usage of 15,889 kWh, savings represented a 9% reduction in energy usage from insulation measures.

Gas-heated homes achieved insulation savings of 296 kWh per home. Expected savings from average insulation were 247 kWh, translating to a 120% realization rate. With gas-heated, participant pre-usage of 11,084 kWh, savings represented a 3% reduction in energy usage from insulation measures.

Table C3, Table C4, and Table C5 summarize model outputs for the regression models Cadmus used to determine the realization rates.

Table C3. Insulation Regression Model for Utah (Overall Model)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	9,999,545	2,499,886	37,817	<.0001
Error	173043	11,439,125	66		
Corrected Total	173047	21,438,670			
Root MSE		8.13054	R-Square		0.4664
Dependent Mean		1.27493E-17	Adj. R-Square		0.4664
Coefficient of Variation		6.37722E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	-1.90945	0.04381	-43.59	<.0001
PartPost	**1**	**-0.93935**	**0.09825**	**-9.56**	**<.0001**
AvgHdd	1	0.24045	0.00199	120.61	<.0001
AvgCdd	1	1.77481	0.00497	356.84	<.0001

Table C4. Insulation Regression Model for Utah (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	7,976,094	1,994,023	29,461	<.0001
Error	140373	9,500,842	67.6828		
Corrected Total	140377	17,476,936			
Root MSE		8.22696	R-Square		0.4564
Dependent Mean		1.8551E-17	Adj. R-Square		0.4564
Coefficient of Variation		4.43477E+19			

Source	Parameter Estimates				
	DF	Parameter Estimates	Standard Error	t value	Prob. t
Post	1	-1.90383	0.04437	-42.91	<.0001
PartPost	**1**	**-3.7435**	**0.42655**	**-8.78**	**<.0001**
AvgHdd	1	0.24819	0.00224	110.64	<.0001
AvgCdd	1	1.767	0.00558	316.76	<.0001

Table C5. Insulation Regression Model for Utah (Gas Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	9,915,742	2,478,935	38,135	<.0001
Error	171537	11,150,774	65.0051		
Corrected Total	171541	21,066,516			
Root MSE		8.06257	R-Square		0.4707
Dependent Mean		1.75004E-17	Adj. R-Square		0.4707
Coefficient of Variation		4.60707E+19			

Source	Parameter Estimates				
	DF	Parameter Estimates	Standard Error	t value	Prob. t
Post	1	-1.90953	0.04344	-43.95	<.0001
PartPost	**1**	**-0.80974**	**0.09921**	**-8.16**	**<.0001**
AvgHdd	1	0.23776	0.00199	119.72	<.0001
AvgCdd	1	1.77505	0.00496	357.72	<.0001

Ductwork Billing Analysis

Cadmus conducted a billing analysis to assess net 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); and
- Nonparticipant homes, serving as the comparison group.

The billing analysis resulted in a 96% net realization rate for duct sealing and duct insulation measures. This produced a net result (rather than gross) as it compared participant usage trends to a nonparticipant group, accounting for market conditions outside of the program.

Ductwork Program Data and Billing Analysis Methodology

Cadmus used the following sources to create the final database for conducting the billing analysis:

- ***Participant program data,*** collected and provided by the program administrator (including account numbers, measure types, installation dates, square footage of insulation installed, heat source, and expected savings for the entire participant population).
- ***Control group data,*** which Cadmus collected from a census of approximately 1,200,000 nonparticipating customers in Utah. This included matching energy use for the control group to quartiles of the participants' pre-participation energy use to ensure comparability of the two groups. To ensure adequate coverage of the nonparticipating population, Cadmus included four times the number of nonparticipants than participants.
- ***Billing data***, provided by Rocky Mountain Power, included all Utah residential accounts. Cadmus matched the 2015–2016 participant program data to the census of billing data for the state (only for participants installing duct sealing and/or duct insulation measures).The data included meter-read dates and kWh consumption from January 2014 through May 2017. The final sample used in the billing analysis consisted of 1,962 participants and 7,848 control customers.
- ***Utah weather data***, including daily average temperatures from January 2014 to May 2017 for 6 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

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

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 with the following:

1. Participant addresses matching to the billing data provided.
2. A minimum of 300 days in each of the pre- and post-periods (i.e., before the earliest installation and after the latest reported installation in 2016).
3. More than 1,773 kWh per year or less than 51,201 kWh per year (the lowest and highest participant usages to remove very low or high usage nonparticipants).
4. Gas-heated accounts (99% of homes in Utah) showing a change in consumption of less than 30% of pre-program usage; this ensured a better match between participants and the control group: electrically heated accounts with consumption up to 50%.
5. Expected savings under 70% of household consumption (accounts for either a mismatch between participant database and billing data or pre-period vacancies).
6. Participants installing other measures through the HES program.

Further, Cadmus examined the individual monthly billing data to check for vacancies, outliers, and seasonal usage changes. If usage patterns proved inconsistent between the pre- and post-periods, the analysis dropped the accounts. Table C6 shows participant and nonparticipant screening criteria used in the billing analysis.

[5] As participants installing measures in mid-late 2016 had less than 10 months of post-period data, Cadmus removed them from the analysis. Similarly, customers who participated in 2015 with measure installation dates before November 2014 had less than 10 months of pre-period data and were removed from the analysis.

Table C6. Screen for Inclusion in Billing Analysis

Screen	Attrition		Remaining	
	Nonparticipant	Participant	Nonparticipant	Participant
Original measures database (insulation installations only) and nonparticipant population			1,216,185	6,376
Matched billing data sample (reduced to nonparticipant, single-family residential accounts in participant zip codes; participant accounts that could be matched to the billing data addresses)	788,677	1,233	427,508	5,143
Reject accounts with less than 300 days in pre- or post-period	177,680	2,490	249,828	2,653
Reject accounts with less than 1,773 kWh or more than 51,201 kWh in pre- or post-period	1,154	-	248,674	2,653
Reject accounts with consumption changing by more than 30% from the pre- to post-period for gas-heated homes and more than 50% for electrically heated homes	30,602	296	218,072	2,357
Reject participant accounts that also received other measures through HES program	-	7	218,072	2,350
Reject accounts with expected savings over 70% of pre-period consumption	-	-	218,072	2,350
Reject accounts with billing data outliers, vacancies, and seasonal usage	17,014	388	201,058	1,962
Nonparticipant sample selection (random sample of nonparticipants to match participant pre-period usage by quartile: four times more than participants)	193,210	-	7,848	1,962
Final Sample			***7,848***	***1,962***

Regression Model

After screening and matching accounts, the final analysis group consisted of 1,962 participants and 7,848 nonparticipants.

Cadmus used the following CSA regression specification to estimate duct sealing and duct insulation savings from the HES Program:

$$ADC_{it} = \alpha_i + \beta_1 HDD_{it} + \beta_2 CDD_{it} + \beta_3 POST_t + \beta_4 PARTPOST_{it} + \varepsilon_{it}$$

Where for customer (i) and month (t):

ADC_{it} = Average daily kWh consumption

HDD_{it} = Average daily HDDs (base 65)

CDD_{it} = Average daily CDDs (base 65)

$POST_t$ = Indicator variable of 1 in the post-period for participants and nonparticipants, 0 otherwise

$PARTPOST_{it}$ = Indicator variable of 1 in the post-period for participants, 0 otherwise

β_4 served as the key coefficient that determined average duct sealing and duct insulation savings. This coefficient averaged daily duct sealing and duct insulation savings per program participant, after accounting for nonparticipant trends. Cadmus included individual customer intercepts (α_i) as part of a fixed-effects model specification to ensure no participants or nonparticipants had an undue influence over the final savings estimate, resulting in a more robust model.[6]

Ductwork Results

Cadmus estimated overall duct sealing and duct insulation savings of 321 kWh per home. Expected average duct sealing and duct insulation savings were 336 kWh, translating to a 96% net realization rate for duct sealing and insulation measures. With average participant pre-usage of 10,788 kWh, savings represented a 3% reduction in total energy usage from duct sealing and duct insulation measures installed. Table C7 presents the overall savings estimate for duct sealing and duct insulation.

Table C7. Ductwork Net Realization Rates

Model	Billing Analysis Participant (n)	Reported kWh Savings per Premise	Evaluated Net kWh Savings per Premise	Net Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Overall	**1,962**	**336**	**321**	**96%**	**±16%**	**80%–111%**
Electric Heat	82	1,473	1,166	79%	±20%	63%–95%
Gas Heat	1,880	286	284	99%	±19%	81%–118%

Cadmus used only the overall model results to determine measure-level net savings, but provided results by space heating fuel: electric and non-electric.

Overall, electrically heated homes achieved duct sealing and duct insulation savings of 1,166 kWh per home. Expected average electrically heated duct sealing and duct insulation savings were 1,473 kWh, translating to a 79% net realization rate. With average electrically heated participant pre-usage of 15,520 kWh, savings represented an 8% reduction in energy usage from duct sealing and duct insulation measures.

[6] Due to the complexity of estimating the model with separate intercepts, Cadmus estimated a difference model, which, for both the dependent variable and the independent variables, subtracted out customer-specific averages. This method produced identical results to the fixed-effects models with separate intercepts; however, using a difference model proved simpler to estimate savings and present final model outputs.

Gas-heated homes achieved duct sealing and duct insulation savings of 284 kWh per home. Expected average duct sealing and duct insulation savings were 286 kWh, translating to a 99% realization rate. With gas-heated participant pre-usage of 10,581 kWh, savings represented a 3% reduction in energy usage from duct sealing and duct insulation measures. Table C8, Table C9, and Table C10 summarize the model outputs for the regression models Cadmus used to determine the realization rates.

Table C8. Ductwork Regression Model for Utah (Overall)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	13,916,113	3,479,028	48,914	<.0001
Error	233732	16,624,453	71.1261		
Corrected Total	233736	30,540,566			
Root MSE		8.43363	R-Square		0.4557
Dependent Mean		-3.3865E-17	Adj. R-Square		0.4557
Coefficient of Variation		-2.49038E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	-1.33211	0.03902	-34.14	<.0001
PartPost	**1**	**-0.87999**	**0.08761**	**-10.04**	**<.0001**
AvgHdd	1	0.20302	0.00177	114.90	<.0001
AvgCdd	1	1.56671	0.00386	405.82	<.0001

Table C9. Ductwork Regression Model for Utah (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	10,635,859	2,658,965	35,691	<.0001
Error	189411	14,110,883	74.4988		
Corrected Total	189415	24,746,742			
Root MSE		8.63127	R-Square		0.4298
Dependent Mean		1.72557E-18	Adj. R-Square		0.4298
Coefficient of Variation		5.00197E+20			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	-1.30918	0.03995	-32.77	<.0001
PartPost	**1**	**-3.19373**	**0.39440**	**-8.10**	**<.0001**
AvgHdd	1	0.21697	0.00202	107.43	<.0001
AvgCdd	1	1.53189	0.00437	350.26	<.0001

Table C10. Ductwork Regression Model for Utah (Gas Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	13,859,442	3,464,861	49,520	<.0001
Error	231795	16,218,393	69.9687		
Corrected Total	231799	30,077,835			
Root MSE		8.36473	R-Square		0.4608
Dependent Mean		-4.0033E-17	Adj. R-Square		0.4608
Coefficient of Variation		-2.08944E+19			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	-1.33582	0.0387	-34.52	<.0001
PartPost	**1**	**-0.77846**	**0.08841**	**-8.81**	**<.0001**
AvgHdd	1	0.20035	0.00176	113.91	<.0001
AvgCdd	1	1.57225	0.00386	407.55	<.0001

Cooling Equipment (Cool Cash) Billing Analysis

Cadmus conducted billing analyses to assess gross energy savings associated with high-efficiency air conditioners and evaporative coolers. The analysis required construction of three regression models:

1. A central air conditioners and sizing and installation measures (SEER 15+) model.[7]
2. An evaporative cooling model.
3. A model of SEER 13 nonparticipant units (to serve as the baseline).[8]

Cooling Equipment Program Data Billing Analysis Methodology

Cadmus used following regression model to estimate consumption for all three groups:

$$ADC = \alpha + \beta_1 CDD + \beta_2 SQFT + \varepsilon$$

[7] This model contained sizing + TXV and proper installation central air-conditioning measures. The realization rate calculated with this model applied to these two measures.

[8] The analysis used the base efficiency nonparticipant group with SEER 13 units. A central assumption underlying this assessment was that participants would have installed a base-efficiency (13 SEER) unit had they not participated in the program. Based on this assumption, Cadmus used a control group composed of 2005 Cool Cash Program participants known to have received a 13 SEER air-conditioning unit—without sizing + TXV or proper installation incentives—as their primary cooling system. SEER 13 air-conditioning equipment represented the federal minimum efficiency level for residential central air conditioners manufactured after January 2006.

Where:

ADC = Average daily kWh consumption

CDD = Average daily CDDs

SQFT = Home square feet

The equation determined energy consumption, defined as average daily kWh consumption, by average daily CDD and home size.

Some estimation error (ε) exists in the regression relationship after accounting for weather and home size. The β_1 coefficient measures energy consumption per CDD. Cadmus estimated average savings for each of the participating groups (15+ SEER and evaporative cooling models) as the difference between their respective model coefficient of CDD and the estimated model coefficient of CDD for the 13 SEER group, multiplied by the average 10-year CDD for Utah.

The models estimated savings by isolating weather impacts from other factors contributing to energy consumption. The savings were determined using only 2016 billing data in the cooling season (where CDD were greater than 0) following their installation of the high-efficiency unit.[9]

Cadmus used the following sources to create the final database for conducting the billing analysis:

- ***Participant program data,*** collected and provided by the program implementer. These data included account numbers, site addresses, unit types, and installation dates for the entire participant population.
- ***Billing data***, including meter-read dates, days in billing cycle, and kWh consumption from January 2014 through May 2017 for all 2015–2016 participants receiving cooling equipment and control group participants.
- ***Utah weather data***, including daily average temperatures and CDDs from January 2014 through May 2017.
- ***Square footage data,*** from the CLEAResult implementer tracking data that tracks the square footage entered in the program application and from PacifiCorp account data. Any missing square feet were looked up in a real estate listing service.[10]

The billing analysis results provided gross realization rates for central air conditioners and evaporative cooler equipment types across both years. Cadmus then applied the appropriate equipment-specific realization rate to reported savings to determine evaluated gross measure savings estimates.

[9] Cadmus used the entire 2016 cooling season for the program nonparticipant control group.

[10] http://www.zillow.com/

Cooling Equipment Results

Cadmus used three regression models to estimate program energy savings: SEER 13 (baseline), central air conditioners and sizing and installation measures (SEER 15+), and evaporative coolers. Cadmus used billing data from April 2016 to December 2016 to ensure availability of adequate data for participants receiving an incentive in 2015 and the early months of 2016. Prior to model specification, Cadmus conducted a detailed quality-assurance review of all available data to identify missing values or data quality issues; the review found few data points missing. Following standard analytical practice, Cadmus screened data for extreme kWh values and eliminated outliers from the analysis.

The models revealed that several variables could be excluded, primarily those for groups with similar characteristics. For example, the evaporative coolers model did not incorporate home types and numbers of stories as these variables highly correlated with square footage, which the model already included.

Table C11 shows the regression model results.[11] The SEER 13 nonparticipant group usage is estimated at 1.33 kWh per CDD. Cadmus used this baseline to estimate savings from each participating central air conditioner and evaporative cooler unit.

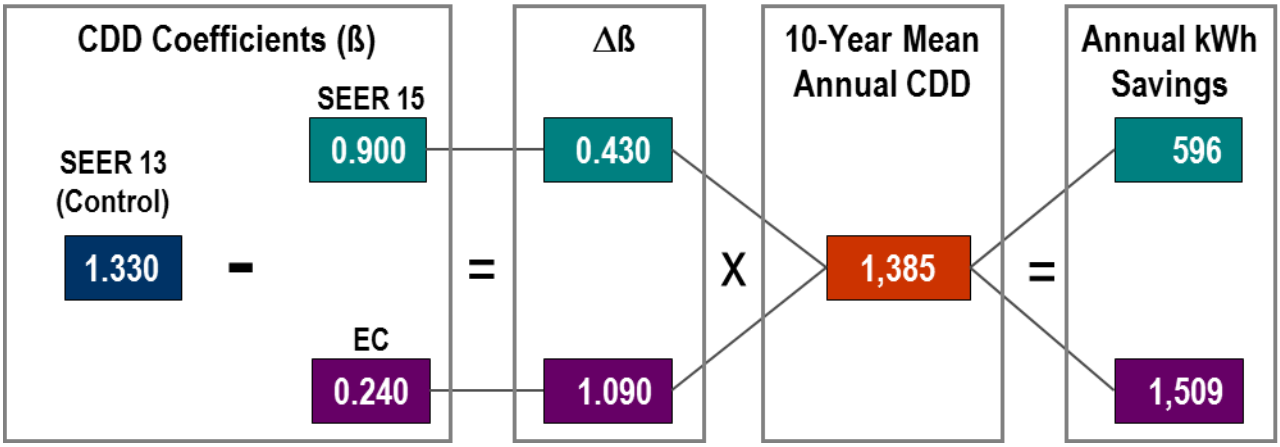
Table C11. Cool Cash Billing Data Regression Results

Group	Consumption per CDD (kWh)	Annual Consumption Based on 1,385 Average CDD (kWh)	Evaluated Gross Savings (kWh)
SEER 13	1.330	1,842	N/A
Evaporative Cooling	0.240	332	1,509
Central Air Conditioner	0.900	1,246	596

Figure C1 illustrates calculations used to derive estimated annual kWh savings.

[11] For all three models, the F-test proved statistically significant. In most instances, parameters for other independent variables proved significant and had the correct signs. The F-test determined whether two population variances were equal by comparing the ratio of their variances. If the variances were equal, the variances' ratio would be 1. Typically, this test is used to compare the validity of models.

Figure C1. Derivation of kWh Savings



Cadmus estimated overall evaporative cooler savings of 1,509 kWh per participant. The average evaporative cooler produced expected savings of 1,406 kWh, translating to a 107% gross realization rate.

Cadmus estimated overall central air conditioner savings of 596 kWh per participant. The average central air conditioner produced expected savings of 533 kWh, translating to a 112% gross realization rate.

Table C12 presents overall gross savings estimates and realization rates for 2015–2016 cooling equipment.

Table C12. Cooling Equipment Gross Realization Rates

Measure	Billing Analysis Participants (n)	Reported kWh Savings per Premise	Evaluated Gross kWh Savings per Premise	Gross Realization Rate	Relative Precision at 90% Confidence	90% Confidence Bounds
Evaporative Coolers	3,936	1,406	1,509	107%	±7%	100% - 115%
Central Air Conditioners	3,008	533	596	112%	±18%	92% - 131%

These realization rates indicated, on average, cooling equipment incented in the 2015–2016 program period saved between 107%–112% of reported energy.

Table C13, Table C14, and Table C15 present model outputs for each of the three analysis groups.

Table C13. SEER 13 Central Air Conditioner Nonparticipant Regression Model Output

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	153,147	76,574	533.17	<.0001
Error	1,633	234,531	143.62		
Corrected Total	1,635	387,678			
Root MSE		11.9842	R-Square		0.3950
Dependent Mean		29.2712	Adj. R-Square		0.3943
Coeff Var		40.9418			
Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	10.8066	0.7976	13.55	<.0001
Avgcdd	1	1.3297	0.0446	29.82	<.0001
Sqft	1	0.0054	0.0004	14.04	<.0001

Table C14. Evaporative Cooling Equipment Participant Regression Model Output

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	133,631	66,815	1188.35	<.0001
Error	22,002	1,237,070	56.23		
Corrected Total	22,004	1,370,701			
Root MSE		7.4984	R-Square		0.0975
Dependent Mean		19.3748	Adj. R-Square		0.0974
Coeff Var		38.7016			
Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	13.2929	0.1376	96.59	<.0001
Avgcdd	1	0.2400	0.0078	30.79	<.0001
Sqft	1	0.0025	0.0001	39.05	<.0001

Table C15. SEER 15 Central Air Conditioner Participant Regression Model Output

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	792,990	396,495	4098.54	<.0001
Error	17,728	1,715,018	96.74		
Corrected Total	17,730	2,508,008			
Root MSE		9.8357	R-Square		0.3162
Dependent Mean		28.3931	Adj. R-Square		0.3161
Coeff Var		34.6411			
Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	13.3857	0.2147	62.34	<.0001
Avgcdd	1	0.8995	0.0167	79.74	<.0001
Sqft	1	0.0035	0.0001	49.62	<.0001

CADMUS

Appendix D. Self-Reported Net-to-Gross Methodology

Net-to-gross (NTG) estimates provide 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 are customers who would have purchased an incented appliance or equipment without any support from the program (e.g., taking the incentive). Participant spillover is the amount of savings obtained by customers investing in additional energy-efficient measures or activities due to their program participation. Various methods can be used to estimate program freeridership and spillover. For this evaluation, Cadmus used self-reports from survey participants to estimate NTG for appliances, HVAC, weatherization, and kit measure categories; as this method could gauge net effects for many measures at once, it enabled Cadmus to monitor freeridership and spillover over several evaluation efforts.

Survey Design

Direct questions (for example: "Would you have installed measure X without the program incentive?") tend to 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?" An effective solution—and an industry standard—for avoiding such bias involves asking a question in several different ways, then checking for consistent responses.

Cadmus used industry-tested survey questions to determine why customers installed a given measure and what influence the program had on their decisions. For rebate measure participants, Cadmus used the survey to establish what decision makers might have done in the program's absence, via five core freeridership questions:

1. Would participants have installed measures without the program?
2. Had participants ordered or installed the measures before learning about the program?
3. Would participants have installed the measures at the same efficiency levels without the program incentive?
4. Would participants have installed the same quantity of measures without the program?
5. In the program's absence, when would respondents have installed the measures?

Cadmus used a separate set of questions and a scoring approach when estimating 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 the participant already used the measure in their home 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 what decision makers might have done in the program's absence, via the core questions below:

1. Before the participant signed up for the kit, did they already have the measure installed in their home?
2. Was the participant already planning to purchase the measure at the time they signed 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? (For example: at the same time, later but within the same year, or in one year or more?)

Cadmus sought to answer three primary questions using a 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 Rocky Mountain 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 Rocky Mountain 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 addressed each measure (per the survey format):

1. Did you have any other high-efficiency [MEASURE] installed in your home at the time you signed up for the kit?
2. At the time you signed up for the kit, were you already planning on buying high-efficiency [MEASURE] for your home?
3. [*Ask if question 2 is Yes]* In terms of timing, when would you have purchased the high-efficiency [MEASURE]?

Participant Spillover Survey Questions

As noted, Cadmus used the spillover question results to determine whether program participants installed additional energy-saving measures since participating in the program. Savings that participants received from additional measures were considered spillover if the program significantly influenced their decisions to purchase additional measures, provided they did not receive additional incentives for those measures.

Using the surveys, Cadmus specifically asked residential participants whether they installed the following measures:

- Clothes washers
- Refrigerators
- Dishwashers
- Windows
- Fixtures
- Heat pumps
- Ceiling fans
- Electric water heaters
- CFLs
- Insulation

If the participant installed one or more of these measures, Cadmus asked additional questions about what year they purchased the measure, if 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 in the same survey, asked by telephone with randomly selected program participants. Prior to beginning the survey effort, Cadmus pre-tested 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. This included assigning a freeridership score to each question response pattern, and calculating confidence and precision estimates based on the distribution of these scores (a specific approach cited in the National Action Plan for Energy Efficiency's *Handbook on DSM Evaluation*, 2007 edition, page 5-1).

Cadmus left the response patterns and scoring weights explicit; so they could be discussed and changed. This involved using a rules-based approach to assign scoring weights to each response from each freeridership question. This allowed sensitivity analysis to be performed instantaneously, and tested the stability of the response patterns and scoring weights. Scoring weights could be changed for a given response option to a given question. In addition, this provided the following important features:

- Derivation of a partial freeridership score, based on the likelihood of a respondent taking similar actions in the incentive's absence
- Use of a rules-based approach for consistency among multiple respondents
- Use of open-ended questions to ensure quantitative scores matched respondents' more detailed explanations regarding program attribution
- The ability to change weightings in a "what if" exercise, testing the stability of the response patterns and scoring weights

This method offered a key advantage by including partial freeridership. Cadmus' experience has shown that program participants do not fall neatly into freerider and non-freerider categories. The study assigned partial freeridership scores to participants with plans to install the measure before hearing about the program, but for whom the program exerted some influence over their decisions. Further, by including partial freeridership, Cadmus could use "don't know" and "refused" responses rather than removing those respondents entirely from the analysis.

Cadmus assessed rebated measure freeridership at three levels:

1. Converting each participant's survey response into freeridership matrix terminology.
2. Assigning each participant's response combination a score from the matrix.
3. Aggregating all participants into an average freeridership score for the entire program category.

Cadmus assessed freeridership for each kit measure by estimating up to two separate freeridership scores:

1. Estimating a *future intent* freeridership score from questions focused on a participant's *future intent* to buy the kit measure within one year at the time of signing up to receive the kit.
2. In some instances, estimating a *prior use* freeridership score from a question focused on *prior use* of the kit measure in question in the 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 was unsure whether they had already purchased or planned to purchase the measure before learning about the incentive, Cadmus considered them as an unlikely freerider.

Table D1. Assignments of HES Rebate Measure Survey Response Options into Matrix Terminology*

Already planning to purchase?	Already purchased or installed?	Confirmatory: Already purchased installed?	Installed same measure without incentive?	Installed something without incentive?	Installed same efficiency?	Installed same quantity?	Installed at the same time?	Would not have installed measure?	Installed lower efficiency?	Installed lower quantity?	Installed at the same time?
Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Same time (Yes)	Yes (Yes)	Yes (Yes)	Yes (Yes)	Same time (Yes)
No (No)	No (No)	No (No)	No (No)	No (No)	No (No)	No (No)	Within one year (P)	No (No)	No (No)	No (No)	Within one year (P)
DK (No)	DK (No)	DK (No)	DK (No)	DK (P)	DK (P)	DK (P)	Over one year (No)	DK (P)	DK (P)	DK (P)	Over one year (No)
RF (No)	RF (No)	RF (No)	RF (No)	RF (P)	RF (P)	RF (P)	DK (P)	RF (P)	RF (P)	RF (P)	DK (P)
							RF (P)				RF (P)

*In this table, (P) = partial, RF = refused, and DK = don't know.

Participant Freeridership Scoring

Non-lighting Rebate Measure

After converting survey responses into matrix terminology, Cadmus created a freeridership matrix, assigning a freeridership score to each participant's combined responses. In creating the matrix, this process considered all combinations of survey question responses, and assigned each combination a freeridership score of 0% to 100%. Using this matrix, Cadmus scored every participants' combination of responses.

Kit Measure

If a respondent did not plan to purchase a kit measure within one year at the time that they signed up to receive the kit, they were automatically estimated at 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 D2. Kit Measure *Future Intent* Question Freeridership Scoring

Response	*Future Intent* FR Score
Around the same time I received the kit	100%
Later but within the same year	50%
In one year or more	0%
[DON'T READ] Don't Know	25%

If a respondent did not already have any of the measures installed in their home at the time they signed up for the kit, they received a *prior-use* freeridership score of 0%, and this *prior-use* freeridership estimate was averaged with their *future intent* freeridership score only if they would have purchased the measure within one year of when they initially signed 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 also said they did not use any of the measures in their home at the time they signed up for the kit, their *future intent* freeridership score of 100% was averaged with their *prior use* freeridership of 0%, using the arithmetic mean to arrive at a participant's final freeridership score of 50% for the measure. If the respondent said they would have purchased the measure at the same time they received the kit, and used the measure in their home at the time they signed up for the kit, their final freeridership score was 100%, coming from their *future intent* freeridership score.

Measure Category Freeridership Scoring

Non-lighting Rebate Measures

After assigning a freeridership score to every survey respondent, Cadmus calculated a savings-weighted average freerider score for the program category. Using the following calculation, this individually weighted each respondent's freerider scores by the estimated savings from equipment they installed:

$$Savings\ Weighted\ Freeridership = \frac{\sum(Respondent\ FR\ Score) * (Rebated\ Measure\ kWh\ Savings)}{\sum(Rebated\ Measure\ kWh\ Savings\ of\ All\ Respondents)}$$

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. Using the following calculation, this individually weighted each respondent's final measure level freeridership scores by estimated savings from equipment they installed:

$$Measure\ Level\ Savings\ Weighted\ Freeridership = \frac{\sum(Kit\ Measure\ Respondent\ FR\ Score) * (Kit\ Measure\ kWh\ Savings)}{\sum(Kit\ Measure\ kWh\ Savings\ of\ All\ Respondents)}$$

Cadmus then weighted the kit measure-level freeridership estimates by the evaluated gross program population kWh savings to arrive at the overall kit measure category freeridership estimate, using the following equation:

$$Kit\ Measure\ Category\ Weighted\ Freeridership = \frac{\sum(Measure\ Level\ FR\ Score) * (Measure\ Level\ kWh\ Population\ Savings)}{\sum(All\ Kit\ Measures\ Population\ kWh\ Savings)}$$

Cadmus' Rebate Measure Freeridership Scoring Model

Cadmus developed an Excel-based model for calculating freeridership and to improve the consistency and quality of the evaluation's results. The model translated raw survey responses into matrix terminology, and assigned a matrix score to each participant's response pattern. Cadmus aggregated the program participants into program categories to calculate average freeridership scores.

The model incorporated the following inputs:

- Raw survey responses from each participant, along with program categories for their incented measures, and—if applicable—their energy savings from those measures
- 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 combination of responses and corresponding freeridership score, 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.

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 the time they signed up to receive the kit. In some instances, a second freeridership score was estimated 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 they 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 was used 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, and averaged these scores to calculate a kit measure's category-level freeridership score, weighted by each measure's gross evaluated population energy savings.

Participant Spillover Methodology

For the HES Program, Cadmus measured participant spillover by asking a sample of participants about their purchases and whether they received an incentive for a particular measure (if they installed another efficient measure or undertook another energy efficiency activity due to their program participation). Cadmus also asked these respondents to rate the HES Program's (and incentive's) relative influence (e.g., high, 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. The analysis began with a subset of data containing only survey respondents who indicated they installed additional energy-savings measures after participating in the HES Program. From this subset, Cadmus removed participants who said the program had little influence on their decisions to purchase additional measures, solely retaining participants who rated the program as highly influential. Cadmus also removed participants who applied for an HES incentive for the additional measures they installed.

For the remaining participants with spillover savings, Cadmus estimated the energy savings from additional measures installed, and calculated savings values, matching these to additional measures installed by survey participants.

Cadmus calculated the spillover percentage by dividing the sum of additional spillover savings by the total incentivized gross savings achieved by all respondents in the program category:

$$Spillover\ \% = \frac{\sum Spillover\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}{\sum Program\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}$$

CADMUS

Appendix E. 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), resulting in energy savings caused by—but not rebated through—utilities' demand-side management activities.

To understand whether Rocky Mountain 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 Rocky Mountain Power. From the 250 customers surveyed, Cadmus screened out 39 customers who self-reported that they participated in a Rocky Mountain Power residential program during 2015 or 2016. When estimating NPSO, Cadmus excluded these customers from analysis, focusing on identified nonparticipants; thus, the analysis avoided potential double-counting program savings and/or program-specific spillover.

Cadmus limited the NPSO analysis to the same efficiency measures rebated through Rocky Mountain Power's programs (known as "like" spillover). Examples included installing a high-efficiency clothes washer and installing high-efficiency insulation that participants (for whatever reason) did not apply for and hence did not receive an incentive. Cadmus excluded 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 Rocky Mountain Power. This question determined whether Rocky Mountain Power's energy efficiency initiatives motivated energy-efficient purchases. The surveys asked respondents to address the following factors:

- Information about energy efficiency provided by Rocky Mountain Power
- Information from friends or family who installed energy-efficient equipment and received an incentive from Rocky Mountain Power
- Respondents' experiences with past Rocky Mountain Power incentive programs

Cadmus estimated NPSO savings from respondents who rated any of the above factors as "very important" for any reported energy-efficient actions or installations.

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 E1, Cadmus determine total NPSO generated by Rocky Mountain Power's marketing efforts during the 2015–2016 evaluation year.

Table E1. 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 E2
D	Total Residential Customer Nonparticipant Population	Based on 2016 Residential Customer Accounts provided by Rocky Mountain Power and 2015–2016 program tracking Data
E	NPSO kWh Savings Applied to Population	[(A÷B)×C)] × D
F	Total Gross Evaluated Savings	2015-2016 Evaluation
G	NPSO as a Percentage of Total Residential Portfolio Evaluated Savings	E ÷ F

Results

Of 250 Rocky Mountain Power Idaho customers surveyed, three nonparticipant respondents reported installing four different measure types attributed to Rocky Mountain Power's influence. Table E2 presents measures and gross evaluated kWh savings that Cadmus attributed to Rocky Mountain Power Idaho, generating average savings of 69 kWh per NPSO measure.

Table E2. NPSO Response Summary

Reported Spillover Measures	Quantity	Unit Energy Savings (kWh)*	Total Savings (kWh)	Average Savings Per Spillover Measure (kWh)
ENERGY STAR Clothes Washer	1	108.2 per unit	108	
ENERGY STAR Refrigerator	1	176.5 per unit	177	
High-Efficiency Evaporative Cooler	1	804.2 per unit	804	
Windows	13 square feet	0.660 per unit	9	
Total	**16**		**1,097**	**69 (Variable C)**

*Unit energy savings (kWh) estimated for each measure were generated from average 2015–2016 HES evaluated gross savings by measure.

Table E3 presents variables used to estimate overall NPSO for the HES Program, a figure Cadmus estimated as 3% of total Rocky Mountain Power residential ***watt***smart program evaluated savings. Cadmus applied the 3% NPSO equally across the Rocky Mountain Power residential ***watt***smart program measures.

Table E3. NPSO Analysis Results

Variable	Metric	Value	Source
A	Number of Like Spillover Nonparticipant Measures	16	Survey data
B	Total Nonparticipant Customers Surveyed	211	Survey disposition
C	Weighted Average of Per Unit Measures Savings in kWh	69	Calculated in Table E2
D	Total Residential Customer Nonparticipant Population	560,503	Based on 2016 Residential Customer Accounts provided by Rocky Mountain Power and 2015–2016 program tracking Data
E	NPSO kWh Savings Applied to Population	2,915,315	((A÷B)×C)) × D
F	Total Gross Evaluated Savings	107,504,959	2015-2016 Residential ***watt***smart Evaluated Savings
G	NPSO as a Percentage of Total Residential Portfolio Reported Savings	3%	E ÷ F

Appendix F. 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 F1 shows cost-effectiveness inputs for the evaluated results.

Table F1. Utah Measure Category Cost-Effectiveness Inputs

Input Description	2015	2016*	Total
Average Measure Life**			
Appliances	15.3	21.1	15.6
Building Shell	30.0	30.0	20.0
Home Electronics	5.0	N/A	5.0
HVAC	16.4	16.2	16.2
Lighting	9.9	11.8	10.6
Kits	8.1	10.2	8.2
Water Heating	15.0	15.0	15.0
Evaluated Energy Savings (kWh/year)***			
Appliances	641,562	557,733	1,199,296
Building Shell	1,741,790	1,109,512	2,851,302
Home Electronics	413,880	N/A	413,880
HVAC	9,106,522	10,492,241	19,598,763
Lighting	58,083,235	23,522,865	81,606,100
Kits	1,688,263	122,321	1,810,585
Water Heating	6,660	15,191	21,851
Total Utility Cost (excluding incentives)******			
Appliances	$199,187	$191,366	$390,553
Building Shell	$417,945	$312,064	$730,009
Home Electronics	$106,445	N/A	$106,445
HVAC	$2,272,210	$2,987,434	$5,259,644
Lighting	$1,005,561	$1,325,392	$2,330,953
Kits	$181,896	$37,359	$219,255
Water Heating	$1,713	$4,453	4,453
Incentives			
Appliances	$342,201	$246,666	$588,867
Building Shell	$1,033,853	$595,717	$1,629,570
Home Electronics	$206,940	N/A	$206,940
HVAC	$3,545,817	$3,789,346	$7,335,163

Lighting	$8,367,537	$2,164,762	$10,532,299
Kits	$153,291	$20,337	$173,628
Water Heating	$3,350	$7,000	$10,350
Retail Rate	**$0.11**	**$0.11**	

*2016 total costs do not match Table 75 due to an incentive credit of -$1,885 that is not attributed to a specific measure category.

**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 F2, 3, and 4 show cost-effectiveness results for evaluated savings, excluding non-energy impacts. The appliance measure category (again, excluding non-energy impacts) proved not cost-effective from all test perspectives, as shown in Table F2. Table F5 provides annual program non-energy impacts. Table F6, Table F7, and Table F8 provide cost-effectiveness results, including non-energy impacts. The appliance measure category (including non-energy impacts) proved cost-effective from the TRC, PTRC, and PCT perspectives, as shown in Table F6.

Table F2. Utah Appliance 2015-2016 (Excluding Non-Energy Impacts)
(2015 IRP East Plug Load 71%Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.191	$2,374,377	$675,909	($1,698,468)	0.28
TRC	$0.191	$2,374,377	$614,463	($1,759,914)	0.26
UCT	$0.077	$952,069	$614,463	($337,606)	0.65
RIM		$2,369,216	$614,463	($1,754,753)	0.26
PCT		$1,995,773	$1,990,612	($5,161)	1.00
Lifecycle Revenue Impacts ($/kWh)					$0.000039371
Discounted Participant Payback (years)					N/A

Table F3. Utah Appliance 2015 (Excluding Non-Energy Impacts)
(2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.173	$1,216,330	$375,791	($840,538)	0.31
TRC	$0.173	$1,216,330	$341,629	($874,701)	0.28
UCT	$0.077	$541,388	$341,629	($199,759)	0.63
RIM		$1,338,677	$341,629	($997,048)	0.26

PCT		$1,017,143	$1,139,490	$122,347	1.12
Lifecycle Revenue Impacts ($/kWh)					$0.000000973
Discounted Participant Payback (years)					10.52

Table F4. Utah Appliance 2016 (Excluding Non-Energy Impacts) (2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.214	$1,235,173	$320,106	($915,067)	0.26
TRC	$0.214	$1,235,173	$291,005	($944,168)	0.24
UCT	$0.076	$438,032	$291,005	($147,027)	0.66
RIM		$1,099,173	$291,005	($808,168)	0.26
PCT		$1,043,807	$907,807	($136,000)	0.87
Lifecycle Revenue Impacts ($/kWh)					$0.000018414
Discounted Participant Payback (years)					N/A

Table F5. Utah Appliance Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Clothes Washer 2015	$137,203.80	TRC, PTRC, PCT
Clothes Washer 2016	$182,882.88	TRC, PTRC, PCT

Table F6. Utah Appliance 2015-2016 (Including Non-Energy Impacts) (2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.191	$2,374,377	$3,584,066	$1,209,689	1.51
TRC No Adder	$0.191	$2,374,377	$3,522,620	$1,148,243	1.48
UTC	$0.077	$952,069	$614,463	($337,606)	0.65
RIM		$2,369,216	$614,463	($1,754,753)	0.26
PCT		$1,995,773	$4,898,769	$2,902,996	2.45
Lifecycle Revenue Impacts ($/kWh)					$0.000039371
Discounted Participant Payback (years)					4.02

Table F7. Utah Appliance 2015 (Including Non-Energy Impacts)
(2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.173	$1,216,330	$1,682,125	$465,796	1.38
TRC No Adder	$0.173	$1,216,330	$1,647,962	$431,633	1.35
UTC	$0.077	$541,388	$341,629	($199,759)	0.63
RIM		$1,338,677	$341,629	($997,048)	0.26
PCT		$1,017,143	$2,445,824	$1,428,681	2.40
Lifecycle Revenue Impacts ($/kWh)					$0.000022854
Discounted Participant Payback (years)					3.49

Table F8. Utah Appliance 2016 (Including Non-Energy Impacts)
(2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.214	$1,235,173	$2,028,610	$793,437	1.64
TRC No Adder	$0.214	$1,235,173	$1,999,509	$764,336	1.62
UTC	$0.076	$438,032	$291,005	($147,027)	0.66
RIM		$1,099,173	$291,005	($808,168)	0.26
PCT		$1,043,807	$2,616,311	$1,572,504	2.51
Lifecycle Revenue Impacts ($/kWh)					$0.000018414
Discounted Participant Payback (years)					3.50

Appliances—Net Savings

Table F9, Table F10, and Table F11 show cost-effectiveness results for net savings, excluding non-energy impacts. The appliance measure category (again, excluding non-energy impacts) proved not cost-effective from all test perspectives, as shown in Table F9.

Table F12 provides the annual program non-energy impacts. Table F13, Table F14, and Table F15 provide cost-effectiveness results, including non-energy impacts. The appliance measure category (including non-energy impacts) proved cost-effective from the TRC, PTRC, and PCT perspectives, as shown in Table F13.

Table F9. Utah Appliance 2015-2016 Net (Excluding Non-Energy Impacts) (2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.207	$1,675,856	$439,341	($1,236,515)	0.26
TRC	$0.207	$1,675,856	$399,401	($1,276,455)	0.24
UCT	$0.118	$952,069	$399,401	($552,668)	0.42
RIM		$1,873,214	$399,401	($1,473,813)	0.21
PCT		$1,995,773	$1,990,612	($5,161)	1.00
Lifecycle Revenue Impacts ($/kWh)					$0.000033068
Discounted Participant Payback (years)					N/A

Table F10. Utah Appliance 2015 Net (Excluding Non-Energy Impacts) (2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.188	$860,330	$244,264	($616,065)	0.28
TRC	$0.188	$860,330	$222,059	($638,271)	0.26
UCT	$0.118	$541,388	$222,059	($319,329)	0.41
RIM		$1,059,626	$222,059	($837,567)	0.21
PCT		$1,017,143	$1,139,490	$122,347	1.12
Lifecycle Revenue Impacts ($/kWh)					$0.000019199
Discounted Participant Payback (years)					12.13

Table F11. Utah Appliance 2016 Net (Excluding Non-Energy Impacts) (2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.232	$869,841	$208,069	($661,772)	0.24
TRC	$0.232	$869,841	$189,153	($680,687)	0.22
UCT	$0.117	$438,032	$189,153	($248,879)	0.43
RIM		$867,774	$189,153	($678,620)	0.22
PCT		$1,043,807	$907,807	($136,000)	0.87
Lifecycle Revenue Impacts ($/kWh)					$0.000015463
Discounted Participant Payback (years)					N/A

Table F12. Utah Appliance Annual Net Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Clothes Washer 2015	$89,182.47	PTRC, TRC, PCT
Clothes Washer 2016	$118,873.87	PTRC, TRC, PCT

Table F13. Utah Appliance 2015-2016 Net (Including Non-Energy Impacts) (2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.207	$1,675,856	$2,329,643	$653,787	1.39
TRC No Adder	$0.207	$1,675,856	$2,289,703	$613,847	1.37
UTC	$0.118	$952,069	$399,401	($552,668)	0.42
RIM		$1,873,214	$399,401	($1,473,813)	0.21
PCT		$1,995,773	$4,898,769	$2,902,996	2.45
Lifecycle Revenue Impacts ($/kWh)					$0.000033068
Discounted Participant Payback (years)					4.02

Table F14. Utah Appliance 2015 Net (Including Non-Energy Impacts) (2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.188	$860,330	$1,093,381	$233,052	1.27
TRC No Adder	$0.188	$860,330	$1,071,176	$210,846	1.25
UTC	$0.118	$541,388	$222,059	($319,329)	0.41
RIM		$1,059,626	$222,059	($837,567)	0.21
PCT		$1,017,143	$2,445,824	$1,428,681	2.40
Lifecycle Revenue Impacts ($/kWh)					$0.000019199
Discounted Participant Payback (years)					3.49

Table F15. Utah Appliance 2016 Net (Including Non-Energy Impacts)
(2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC + Conservation Adder	$0.232	$869,841	$1,318,596	$448,756	1.52
TRC No Adder	$0.232	$869,841	$1,299,681	$429,841	1.49
UTC	$0.117	$438,032	$189,153	($248,879)	0.43
RIM		$867,774	$189,153	($678,620)	0.22
PCT		$1,043,807	$2,616,311	$1,572,504	2.51
Lifecycle Revenue Impacts ($/kWh)					$0.000015463
Discounted Participant Payback (years)					3.50

HVAC—Evaluated Savings

Table F16, Table F17, and Table F18 show HVAC measure category cost-effectiveness results for evaluated savings, excluding non-energy impacts. The HVAC measure category proved cost-effective from all test perspectives, as shown in Table F16.

Table F16. Utah HVAC 2015-2016
(2015 IRP East Residential Cooling 9% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.057	$12,171,655	$46,825,797	$34,654,142	3.85
TRC	$0.057	$12,171,655	$42,568,907	$30,397,251	3.50
UCT	$0.057	$12,171,655	$42,568,907	$30,397,251	3.50
RIM		$36,814,541	$42,568,907	$5,754,366	1.16
PCT		$2,364,872	$27,007,758	$24,642,885	11.42
Lifecycle Revenue Impacts ($/kWh)					($0.000135000)
Discounted Participant Payback (years)					0.83

Table F17. Utah HVAC 2015
(2015 IRP East Residential Cooling 9% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.063	$5,818,027	$20,118,853	$14,300,826	3.46
TRC	$0.063	$5,818,027	$18,289,866	$12,471,839	3.14
UCT	$0.063	$5,818,027	$18,289,866	$12,471,839	3.14
RIM		$16,441,180	$18,289,866	$1,848,686	1.11
PCT		$1,809,695	$14,044,595	$12,234,900	7.76
Lifecycle Revenue Impacts ($/kWh)					($0.000044480)
Discounted Participant Payback (years)					0.55

Table F18. Utah HVAC 2016
(2015 IRP East Residential Cooling 9% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.057	$6,776,780	$26,025,375	$19,248,595	3.84
TRC	$0.057	$6,776,780	$23,659,432	$16,882,652	3.49
UCT	$0.057	$6,776,780	$23,659,432	$16,882,652	3.49
RIM		$20,529,552	$23,659,432	$3,129,880	1.15
PCT		$592,152	$14,344,924	$13,752,772	24.23
Lifecycle Revenue Impacts ($/kWh)					($0.000074852)
Discounted Participant Payback (years)					0.33

HVAC—Net Savings

Table F19, Table F20, and Table F21 show HVAC measure category cost-effectiveness results for net savings. The HVAC measure category proved cost-effective from all test perspectives, as shown in Table F19.

Table F19. Utah HVAC 2015-2016 Net
(2015 IRP East Residential Cooling 9% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.063	$12,171,655	$41,945,541	$29,773,885	3.45
TRC	$0.063	$12,171,655	$38,132,310	$25,960,654	3.13
UCT	$0.063	$12,171,655	$38,132,310	$25,960,654	3.13
RIM		$34,404,991	$38,132,310	$3,727,319	1.11
PCT		$2,364,872	$27,832,184	$25,467,312	11.77
Lifecycle Revenue Impacts ($/kWh)					($0.000087445)
Discounted Participant Payback (years)					0.83

Table F20. Utah HVAC 2015 Net
(2015 IRP East Residential Cooling 9% Preferred Decrement)

	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.063	$5,818,027	$20,118,853	$14,300,826	3.46
TRC	$0.063	$5,818,027	$18,289,866	$12,471,839	3.14
UCT	$0.063	$5,818,027	$18,289,866	$12,471,839	3.14
RIM		$16,441,180	$18,289,866	$1,848,686	1.11
PCT		$1,809,695	$14,044,595	$12,234,900	7.76
Lifecycle Revenue Impacts ($/kWh)					($0.000044480)
Discounted Participant Payback (years)					0.55

Table F21. Utah HVAC 2016 Net
(2015 IRP East Residential Cooling 9% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.064	$6,776,780	$23,280,345	$16,503,565	3.44
TRC	$0.064	$6,776,780	$21,163,950	$14,387,170	3.12
UCT	$0.064	$6,776,780	$21,163,950	$14,387,170	3.12
RIM		$19,160,201	$21,163,950	$2,003,750	1.10
PCT		$592,152	$14,705,842	$14,113,691	24.83
Lifecycle Revenue Impacts ($/kWh)					($0.000047920)
Discounted Participant Payback (years)					0.33

Lighting – Evaluated Savings

Table F22, Table F23, and Table F24 show cost-effectiveness results for evaluated savings, excluding non-energy impacts. The lighting measure category proved cost-effective from all perspectives except for the RIM and TRC, as show in Table F22.

Table F25 provides the annual program non-energy impacts. Table F26, Table F27, and Table F28 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 F26.

Table F22. Utah Lighting 2015-2016 (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.065	$42,818,590	$43,924,367	$1,105,778	1.03
TRC	$0.065	$42,818,590	$39,931,243	($2,887,347)	0.93
UCT	$0.019	$12,645,322	$39,931,243	$27,285,921	3.16
RIM		$86,216,947	$39,931,243	($46,285,704)	0.46
PCT		$40,570,396	$83,968,753	$43,398,357	2.07
Lifecycle Revenue Impacts ($/kWh)					$0.001263999
Discounted Participant Payback (years)					3.88

Table F23. Utah Lighting 2015 (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.061	$27,937,940	$29,964,694	$2,026,754	1.07
TRC	$0.061	$27,937,940	$27,240,631	($697,309)	0.98
UCT	$0.020	$9,373,098	$27,240,631	$17,867,533	2.91
RIM		$59,903,551	$27,240,631	($32,662,920)	0.45
PCT		$26,932,379	$58,897,990	$31,965,611	2.19
Lifecycle Revenue Impacts ($/kWh)					$0.000928132
Discounted Participant Payback (years)					3.03

Table F24. Utah Lighting 2016 (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.073	$15,871,701	$14,889,387	($982,314)	0.94
TRC	$0.073	$15,871,701	$13,535,806	($2,335,894)	0.85

UCT	$0.016	$3,490,154	$13,535,806	$10,045,652	3.88
RIM		$28,065,868	$13,535,806	($14,530,061)	0.48
PCT		$14,546,309	$26,740,476	$12,194,167	1.84
Lifecycle Revenue Impacts ($/kWh)					$0.000410365
Discounted Participant Payback (years)					5.14

Table F25. Utah Lighting Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Light Bulbs – CFL – 2015	$1,541,025.30	PTRC, TRC, PCT
Light Bulbs – LED – 2015	$988,478.98	PTRC, TRC, PCT
Light Bulbs – CFL -2016	$90,685.95	PTRC, TRC, PCT
Light Bulbs – LED – 2016	$924,306.82	PTRC, TRC, PCT

Table F26. Utah Lighting 2015-2016 (Including Non-Energy Impacts) (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.065	$42,818,590	$69,375,615	$26,557,026	1.62
TRC	$0.065	$42,818,590	$65,382,491	$22,563,901	1.53
UCT	$0.019	$12,645,322	$39,931,243	$27,285,921	3.16
RIM		$86,216,947	$39,931,243	($46,285,704)	0.46
PCT		$40,570,396	$109,420,001	$68,849,605	2.70
Lifecycle Revenue Impacts ($/kWh)					$0.001263999
Discounted Participant Payback (years)					2.82

Table F27. Utah Lighting 2015 (Including Non-Energy Impacts) (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.061	$27,937,940	$47,389,188	$19,451,248	1.70
TRC	$0.061	$27,937,940	$44,665,125	$16,727,185	1.60
UCT	$0.020	$9,373,098	$27,240,631	$17,867,533	2.91
RIM		$59,903,551	$27,240,631	($32,662,920)	0.45
PCT		$26,932,379	$76,322,484	$49,390,104	2.83
Lifecycle Revenue Impacts ($/kWh)					$0.000928132
Discounted Participant Payback (years)					2.14

Table F28. Utah Lighting 2016 (Including Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.073	$15,871,701	$23,450,723	$7,579,023	1.48
TRC	$0.073	$15,871,701	$22,097,143	$6,225,442	1.39
UCT	$0.016	$3,490,154	$13,535,806	$10,045,652	3.88
RIM		$28,065,868	$13,535,806	($14,530,061)	0.48
PCT		$14,546,309	$35,301,812	$20,755,503	2.43
Lifecycle Revenue Impacts ($/kWh)					$0.000410365
Discounted Participant Payback (years)					2.50

Lighting—Net Savings

Table F29, Table F30, and Table F31 show cost-effectiveness results for net savings. The lighting measure category proved cost-effective from the UCT and PCT perspectives, as shown in Table F29.

Table F32 provides the annual program non-energy impacts. Table F33, Table F34, and Table F35 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 perspective, as shown in Table F33.

Table F29. Utah Lighting 2015-2016 Net (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.067	$32,685,813	$32,276,984	($408,829)	0.99
TRC	$0.067	$32,685,813	$29,342,713	($3,343,100)	0.90
UCT	$0.026	$12,645,322	$29,342,713	$16,697,391	2.32
RIM		$66,571,779	$29,342,713	($37,229,067)	0.44
PCT		$40,570,396	$83,968,753	$43,398,357	2.07
Lifecycle Revenue Impacts ($/kWh)					$0.001016675
Discounted Participant Payback (years)					3.88

Table F30. Utah Lighting 2015 Net (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.064	$22,555,627	$23,166,963	$611,335	1.03
TRC	$0.064	$22,555,627	$21,060,875	($1,494,752)	0.93

UCT	$0.027	$9,373,098	$21,060,875	$11,687,777	2.25
RIM		$48,266,180	$21,060,875	($27,205,304)	0.44
PCT		$26,932,379	$58,897,990	$31,965,611	2.19
Lifecycle Revenue Impacts ($/kWh)					$0.000773051
Discounted Participant Payback (years)					3.03

Table F31. Utah Lighting 2016 Net (Excluding Non-Energy Impacts) (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.076	$10,804,856	$9,716,749	($1,088,107)	0.90
TRC	$0.076	$10,804,856	$8,833,408	($1,971,448)	0.82
UCT	$0.025	$3,490,154	$8,833,408	$5,343,254	2.53
RIM		$19,524,753	$8,833,408	($10,691,345)	0.45
PCT		$14,546,309	$26,740,476	$12,194,167	1.84
Lifecycle Revenue Impacts ($/kWh)					$0.000301950
Discounted Participant Payback (years)					5.14

Table F32. Utah Lighting Annual Net Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Light Bulbs – CFL - 2015	$955,435.69	PTRC, TRC, PCT
Light Bulbs – LED - 2015	$850,091.92	PTRC, TRC, PCT
Light Bulbs – CFL -2016	$56,225.29	PTRC, TRC, PCT
Light Bulbs – LED - 2016	$600,799.43	PTRC, TRC, PCT

Table F33. Utah Lighting 2015-2016 Net (Including Non-Energy Impacts) (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.067	$32,685,813	$50,610,629	$17,924,816	1.55
TRC	$0.067	$32,685,813	$47,676,358	$14,990,545	1.46
UCT	$0.026	$12,645,322	$29,342,713	$16,697,391	2.32
RIM		$66,571,779	$29,342,713	($37,229,067)	0.44
PCT		$40,570,396	$109,420,001	$68,849,605	2.70
Lifecycle Revenue Impacts ($/kWh)					$0.001016675
Discounted Participant Payback (years)					2.82

Table F34. Utah Lighting 2015 Net (Including Non-Energy Impacts) (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.064	$22,555,627	$36,294,686	$13,739,058	1.61
TRC	$0.064	$22,555,627	$34,188,598	$11,632,971	1.52
UCT	$0.027	$9,373,098	$21,060,875	$11,687,777	2.25
RIM		$48,266,180	$21,060,875	($27,205,304)	0.44
PCT		$26,932,379	$76,322,484	$49,390,104	2.83
Lifecycle Revenue Impacts ($/kWh)					$0.000773051
Discounted Participant Payback (years)					2.14

Table F35. Utah Lighting 2016 Net (Including Non-Energy Impacts) (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.076	$10,804,856	$15,269,385	$4,464,530	1.41
TRC	$0.076	$10,804,856	$14,386,045	$3,581,189	1.33
UCT	$0.025	$3,490,154	$8,833,408	$5,343,254	2.53
RIM		$19,524,753	$8,833,408	($10,691,345)	0.45
PCT		$14,546,309	$35,301,812	$20,755,503	2.43
Lifecycle Revenue Impacts ($/kWh)					$0.000301950
Discounted Participant Payback (years)					2.50

Building Shell—Evaluated Savings

Table F36, Table F37, and Table F38 show building shell measure category cost-effectiveness results for evaluated savings. The building shell measure category proved cost-effective from the UCT perspective, as shown in Table F36.

Table F36. Utah Building Shell 2015-2016
(2015 IRP East Residential House 31% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.217	$9,035,952	$3,165,965	($5,869,987)	0.35
TRC	$0.217	$9,035,952	$2,878,150	($6,157,802)	0.32
UCT	$0.055	$2,302,896	$2,878,150	$575,254	1.25
RIM		$7,474,851	$2,878,150	($4,596,701)	0.39
PCT		$8,325,429	$6,764,328	($1,561,101)	0.81
Lifecycle Revenue Impacts ($/kWh)					$0.000091221
Discounted Participant Payback (years)					N/A

Table F37. Utah Building Shell 2015
(2015 IRP East Residential House 31% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.233	$6,066,033	$1,958,257	($4,107,776)	0.32
TRC	$0.233	$6,066,033	$1,780,234	($4,285,799)	0.29
UCT	$0.056	$1,451,798	$1,780,234	$328,436	1.23
RIM		$4,667,053	$1,780,234	($2,886,820)	0.38
PCT		$5,648,088	$4,249,108	($1,398,979)	0.75
Lifecycle Revenue Impacts ($/kWh)					$0.000057961
Discounted Participant Payback (years)					N/A

Table F38. Utah Building Shell 2016
(2015 IRP East Residential House 31% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.191	$3,167,716	$1,288,141	($1,879,575)	0.41
TRC	$0.191	$3,167,716	$1,171,037	($1,996,679)	0.37
UCT	$0.055	$907,781	$1,171,037	$263,256	1.29
RIM		$2,994,797	$1,171,037	($1,823,760)	0.39
PCT		$2,855,652	$2,682,733	($172,919)	0.94
Lifecycle Revenue Impacts ($/kWh)					$0.000036404
Discounted Participant Payback (years)					N/A

Building Shell—Net Savings

Table F39, Table F40, and Table F41 show building shell measure category cost-effectiveness results for net evaluated savings. The building shell measure category proved cost-effective from the PCT perspective, as shown in Table F39.

Table F39. Utah Building Shell 2015-2016 Net
(2015 IRP East Residential House 31% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.217	$9,013,134	$3,151,548	($5,861,586)	0.35
TRC	$0.217	$9,013,134	$2,865,043	($6,148,091)	0.32
UCT	$0.056	$2,302,896	$2,865,043	$562,148	1.24
RIM		$7,451,363	$2,865,043	($4,586,320)	0.38
PCT		$8,325,429	$6,764,328	($1,561,101)	0.81
Lifecycle Revenue Impacts ($/kWh)					$0.000091015
Discounted Participant Payback (years)					N/A

Table F40. Utah Building Shell 2015 Net
(2015 IRP East Residential House 31% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.233	$6,056,142	$1,952,292	($4,103,850)	0.32
TRC	$0.233	$6,056,142	$1,774,811	($4,281,331)	0.29
UCT	$0.056	$1,451,798	$1,774,811	$323,013	1.22
RIM		$4,657,259	$1,774,811	($2,882,448)	0.38
PCT		$5,648,088	$4,249,108	($1,398,979)	0.75
Lifecycle Revenue Impacts ($/kWh)					$0.000057874
Discounted Participant Payback (years)					N/A

Table F41. Utah Building Shell 2016 Net
(2015 IRP East Residential House 31% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.191	$3,153,928	$1,279,126	($1,874,801)	0.41
TRC	$0.191	$3,153,928	$1,162,842	($1,991,086)	0.37
UCT	$0.055	$907,781	$1,162,842	$255,061	1.28
RIM		$2,980,192	$1,162,842	($1,817,350)	0.39
PCT		$2,855,652	$2,682,733	($172,919)	0.94
Lifecycle Revenue Impacts ($/kWh)					$0.000036276

Discounted Participant Payback (years)	N/A

Kits—Evaluated Savings

Table F42, Table F43, and Table F44 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 F42.

Table F45 provides the annual program non-energy impacts. Table F46, Table F47, and Table F48 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 F46.

Table F42. Utah Kits 2015-2016 (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.033	$415,002	$795,122	$380,120	1.92
TRC	$0.033	$415,002	$722,838	$307,836	1.74
UCT	$0.031	$389,280	$722,838	$333,558	1.86
RIM		$1,763,800	$722,838	($1,040,962)	0.41
PCT		$198,080	$1,546,878	$1,348,798	7.81
Lifecycle Revenue Impacts ($/kWh)					$0.000032453
Discounted Participant Payback (years)					0.33

Table F43. Utah Kits 2015 (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.030	$357,251	$731,457	$374,207	2.05
TRC	$0.030	$357,251	$664,961	$307,710	1.86
UCT	$0.029	$335,187	$664,961	$329,774	1.98
RIM		$1,602,918	$664,961	($937,957)	0.41
PCT		$175,355	$1,421,022	$1,245,668	8.10
Lifecycle Revenue Impacts ($/kWh)					$0.000030877
Discounted Participant Payback (years)					0.52

Table F44. Utah Kits 2016 (Excluding Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.060	$61,598	$67,905	$6,307	1.10
TRC	$0.060	$61,598	$61,732	$134	1.00
UCT	$0.057	$57,696	$61,732	$4,036	1.07
RIM		$171,596	$61,732	($109,865)	0.36
PCT		$24,239	$134,237	$109,998	5.54
Lifecycle Revenue Impacts ($/kWh)					$0.000003595
Discounted Participant Payback (years)					0.71

Table F45. Utah Kits Annual Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Kits – 2015	$143,789.43	PTRC, TRC, PCT
Kits – 2016	$9,875.81	PTRC, TRC, PCT

Table F46. Utah Kits 2015-2016 (Including Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.033	$415,002	$1,849,047	$1,434,045	4.46
TRC	$0.033	$415,002	$1,776,764	$1,361,762	4.28
UCT	$0.031	$389,280	$722,838	$333,558	1.86
RIM		$1,763,800	$722,838	($1,040,962)	0.41
PCT		$198,080	$2,600,803	$2,402,723	13.13
Lifecycle Revenue Impacts ($/kWh)					$0.000032453
Discounted Participant Payback (years)					0.59

Table F47. Utah Kits 2015 (Including Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.030	$357,251	$1,714,928	$1,357,677	4.80
TRC	$0.030	$357,251	$1,648,432	$1,291,181	4.61
UCT	$0.029	$335,187	$664,961	$329,774	1.98
RIM		$1,602,918	$664,961	($937,957)	0.41
PCT		$175,355	$2,404,493	$2,229,138	13.71
Lifecycle Revenue Impacts ($/kWh)					$0.000030877

Discounted Participant Payback (years)	0.36

Table F48. Utah Kits 2016 (Including Non-Energy Impacts)
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.060	$61,598	$143,052	$81,454	2.32
TRC	$0.060	$61,598	$136,879	$75,281	2.22
UCT	$0.057	$57,696	$61,732	$4,036	1.07
RIM		$171,596	$61,732	($109,865)	0.36
PCT		$24,239	$209,385	$185,146	8.64
Lifecycle Revenue Impacts ($/kWh)					$0.000003595
Discounted Participant Payback (years)					0.55

Kits—Net Savings

Table F49, Table F50, and Table F51 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 F49, which Table F50 provides the annual program non-energy impacts.

Table F52 provides the annual program non-energy impacts. Table F53, Table F54, and Table F55 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 F53.

Table F49. Utah Kits 2015-2016 (Excluding Non-Energy Impacts) Net
(2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.035	$393,213	$707,658	$314,445	1.80
TRC	$0.035	$393,213	$643,326	$250,113	1.64
UCT	$0.034	$389,280	$643,326	$254,045	1.65
RIM		$1,612,603	$643,326	($969,277)	0.40
PCT		$198,080	$1,546,878	$1,348,798	7.81
Lifecycle Revenue Impacts ($/kWh)					$0.000030218
Discounted Participant Payback (years)					0.33

Table F50. Utah Kits 2015 (Excluding Non-Energy Impacts) Net (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.032	$337,962	$650,997	$313,035	1.93
TRC	$0.032	$337,962	$591,815	$253,854	1.75
UCT	$0.032	$335,187	$591,815	$256,628	1.77
RIM		$1,463,468	$591,815	($871,652)	0.40
PCT		$175,355	$1,421,022	$1,245,668	8.10
Lifecycle Revenue Impacts ($/kWh)					$0.000028694
Discounted Participant Payback (years)					0.52

Table F51. Utah Kits 2016 (Excluding Non-Energy Impacts) Net (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.065	$58,932	$60,435	$1,504	1.03
TRC	$0.065	$58,932	$54,941	($3,990)	0.93
UCT	$0.064	$57,696	$54,941	($2,755)	0.95
RIM		$159,067	$54,941	($104,126)	0.35
PCT		$24,239	$134,237	$109,998	5.54
Lifecycle Revenue Impacts ($/kWh)					$0.000003407
Discounted Participant Payback (years)					0.71

Table F52. Utah Kits Annual Net Non-Energy Impacts

Measure	Annual Value	Perspective Adjusted
Kits – 2015	$143,789.43	PTRC, TRC, PCT
Kits – 2016	$9,875.81	PTRC, TRC, PCT

Table F53. Utah Kits 2015-2016 (Including Non-Energy Impacts) Net (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.035	$393,213	$1,645,652	$1,252,439	4.19
TRC	$0.035	$393,213	$1,581,320	$1,188,106	4.02
UCT	$0.034	$389,280	$643,326	$254,045	1.65
RIM		$1,612,603	$643,326	($969,277)	0.40
PCT		$198,080	$2,600,803	$2,402,723	13.13
Lifecycle Revenue Impacts ($/kWh)					$0.000030218

Discounted Participant Payback (years)	0.59

Table F54. Utah Kits 2015 (Including Non-Energy Impacts) Net (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.032	$337,962	$1,526,286	$1,188,324	4.52
TRC	$0.032	$337,962	$1,467,104	$1,129,143	4.34
UCT	$0.032	$335,187	$591,815	$256,628	1.77
RIM		$1,463,468	$591,815	($871,652)	0.40
PCT		$175,355	$2,404,493	$2,229,138	13.71
Lifecycle Revenue Impacts ($/kWh)					$0.000028694
Discounted Participant Payback (years)					0.36

Table F55. Utah Kits 2016 (Including Non-Energy Impacts) Net (2015 IRP East Residential Lighting 47% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.065	$58,932	$127,316	$68,385	2.16
TRC	$0.065	$58,932	$121,822	$62,891	2.07
UCT	$0.064	$57,696	$54,941	($2,755)	0.95
RIM		$159,067	$54,941	($104,126)	0.35
PCT		$24,239	$209,385	$185,146	8.64
Lifecycle Revenue Impacts ($/kWh)					$0.000003407
Discounted Participant Payback (years)					0.55

Electronics—Evaluated Savings

Table F56 shows the electronics measure category's cost-effectiveness results for evaluated savings. The electronics measure category proved not to be cost-effective from any of the test perspectives.

Table F56. Utah Electronics 2015
(2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.274	$547,917	$80,964	($466,953)	0.15
TRC	$0.274	$547,917	$73,604	($474,313)	0.13
UCT	$0.157	$313,385	$73,604	($239,781)	0.23
RIM		$522,463	$73,604	($448,859)	0.14
PCT		$441,472	$416,018	($25,454)	0.94
Lifecycle Revenue Impacts ($/kWh)					$0.000029393
Discounted Participant Payback (years)					N/A

Electronics—Net Savings

Table F57 shows electronics measure category cost-effectiveness results for net savings. The electronics measure category proved not to be cost-effective from any of the test perspectives.

Table F57. Utah Electronics 2015 Net
(2015 IRP East Plug Load 71% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.284	$481,696	$68,820	($412,877)	0.14
TRC	$0.284	$481,696	$62,563	($419,133)	0.13
UCT	$0.185	$313,385	$62,563	($250,822)	0.20
RIM		$491,101	$62,563	($428,538)	0.13
PCT		$441,472	$416,018	($25,454)	0.94
Lifecycle Revenue Impacts ($/kWh)					$0.000028063
Discounted Participant Payback (years)					N/A

Water Heating —Evaluated Savings

Table F58, Table F59, and Table F60 show the water heating measure category's cost-effectiveness results for evaluated savings. The water heating measure category proved cost-effective only from the PCT perspective, as shown in Table F58.

Table F58. Utah Water Heating 2015-2016
(2015 IRP East Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.117	$26,529	$14,228	($12,300)	0.54
TRC	$0.117	$26,529	$12,935	($13,594)	0.49
UCT	$0.070	$15,801	$12,935	($2,866)	0.82
RIM		$41,785	$12,935	($28,850)	0.31
PCT		$20,641	$35,897	$15,256	1.74
Lifecycle Revenue Impacts ($/kWh)					$0.000000788
Discounted Participant Payback (years)					5.71

Table F59. Utah Water Heating 2015
(2015 IRP East Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.110	$7,919	$4,403	($3,516)	0.56
TRC	$0.110	$7,919	$4,002	($3,916)	0.51
UCT	$0.070	$5,063	$4,002	($1,061)	0.79
RIM		$13,236	$4,002	($9,234)	0.30
PCT		$6,206	$11,523	$5,317	1.86
Lifecycle Revenue Impacts ($/kWh)					$0.000000262
Discounted Participant Payback (years)					4.17

Table F60. Utah Water Heating 2016
(2015 IRP East Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.120	$19,849	$10,480	($9,369)	0.53
TRC	$0.120	$19,849	$9,527	($10,322)	0.48
UCT	$0.069	$11,453	$9,527	($1,926)	0.83
RIM		$30,450	$9,527	($20,922)	0.31
PCT		$15,396	$25,997	$10,600	1.69
Lifecycle Revenue Impacts ($/kWh)					$0.000000591
Discounted Participant Payback (years)					5.42

Water Heating —Net Savings

Table F61,

Table F62, and

Table F63 show water heating measure category cost-effectiveness results for net savings. The water heating measure category proved cost-effective only from the PCT perspective, as shown in Table F61.

Table F61. Utah Water Heating 2015-2016 Net
(2015 IRP East Water Heating 53% Preferred Decrement)

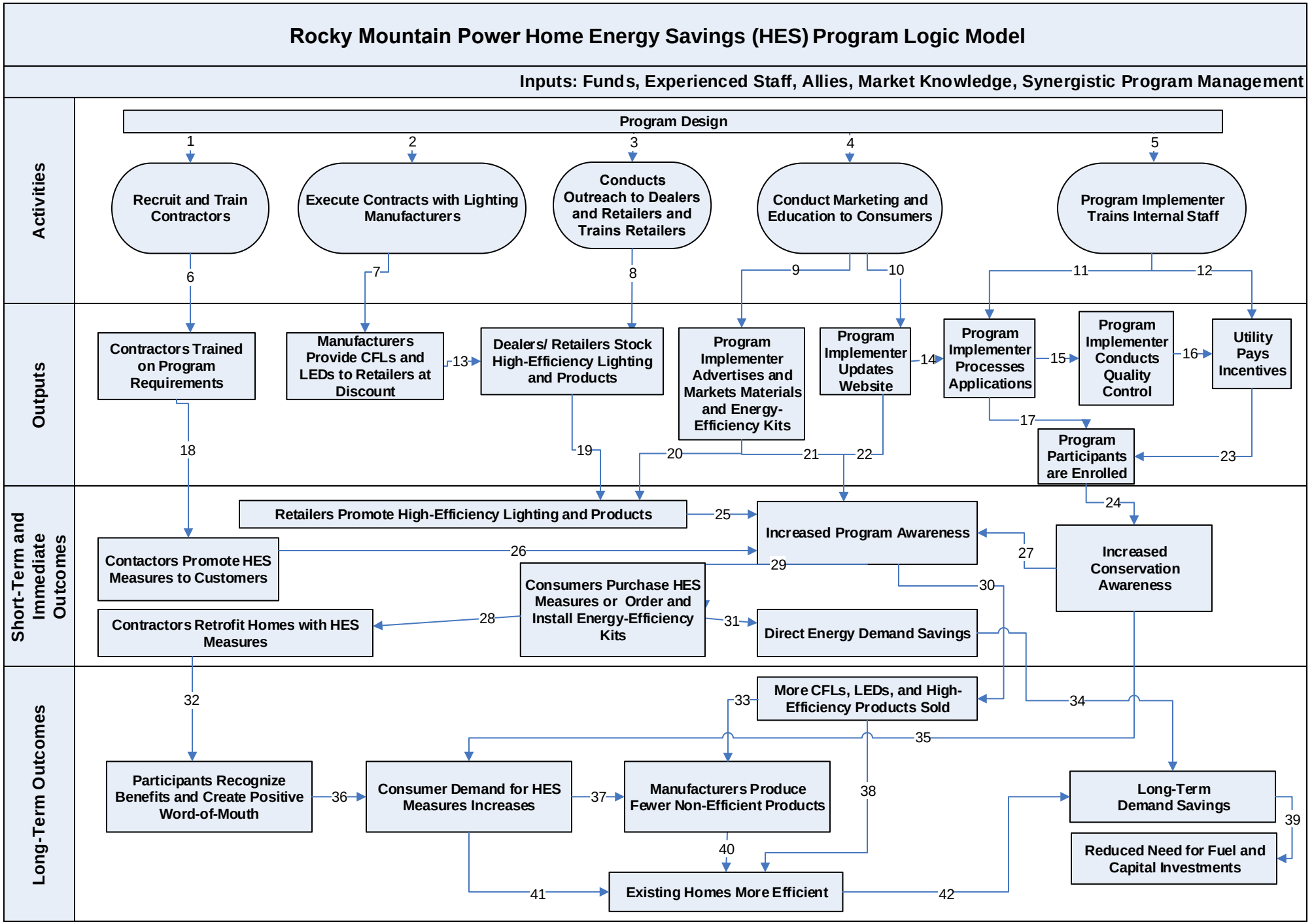
Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.121	$23,805	$12,326	($11,479)	0.52
TRC	$0.121	$23,805	$11,206	($12,599)	0.47
UCT	$0.080	$15,801	$11,206	($4,595)	0.71
RIM		$38,309	$11,206	($27,104)	0.29
PCT		$20,641	$35,897	$15,256	1.74
Lifecycle Revenue Impacts ($/kWh)					$0.000000740
Discounted Participant Payback (years)					5.71

Table F62. Utah Water Heating 2015 Net
(2015 IRP East Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.114	$7,071	$3,778	($3,293)	0.53
TRC	$0.114	$7,071	$3,434	($3,637)	0.49
UCT	$0.082	$5,063	$3,434	($1,629)	0.68
RIM		$12,076	$3,434	($8,642)	0.28
PCT		$6,206	$11,523	$5,317	1.86
Lifecycle Revenue Impacts ($/kWh)					$0.000000246
Discounted Participant Payback (years)					4.17

Table F63. Utah Water Heating 2016 Net
(2015 IRP East Water Heating 53% Preferred Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.124	$17,848	$9,118	($8,730)	0.51
TRC	$0.124	$17,848	$8,289	($9,559)	0.46
UCT	$0.080	$11,453	$8,289	($3,164)	0.72
RIM		$27,980	$8,289	($19,691)	0.30
PCT		$15,396	$25,997	$10,600	1.69
Lifecycle Revenue Impacts ($/kWh)					$0.000000556
Discounted Participant Payback (years)					5.42


Rocky Mountain 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
Program Participants are Enrolled
18
19
20
21
22
23
24
Retailers Promote High-Efficiency Lighting and Products
25
Increased Program Awareness
Contactors Promote HES Measures to Customers
26
27
Increased Conservation Awareness
29
30
Consumers Purchase HES Measures or Order and Install Energy-Efficiency Kits
Contractors Retrofit Homes with HES Measures
28
31
Direct Energy Demand Savings
32
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

CADMUS

Appendix H. Benchmark Detail

The tables in this appendix provide additional detail on programs included in Cadmus' benchmark review of residential lighting and non-lighting.

Table H1. Residential Upstream Lighting Programs

Utility, State	Program Name	Implementer	Measure Detail	Program Year	Units	Net MWh	kWh/ Unit	NTG	WHF	HOU	ISR
Pacific Power, UT	HES	CLEAResult	CFLs (Gen Purpose) CFLs (Specialty) CFL Fixtures	2015–2016	4,277,357	57,554	13	71%	1.014	1.87	70%
			LEDs (Gen Purpose) LEDs (Specialty) LED Fixtures								79%
Ameren, MO	Residential Lighting	ICF	LEDs: 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	64%	0.99	3.15	88%
EmPOWER, MD	Residential Lighting	ICF, Honeywell	CFL Lamps, LED Lamps and Efficient Fixtures Standard/Specialty CFLs, Standard/ Specialty LEDs, and ENERGY STAR Fixtures	1/1/2016–5/31/2016	2,442,683	47,519	20	61%	0.915 to 0.963	2.46	90%
Salt River Project, AZ	Retail Lighting	SRP	CFLs	FY17	693,595	30,488	44	100%	1.075	2.5	99%
PPL, PA	Residential Retail	Ecova	LEDs	6/1/2015–5/31/2016	1,419,223	39,278	28	61%	0.94	2.8	97%

Table H2. 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 Multispeed ES Pool Pumps Var Speed Smart Thermostats	2016	HPWHs: 322 RACs: 324 Room Air Purifiers: 1,300 Multispeed 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 Multispeed: $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; 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%

Utility/PA, State	Program Name	Implementer	Measure Detail	Program Year	Participation	Gross MWh*	NTG
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
Energy Trust, OR	Exiting Homes	CLEAResult	1) Incentives for OR homes that install energy-efficient electric or gas measures 2) Incentives for NW Natural customers in SW WA who install gas measures 3) Energy Saver Kits: LED lightbulbs, 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 Multispeed ES Pool Pumps Var Speed Smart Thermostats	2016	HPWHs: 322 RACs: 324 Room Air Purifiers: 1,300 Multispeed 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%

Utility/PA, State	Program Name	Implementer	Measure Detail	Program Year	Participation	Gross MWh*	NTG
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 Multispeed: $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; includes efficient fossil-fuel water heaters eligible for rebates under the fuel-switching pilot.	PY7	Refrigerators HPWHs Efficient Fossil-Fuel WHs: 4,417	3,053	64%

Utility/PA, State	Program Name	Implementer	Measure Detail	Program Year	Participation	Gross MWh*	NTG
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
Energy Trust, OR	Exiting Homes	CLEAResult	1) Incentives for OR homes that install energy-efficient electric or gas measures 2) Incentives for NW Natural customers in SW WA who install gas measures 3) Energy Saver Kits: LED lightbulbs, 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, defined as values determined by evaluators, derived from final evaluation reports.