2013–2014 Report: Wyoming Home Energy Savings Program Evaluation

October 20, 2016

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List of Acronyms

Acronym	Term
CDD	Cooling degree days
CFL	Compact fluorescent lamp / light bulb
CV	Coefficient of variation
DHW	Domestic hot water
EISA	Energy Independence and Security Act of 2007
HDD	Heating degree days
HES	Home Energy Savings
HOU	Hours of use
HVAC	Heating, ventilation, and air conditioning
ISR	In-service rate (also installation service rate)
KPI	Key performance indicator
kWh	Kilowatt-hour
LED	Light-emitting diode
NTG	Net-to-gross
PCT	Participant cost test
PTRC	PacifiCorp Total Resource Test
RIM	Rate impact measure
SEER	Seasonal Energy Efficiency Rating
SKU	Stock keeping unit
TMY	Typical meteorological year
TRC	Total resource cost
TRM	Technical Reference Manual
UCT	Utility cost test
UMP	Uniform Methods Project

Glossary of Terms

Analysis of Covariance (ANCOVA)

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

Evaluated Gross Savings

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

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

Evaluated Net Savings

Evaluated net savings are the program savings net of what would have occurred in the program's absence. These savings are the observed impacts attributable to the program. Net savings are calculated as the product of evaluated gross savings and net-to-gross (NTG) ratio:

$$Net\ Savings = Evaluated\ Gross\ Savings * NTG$$

Freeridership

Freeridership in energy-efficiency programs is participants who would have adopted the energy-efficient measure in the program's absence. This is often expressed as the freeridership rate, or the proportion of evaluated gross savings that can be classified as freeridership.

Gross Realization Rate

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

In-Service Rate (ISR)

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

Net-to-Gross (NTG)

The NTG ratio is the ratio of net savings to evaluated gross savings. Analytically, NTG is defined as:

$$NTG = (1 - Freeridership\ Rate) + Spillover\ Rate$$

P-Value

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

Spillover

Spillover is the adoption of an energy-efficiency measure induced by the program's presence, but not directly funded by the program. As with freeridership, this is expressed as a fraction of evaluated gross savings (or the *spillover rate*).

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 that there is a 90% probability that the estimated coefficient is different from zero.

Trade Ally

For the purposes of the process evaluation, trade allies are respondents of the participant retailer/contractor survey. Trade allies include retailers and contractors who supply and install discounted compact florescent lamps (CFLs), appliances, HVAC, or insulation through the program.

Executive Summary

Rocky Mountain Power first offered the Home Energy Savings (HES) Program in Wyoming in 2009. The program provides residential customers with incentives to facilitate their purchases of energy-efficient products and services through upstream (manufacturer) and downstream (customer) incentive mechanisms.

During the 2013 and 2014 program years, Rocky Mountain Power's HES program reported gross electricity savings of 13,608,555 kWh. The largest of Rocky Mountain Power's Wyoming residential programs, the HES program contributed 87% of the reported Wyoming residential portfolio savings and 32% of Wyoming's total wattsmart portfolio savings in 2013 and 2014.[1]

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

- ***Appliances:*** Rocky Mountain Power provided customer incentives for efficient clothes washers, dishwashers, refrigerators, freezers, room air conditioners, portable evaporative coolers, ceiling fans, light fixtures, and high-efficiency electric storage water heaters.
- ***Home Electronics:*** Rocky Mountain Power provided customer incentives for desktop computers, flat panel TVs, and monitors. These incentives were discontinued in 2015.
- ***Heating, ventilation, and air conditioning (HVAC):*** Rocky Mountain Power provided customer incentives for high-efficiency heating and cooling equipment and services, heat pump water heaters, and duct sealing and insulation.
- ***Lighting:*** Rocky Mountain Power provided upstream incentives for manufacturers to reduce retail prices on CFLs, and began providing light fixtures upstream starting in 2015.
- ***Weatherization:*** Rocky Mountain Power provided customer incentives for attic, wall, and floor insulation as well as for high-efficiency windows.

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

[1] Residential portfolio and total portfolio savings (at the customer site) sourced from the 2013 and 2014 Rocky Mountain Power Wyoming annual reports.

Key Findings

Cadmus' impact evaluation addressed over 99% of the HES program savings. Cadmus collected primary data on the top savings measures, performed billing analyses for insulation and the duct sealing/insulation measures, and completed engineering reviews using secondary data for the remaining measures. CFLs, which accounted for almost 73% of total HES program reported savings, were the primary focus of the evaluation.

Key Impact Evaluation Findings

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

- ***Appliances:*** Overall, Cadmus estimated a gross realization rate of 91% of reported savings for the appliance measure category. Incented appliances showed an overall installation rate of 100%. Evaluated gross savings realization rates ranged from 35% for light fixtures to 314% for refrigerators. Refrigerators realized a high evaluated gross savings mainly because of differences in the baselines between reported and evaluated savings (current practice baseline vs. federal standard baseline). Appliance measures had a savings-weighted net-to-gross (NTG) ratio of 54%.
- ***Home Electronics:*** Overall, Cadmus estimated a gross realization rate of 21% of reported savings for the home electronics measure category. Incented home electronics showed an overall installation rate of 100%. Evaluated gross savings realization rates ranged from 21% for flat panel TVs to 100% for desktop computers and monitors. Flat panel TVs realized low evaluated gross savings because ENERGY STAR® updated its standards to a more efficient baseline. Home electronics measures had a savings-weighted NTG of 100%.
- ***HVAC:*** Overall, the HVAC measure category realized 87% of reported gross savings. Evaluated gross savings realization rates ranged from 48% (ductless heat pumps) to 100% (central air conditioning, evaporative coolers and heat pump water heaters). Overall, Cadmus estimated an 89% net realization rate for the duct sealing and insulation category. HVAC measures had a savings-weighted NTG of 97%.
- ***Lighting:*** Incented CFL bulbs realized 71% installation rates, based on installation, storage, and removal practices reported through telephone surveys. The HES lighting component realized 69% of reported savings and had a weighted NTG of 58%.
- ***Weatherization:*** Overall, Cadmus estimated a 102% net realization rate for the weatherization measure category,[2] consisting of attic, wall, and floor insulation as well as windows. Cadmus evaluated the insulation measures using a billing analysis that produced a net realization rate, and therefore did not apply a net adjustment to those particular measures, resulting in the high NTG ratio for the entire measure category.

[2] Billing analysis for insulation consisted of comparing a participant group to a nonparticipant group, which produced net realization rates.

Table 1. 2013 and 2014 HES Program Savings*

Measure Category	Evaluated Units**	Reported Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Gross Realization Rate	Precision (at 90% Confidence)	Evaluated Net Savings (kWh)	NTG
Appliance	10,688	847,108	773,076	91%	±3%	417,461	54%
Home Electronics	2,528	451,444	94,209	21%	±3%	94,042	100%
HVAC	338	977,198	851,670	87%	±9%	830,049	97%
Lighting	406,202	9,878,768	6,841,061	69%	±4%	3,983,983	58%
Weatherization***	646,474	1,454,037	1,480,012	102%	±38%	1,479,346	100%
Total	**1,066,230**	**13,608,555**	**10,040,028**	**74%**	**±6%**	**6,804,880**	**68%**

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

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

***The evaluated units for the Weatherization category includes five bonus incentives.

Table 2 and Table 3 show impact evaluation findings by program year. The change in the lighting and overall realization rates are mainly caused by an increase in the gross realization rate for CFLs from 63% in 2013 to 77% in 2014.

Net-to-gross ratios were applied to each measure consistently across the two program years. Most measure-category NTG ratios were the same for 2013 and 2014. The HVAC measure category NTG ratio changed slightly simply because of changes in participation and savings.

Table 2. 2013 HES Program Savings*

Measure Category	Evaluated Units**	Reported Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Gross Realization Rate	Evaluated Net Savings (kWh)	NTG
Appliances	3,487	278,635	375,578	135%	202,812	54%
Home Electronics	1,267	226,424	44,569	20%	44,491	100%
HVAC	125	627,165	548,543	87%	542,605	99%
Lighting	177,123	5,579,608	3,523,601	63%	2,052,016	58%
Weatherization***	456,592	905,734	921,934	102%	921,734	100%
Total	**638,594**	**7,617,566**	**5,414,225**	**71%**	**3,763,658**	**70%**

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

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

***The evaluated units for the Weatherization category includes two bonus incentives.

Table 3. 2014 HES Program Savings*

Measure Category	Evaluated Units**	Reported Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Gross Realization Rate	Evaluated Net Savings (kWh)	NTG
Appliances	7,201	568,473	397,498	70%	214,649	54%
Home Electronics	1,261	225,020	49,640	22%	49,550	100%
HVAC	213	350,033	303,126	87%	287,444	95%
Lighting	229,079	4,299,160	3,317,460	77%	1,931,967	58%
Weatherization	189,883	548,303	558,078	102%	557,612	100%
Total	**427,637**	**5,990,989**	**4,625,803**	**77%**	**3,041,222**	**66%**

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

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

***The evaluated units for the Weatherization category includes three bonus incentives.

Key Process Evaluation Findings

Key process evaluation findings include the following:

- Retailers (32%) and bill inserts (23%) constituted the most commonly cited sources of program awareness for non-lighting participants, while the general population most commonly mentioned bill inserts (44%) and television ads (12%) as ways they learned about the wattsmart offerings.
- Efforts to improve the ease of completing the non-lighting incentive application appear to have had a positive effect on the time it took for participants to receive their incentive and their satisfaction with the process.
  - Sixty-four percent of survey respondents found the incentive application very easy to fill out, and 33% said it was somewhat easy.
  - Eighty-four percent of respondents reported satisfaction with the time required to receive the incentive.
  - Thirty-six percent of respondents said that it took less than four weeks to receive their incentive, compared to 20% in 2011–2012.
- Non-lighting participants expressed overwhelming satisfaction (98%) with the program overall. In addition, non-lighting customers expressed high satisfaction with the measures they installed, their contractor, and the incentive amounts they received.
- Non-lighting participants said they participated to reduce energy costs, replace broken equipment, and increase the comfort of the home. Comfort was much more important to 2013–2014 participants than in past evaluation cycles.
- General population survey respondents expressed consistent satisfaction levels with LEDs (with product satisfaction levels consistently higher than for CFL purchasers).

Cost-Effectiveness Results

As shown in Table 4, the HES program was cost-effective across the 2013–2014 evaluation period from all test perspectives, except the Ratepayer Impact Measure (RIM) test. From the Total Resource Cost (TRC) perspective, the program had an average benefit-cost ratio of 1.87 for the two years.

Table 4. 2013–2014 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)	$0.057	$3,110,910	$6,391,243	$3,280,332	2.05
Total Resource Cost (TRC) No Adder	$0.057	$3,110,910	$5,810,221	$2,699,310	1.87
Utility Cost Test (UCT)	$0.040	$2,158,740	$5,810,221	$3,651,481	2.69
Ratepayer Impact Measure (RIM) Test		$8,063,506	$5,810,221	($2,253,285)	0.72
Participant Cost Test (PCT)		$2,973,237	$8,845,123	$5,871,886	2.97
Lifecycle Revenue Impacts ($/kWh)					$0.000013932
Discounted Participant Payback (years)					2.22

The RIM test measures program impacts on customer rates. Most energy efficiency programs do not pass the RIM test because, although energy efficiency programs reduce energy delivery costs, they also reduce energy sales. As a result, the average rate per unit of energy may increase. A RIM benefit-cost ratio greater than 1.0 indicates that rates, as well as costs, will go down as a result of the program. Typically, this happens only for demand response programs or programs that are targeted to 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 2013 and 2014 program years, based on evaluated net savings. The program proved cost-effective from the TRC perspective for both 2013 and 2014, though a decrease in 2014 net savings coupled with an increase in 2014 program costs resulted in lower cost-effectiveness benefit-cost ratios in 2014 compared to 2013.

Table 5. 2013 Evaluated Net HES Program Cost-Effectiveness Summary

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.047	$1,540,285	$3,890,938	$2,350,653	2.53
TRC No Adder	$0.047	$1,540,285	$3,537,216	$1,996,931	2.30
UCT	$0.030	$978,921	$3,537,216	$2,558,296	3.61
RIM		$4,460,020	$3,537,216	($922,804)	0.79
PCT		$1,524,798	$4,955,583	$3,430,784	3.25
Lifecycle Revenue Impacts ($/kWh)					$0.000005706
Discounted Participant Payback (years)					1.71

Table 6. 2014 Evaluated Net HES Program Cost-Effectiveness Summary

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.071	$1,678,716	$2,672,375	$993,660	1.59
TRC No Adder	$0.071	$1,678,716	$2,429,432	$750,717	1.45
UCT	$0.054	$1,261,014	$2,429,432	$1,168,418	1.93
RIM		$3,851,477	$2,429,432	($1,422,045)	0.63
PCT		$1,548,120	$4,157,218	$2,609,098	2.69
Lifecycle Revenue Impacts ($/kWh)					$0.000008745
Discounted Participant Payback (years)					1.83

Summary and Recommendations

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

- **Measure Categorization:** For some measures (such as light fixtures), measure categories were assigned in the tracking database according to delivery channels rather than end uses. Cadmus also found inconsistent use of measure categories between the participant tracking database and annual report cost-effectiveness assumptions.
  - ***Recommendation***: Assign measure categories by end use to ensure the most appropriate cost-effectiveness results.
- **Clothes Washers Reported Savings:** Cadmus estimated clothes washer energy savings using the same approach described in the ENERGY STAR calculator from April 2013 (which incorporates the federal standard baseline). Reported savings were consistent with the RTF values, which had been calculated using a current practice baseline, not a federal standard baseline, thus the

reported savings tended to decrease savings because the current practice baseline was more efficient than the federal standard. These findings led to the high realization rate of 257%.

- ***Recommendation:*** Use the federal standard baseline when calculating reported clothes washer energy savings.

- **Upstream Lighting Database:** Data tracking improved significantly between 2013 and 2014, however Cadmus experienced difficulties in mapping the program administrator's lighting tracking database to the price scheduling database (for example, inconsistent use of stock keeping units [SKUs] and model numbers).
  - ***Recommendation***: Track all data in a consistent manner across each program evaluation period (i.e. 2015–2016, 2016–2017, etc.).
- **Lighting Cross-Sector Sales**: Cadmus estimated that 3.9% of efficient bulbs purchased at retail stores ultimately would be installed in commercial applications. Bulbs installed in commercial spaces produce higher first-year savings than bulbs installed in a residential space because commercial locations typically have a higher daily use for bulbs than do residential locations (i.e., higher hours of use [HOU]). Currently, Rocky Mountain Power does not account for cross-sector sales from the upstream lighting incentives.
  - ***Recommendation***: Consider accounting for commercial installation of upstream bulbs in the reported savings.
- **Nonparticipant Spillover:** Nonparticipant spillover results in energy savings caused by, but not rebated through, a utility's demand-side management activities. Through responses to the general population survey, Cadmus estimated nonparticipant spillover as 2% of HES program savings. Because the estimation of these savings have not been assessed in previous program evaluations, Cadmus did not apply this adjustment.
  - ***Recommendation***: Consider allowing nonparticipant spillover analysis to be an integral component of NTG estimations for all programs.
- **Customer Outreach:** Retailers and bill inserts constituted the most commonly cited sources of program awareness for non-lighting participants; however, retailers represented a much smaller source of awareness than in 2011–2012. General population survey respondents most commonly mentioned bill inserts and TV as ways they learned about the lighting discounts, with a growing number citing retailers, demonstrating that customers learn about HES through diverse means.
  - ***Recommendation***: Continue to pursue a multi-touch marketing strategy, using a mix of bill inserts, retailer training, and selected mass marketing approaches such as occasional TV ads. Given the large percentage of customers who learned of wattsmart offerings through bill inserts, examine the proportion of customers who elect to receive online bills and ensure that these online channels proportionately advertise with appropriate messaging to motivate customers to participate. This messaging should promote long-lasting products, light quality, saving energy, replacing equipment, and reducing costs.

- **Satisfaction with Program Experience:** Customers generally expressed satisfaction with their program experiences, demonstrating consistency with the results from prior years. Non-lighting customers noted satisfaction with the measures they installed, their contractors, and the incentive amounts. Cadmus was not able to verify the efficacy of the program administrator's efforts to reach out to non-registered contractors who worked with rebate-seeking participants.
  - ***Recommendation***: Continue regular training with trade allies (e.g., distributors, retailers, sales associates, contractors) to update them on tariff changes and, where appropriate, support them with sales and marketing training. Analyze success of efforts to register non-registered contractors who worked with rebate participants within 90 days to determine whether the additional outreach mitigated the number of rejected applications because of non-qualified contractors.

Introduction

Program Description

Rocky Mountain Power contracted with CLEAResult to administer the Home Energy Savings (HES) Program during 2013 and 2014 program years and provide prescriptive incentives to residential customers who purchased qualifying, high-efficiency appliances, home electronics, HVAC, and weatherization measures.[3] The HES program also included an upstream lighting component, with incentives applied to eligible CFLs at the manufacturer level, providing discounted high-efficiency lighting options.

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

- Appliances:
  - Ceiling fan
  - Clothes washer
  - Dishwasher
  - Electric water heater
  - Freezer
  - Light fixture
  - Portable evaporative cooler
  - Refrigerator
  - Room air conditioner
- Home electronics:
  - Desktop computer
  - Flat panel TV
  - Monitor
- HVAC:
  - Central air conditioner proper sizing
  - Central air conditioners
  - Duct sealing and insulation
  - Ductless heat pump
  - Evaporative cooler
  - Heat pump
  - Heat pump water heater
  - Single head ductless heat pump
- Lighting:
  - CFLs
- Weatherization:
  - Insulation (attic, floor, and wall)
  - Windows

Program Participation

During the 2013–2014 HES program years, Rocky Mountain Power provided prescriptive incentives to over 3,000 residential customers and provided upstream discounts for over 400,000 products. Table 7 shows participation and savings by measure category and measure for this period.

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

Table 7. HES Reported Quantity and Savings by Measure, 2013–2014

Measure Category	Measure Name	Reported Participants	Reported Quantity	Quantity Type	Reported Savings
Appliance	Ceiling Fan	4	7	Units	1,113
	Clothes Washer	1,121	1,121	Units	152,889
	Dishwasher	634	637	Units	28,893
	Electric Water Heater	57	74	Units	9,100
	Freezer	92	93	Units	3,720
	Light Fixture	610	7,742	Units	603,876
	Portable Evaporative Cooler	49	49	Units	5,390
	Refrigerator	851	854	Units	37,576
	Room Air Conditioner	104	111	Units	4,551
Home Electronics	Desktop Computer	4	4	Units	308
	Flat Panel TV	2,457	2,520	Units	451,080
	Computer Monitor	4	4	Units	56
HVAC	Central Air Conditioner Equipment	87	87	Units	12,364
	Central Air Conditioner Proper Sizing	21	21	Project	1,260
	Duct Sealing and Insulation	89	188	Project	865,454
	Ductless Heat Pump	5	5	Units	25,110
	Evaporative Cooler	30	30	Units	36,990
	Heat Pump	1	1	Units	8,790
	Heat Pump Water Heater	1	1	Units	2,120
	Single Head Ductless Heat Pump	5	5	Units	25,110
Lighting*	CFL Bulb	40,620	406,202	Units	9,878,768
Weatherization **	Attic Insulation	84	617,745	Sq. Ft.	1,332,691
	Floor Insulation	2	3,700	Sq. Ft.	28,077
	Wall Insulation	18	24,093	Sq. Ft.	89,939
	Windows	6	931	Sq. Ft.	3,330
Total					**13,608,555**

Source: Rocky Mountain Power 2013 and 2014 annual reports and 2013–2014 non-lighting and lighting databases provided by the program administrator.

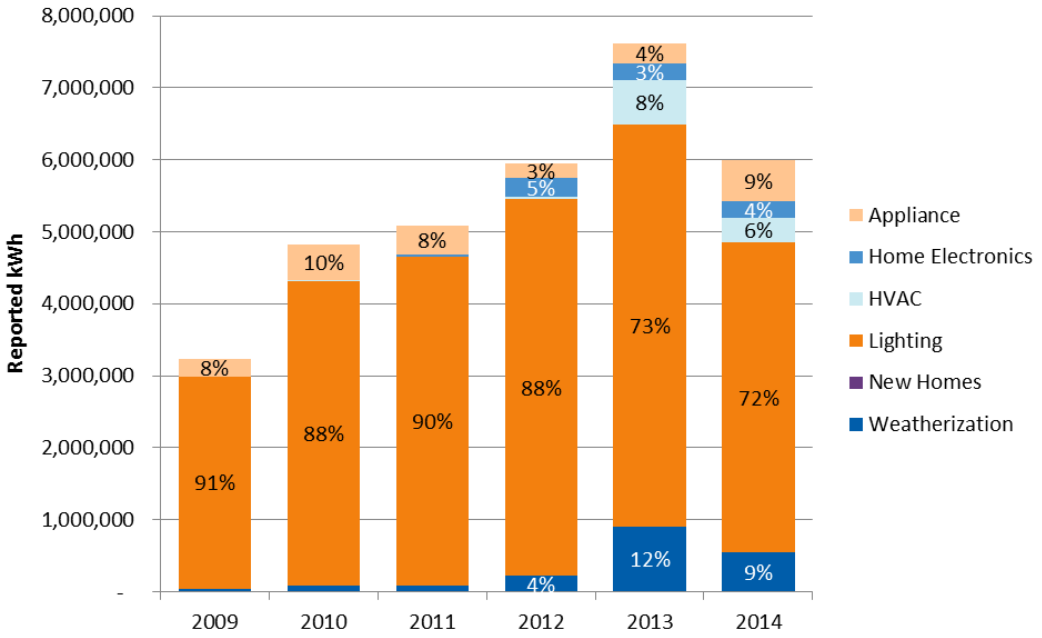
* Participation for upstream products was estimated by Rocky Mountain Power in the annual reports.

** Rocky Mountain Power also reported 5 whole house bonus incentives in the annual reports (2 in 2013 and 3 in 2014). These were incentive-only measures with savings captured in insulation measures.

Historically, lighting savings have comprised a vast majority of HES program savings. The 2013 and 2014 program years were no exception—upstream lighting measures contributed 73% and 72% of the annual reported gross program savings, respectively, as shown in Figure 1. The impact and process evaluations

focused heavily on the HES program's lighting component because of continued high savings from lighting incentives.

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



* Percentages may not add to 100% due to rounding

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
Participant Non-Lighting Surveys	X	X	X
General Population Surveys	X	X*	X
Weatherization and HVAC Billing Analysis	X	X	
Engineering Reviews	X		
Demand Elasticity Modeling		X	
Logic Model Review			X

* This activity provided an estimate of nonparticipant spillover savings that was not applied to the program savings.

Appendix A provides survey and data collection instruments used.

Sample Design and Data Collection Methods

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

Table 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.[5]

Table 9. Sample Disposition for Various HES Program Data Collection Activities in Wyoming

Data Collection Activity	Population	Sampling Frame	Target Completes	Achieved Completes
Program Staff Interview	N/A	N/A	1	1
Program Administrator Interviews	N/A	N/A	1	1
Non-Lighting Participant Surveys	3,378*	1,243	152	105**
General Population Surveys	112,972***	10,000	250	250

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

** Because of the small population of HVAC and weatherization participants, Cadmus was unable to attain the target number of completed surveys. All efforts were made to attain the target without placing undue burden on customers; up to five attempts were made to reach each participant.

***The Lighting population derived from Rocky Mountain Power's average 2014 residential customers in Wyoming. Customer data provided by Rocky Mountain Power.

Non-Lighting Participant Telephone Surveys

Cadmus surveyed 105 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 2013–2014 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.

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

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

Table 10. Non-Lighting Participant Survey Sample

Measure Category	Population	Targeted	Achieved
Appliances	3,217	68	68
HVAC	108	43	18
Weatherization	83	41	19
Total	**3,408***	**152**	**105**

*The total population differs from total population in Table 9 because some participants participated in multiple measure categories.

General Population Surveys

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

Impact Evaluation

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

- Participant surveys
- General population surveys
- Elasticity modeling
- Billing analysis
- Engineering reviews

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 2013 and 2014 Rocky Mountain Power Energy Efficiency and Peak Reduction Annual Reports (annual reports).[6] To determine gross savings, Cadmus applied step 1 through step 3. To determine evaluated net savings, Cadmus applied all four steps shown in Table 11 and described in the following text.

Table 11. Impact Steps to Determine Evaluated Net Savings

Savings Estimate	Step	Action
Evaluated Gross Savings	1	Tracking Database Review: validate accuracy of data in the participant database
	2	Verification: Adjust gross savings with the actual installation rate
	3	Unit Energy Savings: Validate saving calculations (i.e., billing analysis and engineering reviews)
Evaluated Net Savings	4	Attribution: Apply net-to-gross adjustments

The first three steps determined evaluated gross savings:

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

The **fourth step** (applying net adjustments) determined evaluated net savings. Cadmus calculated the net saving adjustments using results from customer self-response and demand elasticity modeling. Table 12 lists the methodology for each gross and net savings step, by measure, in the 2013–2014 program.

[6] Rocky Mountain Power Wyoming Annual Reports: 2013–2014. Available online: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2014/2013-Wyoming-Annual-Report-FINAL.pdf and http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2015/WY_2014AnnualReport_FINAL_061515.pdf

Table 12. 2013–2014 HES Impact Methodology by Measure

Measure Category	Measure Name	% of Savings*	Gross Method			Step 4: Attribution
			Step 1: Database Review	Step 2: Verification	Step 3: Unit Energy Savings	
Appliance	Ceiling Fan	0.0%	Non-Lighting Tracking Database Review	In-Service Rate: Non-Lighting Survey	Reported**	Self-Response: Non-Lighting Survey
	Dishwasher	0.2%				
	Electric Water Heater	0.1%				
	Freezer	0.0%				
	Portable Evaporative Cooler	0.0%				
	Refrigerator	0.3%			Engineering Review	
	Light Fixture	4.4%				
	Clothes Washer	1.1%				
Home Electronics	Flat Panel TV	3.3%				
	Desktop Computer	0.0%			Reported**	
	Monitor	0.0%				
HVAC	Central Air Conditioner Equipment	0.1%				
	Central Air Conditioner Proper Sizing	0.0%				
	Evaporative Cooler	0.3%				
	Ductless Heat Pump	0.2%			Engineering Review	
	Heat Pump	0.1%				
	Heat Pump Water Heater	0.0%				
	Single Head Ductless Heat Pump	0.2%				
	Duct Sealing and Insulation	6.4%		Billing Analysis		
Weatherization	Attic Insulation	9.8%				
	Floor Insulation	0.2%				
	Wall Insulation	0.7%				
	Windows	0.0%		In-Service Rate: Non-Lighting Survey	Reported**	Self-Response: Non-Lighting Survey
Lighting	CFL Bulb	72.6%	Upstream Lighting Tracking Database Review	In-Service Rate: General Population Survey	Engineering Review	Demand Elasticity Modeling

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

** Measures with "reported" percentage of savings less than 0.3% of program savings did not qualify for measurement analysis.

Evaluated Gross Savings

To calculate gross savings for HES program measures, Cadmus conducted tracking database reviews, measure verification, and, lastly, either engineering reviews or billing analysis of measures accounting for at least 99% of program savings. Table 13 presents the share of savings and gross savings evaluation method for measures representing 99% of program savings during the 2013–2014 period.

Table 13. Measure Selection For Step 3: Engineering and Billing Analysis

Measure Category	Measure	Percentage of Reported kWh Savings	Step 3: Evaluation Method
Appliances	Clothes Washer	1.1%	Engineering Review
	Light Fixture	4.4%	Engineering Review
	Refrigerator	0.3%	Engineering Review
Home Electronics	Flat Panel TV	3.3%	Engineering Review
HVAC	Duct Sealing and Insulation	6.4%	Billing Analysis
	Ductless Heat Pump	0.2%	Engineering Review
	Heat Pump	0.1%	Engineering Review
	Single Head Ductless Heat Pump	0.2%	Engineering Review
Lighting	CFL Bulbs	72.6%	Engineering Review
Weatherization	Attic, Floor & Wall Insulation	10.7%	Billing Analysis
Sum % of Reported Savings Evaluated		**99%**	

Table 14 provides the gross savings evaluation results for evaluated quantities, gross savings, and realization rates by measure type.

Table 14. Reported and Evaluated Gross HES Program Savings for 2013–2014

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated Gross	
Appliance	Ceiling Fan	7	1,113	1,113	100%
	Clothes Washer	1,121	152,889	392,668	257%
	Dishwasher	637	28,893	28,893	100%
	Electric Water Heater	74	9,100	9,100	100%
	Freezer	93	3,720	3,720	100%
	Light Fixture	7,742	603,876	209,756	35%
	Portable Evaporative Cooler	49	5,390	5,390	100%
	Refrigerator	854	37,576	117,886	314%
	Room Air Conditioner	111	4,551	4,551	100%

Measure Category	Measure Name	Quantity	Program Savings (kWh)		Realization Rate
			Reported	Evaluated Gross	
Home Electronics	Desktop Computer	4	308	308	100%
	Flat Panel TV	2,520	451,080	93,845	21%
	Monitor	4	56	56	100%
HVAC	Central Air Conditioner Equipment	87	12,364	12,364	100%
	Central Air Conditioner Proper Sizing	21	1,260	1,260	100%
	Duct Sealing and Insulation*	188	865,454	768,823	89%*
	Ductless Heat Pump	5	25,110	12,093	48%
	Evaporative Cooler	30	36,990	36,990	100%
	Heat Pump	1	8,790	5,927	67%
	Heat Pump Water Heater	1	2,120	2,120	100%
	Single Head Ductless Heat Pump	5	25,110	12,093	48%
Lighting	CFL Bulb	406,202	9,878,768	6,841,061	69%
Weatherization**	Attic Insulation	617,745	1,332,691	1,356,552	102%
	Floor Insulation	3,700	28,077	28,580	102%
	Wall Insulation	24,093	89,939	91,549	102%
	Windows	931	3,330	3,331	100%
Total* **			**13,608,555**	**10,040,028**	**74%**

*The duct sealing and insulation group was comprised of primarily multifamily residences, and only one single-family participant. PacifiCorp did not provide multifamily billing data due to the complexity of obtaining unit-level billing data for every customer for every PacifiCorp territory state. Even if the multifamily billing data had been available, finding a representative group of nonparticipants to match the participants would be very difficult. Thus, billing analysis could not be performed for Wyoming. The billing analysis results from the Washington HES overall duct sealing billing analysis realization rate (89%) was applied for Wyoming.

**Quantities for weatherization measures are in square feet.

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

Step 1: Tracking Database Reviews

The program administrator provided two tracking databases containing Wyoming data, covering all 2013 and 2014 participation for these two delivery methods—upstream (lighting) and downstream (non-lighting).

The upstream lighting measures database tracked lighting at a per-bulb level and included other meaningful information such as retailers, electric savings, purchased dates, and SKUs.[7] Cadmus' review

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

of the database tracking for 2013 and 2014 found no discrepancies in total reported quantities or total savings compared to the 2013 and 2014 annual reports.

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

Step 2: Verification

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

Non-Lighting In-Service Rate

For each measure category, Cadmus asked survey respondents a series of questions designed to determine if they had installed products for which they had received incentives. All survey respondents reported installing all measures, resulting in a 100% ISR for all non-lighting measure categories. Table 15 shows the quantities of measures and their ISRs.

Table 15. ISR by Measure Category, 2013–2014

Measure Category	Measure	2013 and 2014			
		Total Surveyed Measures	Installed Measures	Percentage Installed	Percentage Average Weighted ISR
Appliances	Clothes Washer	19	19	100%	100%
	Dishwasher	5	5	100%	
	Light Fixture	14	14	100%	
	Portable Evaporative Cooler	1	1	100%	
	Refrigerator	14	14	100%	
Home Electronics	Flat Panel TV	26	26	100%	100%
HVAC	Central Air Conditioner	1	1	100%	100%
	Central Air Conditioner Proper Sizing	8	8	100%	
	Duct Sealing and Insulation	1	1	100%	
	Ductless Heat Pump	1	1	100%	
	Evaporative Cooler	7	7	100%	
Weatherization	Attic Insulation (Sq. Ft.)	18,342	18,342	100%	100%
	Wall Insulation (Sq. Ft.)	4,684	4,684	100%	

CFL In-Service Rates

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

Of the 250 customers surveyed, 64 did not purchase CFLs and 10 could not confirm or estimate how many they had purchased; consequently, the analysis excluded these data. The analysis also removed an additional 20 responses for other reasons, including not knowing how many bulbs were installed, removed, or stored, or reporting demonstrably inconsistent bulb quantities. Cadmus used data from the remaining 156 respondents to calculate the ISR.

Cadmus implemented two changes in the methodology since the 2011–2012 program evaluation; these changes are important when comparing ISRs across the years (Table 16) and for other jurisdictions (Table 17). The first change affecting the ISR calculations was to designate a bulb that had burned out as having been installed because the burnout rate is considered in the assumed effective useful life.

The second change was in how the survey phrased the question about timing. For this evaluation, the survey asked customers to consider bulbs purchased in the past 12 months rather than those purchased during the entire two-year evaluation period. Cadmus updated this question because of concerns about a customer's ability to recall purchases that occurred more than two years prior to the survey.

The revised formula for calculating the lighting ISR is:

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

Table 16 provides ISR results for 2013–2014 CFLs.

Table 16. 2013 and 2014 First-Year CFL ISR*

Bulb Status	Number of Bulbs Reported	ISR
Purchased	**1,314**	70.8%
Installed	1,010	
Stored	304	
Removed	143	
Removed After Burning Out	63	
In-Service Bulbs (including burned out)	**930**	

*n = 156 respondents

Table 17 compares first-year ISRs evaluated for similar programs across the country (and for some past HES program evaluations in Wyoming). Wyoming's CFL ISR has remained very stable over the past three evaluations (e.g., 2009–2010, 2011–2012, and 2013–2014).

Table 17. Comparison of Evaluated First-Year CFL ISR Estimates

Source	Data Collection Method	Reported Year	ISR
Midwest Utility 1	Self-reporting: determined by interview during home inventory site visits	2016	86%
Northeast Utility	Self-Reporting: 200 telephone surveys	2012	73%
Rocky Mountain Power Wyoming 2011–2012 HES Evaluation	Self-reporting: 245 in-territory lighting surveys	2014	72%
Rocky Mountain Power Wyoming 2013–2014 HES Evaluation	**Self-reporting: 156 in-territory lighting surveys**	**2016**	**71%**
Midwest Utility 2	Self-reporting: 301 customer surveys	2012	68%

*The RTF is an advisory committee in the Northwest that develops standards to verify and evaluate conservation savings.

Step 3: Unit Energy Savings Reviews

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

- CFL bulbs
- Light fixtures
- Clothes washers
- Refrigerators
- Heat pumps
- Flat panel TVs

Cadmus evaluated these measures using billing analysis:

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

Further, Cadmus applied realization rates of 100% to all measures not listed above (when combined, they contributed less than 1% of savings to the program). As shown in Table 18, UES realization rates for evaluated measures ranged between 21% for flat panel TV and 314% for refrigerators.

Table 18. 2013–2014 Measurement Analysis and Gross Unit Realization Rate Summary Table

Measure Category	Measure	Average Unit Energy Savings (kWh/Unit)		UES Realization Rate*	Gross UES Method
		Reported	Evaluated		
Appliance	Clothes Washer	136	350	257%	Engineering Review
	Light Fixture	78	27.1	35%	Engineering Review
	Refrigerator	44	138.0	314%	Engineering Review
Home Electronics	Flat Panel TV	179	37.2	21%	Engineering Review
HVAC	Duct Sealing and Insulation	4,603	4,089	89%	Billing Analysis
	Ductless Heat Pump	5,022	2,419	48%	Engineering Review
	Heat Pump	8,790	5,927	67%	Engineering Review
	Single Head Ductless Heat Pump	5,022	2,419	48%	Engineering Review
Lighting	CFL Bulbs	24	16.8	69%	Engineering Review
Weatherization	Attic Insulation**	2	2.2	102%	Billing Analysis
	Floor Insulation**	8	7.7	102%	Billing Analysis
	Wall Insulation**	4	3.8	102%	Billing Analysis

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

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

The following sections describe the methodology and results of the measurement activities for each measure listed in Table 18.

CFL Bulbs

During the 2013–2014 program years, Rocky Mountain Power incented 406,202 CFL bulbs through 20 different retailers representing 45 stores. Table 19 shows quantities and savings for the nine different bulb types. Overall, upstream lighting represented 73% of the total reported savings for the HES program.

Table 19. 2013–2014 Incented CFL and LEDs Bulbs by Type

Lighting Type	Bulb Category	Bulb Type	Reported Quantity (Bulbs)	Reported Savings (kWh)
CFL	Standard	A-Lamp	6,666	147,409
		Spiral	306,576	7,254,747
	Specialty	3-Way	337	14,423
		Candelabra	1,954	40,442
		Daylight	54,996	1,364,022
		Dimmable	1,066	35,437
		Globe	6,490	149,322
		Outdoor	8,396	261,405
		Reflector	19,721	611,562
Total*			**406,202**	**9,878,768**

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

Cadmus estimated four parameters to calculate gross savings for CFLs:

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

The following equation provides gross lighting savings:

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

Where:

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

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

HOU = The daily lighting operating hours

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

To calculate the various CFL lighting component inputs, Cadmus conducted the primary and secondary data collection and analysis activities shown in Table 20.

Table 20. CFL Bulb Evaluated Gross Savings Activities

Gross Savings Variables	Activity
ΔWatts	Lumen Equivalency Method
ISR	General Population Survey (n=250)
HOU	Multistate HOU Regression Model
WHF	RTF Space Interaction Calculator

Cadmus derived the annual savings algorithm from industry standard engineering practices, consistent with the methodology prescribed by the UMP for calculating residential lighting energy use and savings.[8] The following sections present a discussion of each equation component (except for ISR, which is discussed above in the Step 2: Verification section).

Delta Watts

Delta watts represents the wattage difference between a baseline bulb and an equivalent CFL. Cadmus determined baseline wattages using the 2013–2014 upstream lighting tracking data, which included CFL sales data by SKU numbers and bulb types for the 406,202 bulbs sold through the program.

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

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

- Standard
- EISA-exempt
- Reflector

The UMP was updated in February 2015 and now defines five lamp types:

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

Cadmus used the latest methodology available in the UMP to evaluate delta watts. Table 21 shows the reported quantities for the five lamp categories.

[8] 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

Table 21. 2013 and 2014 CFL Database Quantities by Bulb Types

Bulb Type	2013 Quantity	2013 Percentage	2014 Quantity	2014 Percentage	Overall Quantity	Percentage Overall
Standard	160,917	90.9%	216,881	94.7%	377,798	93.0%
Decorative	1,023	0.6%	721	0.3%	1,744	0.4%
Globe	3,731	2.1%	2,759	1.2%	6,490	1.6%
EISA-Exempt	230	0.1%	107	0.0%	337	0.1%
Reflectors	11,222	6.3%	8,611	3.8%	19,833	4.9%
Total	**177,123**		**229,079**		**406,202**	

Several federal baseline changes took effect in 2013 and 2014 because of the Energy Independence Security Act of 2007 (EISA). As an example of how baseline wattages changed, Table 22 presents the baseline wattage and estimated efficient wattage, grouped by lumen bin for standard bulbs. Starting in 2013, the standard 100-watt bulb baseline declined to 72 watts, and the 75-watt baseline declined to 53 watts. Similarly, starting in 2014, the 60-watt baseline declined to 43 watts, and the 40-watt baseline declined to 29 watts.

Table 22. Lumen Bins for Standard Lamps and Lamp Quantities

Lumen Bin	2012 Baseline Wattage*	2013 Baseline Wattage	2013 Reported Lamp Quantity	2014 Baseline Wattage	2014 Reported Lamp Quantity
0–309	25	25	0	25	0
310–449	25	25	0	25	0
450–799	40	40	8,221	29	7,822
800–1,099	60	60	107,147	43	165,061
1,100–1,599	75	53	17,477	53	17,676
1,600–1,999	100	72	28,072	72	26,322
2,000–2,600	100	72	0	72	0

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

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

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

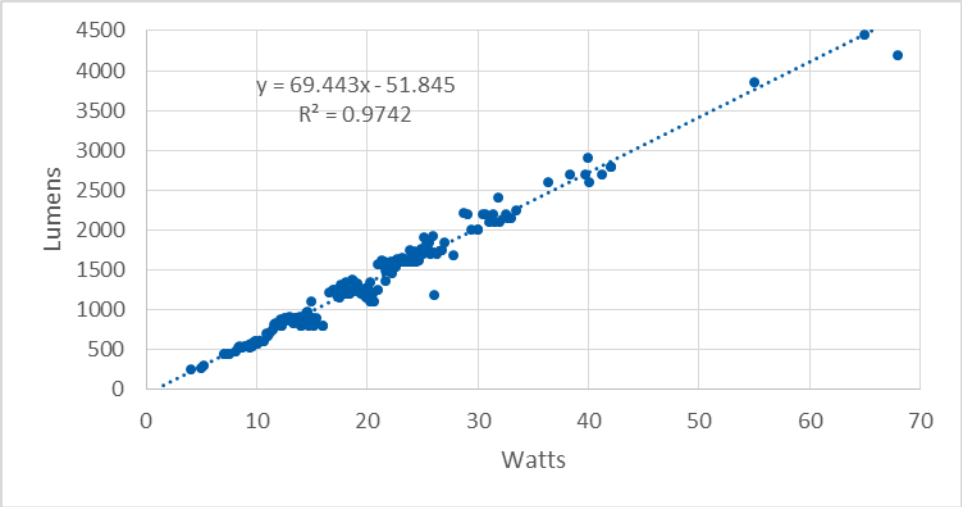
ENERGY STAR Qualified Product List Analysis

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

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

Cadmus addressed these variations by using median lumens to create the relationship that is shown in Figure 2; the figure's calculated trend line shows a strong linear relationship between the CFL wattage and lumen output. Cadmus used this linear relationship to determine the lumen output for the CFL lamps that did not have a model number matching the ENERGY STAR-qualified lamp product list.

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



In total, the upstream lighting analysis employed three linear best-fit lines such as those shown above for CFL standard, reflector, and specialty lamps. Cadmus created an additional trend line from the ENERGY STAR database for CFL fixtures. All trend lines employed are listed in Appendix B.

Hours of Use

For 2013–2014 lighting products, Cadmus calculated an average of 1.83 HOU for CFLs using analysis of covariance (ANCOVA) model coefficients, drawn from combined, multistate, multiyear data produced by

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

two recent CFL HOU metering studies. This model expressed average HOU as a function of room type. Appendix B provides a more detailed explanation of the impact methodology Cadmus used to estimate HOU as well as differences in the model between evaluations.

This method is consistent with those used in the 2009–2010 and 2011–2012 program year evaluations, though the metering studies from which the data were sourced have been updated. The data used for the 2011–2012 evaluation consisted of data for five states (Maryland, Michigan, Maine, Missouri, and Ohio) whereas the data for the current evaluation uses data from only two states (Maryland and Missouri). The number of loggers included in the current data from just two states, however, is greater than the number from the five states used for the previous evaluation, which allowed Cadmus to use the two most recent studies, Missouri and Maryland, without sacrificing precision. Additionally, the Maryland and Missouri studies employed a sampling strategy that prioritized rooms where efficient lighting is most likely to be installed.

Table 23 compares the evaluations' HOU results.

Table 23. HOU by Evaluation Period

Evaluation Period	Evaluated HOU
2009–2010	2.25 hours
2011–2012	2.18 hours
2013–2014 CFLs	1.83 hours

The lower HOU values for 2013–2014 probably resulted from increased saturations of efficient bulbs. As the efficient lighting market matures and the saturation increases within the average home, efficient lamps start being installed in lower-use sockets, whether in rooms with lower use or in supplemental lighting (such as desk lamps).

Cadmus estimated the lighting distribution by room using response data from the general population surveys, as shown in Table 24. The reported proportion of bulbs installed in some room types changed markedly between evaluation cycles. The proportion of bulbs installed in living spaces nearly halved in 2013 and 2014 compared to 2011–2012. The "Other" category (e.g., closets, hallways, garages, dining, home office, and utility or storage rooms) exhibited a large increase. Because many rooms types in the "Other" category include those with a lower average HOU, an increase in the proportion of bulbs installed in these room types lowers the overall average HOU.

Table 24. Survey-Reported CFL Installation Locations

Bulb Location	Percentage of Total CFLs		
	2009–2010	2011–2012	2013–2014
Living Space	30%	29%	17%
Bedroom	26%	28%	26%
Kitchen	13%	10%	16%
Bathroom	14%	17%	10%
Outdoor	3%	3%	3%
Basement	5%	6%	4%
Other	8%	8%	23%
Total*	**100%**	**100%**	**100%**

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

Current estimated HOU remains consistent and very similar to the HOU calculated by the RTF and a recent metering study for the Northwest Energy Efficiency Alliance (NEEA). The RTF workbook approved for 2014 provided an average HOU of 1.9;[11] the current version 4.0 RTF workbook has a value of 2.04,[12] and the NEEA study found an average of 1.8.[13]

Appendix B provides further details as well as a more detailed list of room installations.

Waste Heat Factor

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

For this evaluation, Cadmus used SEEM modeling (Simplified Energy Enthalpy Model) results from the most recent RTF residential CFL savings workbook to serve as a foundation for the analysis[14,15]

[11] RTF savings workbook for residential, screw-in, CFL and LED lamps: ResLightingCFLandLEDLamps_v3_3.xlsm.

[12] Both RTF HOU numbers are weighted average HOUs (i.e., weighted by the number of total lamps provided in the RTF workbook for each category).

[13] Northwest Energy Efficiency Alliance. "Residential Building Stock Assessment: Metering Study". April 28, 2014. Accessed January 2016: https://neea.org/docs/default-source/reports/residential-building-stock-assessment--metering-study.pdf?sfvrsn=6

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

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

Table 25 and

Table 26 show the RTF's SEEM results and evaluation weightings. Saturation weightings for heating and cooling derive from results of Rocky Mountain Power's surveys of its Wyoming residential customers in 2014; cooling zone weightings derive from typical meteorological year 3 (TMY3) weather data and census population data for Wyoming counties.

Table 25. WHF Heating Inputs Summary

WHF Component	Heating System Type	SEEM Results (kWh/kWh Saved)	Cadmus Saturation Weighting*
Heating Impact	Electric Zonal	-0.440	12.8%
	Electric Forced Air	-0.479	3.4%
	Heat Pump	-0.258	0.6%
	Non-Electric	0.000	83.3%

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

Table 26. 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	43.4%	30%
	Cooling Zone 2	0.053	37.5%	
	Cooling Zone 3	0.074	19.2%	

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

Calculating the weighted averages of values in Table 25 and

Table 26 provided the impacts from heating and cooling of a bulb installed in a conditioned space, shown in Table 27. Summing the heating and cooling impacts produced an estimated combined impact of -0.059 kWh per kWh of lighting savings.

Table 27. WHF Weighted Average Impact, Conditioned Space

Component	kWh/kWh Savings*
Heating	-0.074
Cooling	0.014
Combined	**-0.059**

* Table may not sum to total due to rounding

Cadmus also considered the location of bulbs to determine the appropriate WHF and account for bulbs not installed in conditioned spaces. As shown in Table 28, Cadmus applied bulb allocations by space type from the 2013–2014 Rocky Mountain Power general population survey data to thermal coupling factors from the RTF.

Table 28. Thermal Coupling by Space Type

Space Type	RTF Thermal Coupling Correction Factor	Bulb Allocation*
Basement	50%	3.6%
Main House	75%	92.1%
Outdoor	0%	4.3%
Weighted Average		**70.9%**

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

Multiplying the combined impact from Table 27 with the weighted thermal coupling in Table 28 and adding 1 provided the final WHF shown in Table 29.

Table 29. Wyoming CFL Bulb WHF, Average Installation Location

Fuel	Value	Units
Electric	0.958*	kWh/kWh Saved

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

CFL Bulbs Total Savings

Table 30 shows reported savings inputs and input sources. Cadmus determined these inputs using assumptions provided by Rocky Mountain Power and information drawn from the tracking database. Reported values for ISR, HOU, and WHF were sourced directly from the assumption workbooks provided. Reported values for UES were calculated from the tracking database, and average values for delta watts were back-calculated from the reported savings using the ISR, HOU, and WHF assumptions from the UES workbooks provided.

Table 30. 2013–2014 Reported CFL Bulb Savings Inputs

Bulb Type	Reported Inputs	2013	2014	Source
CFLs	Quantity	177,123	229,079	Database/Annual Report
	Total Gross Savings (kWh)	5,579,608	4,299,160	Database/Annual Report
	Average Unit Energy Savings (kWh/bulb)	31.5	18.8	Database/Annual Report
	Average Delta Watts*	46.9	36.0	Back-calculated
	ISR	80.0%	72.4%	2013: PacifiCorp/PECI 2014: 2011–2012 Wyoming Residential Home Energy Savings Evaluation Report
	HOU	2.30	2.18	2013: RTF (http://rtf.nwcouncil.org/measures/res/archive/EStarLighting_ExistingFY10v1_5.xls) 2014: 2011–2012 Wyoming Residential Home Energy Savings Evaluation Report
	WHF	1.000	0.906	2014: 2011–2012 Wyoming Residential Home Energy Savings Evaluation Report

*Reported delta watts values back-calculated from average reported unit savings and reported ISR, HOU, and WHF.

Table 31 shows evaluated savings inputs and input sources. The preceding section described the sources for these inputs.

Table 31. 2013–2014 Evaluated CFL Bulb Savings Inputs

Bulb Type	Evaluated Inputs	2013	2014	Source
CFLs	Quantity	177,123	229,079	Upstream Lighting Tracking Database
	Total Savings (kWh)	3,523,601	3,317,460	Calculated
	Average Unit Energy Savings (kWh)	19.9	14.5	
	Average Delta Watts	43.8	31.9	Lumens equivalence method
	ISR	70.8%	70.8%	General population survey (n= 250)
	HOU	1.83	1.83	Cadmus HOU model
	WHF	0.958	0.958	RTF, updated for Wyoming

Figure 3 compares the impact of reported and evaluated inputs on savings shown in Table 30 and Table 31. Positive percentages indicate that the inputs caused higher evaluated savings than reported savings. For example, in 2013 the overall evaluated delta watts values were 7% lower than those

reported, HOU was 20% lower, ISR was 12% lower, and WHF was 4%—these added up to evaluated savings that were 37% lower than reported savings (realization rate = 63% for 2013). Here, the largest contributing factor was HOU. The reported HOU value of 2.3 is from an RTF analysis workbook, but Cadmus' model showed HOU to be 1.83, or 20% lower. In addition, Cadmus' population survey found an ISR of 70.8%, 12% lower than the reported value of 80%. Differences in delta watts values stem from using slightly different lumen bins and baselines, and grouping many models together under single wattage-based measures, as opposed to evaluating every model individually as Cadmus did.

Differences in 2014 were not quite as large, with an overall 2014 realization rate of 77% and an overall 2013–2014 realization rate of 69%. HOU was the biggest contributor to this realization rate, though delta watts and ISR made notable contributions as well.

Figure 3. 2013–2014 Impact of Calculation Parameters on Savings

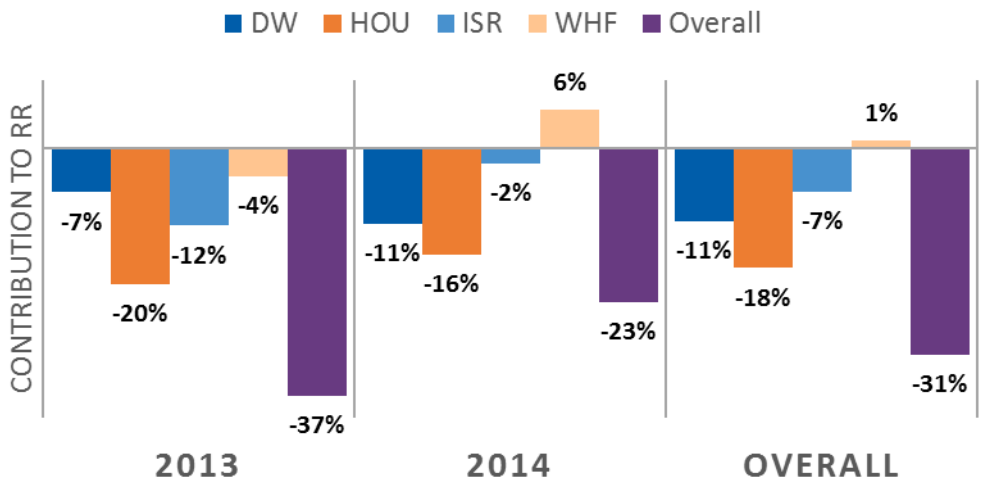


Table 32 provides evaluated CFL quantities, gross savings, and realization rates by bulb type. Overall, CFL bulbs realized 69% of reported savings.

Table 32. 2013–2014 Evaluated and Reported HES Program CFL Savings

Program Year	Technology	Quantity Purchased	Program Savings (kWh)		Average Unit Energy Savings (kWh)		Realization Rate
			Reported	Evaluated	Reported	Evaluated	
2013	CFL	177,123	5,579,608	3,523,601	31.50	19.89	63%
2014	CFL	229,079	4,299,160	3,317,460	18.77	14.48	77%
Total		**406,202**	**9,878,768**	**6,841,061**	**24.32**	**16.84**	**69%**

Light Fixtures

During the 2013–2014 program period, Rocky Mountain Power provided incentives for 7,742 ENERGY STAR light fixtures, representing 4.4% of reported program savings. Light fixture participation ramped up

during the 2013–2014 evaluation period. Because of this increased participation, Cadmus conducted a more granular evaluation of light fixtures in 2013–2014 than in the 2011–2012 program evaluation.

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

- Downlight fixtures
- Fluorescent fixtures
- Miscellaneous fixtures

These categories respectively contributed 92.3%, 3.3%, and 2.2% of program fixtures by quantity (with 2.2% 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, this is the general equation for a lighting gross saving evaluation:

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

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

Table 33. Light Fixture Evaluated Gross Savings Activities and Results

Gross Savings Variables	Activity	Mean Value
Delta Watts	Downlights and Miscellaneous: Lumens Equivalence Fluorescents: RTF	39.8*
ISR	Non-Lighting Participant Survey	1.00
HOU	Multistate HOU Model	1.904*
WHF	RTF Space Interaction Calculator	0.958

* Weighted average for all fixtures

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

Figure 4. Example of a Donwlight Fixture

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

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

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

Results are presented in Table 34, showing that 85.6% of lamps installed in ceiling receptacles were reflector lamps and 13.5% were standard lamps, with the other categories comprising the rest. Cadmus used these saturation values to create an average set of lumen bins and baseline wattages for recessed ceiling receptacles, for both 2013 and 2014. Plots of the weighted reflector and final recessed can lumen bins and baseline wattages can be seen in Appendix B. Like reflector baseline wattages in general, the recessed can baseline wattage values are generally higher than those for standard lamps.

Table 34. 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**	**2225**
Total Households	**38**	**46**	**68**	**65**	**217**

Fluorescent Fixtures

The UMP does not specify a lumens equivalence approach for fluorescent lamps (3.3% of fixtures), and EISA legislation does not provide discrete lumen bins or baseline wattages for these types of lamps. To calculate savings for these lamps, Cadmus applied a single delta watts value for all fluorescent lamps in the database. Although the database includes some circline and other types of fluorescent lights, the majority (> 80%) of fluorescent lamps are two-lamp T8 fluorescents.

Cadmus applied the delta watts value from the RTF for fluorescent fixtures. The High-Performance T8 Lamps Workbook (Version 1.1) provides a delta watts value of 42 W for 4-foot, two-lamp T8 fixtures installed in kitchens and 43 W value for the same fixtures installed in garages.[16] As the installation locations for these fixtures were unknown, Cadmus applied a 42.5 delta watts value for all fluorescent lamp fixtures in the database. Cadmus applied CFL values for HOU and WHF.

Miscellaneous Fixtures

Just 2.2% of fixtures sold could not be classified as downlights or fluorescent lights (e.g., single- and multi-bulb sconce lights, motion sensors, track lighting). Roughly one third were single-lamp CFL fixtures, one third were two-lamp CFL fixtures, and one third were LED fixtures of various types. Cadmus applied the lumens equivalence approach to evaluate these fixtures.

Unknown Fixtures

The database included 2.2% of fixtures falling within unknown categories. Of these, 95% had no model numbers in the database. The remainder could not be matched to the ENERGY STAR database. Consequently, Cadmus applied the weighted average UES for the downlight, fluorescent, and miscellaneous fixture categories.

Lighting Fixture Findings

In 2013–2014, the HES program provided incentives for 7,742 light fixtures. Table 35 provides lamp quantities, savings, and realization rates by fixture type for 2013–2014.

[16] Regional Technical Forum. "RTF Unit Energy Savings Measures. Lighting - High Performance 4-foot T8 Lamps." Accessed May 2016: http://rtf.nwcouncil.org/measures/measure.asp?id=205

Table 35. 2013–2014 Light Fixture Quantity and Gross Savings

Fixture Category	CFL/LED	Quantity	Reported Savings	Evaluated Savings	Realization Rate
Downlight	LED	7,148	557,544	194,611	35%
	CFL	0	0	0	N/A
Fluorescent	N/A	253	19,734	6,898	35%
Miscellaneous	LED	151	11,778	3,189	27%
	CFL	21	1,638	505	31%
Unknown	N/A	169	13,182	4,443	34%
Total		**7,742**	**603,876**	**209,646**	**35%**

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

Realization rates average 35%, quite low for all fixture types and technologies. A reported unit energy savings value of 78 kWh was used for all lighting fixtures. This value comes from a 2009 analysis employing savings values from the Regional Technical Forum and an ENERGY STAR calculator that appears to get savings values from 2006. The values employed by this calculator for HOU, WHF, and ISR are unknown, but the analysis was performed well before EISA baseline wattage reductions, which have significantly reduced lighting savings since 2006.

Clothes Washers

Cadmus estimated clothes washer energy savings using the same approach outlined in the ENERGY STAR calculator from April 2013, which compared the modified energy factor (MEF) of an efficient unit to the MEF of a unit meeting the federal standard. The evaluation divided savings among the three possible end uses—clothes washer machines, dryers, and water heating—and adjusted the savings based on program-specific data from the participant survey, such as the number of loads washed per year and the percentage of loads dried in a dryer. This presented the most appropriate approach because it drew upon the federal standard that was effective from 2011–2015 and, whenever possible, incorporated program-specific information from the tracking database and participant surveys.

Cadmus estimated an average gross evaluated savings value of 350 kWh per unit, yielding a 257% realization rate for 2013–2014. The main factor responsible for the high realization rate is that the reported savings were consistent with the RTF values, which had been calculated using a current practice baseline, not a federal standard baseline (thus tending to decrease savings because the current practice baseline was more efficient than the federal standard).

Using the following equations, Cadmus compared the energy consumption of efficient ENERGY STAR clothes washers to a model that met the minimum federal standard in effect with the 2013–2014 program.

$$kWh_{sav\ total} = kWh_{sav\ dryer} + kWh_{sav\ HW} + kWh_{sav\ mach}$$

$$kWh_{sav\ dryer} = \left[\left(\frac{1}{MEF_{base}} - \frac{1}{MEF_{ES}}\right) \times Loads_{act} \times Cap - kWh_{sav\ HW} - kWh_{sav\ mach}\right] \times (\%Dry)$$

$$kWh_{sav\ HW} = (Ref\ Energy_{base} - Ref\ Energy_{ES}) \times (\%WH) \times \left(\frac{Loads_{act}}{Loads_{ref}}\right)$$

$$kWh_{sav\ mach} = (Ref\ Energy_{base} - Ref\ Energy_{ES}) \times (1 - \%WH) \times \left(\frac{Loads_{act}}{Loads_{ref}}\right)$$

Table 36 defines the variables in the equations above and, when applicable, provides values and sources.

Table 36. Clothes Washer Key Variables and Assumptions

Parameter	Definition	Value	Unit	Source
$kWh_{sav\ total}$	Total energy savings	Varied	$\frac{kWh}{year}$	Calculated
$kWh_{sav\ dryer}$	Total dryer energy savings	Varied	$\frac{kWh}{year}$	Calculated
$kWh_{sav\ HW}$	Total hot water energy savings	Varied	$\frac{kWh}{year}$	Calculated
$kWh_{sav\ mach}$	Total machine energy savings	Varied	$\frac{kWh}{year}$	Calculated
MEF_{base}	Modified energy factor of baseline unit	1.26	$\frac{ft^3 * load}{kWh}$	Federal Standard (as of 2011)
MEF_{ES}	Modified energy factor of ENERGY STAR unit	2.84	$\frac{ft^3 * load}{kWh}$	Tracking Data
$Loads_{act}$	Loads per year	269*	$\frac{loads}{year}$	Wyoming 2013–2014 non-lighting participant survey
Cap	Clothes washer capacity	4.2	ft^3	Tracking Data (Model # lookup of 83% of installed washers)
$\%Dry$	Percentage of loads dried in the dryer	88%**	%	Wyoming 2013–2014 non-lighting participant survey
$Ref\ Energy_{base}$	Reference rated energy consumption of baseline unit	417	$\frac{kWh}{year}$	ENERGY STAR Appliance Calculator (April 2013)
$Ref\ Energy_{ES}$	Reference rated energy consumption of ENERGY STAR unit	186	$\frac{kWh}{year}$	ENERGY STAR Appliance Calculator (April 2013)
$\%WH$	Percentage of rated electricity consumption used for water heating	80%	%	ENERGY STAR Appliance Calculator (April 2013)
$Loads_{ref}$	Reference loads per year	392	$\frac{loads}{year}$	ENERGY STAR Appliance Calculator (April 2013)

*The number of loads per year used in the 2011–2012 Wyoming HES Program Evaluation was 289.

**The percentage of loads dried in the dryer used in the 2011–2012 Wyoming HES Program Evaluation was 82%.

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

Table 37 shows the quantity of units incented, reported and evaluated savings, realization rates, and percentages of reported savings for each combination of DHW and dryer fuel at each efficiency level during 2013 and 2014.

Table 37. Clothes Washer Savings by Performance Level and DWH/Dryer Fuel

DHW	Dryer	Quantity		Reported Per Unit kWh Savings		Evaluated Per Unit kWh Savings		Realization Rate*		Percentage of Reported Savings*	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Electric	Electric	206	136	203	203	451	451	222%	222%	47%	43%
Electric	Other	2	1	93	93	158	158	170%	170%	0%	0%
Other	Electric	403	325	114	114	325	325	285%	285%	52%	57%
Other	Other	31	17	4	4	32	32	792%	792%	0%	0%
Weighted Average**		**642**	**479**	**137**	**135**	**351**	**350**	**256%**	**259%**	**100%**	**100%**

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

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

As shown in Table 37, a clothes washer, paired with a non-electric dryer and a non-electric water heater, offers lower savings than a unit paired with an electric dryer and/or water heater. In 2013 and 2014, the tracking database showed that units combining natural gas dryers and water heaters accounted for 4% of all incented units. Although the savings are low for units with non-electric dryers and water heaters, instituting fuel eligibility requirements could lead to logistical burdens and inaccurate self-reporting if customers are aware that their eligibility depends upon an electric dryer and/or water heater.

Table 38 lists the percentages of savings attributable to each of the three savings components associated with clothes washers—dryers, DWHs, and the machines themselves. Reduced dryer load produces the largest energy savings component, followed by DHW, and finally the clothes washer itself.

Table 38. Clothes Washer Savings by System Component

Source of Clothes Washer Savings	Percentage of Savings*
Dryer	65%
DHW	28%
Clothes Washer	7%

*Calculated using the equations above and the parameters listed in Table 36.

Table 39 shows the percentage of units installed in homes with electrically heated DHW and dryers. The saturation of fuel types for DHW and dryers remained consistent between the 2011–2012 and 2013–2014 performance periods.

Table 39. Clothes Washer Percentage of Electric DHW and Dryer Fuel

Input Categories		2013–2014 Saturation of Fuel Types	2011–2012 Saturation of Fuel Types	Source
DHW Fuel	Electric	30.8%	31.8%	WY 2011–2012 and 2013–2014 Non-Lighting Tracking Databases
	Other	69.2%	68.2%	
Dryer Fuel	Electric	95.5%	95.9%	
	Other	4.6%	4.1%	

Flat Panel TVs

Cadmus estimated flat panel TV energy savings using the approach outlined in the 2013 ENERGY STAR Consumer Electronics Calculator. Cadmus divided the operation of a TV into two modes—on and standby—and assumed that the average TV is in the on-mode for five hours per day and the standby-mode for 19 hours per day; this is consistent with the ENERGY STAR calculator and the 2011–2012 Rocky Mountain Power Evaluation. According to the ENERGY STAR calculator, baseline units consume the same amount of power as efficient units while in standby-mode, resulting in zero standby-mode energy savings. Cadmus used the ENERGY STAR TV product list from June 2013 to look up on-mode operating power and screen area for 76% of the incented units. To estimate baseline energy consumption, Cadmus used this equation from the ENERGY STAR calculator, which relies on the screen area of the TV.

$$kWh_{sav} = \left[\left(P_{on} \times h_{on} + P_{stdby} \times h_{stdby}\right)_{base} - \left(P_{on} \times h_{on} + P_{stdby} \times h_{stdby}\right)_{ES}\right] \times 365$$

$$(P_{on})_{base} = 0.552 \times A^{0.737}$$

Table 40 defines the variables in the equations above and provides values and sources when applicable.

Table 40. Flat Panel TV Key Parameters and Assumptions

Parameter	Definition	Values	Unit	Source
kWh_{sav}	Total energy savings	Varied	$\frac{kWh}{year}$	Calculated
$(P_{on})_{base}$	Baseline on-mode operating power	Varied	kW	Calculated*
$(P_{on})_{ES}$	Efficient on-mode operating power	Varied	kW	ENERGY STAR TV Product List (June 2013)
$(P_{stdby})_{base} = (P_{stdby})_{ES}$	Standby mode operating power	Varied	kW	ENERGY STAR TV Product List (June 2013)
$(h_{on})_{base} = (h_{on})_{ES}$	Hours per day of on-mode operation per day	5	$\frac{hours}{day}$	ENERGY STAR Consumer Electronics Calculator (Sept. 2013)
$(h_{stdby})_{base} = (h_{stdby})_{ES}$	Hours per day of standby operation per day	19	$\frac{hours}{day}$	ENERGY STAR Consumer Electronics Calculator (Sept. 2013)
365	Days per year	365	$\frac{days}{year}$	Constant
A	Screen area	Varied	in^2	ENERGY STAR TV Product List (June 2013)

*Equation from ENERGY STAR consumer electronics calculator (Sept. 2013)

Table 41 shows the quantity of TVs incented in 2013 and 2014, the reported and evaluated savings, and realization rates.

Table 41. Flat Panel TV Reported and Evaluated Savings

Year	Quantity	Reported Per Unit Savings	Evaluated Per Unit Savings	Realization Rate
2013	1,264	179	35	20%
2014	1,256	179	39	22%
Average*	**2,520**	**179**	**37**	**21%**

* "Quantity" is a summation, not an average.

Cadmus used the 2013 ENERGY STAR consumer electronics calculator to determine evaluated savings because this method captures the appropriate baseline for the 2013–2014 evaluation period. The evaluated savings are much lower than the reported savings because the efficiency of baseline units has improved significantly.

Using the equation for baseline on-mode operating power from the 2011 ENERGY STAR Consumer Electronics Calculator—as was done in the 2011–2012 evaluation—the evaluated per unit savings is 193 kWh/year and the realization rate is 108%. As the efficiency of standard units continues to improve, the energy savings from this measure will continue to decrease.

Refrigerators

Cadmus estimated refrigerator energy savings using ENERGY STAR refrigerator product lists, from which it extracted the expected annual energy consumption of rebated units as well as the associated baseline energy consumption of a comparable unit meeting the federal standard.

The federal standard for refrigerators was updated in September of 2014. However, Cadmus used the federal standard from before this update as the baseline for all units reported between January 2013 and September 2014 and the updated federal standard as the baseline for all units reported between October 2014 and December 2014.

Cadmus used the ENERGY STAR product lists published before and after the federal standard was updated to gather annual energy consumption for all of the units incented in 2013 and 2014. For 93% of the incented units, the ENERGY STAR product lists included an associated baseline consumption. If the unit was not included in the databases, Cadmus made two assumptions—the incented units were 20% more efficient than the federal standard if the unit was reported from January 2013 to September 2014 and 10% if the unit was reported from October to December 2014. In this way, the incented units met the requirements of the ENERGY STAR certification before and after the federal standard changed.

Table 42 shows the quantity of refrigerators incented in 2013 and 2014 (before and after federal standard update), the reported and evaluated savings, and realization rates.

Table 42. Refrigerator Reported and Evaluated Savings

Year	Quantity	Reported Per Unit Savings	Evaluated Per Unit Savings	Realization Rate
2013	509	44	145	329%
2014 (Jan-Sep)	266	44	148	337%
2014 (Oct-Dec)	79	44	59	135%
Total	**854**	**44**	**138**	**314%**

The reported per unit savings (44 kWh/year) is the value proposed in an RTF workbook from July 12, 2011.[17] This workbook uses a market baseline, which assumes that baseline refrigerators are 12.5% more efficient than units meeting the federal standard.

The updated federal standard significantly increased the baseline unit efficiency, decreasing savings. In the future, Rocky Mountain Power should use the savings value of 59 kWh/year that was estimated for units reported from October to December in 2014.

[17] Regional Technical Forum. Residential: Appliances – Refrigerators, ResRefrigerators_v2_1.xlsx. July 12, 2011. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=122#

Heat Pumps

Cadmus evaluated savings for two heat pump measures— ductless heat pumps and electric system to heat pump conversions—for which Rocky Mountain Power offered incentives. Cadmus estimated savings for both measures using version 3.2 of the RTF residential single-family heat pump savings workbook.[18]

Whenever possible, Cadmus refined the RTF model by incorporating program or Wyoming-specific data. That is, it used Wyoming participant surveys to more completely define the baseline condition, estimating that prior to the installation of heat pumps 22% of homes had central air conditioning, 88% used electric resistance zonal systems, and 12% used electric forced air furnaces.

The RTF provides unique savings values for distinct heating and cooling zones, which are defined by the average annual heating degree days (HDDs) and cooling degree days (CDDs). All of the units incented in 2013 and 2014 were located within Natrona County and Converse County, which both fall into cooling and heating zone two, as defined by the RTF.

Table 43 shows the quantity of each heat pump measure incented in 2013 and 2014, the reported and evaluated savings, and realization rates. Rocky Mountain Power used a savings modeling software from CLEAResult that produced higher per-unit savings which accounts for the lower realization rates. Cadmus reviewed this tool and found it to be reasonable, but chose to use the RTF to be consistent with the region.

Table 43. 2013–2014 Reported and Evaluated Heat Pump Savings

Program Measure Name	Quantity	Reported Per-Unit Savings	Evaluated Per-Unit Savings	Realization Rate
Single Head Ductless Heat Pump	10	5,022	2,419	48%
Electric System to Heat Pump Conversion	1	8,790	5,927	67%

Attic, Wall, and Floor Insulation

Cadmus conducted a billing analysis to assess the actual net energy savings associated with insulation measure installations.[19] The analysis determined the savings estimate using a pooled, conditional savings analysis (CSA) regression model, which involved these groups:

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

[18] Regional Technical Forum. Residential: Heating/Cooling – Air Source Heat Pump Conversions SF, ResSFExisitngHVAC_v3_2.xlsx. May 12, 2015. Available online: http://rtf.nwcouncil.org/measures/measure.asp?id=131

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

Cadmus used program participants, a control group, billing consumption, and Wyoming weather data to create a final database for conducting the billing analysis. This required matching participant program data with billing data and, using zip codes, mapping daily HDDs and CDDs to respective monthly read-date periods. The process defined the billing analysis pre-period as 2012 (before measure installations occurred) and the post-period as September 2014 through August 2015.[20]

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

Insulation Results

Cadmus estimated average insulation savings of 819 kWh per participant, translating to a 102% net realization rate for insulation measures. This analysis resulted in net (rather than gross) savings because it compared participant use trends to a nonparticipant group, thereby accounting for market conditions outside of the program.

With an average participant pre-use of 12,391 kWh, savings represented a 7% reduction in total energy use from insulation measures installed. Table 44 presents the overall net savings estimate for wall, floor, and attic insulation.

Table 44. 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	**48**	**805**	**819**	**102%**	**±55%**	**45%–158%**
Electric Heat	7	3,448	2,492	72%	±44%	40%–104%
Gas Heat	41	354	537	152%	±87%	20%–284%

* Overall model includes both electric and gas heat.

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

Overall, homes with electric heat achieved insulation savings of 2,492 kWh per home. The expected insulation savings averaged 3,448 kWh, translating to a 72% realization rate. With an average participant pre-installation usage of 18,104 kWh, the savings for homes with electric heat represented a 14% reduction in energy use from insulation measures.

Overall, homes heated with gas achieved insulation savings of 537 kWh per home. Average expected insulation savings were 354 kWh, translating to a 152% realization rate. With an average participant pre-

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

installation usage of 11,415 kWh, savings for homes heated with gas represented a 5% reduction in energy use from insulation measures.

Duct Sealing and Insulation

Cadmus was not able to conduct a separate Wyoming billing analysis for duct sealing and insulation because the participants were mainly in multifamily residences that were predominantly electrically heated, and there was only one single-family participant remaining after billing analysis screening. Instead, Cadmus applied to Wyoming the overall realization rate for Pacific Power's Washington home duct sealing and insulation (which had more participant data). The results from Utah were not used because almost all the duct sealing customers in Utah were gas heated single family residences and were not expected to have savings or realization rates similar to electrically heated apartments in Wyoming. However, Washington duct sealing participants had predominantly electrically heated homes (97%). As a result, applying the Washington realization rates are most appropriate.

Duct Sealing and Insulation Results

Since it was not possible to estimate separate duct sealing and insulation savings for Wyoming, the duct sealing and insulation billing analysis results for Washington are presented in this section. Cadmus estimated average duct sealing and duct insulation savings of 2,183 kWh per home, translating to an 89% net realization rate for these measures. As with insulation results, this produced net (rather than gross) savings because it compared participant usage trends to a nonparticipant group, thereby accounting for market conditions outside of the program.

With average participant pre-installation usage of 18,300 kWh, savings represented a 12% reduction in total energy use from duct sealing and duct insulation measures installed. Table 45 presents the overall savings estimate for duct sealing and duct insulation.

Table 45. 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	**143**	**2,457**	**2,183**	**89%**	**±13%**	**77%–101%**
Electric Heat (All)	138	2,538	2,241	88%	±13%	77%-100%
Electric Heat (Heat Pump)	42	4,737	4,039	85%	±13%	74%-96%
Electric Heat (Non-Heat Pump)	96	1,576	1,456	92%	±23%	71%-114%

* Overall model includes both electric and gas heat.

Cadmus used only overall Pacific Power Washington model results (electric and gas heat combined) to determine Wyoming measure-level net savings, but it provided results by for all electric and electric heat types (i.e., heat pump and non-heat pump participants). Overall, participants with electric heat

achieved savings of 2,241 kWh (12%), those with heat pumps achieved savings of 4,039 kWh (18%), and those without heat pumps achieved 1,576 kWh (9%).

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 bulbs, Cadmus conducted demand elasticity modeling, which estimated freeridership by modeling the elasticity of a discounted bulb's price. For non-lighting measure categories, Cadmus conducted freeridership and participant spillover analysis using responses from the non-lighting survey.

Further, Cadmus included a spillover battery in the general population survey to estimate nonparticipant spillover, consisting of savings generated by customers motivated by the program's reputation and marketing to conduct energy efficiency installations that did not receive an incentive. The analysis did not apply nonparticipant spillover to program savings for this period; however, it was calculated for informational purposes at 2% of total HES program savings. Appendix E provides detailed nonparticipant spillover analysis methods and results.

Table 46 provides these net savings evaluation results—evaluated gross savings, evaluated net savings, and NTG by measure type, as well as the NTG methodology used.

Table 46. HES Program NTG Methods and Results for 2013–2014

Measure Category	Measure Name	Program Savings (kWh)		NTG	NTG Methodology
		Evaluated Gross	Evaluated Net		
Appliance	Ceiling Fan	1,113	601	54%	Self-Response NTG
	Clothes Washer	392,668	212,041		
	Dishwasher	28,893	15,602		
	Electric Water Heater	9,100	4,914		
	Freezer	3,720	2,009		
	Light Fixture	209,756	113,268		
	Portable Evaporative Cooler	5,390	2,910		
	Refrigerator	117,886	63,658		
	Room Air Conditioner	4,551	2,458		
Home Electronics	Desktop Computer	308	166		
	Monitor	56	30		
	Flat Panel TV	93,845	93,845	100%	No Adjustments*

Measure Category	Measure Name	Program Savings (kWh)		NTG	NTG Methodology
		Evaluated Gross	Evaluated Net		
HVAC	Central Air Conditioner Equipment	12,364	7,295	59%	Self-Response NTG
	Central Air Conditioner Proper Sizing	1,260	743		
	Evaporative Cooler	36,990	21,824		
	Heat Pump Water Heater	2,120	1,251		
	Single Head Ductless Heat Pump	12,093	12,093	100%	No Adjustments*
	Ductless Heat Pump	12,093	12,093		
	Heat Pump	5,927	5,927		
	Duct Sealing and Insulation	768,823	768,823	100%	No Adjustments**
Lighting	CFL Bulb	6,841,061	3,983,983	58%	Demand Elasticity Modeling
Weatherization	Attic Insulation	1,356,552	1,356,552	100%	No Adjustments**
	Floor Insulation	28,580	28,580		
	Wall Insulation	91,549	91,549		
	Windows	3,331	2,665	80%	Self-Response NTG
Total		**10,040,028**	**6,804,880**	**68%**	

* No net adjustments applied to measures as the engineering review used a current practice baseline to estimate savings, producing a net result.

**No net adjustments applied to insulation and ductwork measures as the billing analysis conducted to generate savings produced a net result.

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

Lighting Evaluated Net Savings

To estimate HES program freeridership for CFLs, Cadmus performed demand elasticity modeling, which is 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. The analysis expressed sales as a function of price (including incentives), seasonality, retail channel, and bulb characteristics. Appendix B gives more details about the equation for the elasticity model.

To complete the analysis, Cadmus used model coefficients to predict sales both with program incentives in place, as observed in the tracking data, and as though prices had remained at their original levels and promotional events had not taken place, in effect predicting sales absent program intervention. Cadmus then multiplied predicted sales—at the incented program price and at the price absent program

incentives—by the evaluated gross kWh savings per bulb.[21] The difference in savings between the hypothetical original price scenario and what actually occurred produced the CFL bulb savings attributable to the program.

However, because the Rocky Mountain Power program had insufficient price variation for an evaluation specific to its Wyoming territory, Cadmus combined the sales from Wyoming with Rocky Mountain Power's Utah and Idaho sales data to produce the elasticity estimates. While there may be differences in consumer behavior between the three regions, the combined Rocky Mountain Power sales is primary data for Rocky Mountain Power covering the evaluation period and is the most representative data available with which to estimate price elasticities. Cadmus then applied these elasticity estimates to Wyoming sales data to reflect the observed markdown levels (the incentive price compared to the price without the incentive) specific to Rocky Mountain Power Wyoming. The elasticity estimate was 1.03% for CFLs. Table 47 shows the net savings results.

Table 47. Lighting Freeridership and NTG

Bulb Type	Freeridership	NTG
CFLs	42%	58%

Overall, freerider savings were estimated at 42%, resulting in a 58% NTG. The average markdown per bulb was 57% with a final, average per-bulb-price of $0.96. Because the elasticity was near 1, meaning a 1% change in price results in a 1% change in quantity, the proportion of net savings essentially reflects the markdown level.

Table 48. Per-Bulb Price and Freeridership by Retail Channel and Bulb Type

Bulb Type	Average Original Price Per Bulb	Average Final Price Per Bulb	Markdown %	Freeridership
CFL	$2.21	$0.96	57%	42%

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

Freeridership Comparisons

Table 49 **Error! Reference source not found.**CFL freeridership estimates from several recent evaluations using the elasticity model approach. The table also shows the average, sales-weighted original retail price of program bulbs and the markdown as a percentage of the original price, which is a significant driver of freeridership estimates. freeridership estimates. freeridership estimates.

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

Table 49. Comparisons of CFL Freeridership and Incentive Levels

Utility	Bulb Type	Average Original Price per Bulb	Average Markdown per Bulb	Percentage Markdown	Freeridership
Mid-Atlantic Utility 1 (2012-2013)	Standard	$1.97	$1.41	72%	27%
Mid-Atlantic Utility 3 (2012-2013)	Standard	$2.10	$1.59	76%	27%
New England (2011)	Standard	$2.11	$1.00	47%	32%
Mid-Atlantic Utility 2 (2012-2013)	Standard	$2.14	$1.43	67%	35%
Mid-Atlantic Utility 4 (2012-2013)	Standard	$2.22	$1.46	66%	35%
Rocky Mountain Power Wyoming 2013–2014	**Standard**	**$2.21**	**$0.96**	**57%**	**42%**
Midwest Utility (2014)	Standard	$1.82	$1.13	62%	43%
Rocky Mountain Power Idaho 2013–2014	Standard	$2.23	$1.11	53%	45%
Southeast (2013)	Standard	$2.15	$1.09	51%	48%

The freeridership estimates for Rocky Mountain Power are within the range of those observed in other programs; however, they have increased since the 2011–2012 evaluation from 35% to 42%. The most obvious difference that could account for this increase is a decrease in the markdown levels. In the 2011–2012 program years, the average markdown for standard CFLs was near 70% compared with 57% in the 2013–2014 program years.

Another factor contributing to freeridership could be the maturation of the efficient lighting market. As CFLs become a more familiar and accepted technology, demand may become less elastic—that is, consumers who are willing to substitute CFLs for less efficient bulbs may have become less dependent on promotional activities over time. Some of this effect may be because of utility-sponsored programs, such as the Rocky Mountain Power program, as well as factors such as improved lighting quality and customers realizing energy savings from switching to CFLs. For customers who are less inclined to substitute CFLs, their decision may remain the same regardless of price changes.

Saturation of CFLs could be another factor contributing to freeridership. Customers who responded to price drops in 2011 or 2012 by stocking up on CFLs may need to buy fewer bulbs in subsequent years if they still have previously purchased bulbs in storage. That is, if customers have already purchased CFLs in the past and do not have an immediate need to buy more, the program would need to discount CFLs to a greater degree to entice customers to purchase more bulbs, which would lead to lower observed elasticities.

Non-Lighting Evaluated Net Savings

Cadmus relied on the non-lighting participant survey to determine non-lighting NTG for appliance and home electronics, HVAC, and weatherization measure categories for 2013 and 2014 participants.

Freeridership and participant spillover constitute the NTG. Cadmus used the following formula to determine the final NTG ratio for each non-lighting program measure:

Net-to-gross ratio = (1 – Freeridership) + Spillover

Methodology

Cadmus determined the freeridership amount based on an approach previously developed for Rocky Mountain Power's 2009-2010 program evaluation[22] and most recently used for the 2011-2012 HES program. The approach ascertained freeridership using patterns of responses to a series of survey questions. These questions—answered as "yes," "no," or "don't know"—asked whether participants would have installed the same equipment in the program's absence, at the same time, amount, and efficiency. Question response patterns received freerider scores, and confidence and precision estimates were calculated based on score distributions.[23]

Cadmus determined participant spillover by estimating the savings amount 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.

Cadmus then used freeridership and spillover results to calculate the program NTG ratio. Appendix D provides a detailed explanation of Cadmus' self-reported NTG methodology.

Freeridership

After conducting non-lighting participant surveys with appliances and home electronics, HVAC, and weatherization participants, Cadmus converted the responses to six freeridership questions into a score for each participant, using the Excel-based matrix approach described in Appendix D. Cadmus then derived each participant's freerider score by translating their responses into a matrix value and applying a rules-based calculation.

Figure 5 shows freeridership score distributions for appliance and home electronics, HVAC, and weatherization survey respondents.

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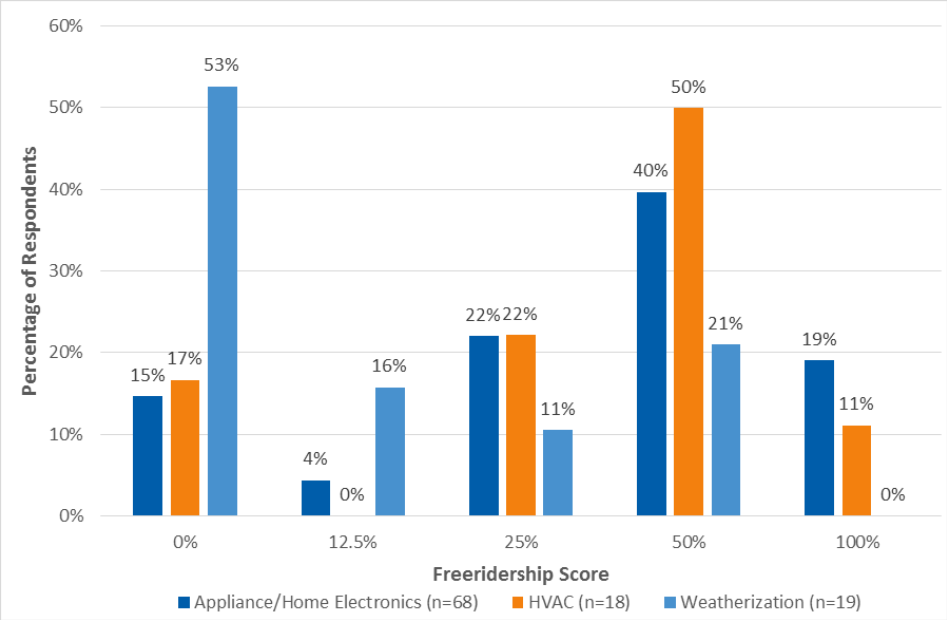
[22] Rocky Mountain Power. Wyoming Evaluation 2009-2010 Report: Appendix I. NTG Evaluation Methodology. http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/DSM_WY_HES_Report_2011.pdf

[23] 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: www.epa.gov/eeactionplan.

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 the final freeridership rates.

Approximately 15% of appliance and home electronic measure category respondents and 17% of HVAC measure category respondents indicated no freeridership. Almost 53% of weatherization measure category respondents were estimated as non-freeriders. That is, they would not have purchased the efficient measure in the absence of Rocky Mountain Power's program. More HVAC respondents indicated high freeridership (scores of 50-100%) than the other measure categories.

Spillover

This section presents the results from additional, energy-efficient measures customers installed after participating in the HES program. Although many participants installed such measures after receiving incentives from Rocky Mountain Power, Cadmus attributed program spillover only to additional purchases significantly influenced by HES program participation and not claimed through the program. No respondents fell into this category and the resulting spillover estimate is 0%.

Non-Lighting NTG Findings

Cadmus conducted 68 surveys with participants in each measure category (appliance/home electronics, HVAC, and weatherization) to generate NTG ratios ranging from 54% for appliance/home electronics measures to 80% for weatherization.

Table 50 lists these findings. The NTG column indicates the percentage of gross savings attributable to the program. For example, participants purchasing an appliance measure received a 54% NTG, indicating that 54% of gross savings for appliance measures could be attributed to the HES program.

Table 50. Non-Lighting NTG Ratio by Measure Category

Program Category	Responses (n)	Freeridership Ratio	Spillover Ratio	NTG	Absolute Precision at 90% Confidence
Appliance / Home Electronics	68	46%	0%	54%	±6%
HVAC	18	41%	0%	59%	±7%
Weatherization	19	20%	0%	80%	±9%

*Weighted by evaluated program savings.

Table 51 shows freeridership, spillover, and NTG estimates for appliance and home electronic, HVAC, and weatherization rebate programs reported for prior Rocky Mountain Power program years as well as for other utilities with similar programs and measure offerings.

Table 51. Non-Lighting NTG Comparisons*

Utility/Region	Reported Year	Responses (n)	Percentage FR**	Percentage Spillover	NTG
Appliances					
Rocky Mountain Power Wyoming 2013–2014 HES Evaluation: Appliance/Home Electronics	**2016**	**68**	**46%**	**0%**	**54%**
Rocky Mountain Power Wyoming 2011–2012 HES Evaluation: Appliance	2013	210	46%	6%	60%
Rocky Mountain Power Wyoming 2011–2012 HES Evaluation: Home Electronics	2013	65	43%	0%	57%
Northeast Utility—Appliance	2015	65	65%	3%	38%
Northwest Utility—Appliance	2014	73	79%	2%	23 %
HVAC					
Rocky Mountain Power Wyoming 2013–2014 HES Evaluation: HVAC	**2016**	**18**	**41%**	**0%**	**59%**
Midwest Utility—HVAC	2015	73	51%	1%	50%
Northwest Utility—HVAC	2014	48	72%	1%	29%
Weatherization					
Rocky Mountain Power Wyoming 2013–2014 HES Evaluation: Weatherization	**2016**	**19**	**20%**	**0%**	**80%**
Midwest Utility—Weatherization	2015	208	30%	2%	72%
Midwest Utility—Weatherization	2015	79	36%	2%	66%

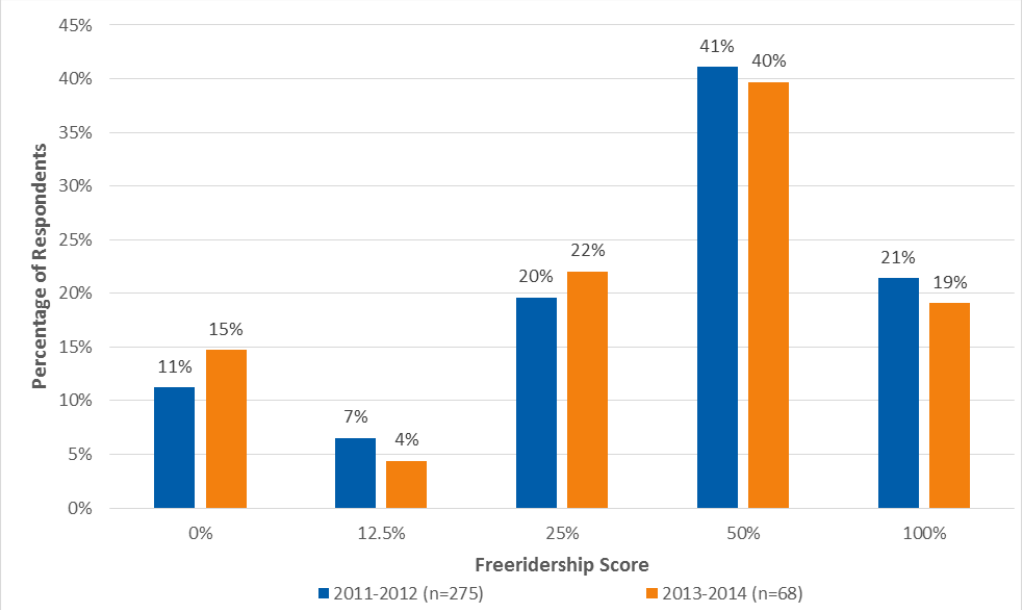
*NTG values derive from self-response surveys, though differences in analysis and scoring methodologies may vary across evaluations.

** FR = Freeridership.

For the appliance and home electronic measure category, respondents in 2013–2014 had very similar freeridership distributions compared to the combined 2011–2012 appliance and home electronic measure category respondents, as shown in Figure 6. The similar freeridership distributions between the

two evaluation periods result in the same overall freeridership estimate of 46%. The difference in NTG between the two evaluation periods results from there being no indications of spillover in 2013–2014, while in 2011–2012 there were spillover savings attributed to Rocky Mountain Power that equaled 6% of the total analysis sample evaluated program savings.

Figure 6. Distribution of Freeridership Scores by Program Cycle*



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

In 2013–2014, the HVAC measure category's 59% NTG estimate was higher than for other utilities' comparable HVAC programs. The 2011–2012 Wyoming HES evaluation did not collect NTG survey data from HVAC measure category participants.

In 2013–2014, the weatherization measure category's 80% NTG estimate was higher than for other utilities' comparable weatherization programs. The 2011–2012 Wyoming HES evaluation did not collect NTG survey data from weatherization measure category participants.

Process Evaluation

This section describes detailed findings of the process evaluation of the HES program. Cadmus drew upon analysis of data collected through program staff interviews, a participant survey, the general population survey, and secondary research. In conducting the evaluation, Cadmus focused on assessing these research activities:

- Effectiveness of the delivery structure and implementation strategy
- Marketing approaches and materials review
- Customer satisfaction
- Internal and external communication channels

During the evaluation kick-off meeting, program stakeholders and Cadmus identified the key research topics as well as other topics of interest. Cadmus' primary research questions are listed in Table 52.

Table 52. Research Areas

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

Methodology

Cadmus conducted the following process evaluation research:

- Program and marketing materials review
- Utility and administrator staff interviews
- General population survey
- Non-lighting participant survey

Program Materials Review

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

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

- In assessing program progress and analyzing trends across program years, Cadmus considered the findings and conclusions from the *Rocky Mountain Power 2011–2012 Wyoming Residential Home Energy Savings Evaluation* and the *Rocky Mountain Power 2009–2010 Wyoming Residential Home Energy Savings Evaluation*.
- Cadmus reviewed the HES program logic model and determined it reflected the 2013–2014 program processes (see Appendix H).
- Cadmus reviewed Rocky Mountain Power's marketing plans and online materials and compared its messages to the challenges and motivations described by customers in order to assess if the program's marketing has been appropriately targeted. Cadmus reviewed the HES program marketing strategy, executional plans, and online (website) and social media elements.

Utility and Administrator Staff Interviews

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

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

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

Participant Survey

Cadmus conducted a telephone survey with non-lighting participating customers, designing the survey instrument to collect data regarding these process topics:

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

General Population Survey

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

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

Program Implementation and Delivery

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

Program Overview

Through the HES program, Rocky Mountain Power provided cash incentives to residential customers for purchases of energy-efficient products, home improvements, and heating and cooling equipment and services. Under the program, customers could install multiple measures to create customized efficiency portfolios, thus lowering their utility bills. Rocky Mountain Power encouraged all of its residential customers, including non-homeowners and owners of multifamily buildings and manufactured homes, to participate in the program.

During the evaluation period, Rocky Mountain Power in Wyoming offered energy efficiency measures in two primary categories—lighting and non-lighting—according to the program's two delivery channels. (Note that only internal program staff referred to these two categories; the company did not market the program this way to customers.) The lighting component used an upstream incentive mechanism that may not be apparent to customers, whereas the non-lighting component operated using a mail-in or online (for select measures) incentive approach, which required the participant's awareness and action. All incentives for the non-lighting component were prescriptive. In 2015, program staff expanded the program by adding a mail-order energy efficiency kit option.

Tariff Changes

Rocky Mountain Power files program modifications (i.e., tariff changes) with the Wyoming Public Service Commission if changes are made to the program or program measures. Rocky Mountain Power did not file any tariff changes for Wyoming that affected the HES program during the evaluation period. In December 2014, Rocky Mountain Power filed a change to add new qualifying equipment, retire existing measures, and modify incentives for various existing measures. The change was approved in February 2015.

Delivery Structure and Processes

Per program staff, the HES program saw minimal changes to its customer delivery method since 2009. Program staff coordinated with participating distributors, retailers, and trade allies to deliver the

program's different components. For most program-qualifying measures customers received cash-back incentives. For qualifying light bulbs, program staff paid incentives directly to manufacturers, who provided high efficiency bulbs to retailers at a discount; retailers, sales associates, and trade allies supported the program by encouraging customers to purchase higher-efficiency equipment that qualified for an incentive.

Data Tracking

Program Data

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

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

Data issues included the following:

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

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

Rebate Data

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

The program processed upstream lighting invoices through Sprocket, a Salesforce dashboard. The program administrator received invoices from the manufacturer, verified the information's accuracy, and entered data into Sprocket.

Application Processing

Application processing largely remained unchanged during the 2013–2014 program years, with online applications covering most qualifying products. As discussed in the Data Tracking section, program staff contracted with a new vendor, NBS, to process the data measure by measure.

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

As shown in Figure 7, the program experienced a significant increase in the percentage of non-lighting customers reporting it took less than four weeks to receive their incentive. Thirty-six percent of respondents said they received their incentive in less than four weeks in 2013–2014, in contrast with 20% in 2011–2012.[24] The program experienced a decrease in the percentage of customers reporting it took four to six weeks to receive their incentive, with 41% of respondents selecting this response. This represents a significant decrease from 2011–2012, when 56% of respondents reported it took four to six weeks to receive their incentive.[25] 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 if information was missing or incorrect information.

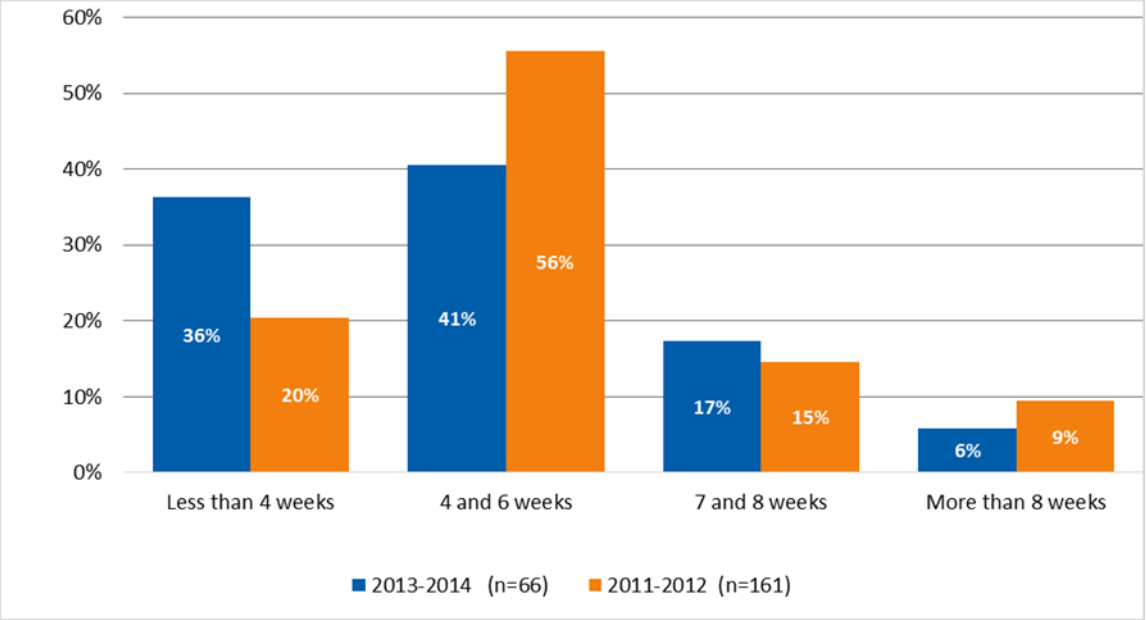
Overall, 84% percent of non-lighting customers expressed satisfaction with the time required to receive the incentive. In response to a separate question, two-thirds of non-lighting customers (66%) expressed high satisfaction rates (very satisfied) with the application process, and 31% said they were somewhat satisfied. Three percent said they were not very satisfied and offered the following reasons:

- "There was too much back and forth."
- "Because the fact that it took two times to do it."
- "Because I was accurate with it and suddenly things I had put on there they didn't qualify so I had to keep on re-doing the application."

[24] Statistically significant increase (p-value <0.10).

[25] Ibid.

Figure 7. Time Between Non-Lighting Application Submission and Incentive Receipt (2011–2014)



Source: Rocky Mountain Power Wyoming HES Residential Non-Lighting Survey (QF6, 2011–2012; QE7, 2013–2014). "Don't know", "refused", and "have not received the incentive yet" responses removed.

Retailers and Trade Allies

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

The program administrator regularly (at least three times per year) offered training to distributors, retailers, and their associates and reported that regular training is necessary for these reasons:

- Address rapid turnover in the industry
- Keep trade allies abreast of program changes
- Work toward the program administrators' goal to use trade ally education to reduce the number of applications with errors

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

Marketing

Approach

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

For 2014, the following five key strategies emerged:

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

Effectiveness

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

The program administrator also noted that the guerrilla (marketing in an unconventional way) tool kit it developed for lighting and appliances effectively engaged retailers. The tool kit provided talking points that educated retail employees about the business case for energy efficiency and its contribution to retailer profits. The program administrator also noted that program mailings were more effective for low- to mid-income and older customers.

Program Challenges and Successes

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

The participation of contractors in 2013 and 2014 who had not yet become a part of the program's trade ally network caused some confusion and frustration for customers. The HES program requires the customer to use an eligible contractor to qualify for rebates. Some applications were rejected, however, and customers expressed frustration that their upgrades did not qualify because they did not use an eligible contractor. To mitigate this, program staff began contacting and encouraging these contractors

to enroll with the program within 90 days of a customer submitting a rebate application so it could be processed.

The Wyoming market's rural customer population also presented significant challenges. Because rural Rocky Mountain Power customers do not visit participating retailers often enough to see program advertisements or purchase some HES program products, program staff began rethinking its marketing and outreach approach with these customers. This ultimately led to development of the energy efficiency kits, which were introduced in 2015.

Customer Response

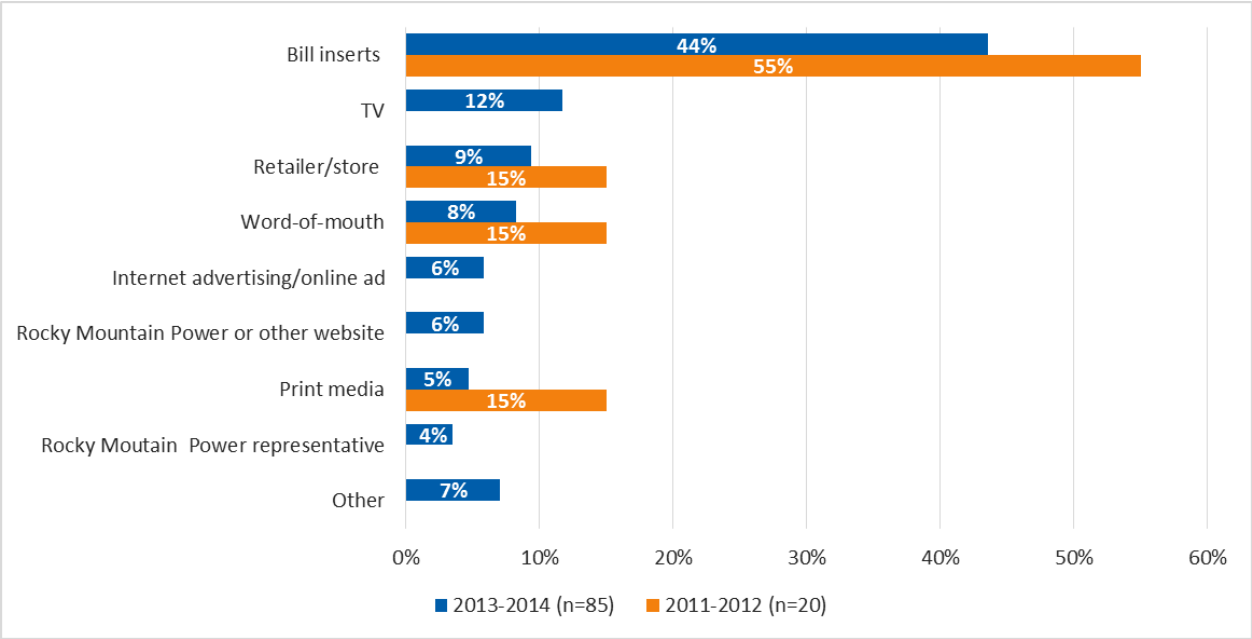
Awareness

The general population of Rocky Mountain Power's customers learned of the wattsmart incentives through a variety of means. The most common source of awareness was consistent during the four program years. In 2013–2014, 44% of respondents said they learned about the program from bill inserts, and in 2011–2012, 55% identified this source.

In 2013–2014, 12% of customers said they learned about the HES program from TV, representing a significant change from 2011–2012, when no customers mentioned TV.[26] Nine percent of customers also learned about the program through a retailer in 2013–2014. Customers have started to use the Rocky Mountain Power website as a primary source of information (6%), as well as online advertising (6%), which will likely constitute a more prominent source of awareness in the future. The "Other" responses included the senior center, through employers, and the radio. Figure 8 presents awareness sources over these time periods.

[26] Statistically significant increase (p-value <0.10).

Figure 8. General Population Survey Source of wattsmart Awareness



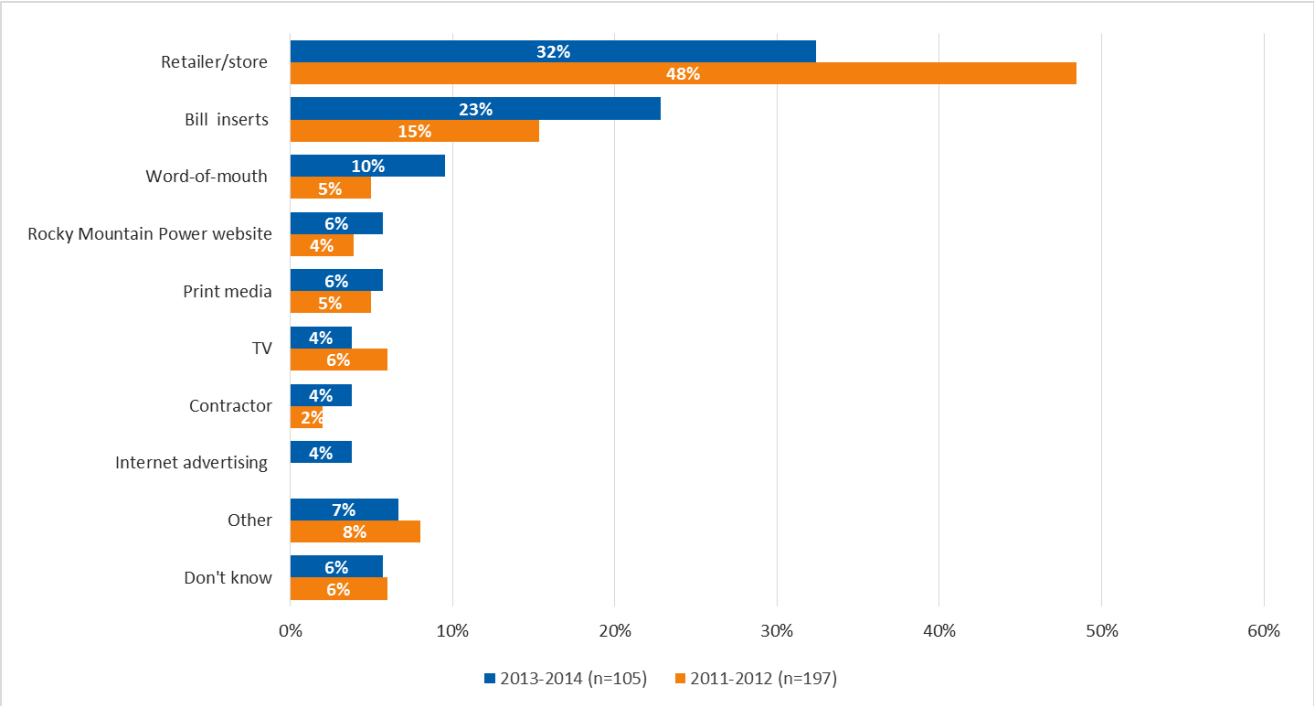
Source: Rocky Mountain Power Wyoming HES Residential General Population Survey (QB2, 2011–2012; QD3, 2013–2014). Don't know and refused responses removed.

As shown in Figure 9, non-lighting participants most commonly mentioned learning of the program through a retailer (32%). Although this was also the most common response in 2011–2012, the decrease is significant.[27] Customers also reported learning of the program through bill inserts more than they did in previous program years, with 23% of respondents saying they learned of the HES program from a bill insert during 2013–2014, compared to 15% in 2011–2012.[28] The "Other" responses included billboard ads, trade show, and Rocky Mountain Power representatives.

[27] Statistically significant decrease (p-value <0.10).

[28] Statistically significant decrease (p-value <0.10).

Figure 9. Non-Lighting Participant Source of Awareness



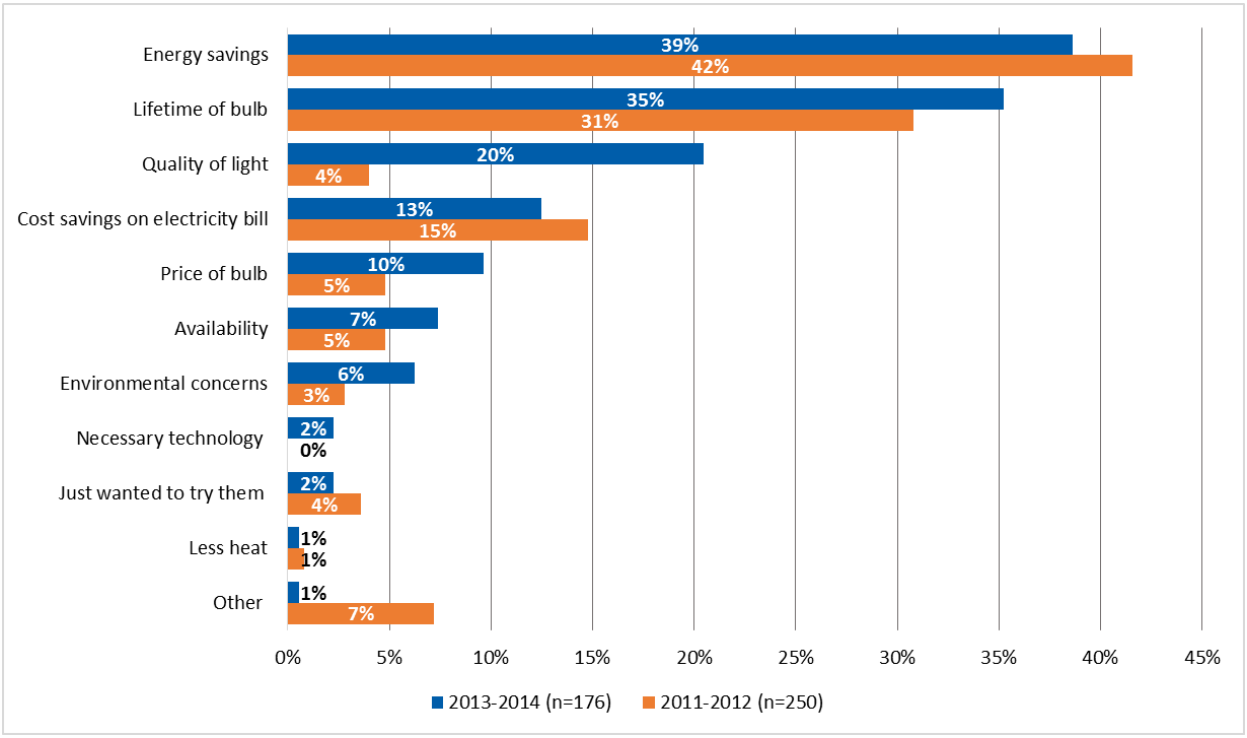
Source: Rocky Mountain Power Wyoming HES Residential Non-lighting Survey (QM1, 2011–2012; QC1, 2013–2014). Refused responses removed. Multiple responses allowed.

Lighting Purchasing Decisions

In the general population survey, Rocky Mountain Power's Wyoming customers expressed a variety of reasons for purchasing energy-efficient bulbs (i.e., CFLs). Customers most commonly cited energy savings (39%) and bulb lifetimes (35%) as the main reasons for purchasing CFLs over other bulb types. As shown in Figure 10, these reasons remained consistent with 2011–2012 findings, except for one key difference: 20% of respondents said the quality of light influenced their decisions in 2013–2014, whereas just 4% specified this reason in 2011–2012.[29]

[29] Statistically significant increase (p-value <0.10).

Figure 10. General Population Reasons for Purchasing CFLs over Other Bulb Types



Source: Rocky Mountain Power Wyoming HES Residential General Population Survey (QE8, 2011–2012; QB8, 2013–2014). Don't know and refused responses removed.

Customers exhibited limited awareness about the bulbs they purchased possibly being part of a sponsored sale, a very common finding for upstream delivery models. For example, only 7% of CFL purchasers stated that bulbs they purchased were part of a utility-sponsored sale. Still, those exhibiting awareness of the utility sponsorship said a discount was influential in their decision to purchase the bulb—50% of CFL purchasers said a discount influenced their decision to buy the bulbs.

Non-Lighting Participation Decisions

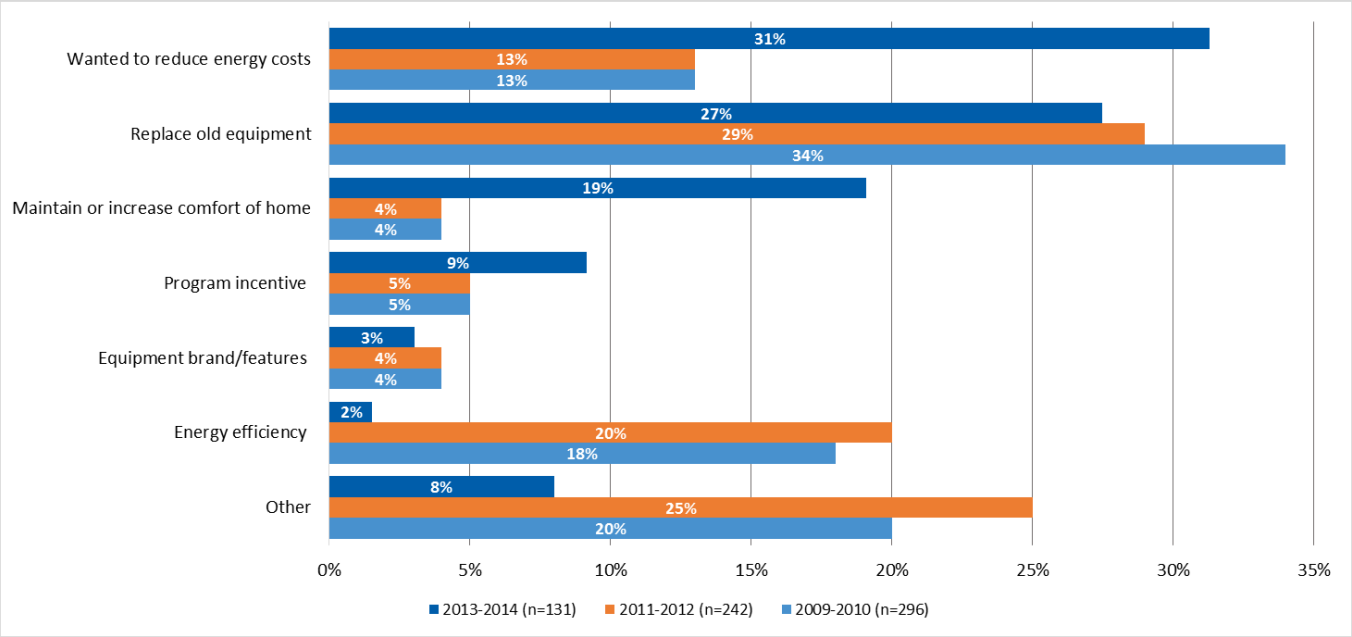
Rocky Mountain Power non-lighting participants said different factors influenced their decision to participate in the program (Figure 11). Most commonly, participants cited a desire to reduce energy cost (31%), demonstrating an increase from the 13% of responses in 2011–2012 and 2009–2010. [30]

Non-lighting participants in 2013–2014 were also motivated to participate in the HES program because they wanted to replace old equipment that did not work or worked poorly (27%) and maintain or increase comfort of the home (19%). These motivations represent a significant increase in the percentage of customers citing reducing energy costs and maintaining or increasing the comfort of the

[30] Statistically significant increase (p-value <0.10).

home.[31] Interestingly, significantly fewer customers cite energy efficiency as a reason for participating in the program than in prior years.[32] The "Other" responses include home remodel, health or environmental concerns, recommendation, price, and availability.

Figure 11. Reasons for Participation (Non-Lighting)



Source: Rocky Mountain Power Wyoming HES Residential Non-lighting Survey (QC5, 2013–2014) (n=200). Don't know and refused responses removed. Multiple responses allowed.

Satisfaction

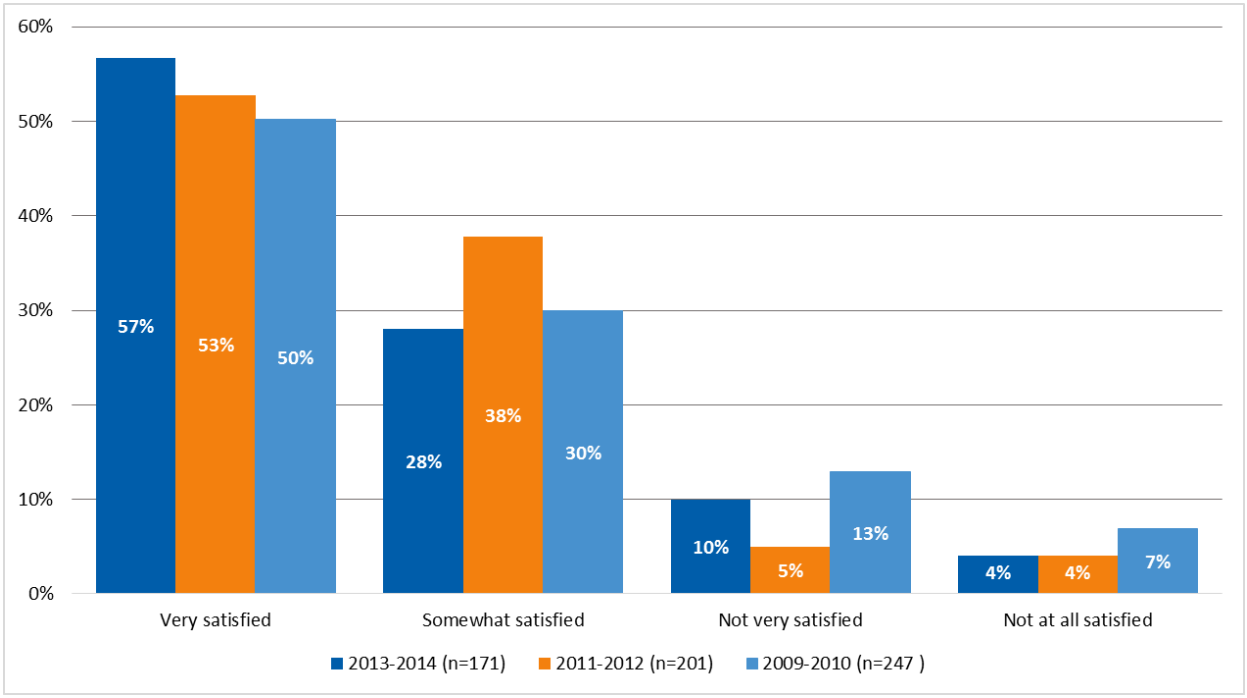
Lighting

Consistent with prior years, 57% of CFL customers said they were very satisfied with their purchase. However, from 2011–2012 to 2013–2014 the program experienced a significant increase in the percentage of customers stating they were not very satisfied with the products, as shown in Figure 12.

[31] Ibid.

[32] Statistically significant decrease (p-value <0.10).

Figure 12. General Population CFL Satisfaction



Source: Rocky Mountain Power Wyoming HES Residential General Population Survey (QG1, 2011–2012, QB15, 2013–2014). Don't know and refused responses removed. Totals may not sum due to rounding.

Non-lighting

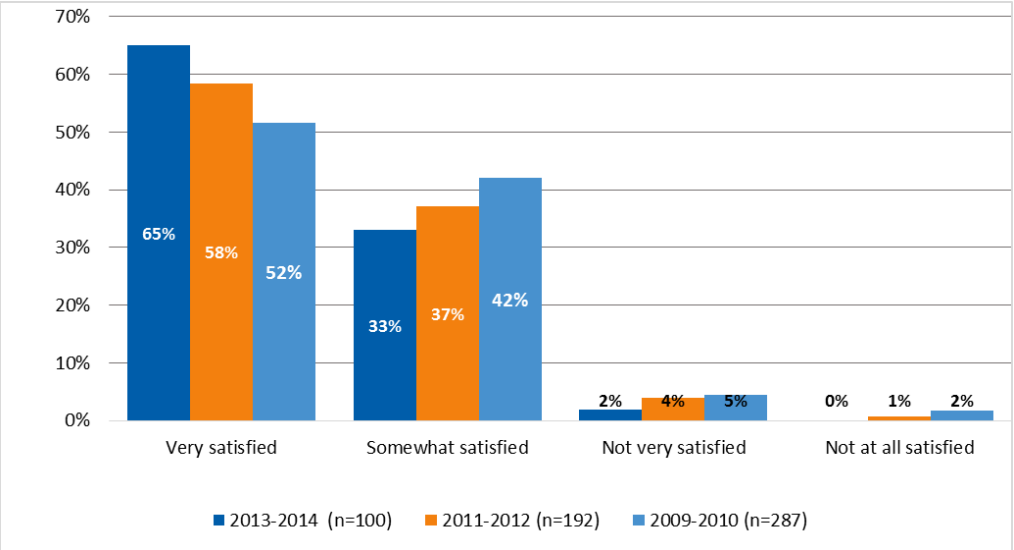
Non-lighting customers overwhelmingly expressed satisfaction with the HES program, with 98% of participants reporting they were satisfied with the program. Participants provided the following reasons for their satisfaction:

- "It helped pay for the insulation."
- "I am glad they sent money for trying to do something right."
- "It is a good program to show people how to be more efficient. Saving as much energy as we can is actually very important in our household so hearing about the program, actually was quite intriguing."

Most dissatisfied customers could not provide a clear reason for their dissatisfaction. Those who could expressed concerns that their applications were not accepted the first time they submitted them.

Comparing year-over-year, satisfaction levels have remained consistent since 2009. Figure 13 illustrates the year-over-year trends. However, when comparing 2009-2010 to 2013-2014, the program experienced a significant increase in customers who reported they were "very satisfied" with the program and a significant decrease in customers who were "not at all satisfied".

Figure 13. Non-Lighting Satisfaction with the wattsmart HES Program

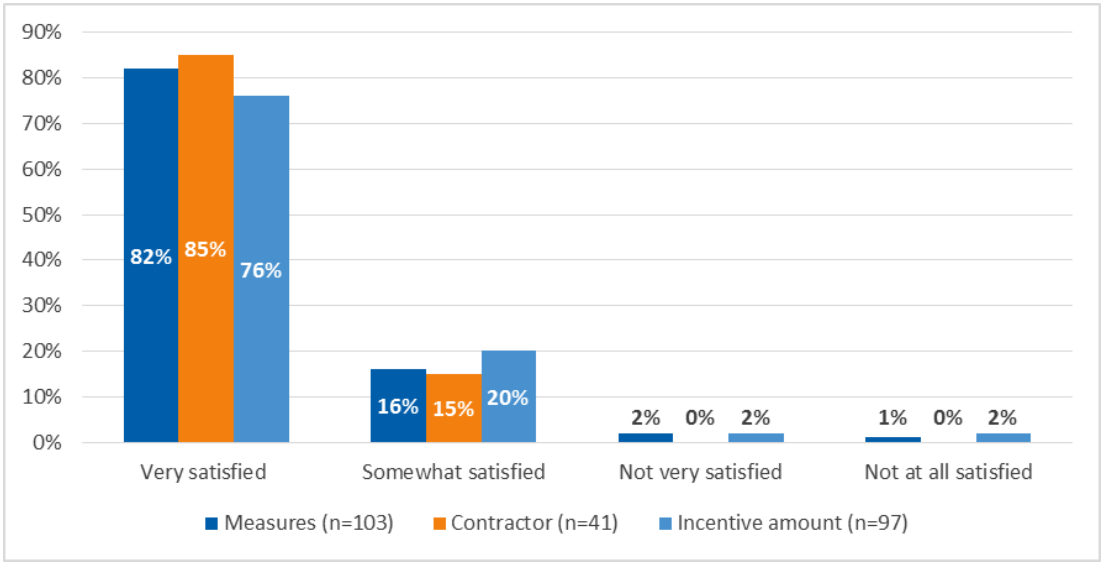


Source: Rocky Mountain Power Wyoming HES Residential Non-lighting Survey (QF9, 2011–2012, QE10, 2013–2014). Don't know and refused responses removed. Totals may not sum due to rounding.

Participation in the program appears to have had a positive or neutral effect on most customers' perceptions of Rocky Mountain Power. When asked whether their participation in the HES program caused their satisfaction with Rocky Mountain Power to change, 31% of non-lighting customers said it increased their satisfaction, 63% said it stayed the same, and 6% said it decreased.

In addition to their overall satisfaction with the HES program, non-lighting customers expressed high satisfaction levels with the measures they installed, their contractors, and the incentive amounts they received. As shown in Figure 14, 82% of non-lighting customers said they were very satisfied with measures installed, and 16% said they were somewhat satisfied.

Figure 14. Non-Lighting Satisfaction with Measures, Contractors, Incentive Amounts



Source: Rocky Mountain Power Wyoming HES Residential Non-lighting Survey (QE1, E3, E6 2013–2014). Don't know and refused responses removed. Totals may not sum due to rounding.

About 40% of participants hired contractors to install measures for which they received program incentives; 82% of these participants reported being very satisfied with their contractors, and 16% were somewhat satisfied. A slightly smaller share of participants expressed satisfaction with the incentive amounts they received, with 76% reporting they were very satisfied with the incentive amounts. An additional 20% said they were somewhat satisfied, and just 2% said they were not very or not at all satisfied.

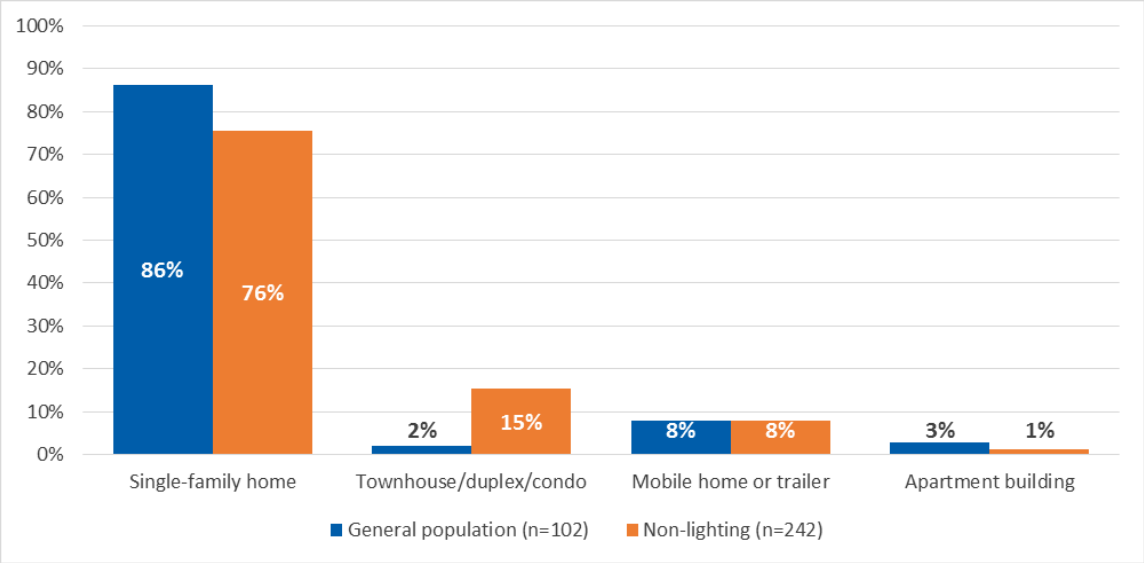
Non-lighting customers also found the HES program incentive application easy to fill out, with 64% of respondents reporting it was very easy to fill out, 33% reporting it was somewhat easy, 2% reporting it was not very easy, and 1% reporting it was not at all easy. Participants experiencing difficulty with filling out the application noted the following challenges:

- "Because I filled it out and had to keep adjusting it. And I didn't get the full credit that the contractor said I was supposed to get."
- "I thought it was quite easy until I got it returned because they said it wasn't filled out correctly."

Customer Demographics

As shown in Figure 15, most of the general population surveyed and non-lighting participants lived in single-family homes, with a small percentage of customers residing in condominiums, townhomes, apartments, or mobile homes.

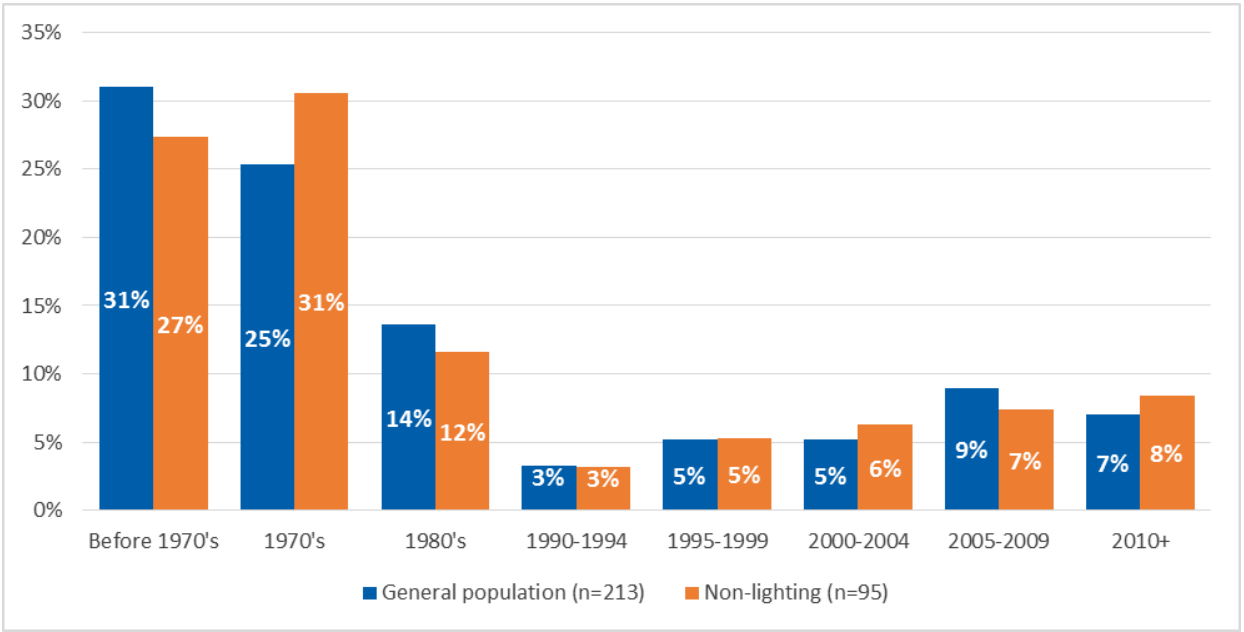
Figure 15. General Population and Non-Lighting Residence Types



Source: Rocky Mountain Power Wyoming HES Residential General Population and Non-lighting Surveys. Don't know and refused responses removed. Totals may not sum due to rounding.

Eighty-three percent of the general population surveyed and 98% of non-lighting participants reported owning their own homes. Figure 16 shows that survey respondents in both groups reported similar home vintages.

Figure 16. General Population and Non-Lighting Home Age



Source: Rocky Mountain Power Wyoming HES Residential General Population and Non-lighting Surveys Don't know and refused responses removed. Totals may not sum due to rounding.

Cost-Effectiveness

In assessing HES program cost-effectiveness, Cadmus analyzed program benefits and costs from five different perspectives, using Cadmus' DSM Portfolio Pro model.[33] The California Standard Practice Manual for assessing demand-side management (DSM) program cost-effectiveness describes the benefit-cost ratios Cadmus used for the following five tests:

- **PacifiCorp Total Resource Cost (PTRC) Test:** This test examined program benefits and costs from 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.
- **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.
- **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.
- **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.
- **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 53 list the components of the five tests.

[33] 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 53. 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 54 provides selected cost analysis inputs for each year, including evaluated energy savings, discount rated, line loss, inflation rated, and total program costs. Rocky Mountain Power provided all of these values, except for energy savings and the discount rate, which Cadmus derived from Rocky Mountain Power's 2013 *Integrated Resource Plan*.

Table 54. Selected Cost Analysis Inputs

Input Description	2013	2014	Total
Evaluated Gross Energy Savings (kWh/year)*	5,414,225	4,625,803	10,040,028
Discount Rate	6.88%	6.88%	N/A
Line Loss	9.51%	9.51%	N/A
Inflation Rate**	1.9%	1.9%	N/A
Total Program Costs	$978,921	$1,261,014	2,239,935

*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.[34] For all analyses, Cadmus used avoided costs associated with Rocky Mountain Power's 2013 *IRP Eastside Class 2 DSM Decrement Values*.[35]

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

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

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

Table 55 presents the 2013–2014 program cost-effectiveness analysis results. Table 56 and Table 57 represent these years individually. For both 2013 and 2014, Cadmus found that the HES program was cost-effective from all perspectives except the RIM test.

The primary criterion for assessing cost-effectiveness in Wyoming is the TRC, which achieved a 1.87 benefit-cost ratio for the combined years' net savings. These results include the evaluated NTG.

The RIM test measures program impacts on customer rates. Many programs do not pass the RIM test because, although 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 55. HES Program Cost-Effectiveness Summary for 2013–2014 (Evaluated Net)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.057	$3,110,910	$6,391,243	$3,280,332	2.05
TRC No Adder	$0.057	$3,110,910	$5,810,221	$2,699,310	1.87
UCT	$0.040	$2,158,740	$5,810,221	$3,651,481	2.69
RIM		$8,063,506	$5,810,221	($2,253,285)	0.72
PCT		$2,973,237	$8,845,123	$5,871,886	2.97
Lifecycle Revenue Impacts ($/kWh)					$0.000013932
Discounted Participant Payback (years)					2.22

Table 56. HES Program Cost-Effectiveness Summary for 2013 (Evaluated NTG)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.047	$1,540,285	$3,890,938	$2,350,653	2.53
TRC No Adder	$0.047	$1,540,285	$3,537,216	$1,996,931	2.30
UCT	$0.030	$978,921	$3,537,216	$2,558,296	3.61
RIM		$4,460,020	$3,537,216	($922,804)	0.79
PCT		$1,524,798	$4,955,583	$3,430,784	3.25
Lifecycle Revenue Impacts ($/kWh)					$0.000005706
Discounted Participant Payback (years)					1.71

Table 57. HES Program Cost-Effectiveness Summary for 2014 (Evaluated NTG)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.071	$1,678,716	$2,672,375	$993,660	1.59
TRC No Adder	$0.071	$1,678,716	$2,429,432	$750,717	1.45
UCT	$0.054	$1,261,014	$2,429,432	$1,168,418	1.93
RIM		$3,851,477	$2,429,432	($1,422,045)	0.63
PCT		$1,548,120	$4,157,218	$2,609,098	2.69
Lifecycle Revenue Impacts ($/kWh)	$0.000008745				
Discounted Participant Payback (years)	1.83				

Conclusions and Recommendations

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

Measure Categorization

Some measure categories were assigned by delivery channels rather than by end uses (e.g., light fixtures were assigned as appliances while in the downstream delivery channel). For cost-effectiveness purposes, measure categories should be allocated by end use to ensure employing the most appropriate load shape.

Recommendation

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

Clothes Washers Reported Savings

Cadmus estimated clothes washer energy savings using the same approach described in the ENERGY STAR calculator from April 2013 (which incorporates the federal standard baseline). Reported savings were consistent with the RTF values, which had been calculated using a current practice baseline, not a federal standard baseline, thus the reported savings tended to decrease savings because the current practice baseline was more efficient than the federal standard. These findings led to the high realization rate of 257%.

Recommendation

Use the federal standard baseline when calculating reported clothes washer energy savings.

Upstream Lighting Tracking Database

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

The tracking database contained several inconsistences: bulb types were inconsistently defined for each SKU; SKUs and model numbers were used interchangeably; and reconciled quantities were inconsistently labeled. The program administrator also could not provide detailed tracking information on product merchandising or promotional events. Data tracking, however, improved significantly between 2013 and 2014. Many of the inconsistencies were because manufacturers updated descriptions between price schedules (the negotiated period for which prices and incentives are agreed upon between manufacturers/retailers and the program implementer). The 2014 tracking data included the schedule name in both the pricing data as well as the sales data, which improved the accuracy in matching prices to sales rather than having to rely on inconsistent secondary descriptions. If the data

continue to be collected in the same way for 2015–2016 as they were in 2014, Cadmus will not face as many challenges in the next evaluation.

Recommendation

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

- Provide consistently defined bulb types for each SKU
- Provide consistent SKUs or model numbers
- Provide tracking data with final and reconciled quantities
- Track all product merchandising and promotional events (were not tracked in either 2013 nor 2014)

Lighting Cross-Sector Sales

Cadmus estimated that 3.9% of efficient bulbs purchased at retail store ultimately would be installed in commercial applications, which is a similar result to findings in other jurisdictions that also implement upstream lighting programs. Bulbs installed in commercial spaces produce more first-year savings than bulbs installed in a residential space because commercial locations typically have a higher daily use of bulbs than do residential locations (i.e., higher HOU). Currently, Rocky Mountain Power does not account for cross-sector sales from the upstream lighting incentives.

Recommendation

Other jurisdictions around the country increasingly have accommodated cross-sector sales factors in calculating reported lighting savings. Cadmus recommends that Rocky Mountain Power explore accounting for commercial installation of upstream bulbs in the reported savings.

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

Nonparticipant Spillover

Nonparticipant spillover results in energy savings caused by, but not rebated through, utilities' demand-side management activities. 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 use and, in some cases, motivate customers to take efficiency actions outside of the utility's program.

Through responses to the general population survey, Cadmus estimated nonparticipant spillover as 2% of HES program savings. Cadmus did not apply this adjustment to 2013-2014 savings, but would encourage continued conversations of if this should be applied in future evaluations.

Recommendation

Consider allowing nonparticipant spillover to be an integral component of NTG estimations for all programs.

Customer Outreach

Retailers and bill inserts constituted the most commonly cited sources for program awareness for non-lighting participants, though retailers represented a smaller source of awareness than in 2011–2012. General population survey respondents most commonly mentioned bill inserts and TV as ways they learned about the lighting discounts, with a growing number citing retailers, the website, and online advertising, demonstrating that customers learn about HES through diverse means.

Recommendation

Continue to pursue a multi-touch marketing strategy, using a mix of bill inserts, retailer training, digital advertising, and targeted mass marketing approaches such as occasional TV ads. Given the large percentage of customers who learned of wattsmart offerings through bill inserts, examine the proportion of customers who elect to receive online bills and ensure these online channels proportionately advertise the programs with the appropriate messaging to motivate customers to participate. This messaging should promote long-lasting products, light quality, saving energy, replacing equipment, and reducing costs.

Satisfaction with Program Experience

Customers generally expressed satisfaction with their program experiences, demonstrating consistency with prior years for both general population and non-lighting customers. Non-lighting customers noted satisfaction with the measures they installed, their contractors, and the incentive amounts. Cadmus was not able to verify the efficacy of the program administrator's efforts to reach out to non-registered contractors who worked with rebate-seeking participants.

Recommendation

Continue regular training with trade allies (e.g., distributors, retailers, sales associates, contractors), updating them on tariff changes and, where appropriate, supporting them with sales and marketing training. Analyze success of efforts to register non-registered contractors who worked with rebate participants within 90 days to determine whether the additional outreach mitigated the number of rejected applications because of non-qualified contractors.

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 A. Survey Instruments and Data Collection Tools

CADMUS

PacifiCorp HES Program PM Staff Interview Guide
PY 2013 - 2014

Name:

Title:

Interviewer:

Date of Interview:

Introduction

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

Program Overview, Management Roles and Responsibilities:

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

a. How long have you been involved?

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

Program Goal and Objectives:

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

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

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

a. How or why were these goals developed?

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

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

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

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

Program Design:

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

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

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

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

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

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

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

d. Have there been any tariff changes since 2012?

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

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

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

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

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

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

Program Marketing

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

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

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

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

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

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

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

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

Customer Experience:

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

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

Trade Ally Experience:

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

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

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

    a. What steps have been taken to address these?

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

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

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

Data Tracking and Savings

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

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

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

Closing

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

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

Thank you very much for your time today!

CADMUS

PacifiCorp Home Energy Savings Participant Survey

[UTILITY]

Washington: Pacific Power

Utah, Wyoming, and Idaho: Rocky Mountain Power

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

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

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

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

[MEASURE]

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

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

A. Introduction

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

Responses to Customer Questions [IF NEEDED]

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

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

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

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

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

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

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

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

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

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

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

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

B. Measure Verification

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

C. Program Awareness & Purchase Decisions

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

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

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

1. Yes
2. No

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

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

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

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

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

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

D. Measure Usage

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

D11. How many years old is the heating system?

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

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

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

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

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

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

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

1. **[RECORD]**

98. Don't Know
99. Refused

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

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

98. Don't Know
99. Refused

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

E. Satisfaction

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

F. Freeridership

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

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

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

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

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

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

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

[IF F3= 1 SKIP TO F13]

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

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

[IF F4 = 1 THEN SKIP TO F6]

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

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

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

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

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

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

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

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

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

[SKIP TO F13]

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

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

[IF F9 = 1 SKIP TO F13]

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

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

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

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

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

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

F13. In your own words, please tell me the influence the Home Energy Saving incentive had on your decision to purchase **[INSERT MEASURE](S)?**

1. _____ **[RECORD RESPONSE]**

G. Spillover

G1. Since participating in the program, have you added any other energy efficient equipment or services in your home that were not incentivized through the wattsmart Home Energy Savings Program?

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

[IF G1 = 2, -98 OR -99 SKIP TO H1]

G2. What high-efficiency energy-saving equipment or services have you purchased since applying for the incentive, not including the **[INSERT MEASURE]** that we have been discussing today? **[LIST OF OTHER ELIGIBLE APPLIANCES AND MEASURES OTHER THAN THOSE LISTED IN PROGRAM RECORDS. PROMPT IF NEEDED]**

1. Clothes Washer **[RECORD QUANTITY]**
2. Refrigerator **[RECORD QUANTITY]**
3. Dishwasher **[RECORD QUANTITY]**
4. Windows **[RECORD QUANTITY IN SQ FT]**
5. Fixtures **[RECORD QUANTITY]**
6. Heat Pump **[RECORD QUANTITY]**
7. Central Air Conditioner **[RECORD QUANTITY]**
8. Room Air Conditioner **[RECORD QUANTITY]**
9. Ceiling Fans **[RECORD QUANTITY]**
10. Electric Storage Water Heater **[RECORD QUANTITY]**
11. Electric Heat Pump Water Heater **[RECORD QUANTITY]**
12. CFLs **[RECORD QUANTITY]**
13. LEDs **[RECORD QUANTITY]**
14. Insulation **[RECORD QUANTITY IN SQ FT]**
15. Air Sealing **[RECORD QUANTITY IN CFM REDUCTION]**
16. Duct Sealing **[RECORD QUANTITY IN CFM REDUCTION]**
17. Programmable thermostat **[RECORD QUANTITY]**
18. Other **[RECORD]** **[RECORD QUANTITY]**
19. None
98. Don't Know
99. Refused

[IF G2 = 12 (ONLY), -98 OR -99 SKIP TO H1. REPEAT G3 THROUGH G5 FOR ALL RESPONSES TO G2]

G3. In what year did you purchase **[INSERT MEASURE TYPE FROM G2]**?

1. 2013
2. 2014
3. Other **[RECORD YEAR]**
98. Don't Know
99. Refused

G4. Did you receive an incentive for **[INSERT MEASURE TYPE FROM G2]?**

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

G5. How influential would you say the wattsmart Home Energy Savings program was in your decision to add the **[INSERT MEASURE FROM G2]** to your home? Was it… **[REPEAT FOR EACH MEASURE LISTED IN G2]**

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

H. Demographics

I have just a few more questions about your household. Again, all your answers will be strictly confidential.

H1. Which of the following best describes your house? **[READ LIST]:**

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

H2. Do you rent or own your home?

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

H3. Including yourself and any children, how many people currently live in your home?

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

H4. About when was this building first built? **[READ LIST IF NEEDED]**

1. Before 1970's
2. 1970's
3. 1980's
4. 1990-94
5. 1995-99
6. 2000-2004
7. 2005-2009
8. 2010 +
9. OTHER **[RECORD]**
98. **[DO NOT READ]** don't know
99. **[DO NOT READ]** refused

H5. What type of foundation does your home have? **[READ LIST IF NEEDED]**

1. Full finished basement
2. Unfinished Basement
3. Crawlspace
4. Slab on Grade
5. OTHER **[RECORD]**
98. **[DO NOT READ]** don't know
99. **[DO NOT READ]** refused

H6. Approximately how many square feet is the home in which the **[INSERT MEASURE](S)** was installed or purchased for? **[READ LIST IF NEEDED]**

1. Under 1,000 square feet
2. 1,000 – 1,500 square feet
3. 1,501 – 2,000 square feet
4. 2,001 – 2,500 square feet
5. Over 2,500 square feet
98. **[DO NOT READ]** don't know
99. **[DO NOT READ]** refused

H7. **[SKIP IF MEASURE = ELECTRIC WATER HEATER OR HEAT PUMP WATER HEATER]** What is the fuel used by your primary water heater?

1. Electricity
2. Natural gas
3. Fuel oil
4. Other **[RECORD]**
98. Don't know
99. refused

I. Conclusion

I1. That concludes the survey. Do you have any additional feedback or comments?

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

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

CADMUS

PacifiCorp HES Upstream Lighting Survey

Audience: This survey is designed for PacifiCorp residential customers in Utah, Idaho, Washington, Wyoming and California (pending). The primary purpose of this survey is to collect information on awareness, satisfaction, installation of energy efficient lighting and energy efficient equipment purchases and motivations. This survey will be administered through telephone calls.

Quota: 250 completed surveys for each state (UT, ID, WA, WY and CA [pending])

Topics	Researchable Questions	Survey Questions
Awareness	Are respondents aware of CFL and LED lighting products?	B1, B2, C1
Installation	What percent of CFLs and LEDs purchased in the past 12 months were installed in the home? Where were the purchased CFLs and LEDs installed (room)?	B4, B9, C3, C8
Disposal and Storage	What percent of CFLs/LEDs purchased in the past 12 months were removed and why? What percent of CFLs/LEDs purchased in the past 12 months are in storage for future use?	**Error! Reference source not found.**-B12, C9-C11
Satisfaction with CFLs and LEDs	How satisfied are residents with their CFLs and LEDs? What do they like or dislike about them?	B8, B15, B16, C7, C14, C15
PacifiCorp Programs	Are respondents aware of the PacifiCorp programs? How did they hear about them? Have respondents visited the Home Energy Savings Website?	Section D
Participant Decisions	What actions are residents taking to save energy? Did they receive a rebate from PacifiCorp during the 2013-2014 program period? How influential were the PacifiCorp programs in their decision to install the equipment?	Section E
Demographics	How do awareness /activities/behaviors vary by demographic characteristics?	Section F

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

[UTILITY]

Washington and California: Pacific Power

Utah, Wyoming, and Idaho: Rocky Mountain Power

A. Introduction

A1. **[TO RESPONDENT]** Hello, I'm **[INSERT FIRST NAME]**, calling from **[INSERT SURVEY FIRM],** on behalf of **[UTILITY]**. May I please speak with **[INSERT NAME]**?

Hello, we are conducting a survey about household lighting and home energy use and would like to ask you some questions about your household's lighting and energy use. We would greatly appreciate your opinions.

[IF NOT AVAILABLE, ASK FOR AN ADULT IN THE HOUSEHOLD WHO IS RESPONSIBLE FOR PURCHASING THE LIGHT BULBS. IF NO ONE APPROPRIATE IS AVAILABLE, TRY TO RESCHEDULE AND THEN TERMINATE. IF TRANSFERRED TO ANOTHER PERSON, REPEAT INTRO AND THEN CONTINUE.]

Responses to Customer Questions [IF NEEDED]

(**Timing:** This survey should take about 10 to 15 minutes of your time. Is this a good time for us to speak with you?)

(**Who are you with**: I'm with **[INSERT SURVEY FIRM]**, an independent research firm that has been hired by **[UTILITY]** to conduct this research. I am calling to learn about your household lighting and home energy use)

(**Sales concern:** I am not selling anything; we would simply like to learn about your household lighting and home energy use. Your responses will be kept confidential. If you would like to talk with someone from the Home Energy Savings Program about this study, feel free to call 1-800-942-0266, or visit their website: http://www.homeenergysavings.net/.)

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

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

A2. This call may be monitored for quality assurance. First, are you the person who usually purchases light bulbs for your household?

1. Yes
2. No, but person who does can come to phone **[START OVER AT INTRO SCREEN WITH NEW RESPONDENT]**
3. No, and the person who does is not available **[SCHEDULE CALLBACK]**

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

A3. Have you, or anyone in your household, ever been employed by or affiliated with **[INSERT UTILITY]** or any of its affiliates?

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

B. CFL Awareness and Purchases

B1. Before this call today, had you ever heard of a type of energy-efficient light bulb called a "compact fluorescent light bulb", or CFL, for short?

1. Yes **[SKIP TO B3]**
2. No

B2. CFLs usually do not look like traditional incandescent light bulbs. The most common type of CFL has a spiral shape, resembling soft-serve ice cream, and it fits in a regular light bulb socket. Before today, had you heard of CFLs?

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

B3. I have some questions about your lighting purchases during the last twelve months. Did you purchase any CFLs in the last twelve months?

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

B4. During the last twelve months, how many *CFLs* did you or your household purchase? Please try to estimate the total number of *individual CFL bulbs*, as opposed to packages. **[IF "DON'T KNOW," PROBE: "IS IT LESS THAN OR MORE THAN FIVE BULBS?" WORK FROM THERE TO GET AN ESTIMATE]**

1. **[RECORD # OF CFLS: NUMERIC OPEN END] [IF QUANTITY=0, SKIP TO C1]**
98. Don't Know **[PROBE: "IS IT LESS THAN OR MORE THAN FIVE BULBS?" WORK FROM THERE TO GET AN ESTIMATE] [IF UNABLE TO GET AN ANSWER, SKIP TO C1]**
99. Refused **[SKIP TO C1]**

B5. Where did you purchased the **[B4.1]** CFLs? **[PROBE FOR RETAIL CHAINS OR ONLINE] [DO NOT READ, MULTIPLE REPSONSES ALLOWED]**

1. Ace Hardware **[CITY, STATE, # PURCHASED]**
2. Broulim's Fresh Foods **[CITY, STATE, # PURCHASED]**
3. Barrett's Foodtown **[CITY, STATE, # PURCHASED]**
4. Batteries Plus **[CITY, STATE, # PURCHASED]**
5. Bi-Mart **[CITY, STATE, # PURCHASED]**
6. Big Lots **[CITY, STATE, # PURCHASED]**
7. Corner Grocery & Hardware **[CITY, STATE, # PURCHASED]**
8. Costco **[CITY, STATE, # PURCHASED]**
9. Delta Jubilee Foods **[CITY, STATE, # PURCHASED]**
10. Do It Best **[CITY, STATE, # PURCHASED]**
11. Dollar Tree **[CITY, STATE, # PURCHASED]**
12. Family Dollar **[CITY, STATE, # PURCHASED]**
13. Fresh Markets **[CITY, STATE, # PURCHASED]**
14. Kamas Foodtown **[CITY, STATE, # PURCHASED]**
15. Kroger – Fred Meyer **[CITY, STATE, # PURCHASED]**
16. Griffith Foodtown **[CITY, STATE, # PURCHASED]**
17. Gunnison Market **[CITY, STATE, # PURCHASED]**
18. Hess Lumber Co **[CITY, STATE, # PURCHASED]**
19. Habitat for Humanity **[CITY, STATE, # PURCHASED]**
20. Harmons **[CITY, STATE, # PURCHASED]**
21. Lowe's **[CITY, STATE, # PURCHASED]**
22. Menards **[CITY, STATE, # PURCHASED]**
23. Petersons Fresh Market **[CITY, STATE, # PURCHASED]**
24. Rancho Markets **[CITY, STATE, # PURCHASED]**
25. Ream's Foods **[CITY, STATE, # PURCHASED]**
26. Ridley's **[CITY, STATE, # PURCHASED]**
27. Safeway **[CITY, STATE, # PURCHASED]**
28. Sam's Club **[CITY, STATE, # PURCHASED]**
29. Smith's **[CITY, STATE, # PURCHASED]**
30. Stokes Market Place **[CITY, STATE, # PURCHASED]**
31. Sutherlands **[CITY, STATE, # PURCHASED]**
32. Thomas Market **[CITY, STATE, # PURCHASED]**
33. Target **[CITY, STATE, # PURCHASED]**
34. Home Depot **[CITY, STATE, # PURCHASED]**
35. The Market **[CITY, STATE, # PURCHASED]**
36. True Value Hardware **[CITY, STATE, # PURCHASED]**
37. Walgreens **[CITY, STATE, # PURCHASED]**
38. Walmart **[CITY, STATE, # PURCHASED]**

39. Winegar's Supermarkets **[CITY, STATE, # PURCHASED]**
40. Online **[WEBSITE, # PURCHASED]**
98. Other **[RECORD STORE NAME, CITY, STATE, # PURCHASED]**
98. Don't Know
99. Refused

B6. Do you recall if any of the **[B4.1]** CFLs you purchased part of a **[INSERT UTILTY]** sponsored sale?

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

B7. **[ASK IF B6 = 1, OTHERWISE SKIP TO B8]** Did the **[INSERT UTILTY]** discount influence your decision to purchase CFLs over another type of bulb?

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

B8. What **[IF B7=1 SAY "OTHER"]** factors were important for your decision to buy CFLs over other types of bulbs? **[DO NOT READ. MULTIPLE RESPONSES ALLOWED]**

1. Energy savings
2. Cost savings on electricity bill
3. Price of bulb
4. Environmental concerns
5. Quality of light
6. Lifetime of bulb
7. Other **[RECORD]**
98. Don't Know
99. Refused

B9. Now I'd like to ask you a few questions about the **[B4.1]** CFLs you purchased in the last twelve months. How many did you install in your home since you purchased them?

1. **[RECORD # OF CFLS]**
2. None **[SKIP TO B12]**
98. Don't Know **[SKIP TO B15]**
99. Refused **[SKIP TO B15]**

B10. Have you since removed any of those CFL bulbs from the sockets?

1. Yes **[ASK "HOW MANY DID YOU REMOVE?" RECORD # OF CFLS]**
2. No **[SKIP TO B12]**
98. Don't Know
99. Refused

B11. What were the reasons you removed the **[B10.1]** purchased CFLs from the sockets? **[QUANTITIES SHOULD ADD TO B10.1, IF NOT, ASK "WHAT ABOUT THE REMAINING BULBS YOU REMOVED?] [DO NOT READ, MULTIPLE RESPONSES ALLOWED]**

1. Bulb burned out **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
2. Bulbs were too bright **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
3. Bulbs were not bright enough **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
4. Delay in light coming on **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
5. Did not work with dimmer/3-way switch **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
6. Didn't fit properly **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
7. Stuck out of fixture **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
8. Light color **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
9. Concerned about mercury **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
10. Replaced with LEDs for better efficiency **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
11. Other **[RECORD VERBATIM] [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF CFLS]**
98. Don't Know
99. Refused

B12. Are any of the **[B4.1]** CFLs you purchased in the last twelve months currently in storage for later use?

1. Yes **[ASK: "HOW MANY ARE NOW IN STORAGE?" RECORD # OF CFLS]**
2. No
98. Don't Know
99. Refused

B13. **[SKIP TO C1 IF B9= 2, 98 OR 99]** Of the **[B9.1]** bulbs that you installed in your home that were purchased during the last twelve months, can you tell me how many CFLs were installed in each room in your house?

1. Bedroom **[RECORD]**
2. Bedroom (unoccupied) **[RECORD]**
3. Basement **[RECORD]**
4. Bathroom **[RECORD]**
5. Closet **[RECORD]**
6. Dining **[RECORD]**
7. Foyer **[RECORD]**
8. Garage **[RECORD]**
9. Hallway **[RECORD]**
10. Kitchen **[RECORD]**
11. Office/Den **[RECORD]**
12. Living Space **[RECORD]**
13. Storage **[RECORD]**
14. Outdoor **[RECORD]**
15. Utility **[RECORD]**
16. Other **[RECORD VERBATIM]**

98. Don't Know
99. Refused

B14. **[ASK ONLY IF TOTAL BULBS IN B13 <QUANTITY FROM B9.1 (IF TOTAL NUMBER OF BULBS LISTED IN EACH ROOM DOES NOT MATCH THE NUMBER OF BULBS INSTALLED STATED IN B9.1, OTHERWISE SKIP TO B15]** Thanks, that accounts for **[TOTAL BULBS IN B13]** of the total quantity that were installed in your home. Can you tell me where the **[B9.1 MINUS TOTAL BULBS IN B13]** other bulbs were installed?

1. **[RECORD VERBATIM]**

98. Don't Know
99. Refused

B15. How satisfied are you with the compact fluorescent light bulb(s) that you purchased during the last twelve months? Would you say you are… **[READ]**

1. Very Satisfied
2. Somewhat Satisfied
3. Not Very Satisfied
4. Not At All Satisfied

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

B16. **[ASK ONLY IF B15 = 3 OR 4]** Why would you say you are **[INSERT ANSWER FROM B15]** with CFLs? **[DO NOT READ LIST AND RECORD ALL THAT APPLY]**

1. Bulb burned out
2. Bulbs are too bright
3. Bulbs are not bright enough
4. Delay in light coming on
5. Did not work with dimmer/3-way switch
6. Didn't fit properly
7. Stuck out of fixture
8. Light color
9. Too expensive
10. Concerned about mercury
11. Replaced with LEDs for better efficiency
12. Other **[RECORD VERBATIM]**
98. Don't Know
99. Refused

C. LED Awareness and Purchases

C1. Another type of light bulb that is used in homes is called a light emitting diode or L-E-D **[SAY THE LETTERS L-E-D]**. These bulbs have regular screw bases that fit into most household sockets. **[IF NEEDED: LEDS HAVE HISTORICALLY BEEN USED FOR NIGHTLIGHTS, FLASHLIGHTS, AND HOLIDAY LIGHTS. HOWEVER, WE ARE NOT ASKING ABOUT THESE TYPES OF LEDS.]**. Before today, had you heard of LEDs that can be used in regular, screw based light sockets?

1. Yes
2. No **[IF ALSO B2= 2 THANK AND TERMINATE, OTHERWISE CONTINUE]**

C2. Did you purchase any LEDs in the last twelve months?

1. Yes
2. No **[THANK AND TERMINATE IF B2= 2, B3=2, OR B4.1 = 0, OTHERWISE SKIP TO SECTION D]**
98. Don't Know **[THANK AND TERMINATE IF B2= 2, B3=2, OR B4.1 = 0, OTHERWISE SKIP TO SECTION D]**
99. Refused **[THANK AND TERMINATE IF B2= 2, B3=2, OR B4.1 = 0, OTHERWISE SKIP TO SECTION D]**

C3. In the last 12 months, how many screw base *LEDs* did you or your household purchase? Please try to estimate the total number of *individual LED bulbs*, as opposed to packages. **[IF "DON'T KNOW," PROBE: "IS IT LESS THAN OR MORE THAN FIVE BULBS?" WORK FROM THERE TO GET AN ESTIMATE]**

[NUMERIC OPEN END: RECORD NUMBER OF LEDS, NOT A RANGE.] [IF QUANTITY=0 AND (IF B2= 2, B3=2, OR B4.1 = 0) THANK AND TERMINATE, OTHERWISE IF QUANTITY = 0 SKIP TO SECTION D]

1. **[RECORD # OF LEDS]**
98. Don't Know **[PROBE FOR ESTIMATES; IF UNABLE TO GET AN ANSWER, SKIP TO D1]**
99. Refused **[SKIP TO D1]**

C4. Where did you purchased the **[C3.1]** LEDs? **[PROBE FOR RETAIL CHAINS OR ONLINE] [DO NOT READ, MULTIPLE REPSONSES ALLOWED]**

1. Ace Hardware **[CITY, STATE, # PURCHASED]**
2. Broulim's Fresh Foods **[CITY, STATE, # PURCHASED]**
3. Barrett's Foodtown **[CITY, STATE, # PURCHASED]**
4. Batteries Plus **[CITY, STATE, # PURCHASED]**
5. Bi-Mart **[CITY, STATE, # PURCHASED]**
6. Big Lots **[CITY, STATE, # PURCHASED]**
7. Corner Grocery & Hardware **[CITY, STATE, # PURCHASED]**
8. Costco **[CITY, STATE, # PURCHASED]**
9. Delta Jubilee Foods **[CITY, STATE, # PURCHASED]**
10. Do It Best **[CITY, STATE, # PURCHASED]**
11. Dollar Tree **[CITY, STATE, # PURCHASED]**
12. Family Dollar **[CITY, STATE, # PURCHASED]**
13. Fresh Markets **[CITY, STATE, # PURCHASED]**
14. Kamas Foodtown **[CITY, STATE, # PURCHASED]**
15. Kroger – Fred Meyer **[CITY, STATE, # PURCHASED]**
16. Griffith Foodtown **[CITY, STATE, # PURCHASED]**
17. Gunnison Market **[CITY, STATE, # PURCHASED]**
18. Hess Lumber Co **[CITY, STATE, # PURCHASED]**
19. Habitat for Humanity **[CITY, STATE, # PURCHASED]**
20. Harmons **[CITY, STATE, # PURCHASED]**
21. Lowe's **[CITY, STATE, # PURCHASED]**
22. Menards **[CITY, STATE, # PURCHASED]**
23. Petersons Fresh Market **[CITY, STATE, # PURCHASED]**
24. Rancho Markets **[CITY, STATE, # PURCHASED]**
25. Ream's Foods **[CITY, STATE, # PURCHASED]**
26. Ridley's **[CITY, STATE, # PURCHASED]**
27. Safeway **[CITY, STATE, # PURCHASED]**
28. Sam's Club **[CITY, STATE, # PURCHASED]**
29. Smith's **[CITY, STATE, # PURCHASED]**
30. Stokes Market Place **[CITY, STATE, # PURCHASED]**
31. Sutherlands **[CITY, STATE, # PURCHASED]**
32. Thomas Market **[CITY, STATE, # PURCHASED]**
33. Target **[CITY, STATE, # PURCHASED]**
34. Home Depot **[CITY, STATE, # PURCHASED]**
35. The Market **[CITY, STATE, # PURCHASED]**
36. True Value Hardware **[CITY, STATE, # PURCHASED]**
37. Walgreens **[CITY, STATE, # PURCHASED]**
38. Walmart **[CITY, STATE, # PURCHASED]**

39. Winegar's Supermarkets **[CITY, STATE, # PURCHASED]**
40. Online **[WEBSITE, # PURCHASED]**
98. Other **[RECORD STORE NAME, CITY, STATE, # PURCHASED]**
98. Don't Know

C5. RefusedWere any of the **[C3.1]** LEDs you purchased part of a **[INSERT UTILTY]** sponsored sale?

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

C6. **[ASK IF C5 = 1, OTHERWISE SKIP TO C7]** Did the **[INSERT UTILTY]** discount influence your decision to purchase LEDs over another type of bulb?

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

C7. What **[IF C6=1 SAY "OTHER"]** factors were important for your decision to buy LEDs over other types of bulbs? **[DO NOT READ. MULTIPLE RESPONSES ALLOWED]**

1. Energy savings
2. Cost savings on electricity bill
3. Price of bulb
4. Environmental concerns
5. CFL disposal concerns
6. Quality of light
7. Lifetime of bulb
8. Interested in the latest technology
9. Other **[RECORD]**
98. Don't Know
99. Refused

C8. Now I'd like to ask you a few questions about the **[C3.1]** LED(s) you acquired in the last twelve months. How many did you install in your home since you purchased them?

1. **[RECORD # OF LEDS]**
2. None **[SKIP TO C11]**
98. Don't Know **[SKIP TO D1]**
99. Refused **[SKIP TO D1]**

C9. Have you since removed any of those LED bulbs from the sockets?

1. **YES [ASK "HOW MANY DID YOU REMOVED?" RECORD # OF LEDS]**
2. No **[SKIP TO C11]**
98. Don't Know **[SKIP TO C11]**
99. Refused **[SKIP TO C11]**

C10. What were the reasons you removed the **[C9.1]** purchased LEDs from the sockets? **[QUANTITIES SHOULD ADD TO B10.1, IF NOT, ASK "WHAT ABOUT THE REMAINING BULBS YOU REMOVED?] [DO NOT READ, MULTIPLE RESPONSES ALLOWED]**

1. Bulb burned out **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
2. Bulbs were too bright **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
3. Bulbs were not bright enough **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
4. Delay in light coming on **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
5. Did not work with dimmer/3-way switch **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
6. Didn't fit properly **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
7. Stuck out of fixture **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
8. Light color **[ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
9. Light is too pointed/narrow **[RECORD VERBATIM] [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
10. Other **[RECORD VERBATIM] [ASK: "HOW MANY DID YOU REMOVE BECAUSE OF THIS?" RECORD # OF LEDS]**
98. Don't Know
99. Refused

C11. Are any of the **[C3.1]** LEDs you purchased in the last twelve months currently in storage for later use?

1. Yes **[ASK: "HOW MANY ARE NOW IN STORAGE?" RECORD # OF LEDS]**
2. No
98. Don't Know
99. Refused

C12. **[SKIP TO C14 IF C8= 2, 99, OR 98]** Of the **[C8.1]** bulbs that are currently installed in your home that were purchased during the last twelve months, can you tell me how many LEDs are installed in each room in your house?

1. Bedroom **[RECORD]**
2. Bedroom (unoccupied) **[RECORD]**
3. Basement **[RECORD]**
4. Bathroom **[RECORD]**
5. Closet **[RECORD]**
6. Dining **[RECORD]**
7. Foyer **[RECORD]**
8. Garage **[RECORD]**
9. Hallway **[RECORD]**
10. Kitchen **[RECORD]**
11. Office/Den **[RECORD]**
12. Living Space **[RECORD]**
13. Storage **[RECORD]**
14. Outdoor **[RECORD]**
15. Utility **[RECORD]**
16. Other **[RECORD VERBATIM]**
98. Don't Know
99. Refused

C13. **[ASK ONLY IF TOTAL BULBS IN C12<C8.1 (IF TOTAL NUMBER OF BULBS LISTED IN EACH ROOM DOES NOT MATCH THE NUMBER OF BULBS INSTALLED STATED IN C8.1)OTHERWISE SKIP TO C13]** Thanks, that accounts for **[TOTAL BULBS IN C12]** of the total quantity that were installed in your home. Can you tell me where the **[C8.1 MINUS TOTAL BULBS IN C12]** other bulbs were installed?

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

C14. How satisfied are you with the LEDs that you purchased during the last twelve months? Would you say you are… **[READ]**

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

C15. **[ASK ONLY IF C14= 3 OR 4]** Why would you say you are **[INSERT ANSWER FROM C14]** with LEDs? **[DO NOT READ LIST AND RECORD ALL THAT APPLY]**

1. Light is too pointed/narrow
2. Too expensive
3. Bulbs are too bright
4. Bulbs are not bright enough
5. Delay in light coming on
6. Did not work with dimmer/3-way switch
7. Didn't fit properly
8. Stuck out of fixture
9. Light color
10. Other **[RECORD VERBATIM]**

98. Don't Know
99. Refused

D. Program Awareness

D1. Before this call, were you aware that **[INSERT UTILITY]** offers energy-efficiency programs that provide monetary incentives to customers for installing equipment that will reduce their utility bills?

1. Yes
2. No

98. Don't Know
99. Refused

D2. One of these **[INSERT UTILITY]** programs is the "Wattsmart Home Energy Savings Program" and it provides discounts on CFLs, LEDs light fixtures and room air conditioners at participating retailers in your area as well as incentives for high-efficiency home equipment and upgrades such as appliances and insulation. Before today, were you aware of this program?

1. Yes
2. No **[SKIP TO SECTION E]**

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

D3. How did you first hear about **[INSERT UTILITY]'s** Wattsmart Home Energy Savings program**? [DO NOT READ LIST. RECORD FIRST RESPONSE. ONE ANSWER ONLY]**

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

D4. **[ASK ONLY IF D3<>3 OR 4]** Have you ever visited the Wattsmart Home Energy Savings Website?

1. Yes
2. No

D5. **[ASK ONLY IF D4 = 1 OR D3=3 OR 4, OTHERWISE SKIP TO SECTION E]** Was the website… **[READ]**

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

D6. What would make the website more helpful for you? **[DO NOT READ RESPONSES. MARK ALL THAT APPLY]**

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

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

E. Nonparticipant Spillover

E1. **[INSERT UTILITY]'s** Home Energy Reporting (HER) program is designed to generate energy savings by providing residential customers with sets of information about the specific energy use and related energy conservation suggestions and tips. Were you participating in this program in 2013 or 2014?

1. Yes
2. No **[SKIP TO SECTION F]**

98. Don't Know
99. Refused

[ASK SECTION E ONLY IF D1 = 1, OTHERWISE SKIP TO F1] Now, I have a few questions about energy efficient improvements that you made or energy efficient equipment you installed specifically in either 2013 or 2014 that might affect your home's energy use.

Number	Measure	**E1.1** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.1=1]** **E2.1** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.1** How many did you install? **[RECORD QTY]**
1	High-efficiency Boiler (a)		N/A	
2	High-efficiency Water Heater (b)			
3	High-efficiency heat pump water heater (c)			
4	High-efficiency Furnace (d)			

Number	Measure	**E1.2** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.2=1]** **E2.2** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.2** How many did you install? **[RECORD QTY]**
5	High-efficiency Air Source Heat Pump (e)			
6	High-efficiency Ground Source Heat Pump (f)			
7	High-efficiency Ductless Heat Pump (g)			
8	High-efficiency Central Air Conditioner *(h)*			
9	High-efficiency Evaporative Cooler (i)			

Number	Measure	**E1.3** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.3=1]** **E2.3** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.3** How many did you install? **[RECORD QTY]**
10	ENEGY STAR Room Air Conditioner (j)			
11	ENERGY STAR Clothes Washer (k)			
12	ENERGY STAR Dishwasher (l)			
13	ENERGY STAR Freezer (m)			
14	ENERGY STAR Refrigerator (n)			

Number	Measure	**E1.4** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.4=1]** **E2.4** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.4** How many square feet did you install? **[RECORD QTY IN SQUARE FEET]**
15	Attic insulation (0)			
16	Wall insulation (p)			
17	Duct insulation (q)			
18	Duct sealing (r)			
19	Windows (s)			

Number	Measure	**E1.5** In 2013 and 2014, did you install any of the following items in your home? **[READ MEASURES]** Yes=measure number in far left corner	**[ASK FOR EACH ITEM WHERE E1.5=1]** **E2.5** Did you receive a rebate or discount from **[INSERT UTILITY]** for this purchase? 1=Yes 2=No 98=Don't know 99= Refused	**E3.5** How many did you install? **[RECORD QTY]**
20	High-Efficiency Showerhead (t)			
21	High-Efficiency Faucet aerator (u)			
22	Any other energy-efficient products? [SPECIFY] (v)			
23	Did not install anything (w)		N/A	N/A
24	Don't know (x)		N/A	N/A
25	Refused (y)		N/A	N/A

[ASK E5 SERIES FOR EACH MEASURE WITH E1 FLAGGED IN TABLES ABOVE (E1.1; E1.2; E1.3; E1.4; E1.5]

E5. On a 1 to 4 scale, with 1 meaning "not at all important", to 4, meaning the item was "very important", how important were each of the following on your decision to install energy efficient equipment or make energy-efficiency improvements?

How important was **[INSERT STATEMENT FROM TABLE BELOW]** on your decision to purchase the **[INSERT MEASURE NAME FROM E1.X]**? **[REPEAT SCALE AS NEEDED; REPEAT FOR ALL STATEMENTS AND ALL MEASURES]**

Statement	Not at all important	Not very important	Somewhat Important	Very Important	Don't know	Not applicable
	1	2	4	5	98	96
a. General information about energy efficiency provided by **[INSERT UTILITY]**.						
b. Information from friends or family members who installed energy efficient equipment and received a rebate from **[INSERT UTILITY].**						
c. Your experience with a past **[INSERT UTILITY]** energy efficiency program.						

E6. **[ASK IF E2.1-5 = 2 OTHERWISE SKIP TO SECTION 98]** What are the reasons you did not apply for a rebate from **[INSERT UTILITY]** for these energy efficiency improvements? **[DO NOT READ LIST; RECORD ALL THAT APPLY]**

1. Didn't know/wasn't aware
2. Was going to apply but forgot
3. Not interested
4. Too busy/didn't have time
5. Dollar rebate for rebate was not high enough
6. Application too difficult to fill out
7. Did apply but never received rebate
8. Other **[SPECIFY]**

98. Don't Know
99. Refused

F. Demographics

F1. Next are a few questions for statistical purposes only. Which of the following best describes your house? **[READ LIST]**

1. Single-family home
2. Townhouse or duplex
3. Mobile home or trailer
4. Apartment building with 4 or more units
5. Other **[RECORD]**

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

F2. Do you or members of your household own this home or do you rent?

1. Own
2. Rent
3. Other **[RECORD]**

98. Don't Know
99. Refused

F3. About when was this building first built? **[READ LIST IF NEEDED]**

1. Before 1970's
2. 1970's
3. 1980's
4. 1990-94
5. 1995-99
6. 2000-2004
7. 2005-2009
8. 2010 +
9. OTHER **[RECORD]**

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

F4. What is the primary heating source for your home? **[READ LIST IF NEEDED]**

1. Forced air natural gas furnace
2. Forced air propane furnace
3. Air Source Heat Pump **[FUEL SOURCE]**
4. Ground Source Heat Pump **[FUEL SOURCE]**
5. Electric baseboard heat
6. Gas fired boiler/radiant heat
7. Oil fired boiler/radiant heat
8. Passive Solar
9. Pellet stove
10. Wood stove
11. Other **[RECORD]**

98. Don't Know
99. Refused

F5. How old is the primary heating system? **[RECORD RESPONSE IN YEARS]**

1. **[RECORD 1-100]**

98. Don't Know
99. Refused

F6. What type of air conditioning system, if any, do you use in your home? **[INDICATE ALL THAT APPLY]**

1. Central Air Conditioner
2. Room Air Conditioner
3. Evaporative Cooler
4. Air Source Heat Pump
5. Ground Source Heat Pump
6. Whole house fan
7. No cooling system
8. Other **[SPECIFY]**

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

F7. **[SKIP IF F6= 7,98 OR 99]** How many years old is your primary cooling system? **[RECORD RESPONSE IN YEARS]**

1. **[RECORD]**

98. Don't Know
99. Refused

F8. What type of fuel is the primary source for your water heating? **[INDICATE ALL THAT APPLY]**

1. Electricity
2. Natural Gas
3. Propane
4. Other [RECORD]
98. **[DO NOT READ]** Don't Know
99. **[DO NOT READ]** Refused

F9. Including yourself and any children, how many people currently live in your home?

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

F10. **[ASK ONLY IF F9> 1]** Are any of the people living in your home dependent children under the age of 18?

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

G. Conclusion

G1. Do you have any additional feedback or comments regarding your household lighting?

1. Yes **[RECORD VERBATIM]**
2. No
98. Don't Know
99. Refused

G2. **[SEX; DO NOT READ]**

1. Female
2. Male
98. Don't Know

That concludes the survey. Thank you very much for your time and feedback.

Appendix A: Lighting Leakage Survey

A1 Hello, my name is _____, and we're doing a survey about light bulbs today. This is a short survey that will only take about five minutes to complete, and we will give you a $10 gift card that you can use in this store today for your time. You will remain completely anonymous. Do you have five minutes to answer some questions today?

- ❍ 1. (Yes) (1)
- ❍ 99. (No/Refused) (2)

If 1. (Yes) Is Selected, Then Skip To A3

If 99. (No/Refused) Is Selected

A2 OK, thanks for your consideration. Though if you don't mind answering one question for me, could you please tell me which utility provides electric service to your home? [SHOW UTILITY LOGOS IF NEEDED. THANK THE CUSTOMER AND END SURVEY AFTER THIS QUESTION]

- ❍ 1. Pacific Power (1)
- ❍ 2. Rocky Mountain Power (2)
- ❍ 91. Any other utility (specify) (3) _____
- ❍ 98. Don't know (4)
- ❍ 99. Refused (5)

Then Skip To E1 short

A3 Which utility provides electric service to your home? [SHOW UTILITY LOGOS IF NEEDED]

- ❍ 1. Pacific Power (1)
- ❍ 2. Rocky Mountain Power (2)
- ❍ 91. Any other utility (specify) (3) _____
- ❍ 98. Don't know (4)
- ❍ 99. Refused (5)

A4 Which zip code do you live in?

- ❍ Record response if given (1) _____
- ❍ 98. Don't know (2)
- ❍ 99. Refused (3)

B1 Do you plan to install the bulbs you're purchasing today in your home, at a business, or someplace else? [CHECK ALL THAT APPLY – ONLY CHECK ONE IF ALL BULBS ARE BEING INSTALLED AT THE SAME ADDRESS]

- ❑ 1. (bulbs will be installed at my home) (1)
- ❑ 2. (bulbs will be installed at my vacation home (or other personal property) (2)
- ❑ 3. (bulbs will be installed at a business / location that is not a residence, including non-profits) (3)
- ❑ 4. (purchasing bulbs for somebody else / not my home or business) (4)
- ❑ 98. (Don't know) (5)
- ❑ 99. (Refused) (6)

If (bulbs will be installed at a business / location that is not a residence, including non-profits) Is Selected

B1a What kind of business is this (what do they do)?

- ❍ A: AGRICULTURE, FORESTRY AND FISHING (VETERINARY, CROPS, HUNTING) (1)
- ❍ B: MINING (GRAVEL, COAL, OIL, METAL, CHEMICAL, NONMETALLIC MINERALS) (2)
- ❍ C: CONTRACT CONSTRUCTION (PLUMBING, PAINTING, ELECTRICAL, ROOFING) (3)
- ❍ D: MANUFACTURING (TEXTILES, FURNITURE, FABRICATED METAL, PRODUCTS) (4)
- ❍ E: TRANSPORTATION, COMMUNICATION, ELECTRIC (FREIGHT, COURIER, CABLE) (5)
- ❍ F: WHOLESALE TRADE (GROCERY SUPPLIERS, RAW MATERIALS, APPAREL) (6)
- ❍ G: RETAIL TRADE (MARKETS, CLOTHING STORES, RESTAURANTS, CAR DEALERS) (7)
- ❍ H: FINANCE, INSURANCE AND REAL ESTATE (BANKS, MORTGAGE BROKERS) (8)
- ❍ I: SERVICES (BEAUTY QUALITY) (9)
- ❍ K: NONCLASSIFIABLE ESTABLISHMENTS (OTHERS) [RECORD RESPONSE] (10) _____
- ❍ (98. don't know) (11)
- ❍ (99. refused) (12)

If (bulbs will be installed at a business / location that is not a residence, including non-profits) Is Selected

B1b What zip code or city is this business located in? [RECORD ZIP CODE IF KNOWN]

- ❍ (RECORD RESPONSE IF GIVEN) (1) _____
- ❍ (98. don't know) (2)
- ❍ (99. refused) (3)

If (bulbs will be installed at a business / location that is not a residence, including non-profits) Is Selected

B1c Do you know which utility provides power for this business? [RECORD NAME OF UTILITY IF KNOWN]

- ❍ (1. Pacific Power) (1)
- ❍ (2. Rocky Mountain Power) (2)
- ❍ (3. Any other utility - SPECIFY) (3) _____
- ❍ (98. don't know) (4)
- ❍ (99. refused) (5)

If (purchasing bulbs for somebody else / not my home or business) Is Selected

B1d Do you know where these bulbs that you are purchasing for somebody else will be installed? (Do you know the zip code or city?) [RECORD RESPONSE – ZIP CODE IS IDEAL, OR CITY AND STATE, OR JUST A VERBAL DESCRIPTION IF ADDRESS IS NOT KNOWN – for example “my mother-in-law’s house”]

- ❍ (1. RECORD RESPONSE IF GIVEN) (1) _____
- ❍ (98. don't know) (2)
- ❍ (99. refused) (3)

B2 How many minutes does it take to drive to this store from the place where you intend to install these bulbs?

- ❍ (Less than 10 minutes) (1)
- ❍ (10 up to 20 minutes) (2)
- ❍ (20 up to 30 minutes) (3)
- ❍ (30 up to 40 minutes) (4)
- ❍ (40 up to 50 minutes) (5)
- ❍ (50 minutes up to an hour) (6)
- ❍ (An hour or more) (7)
- ❍ (Other response or multiple locations - record details below) (8) _____
- ❍ (98. don't know) (9)
- ❍ (99. refused) (10)

B3 What kind of light bulbs are you purchasing today? [GO OVER THE LIGHT BULBS IN THE CUSTOMER'S CART AND RECORD HOW MANY OF EACH TYPE – ONLY CONTINUE IF THERE IS AT LEAST ONE LIGHT BULB IN THEIR CART.]

- ❑ (Enter quantity of INCANDESCENT bulbs) (1) _____
- ❑ (Enter quantity of HALOGEN bulbs) (2) _____
- ❑ (Enter quantity of CFL bulbs) (3) _____
- ❑ (Enter quantity of LED bulbs) (4) _____
- ❑ (Enter quantity AND TYPE of OTHER bulbs) (5) _____

B3scan [SCAN THE BARCODES FOR THE LIGHT BULBS IN THEIR CART AND COPY-PASTE THE NUMBERS INTO THE FIELDS BELOW - ONLY NEED TO SCAN ONE PACKAGE OF EACH TYPE OR WATTAGE; DO NOT SCAN MULTIPLE PACKS OF EXACTLY THE SAME BULBS.]

- ❑ First light bulb type (1) _____
- ❑ Second light bulb type (2) _____
- ❑ Third light bulb type (3) _____
- ❑ Fourth light bulb type (4) _____
- ❑ Fifth light bulb type (5) _____
- ❑ Sixth light bulb type (6) _____
- ❑ Seventh light bulb type (7) _____
- ❑ Eighth light bulb type (8) _____

If (Enter quantity of INCANDESCENT bulbs) Is Greater Than or Equal to 1

B3i What type and wattage of light bulb will you replace with the INCANDESCENT bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity of HALOGEN bulbs) Is Greater Than or Equal to 1

B3h What type and wattage of light bulb will you replace with the HALOGEN bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity of CFL bulbs) Is Greater Than or Equal to 1

B3c What type and wattage of light bulb will you replace with the CFL bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity of LED bulbs) Is Greater Than or Equal to 1

B3l What type and wattage of light bulb will you replace with the LED bulbs you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

If (Enter quantity AND TYPE of OTHER bulbs) Is Selected

B3o What type and wattage of light bulb will you replace with the ${q://QID7/ChoiceTextEntryValue/5} you are purchasing today?

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (6. purchasing bulbs for general use / that will go in storage / not specifically replacing any particular bulbs) (6)
- ❑ (7. no bulbs previously installed / new fixture or previously empty sockets) (7)
- ❑ (98. don't know) (8)
- ❑ (99. refused) (9)

B4 Do you know if any of these bulbs are being sold at a discounted price?

- ❍ (Yes, some are discounted) (1)
- ❍ (None are discounted) (2)
- ❍ (98. don't know) (3)
- ❍ (99. refused) (4)

C1 Were you planning to purchase all of these bulbs before you arrived at this store?

- ❍ (All bulbs in their cart are planned purchases) (1)
- ❍ (Some bulbs in their cart are planned purchases, and some are not) (2)
- ❍ (Customer had planned to purchase more bulbs than are in their cart) (3)
- ❍ (Had not been intending to purchase any bulbs before arriving at the store) (4)
- ❍ (98. don't know) (5)
- ❍ (99. refused) (6)

If (Some bulbs in their cart are planned purchases, and some are not) Is Selected Or (Had not been intending to purchase any bulbs before arriving at the store) Is Selected

C2 What made you decide to purchase these bulbs after you got to the store? [CHECK ALL THAT APPLY]

- ❑ (did not know this type of bulb was available / have not seen these bulbs before) (1)
- ❑ (better value of buying in bulk / buying a larger package size) (2)
- ❑ (regular prices were lower than expected – but not "on sale") (3)
- ❑ (in-store promotional price / these bulbs are "on sale") (4)
- ❑ (in-store advertising / displays) (5)
- ❑ (in-store coupon) (6)
- ❑ (rebate offer) (7)
- ❑ (recommendation of store employee) (8)
- ❑ (other reason given) [RECORD RESPONSE] (9) _____
- ❑ (98. don't know) (10)
- ❑ (99. refused) (11)

If (Customer had planned to purchase more bulbs than are in their cart) Is Selected

C3 What kind of bulbs had you been planning to purchase before you got to the store, but then decided not to purchase? [CHECK ALL THAT APPLY - INCLUDING BULBS THAT THEY ARE PURCHASING IF THEY HAD BEEN INTENDING TO PURCHASE MORE OF THAT TYPE THAN THEY DID]

- ❑ (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN (1) _____
- ❑ (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN (2) _____
- ❑ (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN (3) _____
- ❑ (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN (4) _____
- ❑ (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN (5) _____
- ❑ (98. don't know) (6)
- ❑ (99. refused) (7)

If (Customer had planned to purchase more bulbs than are in their cart) Is Selected

C4 How many of these bulbs that you were planning to purchase before you got to the store did you end up not purchasing? [CHECK ALL THAT APPLY - INCLUDING BULBS THAT THEY ARE PURCHASING IF THEY HAD BEEN INTENDING TO PURCHASE MORE OF THAT TYPE THAN THEY DID]

If (1. Incandescent bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (1. Incandescent bulbs) RECORD QUANTITY (1) _____

If (2. Halogen bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (2. Halogen bulbs) RECORD QUANTITY (2) _____

If (3. CFL bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (3. CFL bulbs) RECORD QUANTITY (3) _____

If (4. LED bulbs) RECORD WATTAGE(S) IF KNOWN Is Selected

- ❑ (4. LED bulbs) RECORD QUANTITY (4) _____

If (5. other type of bulbs) RECORD TYPE AND WATTAGE(S) IF KNOWN Is Selected

- ❑ (5. other type of bulbs) RECORD TYPE AND QUANTITY (5) _____

❑ (98. don't know) (6)

❑ (99. refused) (7)

If (Customer had planned to purchase more bulbs than are in their cart) Is Selected

C5 Why didn’t you purchase these bulbs that you had been planning to buy? [CHECK ALL THAT APPLY]

❑ (the type of bulb was not available / could not find them) (1)

❑ (found a better value) (2)

❑ (saw the deal on the program bulbs) (3)

❑ (saw a deal with different bulbs) (4)

❑ (prices were higher than expected) (5)

❑ (found bulbs that were a better deal) (6)

❑ (found bulbs that were better suited for my purpose) (7)

❑ (decided to go with more efficient bulbs) (8)

❑ (in-store coupon for other bulbs) (9)

❑ (rebate offer for other bulbs) (10)

❑ (recommendation of store employee) (11)

❑ (other) [RECORD RESPONSE] (12) _____

❑ (98. don't know) (13)

❑ (99. refused) (14)

C6 What factors led you to purchase these light bulbs? [CHECK ALL THAT APPLY]

- ❑ 1. (low bulb price / reduced price / on sale) (1)
- ❑ 2. (information in the store / store display or advertising) (2)
- ❑ 3. (information from a utility) (3)
- ❑ 4. (advertising, online or elsewhere) - SPECIFY SOURCE OF AD (radio, TV, online, etc.) (4) _____
- ❑ 5. (someone made a recommendation) - SPECIFY WHO RECOMMENDED (5) _____
- ❑ 6. (energy efficiency / saving energy) (6)
- ❑ 7. (saving money on utility bills) (7)
- ❑ 8. (good for the environment / "green" reasons) (8)
- ❑ 9. (bulb color / light quality) (9)
- ❑ 10. (appearance of the bulb / looks good in my fixtures) (10)
- ❑ 11. (hard to find bulb for a unique fixture) (11)
- ❑ 12. (these are the bulbs I always buy / I am used to) (12)
- ❑ 13. (I needed bulbs right away) (13)
- ❑ 14. (just stocking up / these are spare bulbs) (14)
- ❑ 15. (other reasons given) [RECORD RESPONSE] (15) _____
- ❑ 98. (Don't know) (16)
- ❑ 99. (Refused) (17)

D1 Are you going to purchase any other energy-saving items such as power strips, low-flow showerheads, or any Energy Star products while you are at this store today? [INCLUDING ITEMS THEY INTEND TO PURCHASE WHICH ARE NOT IN THEIR CART YET]

- ❍ (Yes) (1)
- ❍ (No) (2)
- ❍ (98. Don't know) (3)
- ❍ (99. Refused) (4)

If “Are you going to purchase any other energy-saving items such as power strips, low-flow showerheads, or any Energy Star products while you are at this store today?” [INCLUDING ITEMS THEY INTEND... (Yes) Is Selected

D1b What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY (showerhead, insulation, thermostat, etc.)]

- ❑ Record name of first item (1) _____
- ❑ Record name of second item (2) _____
- ❑ Record name of third item (3) _____
- ❑ Record name of fourth item (4) _____
- ❑ Record name of fifth item (5) _____
- ❑ Record name of sixth item (6) _____
- ❑ (99. Refused) (7)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of first item Selected

D1b1 How much/many of [D1b] do you plan to use/install right away?

- ❍ (All of it will be installed/used right away) (1)
- ❍ (Some of it will be installed/used right away) - RECORD QUANTITY THAT WILL BE USED RIGHT AWAY (2) _____
- ❍ (None of it will be installed/used right away) (3)
- ❍ (98. Don’t know) (4)
- ❍ (99. Refused) (5)

If What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” … Record name of first item Is Selected

D2.1 Do you have any rebates or coupons for [D1b]?

- ❍ (Yes) - SPECIFY WHO IS OFFERING REBATE OR COUPON BELOW (1) _____
- ❍ (No) (2)
- ❍ (98. Don’t know) (3)
- ❍ (99. Refused) (4)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of second item Is Selected

D1b2 How much/many of [D1b] do you plan to use/install right away?

- ❍ (All of it will be installed/used right away) (1)
- ❍ (Some of it will be installed/used right away) - RECORD QUANTITY THAT WILL BE USED RIGHT AWAY (2) _____
- ❍ (None of it will be installed/used right away) (3)
- ❍ (98. Don’t know) (4)
- ❍ (99. Refused) (5)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of second item Is Selected

D2.2 Do you have any rebates or coupons for [DB1]?

- ❍ (Yes) - SPECIFY WHO IS OFFERING REBATE OR COUPON BELOW (1) _____
- ❍ (No) (2)
- ❍ (98. Don’t know) (3)
- ❍ (99. Refused) (4)

If “What energy-saving items are you going to purchase today? [RECORD A BRIEF DESCRIPTION OF UP TO SIX TYPES OF "ENERGY-SAVING" ITEMS BEING PURCHASED AT THE STORE TODAY” ... Record name of second item Is Selected

D1b3 How much/many of [DB1] do you plan to use/install right away?

- ❍ (All of it will be installed/used right away) (1)
- ❍ (Some of it will be installed/used right away) - RECORD QUANTITY THAT WILL BE USED RIGHT AWAY (2) _____
- ❍ (None of it will be installed/used right away) (3)
- ❍ (98. Don’t know) (4)
- ❍ (99. Refused) (5)

[REPEAT FOR UP TO SIX ITEMS]

If What energy-saving items are you going to purchase today? Is Selected

D3.1 Please tell me how important your experience purchasing efficient light bulbs was in your decision to purchase [db1] Would you say it was . . .

- ❍ Very important (1)
- ❍ Somewhat important (2)
- ❍ Not very important, or (3)
- ❍ Not important at all? (4)
- ❍ 98. (Don't know) (5)
- ❍ 99. (Refused) (6)

[REPEAT FOR UP TO SIX ITEMS]

E1 Thank you for your time and feedback today! [GIVE CUSTOMER THE GIFT CARD]

- ❍ ENTER YOUR INITIALS AND CLICK NEXT TO CONFIRM SURVEY COMPLETED _____

E1short Thank you for your time! [DO NOT GIVE CUSTOMER A GIFT CARD]

- ❍ ENTER YOUR INITIALS AND CLICK NEXT TO CONFIRM SURVEY COMPLETED _____

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Appendix B. Lighting Impacts

This appendix contains further details on the following lighting topics that are introduced in the main body of the report:

1. Hours of Use (HOU)
2. Delta Watts
3. Cross-Sector Sales
4. Demand Elasticity Modeling

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

HOU

Cadmus estimated CFL HOU using a multistate modeling approach, built on light logger data collected from two states: Missouri and Maryland. Missouri and Maryland metering data were also employed in the previous 2011-2012 evaluation, however, since both states continued collecting metering data since the prior evaluation, Cadmus used the most recent data available from these states. The metering dataset consisted of a total of 2,274 loggers.

Cadmus chose these studies for the following reasons:

- The majority of the data used in the 2011-2012 evaluation was collected in 2010. Upstream lighting programs feature customer engagement and educational components as well as providing incentives for efficient lighting products. Updating data sources captures changes in behaviors over time as a result of these components.
- These extended studies also accounted for CFLs and LEDs separately for Rocky Mountain Power programs that incented LEDs, which allows Cadmus to estimate HOU for each lighting technology. Prior metering data did not account for this breakout as LEDs were much rarer a few years ago.
- These two studies employed a sampling strategy that prioritized rooms where efficient lighting is most likely to be installed.
- The total number of loggers was greater than the five combined studies from the previous evaluation (2,274 compared to 2,106 in 2011-2012). This allowed Cadmus to choose the most representative studies without sacrificing precision with smaller numbers of loggers.

Missouri and Maryland Metering Protocol

Following whole-house lighting audits, Cadmus installed up to 10 light meters on randomly selected lighting fixture groups, targeting incandescents, CFLs, and medium screw-based LEDs. To ensure unbiased installations, Cadmus used an iPad tool to randomly select fixtures receiving the meters. The

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

iPad tool assigned meter installations based on room priorities, with the first five meters assigned to each of five priority room types (e.g., living area, dining room, kitchen, master bedroom, bathroom). The remaining five meters were randomly assigned to any fixture in any non-priority room (e.g., secondary bedrooms, closet, hall, basement, office, laundry, mechanical). Randomly assigning meters in this manner sought to improve precision around priority rooms (where most lamps are installed).

Data from the removal site visits were incorporated into the iPad tool and database to augment the installation information for each site and meter. As part of the lighting logger removal process, technicians conducted a series of pre-removal meter diagnostics, which included the following:

- Completing a logger state test (which determined if the meter functioned properly and whether ambient light affected the meter's operation);
- A visual review of the total time the logger recorded the fixture switched to on;
- Verbal verification from the customer that they used the light fixture;
- Verbal verification from the customer that the logger remained in place for the study's duration; and
- Recording the condition of the logger and battery status.

Model Specification

To estimate HOU, Cadmus determined the total "on" time for each individual light logger per day, using the following guidelines:

- If a light logger did not record any light for an entire day, the day's HOU was set to zero.
- If a light logger registered a light turned on at 8:30 p.m. on Monday and turned off at 1:30 a.m. on Tuesday morning, 3.5 hours were added to Monday's HOU and 1.5 hours to Tuesday's HOU.

Cadmus modeled daily HOU as a function of room type using an analysis of covariance (ANCOVA) model.

ANCOVA models are regression models that model a continuous variable as a function of a single, continuous, explanatory variable and a set of binary variables. This way, an ANCOVA model simply serves as an analysis of variance (ANOVA) model with a continuous explanatory variable added.

Cadmus chose this specification due to its simplicity, making it suitable in a wide variety of contexts. Though the model lacked the specificity of other methods, it offered estimates not nearly as sensitive to small differences in explanatory variables (compared to more complex methods). Therefore, these models could produce consistent estimates of average daily HOU for a given region, using the specific distribution of bulbs by room.

Cadmus specified final models as cross-sectional, ANCOVA regressions:

$$Average\ Daily\ HOU = \beta_1 * \text{Basement} + \beta_2 * \text{Bathroom} + \beta_3 * \text{Bedroom} + \beta_4 * \text{Closet} + \beta_5 * \text{Dining} + \beta_6 * \text{Foyer} + \beta_7 * \text{Garage} + \beta_8 * \text{Hallway} + \beta_9 * \text{Kitchen} + \beta_{10} * \text{Living Space} + \beta_{11} * \text{Office} + \beta_{12} * \text{Outdoor} + \beta_{13} * \text{Storage} + \beta_{14} * \text{Utility} + \beta_{15} * \text{Other} + \beta_{16} * \text{SinHOU}$$

Where:

Basement	=	a dummy variable equal to 1, if the bulb is in the basement, and 0 otherwise;
Bathroom	=	a dummy variable equal to 1, if the bulb is in the bathroom, and 0 otherwise;
Bedroom	=	a dummy variable equal to 1, if the bulb is in a bedroom, and 0 otherwise;
Closet	=	a dummy variable equal to 1, if the bulb is in the closet, and 0 otherwise;
Dining	=	a dummy variable equal to 1, if the bulb is in the dining room, and 0 otherwise;
Foyer	=	a dummy variable equal to 1, if the bulb is in the foyer, and 0 otherwise;
Garage	=	a dummy variable equal to 1, if the bulb is in the garage, and 0 otherwise;
Hallway	=	a dummy variable equal to 1, if the bulb is in the hallway, and 0 otherwise;
Kitchen	=	a dummy variable equal to 1, if the bulb is in the kitchen, and 0 otherwise;
Living Space	=	a dummy variable equal to 1, if the bulb is in the living space, and 0 otherwise;
Office	=	a dummy variable equal to 1, if the bulb is in an office, and 0 otherwise;
Outdoor	=	a dummy variable equal to 1, if the bulb is outdoors, and 0 otherwise;
Storage	=	a dummy variable equal to 1, if the bulb is in a storage room, and 0 otherwise;
Utility	=	a dummy variable equal to 1, if the bulb is in the utility room, and 0 otherwise;
Other	=	a dummy variable equals to 1, if the bulb is in a low-use room (such as a utility room, laundry room, or closet), and 0 otherwise; and
SinHOU	=	amplitude of sinusoid function.

As not all loggers collected a full year of data, Cadmus estimated an annual average HOU for all lamps, fitting the data to a sinusoidal curve that represented changes in the hours of available daylight per day.[2]

Cadmus tested the potential influences of other demographic and day type variables in model specifications, such as: home characteristics and weekend/weekday. These variables, however, were not

[2] Page 15 of the Uniform Methods Protocol for lighting impact evaluations recommends using the sinusoidal annualization approach due to the strong relationship between daylight hours and lighting usage observed in a large number of studies. Available online at: http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf

included as their estimated coefficients did not differ significantly from zero or produced signs inconsistent with expectations.

Final Estimates and Extrapolation

Cadmus used these model parameters to predict average daily use by taking the sum of the product of each coefficient shown in Table B1 and its corresponding average independent variable.

Table B1. HOU Model Coefficients and Significance

Parm	Estimate	Stderr	LowerCL	UpperCL	Z	ProbZ
Basement	2.01	0.46	1.10	2.93	4.33	<.0001
Bathroom	1.38	0.12	1.14	1.62	11.08	<.0001
Bedroom	1.28	0.08	1.13	1.43	16.42	<.0001
Closet	0.49	0.08	0.34	0.63	6.46	<.0001
Dining	1.40	0.16	1.09	1.71	8.92	<.0001
Foyer	2.02	1.35	-0.63	4.68	1.49	0.1352
Garage	1.47	0.48	0.52	2.41	3.03	0.0024
Hallway	1.21	0.17	0.87	1.55	6.99	<.0001
Kitchen	3.25	0.26	2.74	3.76	12.56	<.0001
Living_Space	2.21	0.16	1.89	2.52	13.64	<.0001
Office_Den	1.36	0.21	0.95	1.77	6.44	<.0001
Other	1.12	0.37	0.40	1.84	3.07	0.0022
Outdoor	2.39	0.43	1.55	3.23	5.58	<.0001
Storage	0.07	0.02	0.03	0.11	3.42	0.0006
Utility	0.95	0.25	0.46	1.43	3.79	0.0001

Table B2 shows independent variables used, calculated from participant survey responses when asked which rooms respondents' installed bulbs in.

Table B2. Weekday HOU Estimation Input Values

Variable	CFL Value
Bedroom	26%
Basement	4%
Bathroom	10%
Closet	1%
Dining	9%
Foyer	1%
Garage	2%
Hallway	2%
Kitchen	16%
Office/Den	2%
Living Space	17%
Storage	0%
Outdoor	3%
Utility	1%
Other	6%

Using these values, the equation calculated a 1.83 average daily HOU for CFLs.

The lower HOU value of 1.83 for CFLs in 2013-2014, down from 2.18 in 2011-2012, was likely in-part due to increased saturation of efficient bulbs. As the efficient lighting market matures and saturation increases within the average home, efficient lamps are installed not just in high-use sockets but also in lower use sockets, whether in rooms with lower usage or supplemental lighting, such as desk lamps.

The survey responses indicated changes in the proportion of bulbs installed in various rooms between the 2011-2012 cycle and the current evaluation. The share of bulbs installed in living spaces (which have a higher average usage) dropped from 29% in 2011-2012 to 17% for CFLs in 2013.

Conversely, the share of bulbs installed into room types designated as “other” in the 2011-2012 cycle (such as utility rooms, closets, hallways) increased from 8% in 2011-2012 to 23% in the current evaluation. These room types tend to have lower average hours of use.

Delta Watts Lumen Bins

Table B3 through Table B11 provide lumen bins by lamp types applied in the gross evaluated lighting evaluation (CFLs and light fixtures). The tables include evaluated baseline wattages by year and total lamp quantities sold in 2013–2014.

Table B3. Lumen Bins and Quantities for Standard Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Estimated CFL Efficient Wattage	Lamp Quantity
0–309	25	25	1–5	0
310–449	25	25	6–7	0
450–799	40	29	8–12	16,043
800–1,099	60	43	13–17	272,208
1,100–1,599	53	53	18–24	35,153
1,600–1,999	72	72	25–30	54,394
2,000–2,600	72	72	31–38	0

Table B4. Lumen Bins and Quantities for Globe Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity*
250–349	25	25	0
350–499	40	29	463
500–574	60	43	1,261
575–649	53	53	999
650–1099	72	72	3,767
1100–1300	72	72	0

*Cadmus was unable to evaluate 150 globe lamps with less than 250 lumens

Table B5. Lumen Bins and Quantities for Decorative Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
70–89	10	10	32
90–149	15	15	0
150–299	25	25	18
300–499	40	29	1,694
500–699	60	43	0

Table B6. Lumen Bins and Quantities for EISA-Exempt Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
310–449	25	25	0
450–799	40	40	0
800–1099	60	60	0
1100–1599	75	75	0
1600–1999	100	100	214
2000–2600	150	150	123

Table B7. Lumen Bins and Quantities for D > 20 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
300–639	30	30	649
640–739	40	40	9,433
740–849	45	45	123
850–1179	50	50	282
1180–1419	65	65	3,479
1420–1789	75	75	0
1790–2049	90	90	0
2050–2579	100	100	0
2580–3429	120	120	0

Table B8. Lumen Bins and Quantities for BR30, BR40, ER40 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
300–399	30	30	0
400–449	40	40	0
450–499	45	45	0
500–649	50	50	0
650–1179	65	65	5,603
1180–1419	65	65	0
1420–1789	75	75	0
1790–2049	90	90	0
2050–2579	100	100	0
2580–3429	120	120	0

Table B9. Lumen Bins and Quantities 20 ≥ D > 18 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
300–539	20	20	0
540–629	30	30	0
630–719	40	40	0
720–999	45	45	0
1000–1199	50	50	0
1200–1519	65	65	0
1520–1729	75	75	0
1730–2189	90	90	0
2190–2899	100	100	0

Table B10. Lumen Bins and Quantities for R20 Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
300–399	30	30	0
400–449	40	40	0
450–719	45	45	264
720–999	50	50	0
1000–1199	65	65	0
1200–1519	75	75	0
1520–1729	90	90	0
1730–2189	100	100	0
2190–2899	120	120	0

Table B11. Lumen Bins and Quantities for 18 ≥ D Reflector Lamps

Lumen Bin	2013 Baseline Wattage	2014 Baseline Wattage	Lamp Quantity
200-299	20	20	0
300-399	30	30	0
400-449	40	40	0
450-499	45	45	0
500-649	50	50	0
650-1199	65	65	0

Figure B1 displays 2014 baseline wattage plotted as a function of lumen output for standard, globe, decorative, and EISA-exempt lamps, as well as the three most common reflector types. This figure shows this correlation up to 2000 lumens (only 0.03% of lamps had lumen output greater than 2000 lm).

Figure B1: Plot of 2014 Baseline Wattage vs. Lamp Lumens for Various Lamp Types

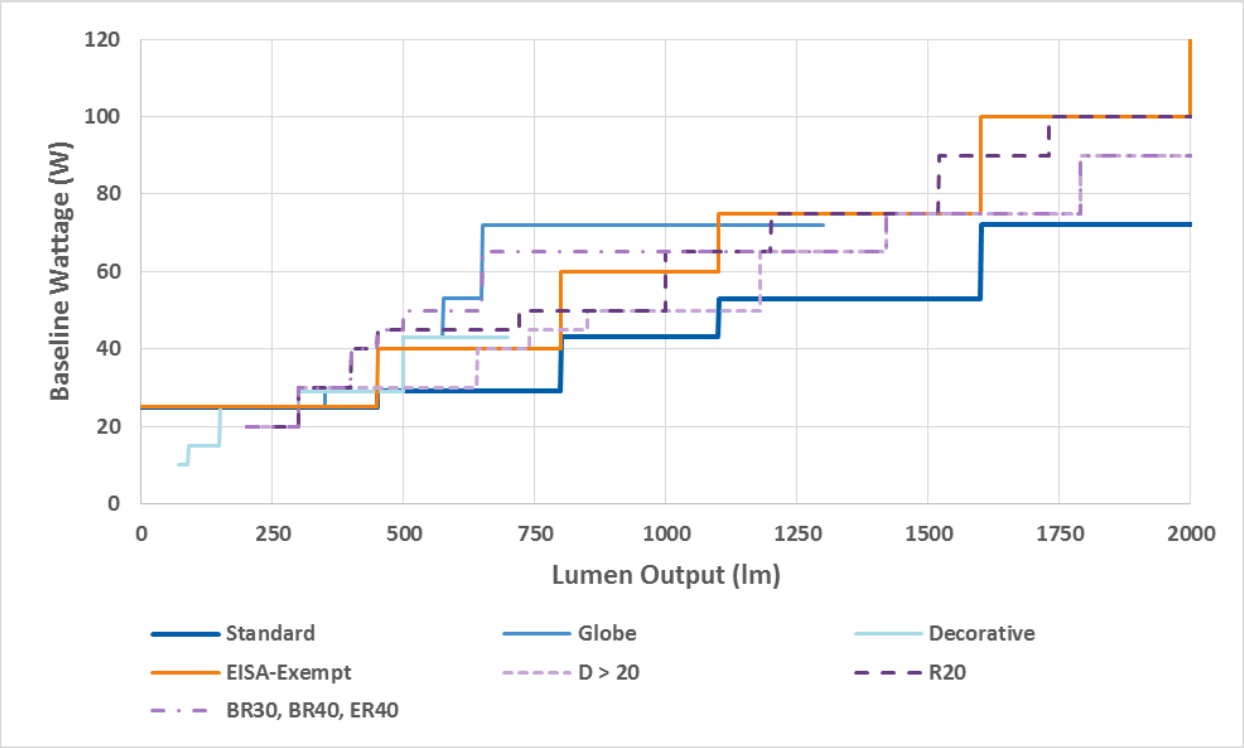
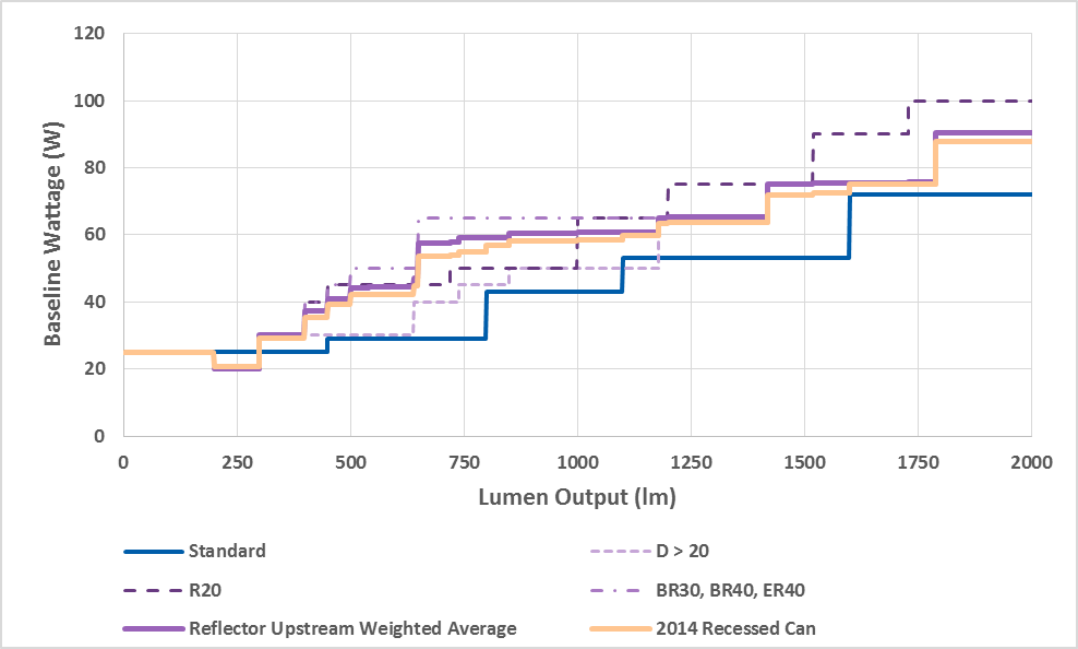


Figure B2 also displays lumen bins and baseline wattages for standard bulbs and the three most common reflector types. It also displays the average combined reflector lumen bins, weighted by quantities, and the average recessed can lumen bins, weighted by bulb type saturation in recessed can receptacles. Standard and recessed can baseline wattages reflect 2014 values.

Figure B2: Plot of Cadmus-created Weighted Reflector and 2014 Recessed Can Baseline Wattages



Watts vs. Lumen ENERGY STAR Linear Fits

Figure B3 through Figure B6 show watts vs. lumens from the ENERGY STAR database for four different lamp categories. Standard, reflector, and specialty CFL lamps are represented. When lumens could not be determined for a particular model of bulb, these linear fits were used to obtain that bulb's lumen output.

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

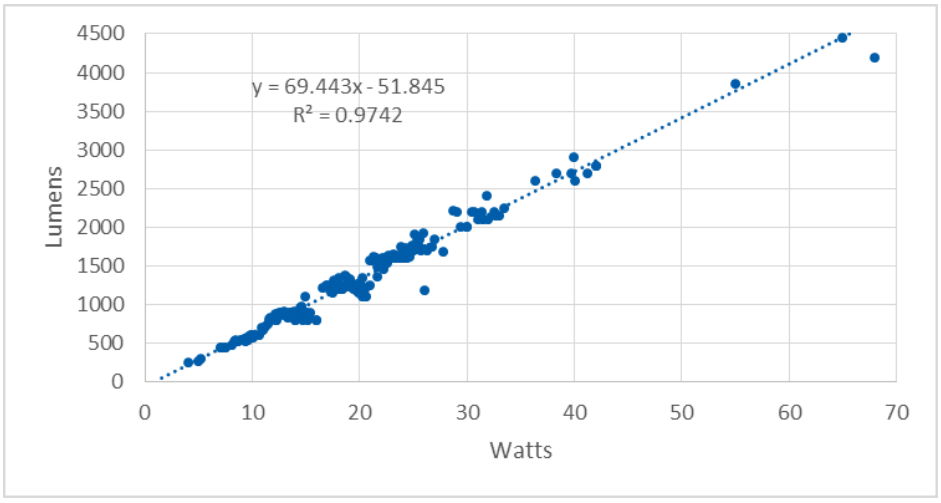


Figure B4: Median Lumens vs. Wattage for ENERGY STAR-Qualified Reflector CFLs

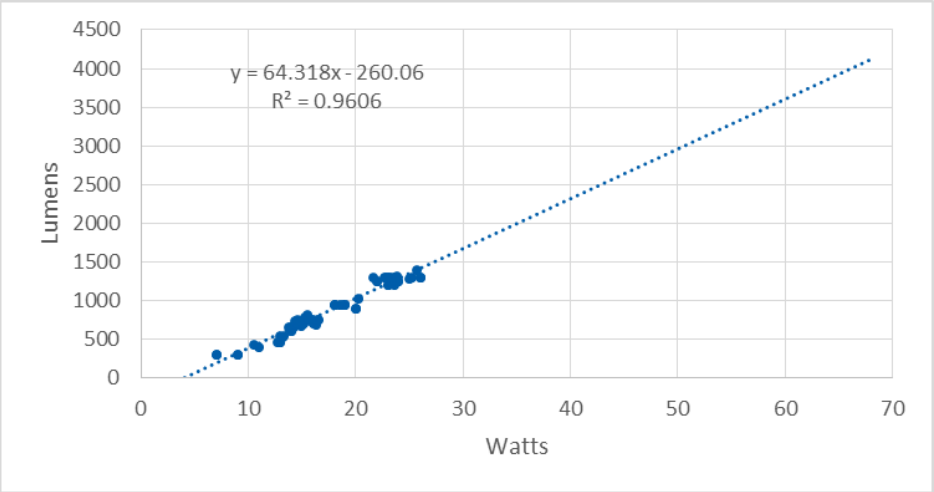


Figure B5: Median Lumens vs. Wattage for ENERGY STAR-Qualified Specialty CFLs

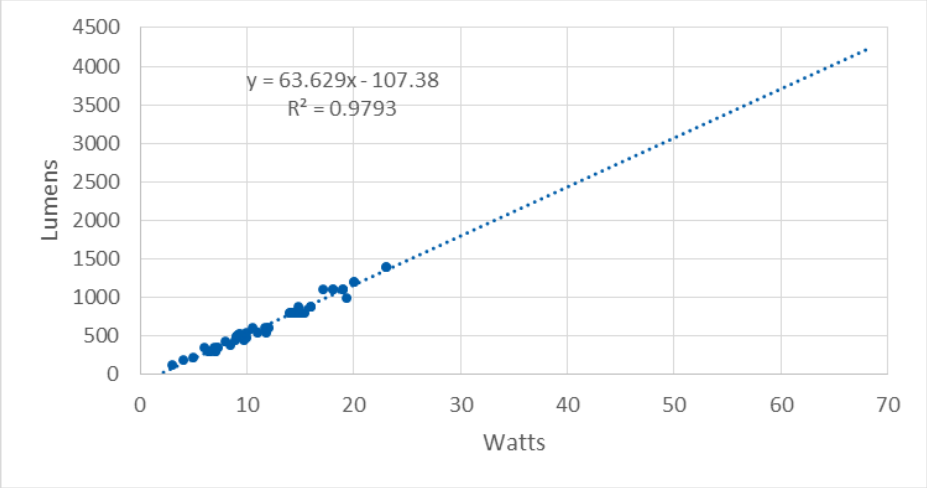
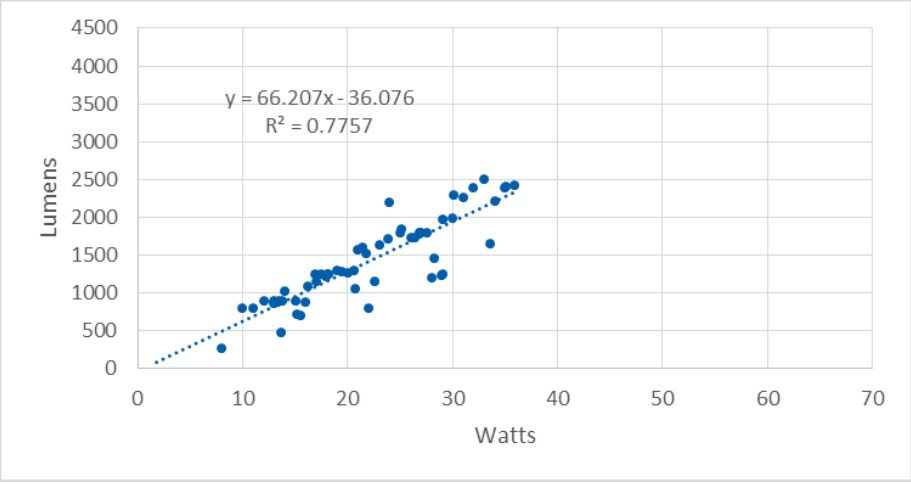


Figure B6: Median Lumens vs. Wattage for ENERGY STAR-Qualified CFL Fixtures



Cross-Sector Lighting Sales

Cadmus performed intercept surveys in Utah, Washington, and Idaho to collect information from customers about efficient bulb purchases and whether they intended to install these bulbs in residential or commercial applications, then using these data to calculate a cross-sector sales percentage. Cadmus combined the data from the three states to maximize the confidence and precision around the estimate. The estimated cross-sector lighting sales factor not applied to the gross savings analysis for this evaluation.

During these surveys, field staff intercepted customers as they left stores if they purchased lighting products from a participating retail; staff asked customers questions addressing their efficient bulb purchases. For cross-sector sales purposes, staff asked customers about their intentions to install the purchased bulbs in residential or commercial applications. Table B12 summarizes respondent results. In total, Cadmus completed 630 surveys, and 363 of the respondents purchased one or more efficient bulbs. Of all respondents, 347 said they intended to install their bulbs in residential applications and 16 intended to install them in commercial applications.

Table B12. Cross-Sector Respondent Counts

Respondent Count	Application	
	Residential	Commercial
CFL	125	10
LED	227	6
CFL or LED	347	16
Total Respondents*		**363**

***Results aggregated across three states: interviews were conducted in Utah, Washington, and Idaho, but only one respondent intended to install bulbs in commercial applications in Washington and Idaho.

Table B13 summarizes the quantity of bulbs purchased by respondents. In total, respondents intended to install 1,536 CFLs and LEDs in residential applications and 62 in commercial applications.

Table B13. Cross-Sector Bulb Counts

Bulb Count	Application	
	Residential	Commercial
CFLs	632	50
LEDs	904	12
Total Bulbs	**1,536**	**62**

Cadmus used the bulb quantities shown in Table B13 to calculate a cross-sector sales percentage of 3.9% using the following equation:

$$\frac{Commercial\ CFLs\ \&\ LEDs}{All\ CFLs\ \&\ LEDs} = \frac{62}{1{,}598} = 3.9\%$$

The denominator in the equation represents the total number of efficient bulbs installed in residential and commercial facilities (1,536 + 62 = 1,598). Cadmus determined a 90% confidence interval of 2.2%–5.5% for the cross-sector sales percentage of 3.9%.

Demand Elasticity Modeling

As lighting products incur price changes and promotion over the program period, they provide valuable information regarding the correlation between sales and prices. Cadmus developed a demand elasticity model to estimate freeridership for the upstream markdown channel in program years 2013 and 2014. A description follows detailing the methodology and analysis results.

Because of the relatively small size of the programs in Rocky Mountain Power's Wyoming's service territory, Cadmus combined the data from all Rocky Mountain Power states when estimating the price elasticity model (Idaho, Utah, and Wyoming). This increased the number of observations with which to estimate price elasticities and the representativeness of the mix of bulbs and retailers with observed price variation.

The modeling process is described below that was used to estimate price elasticities. The elasticity estimates from the overall model are then applied to the average markdown levels observed in the Wyoming sales by bulb technology. Using the formula for a price elasticity:

$$Elasticity = \frac{\Delta Quantity\%}{\Delta Price\%}$$

The net sales lift (ΔQuantity%) is equal to Elasticity times the markdown (ΔPrice%).

Demand Elasticity Methodology

Demand elasticity modeling draws upon the same economic principle that drives program design: changes in price and promotion generate changes in quantities sold (i.e., the upstream buy-down approach). Demand elasticity modeling uses sales and promotion information to achieve the following:

- Quantify the relationship of price and promotion to sales;
- Determine likely sales levels without the program's intervention (baseline sales); and
- Estimate freeridership by comparing modeled baseline sales with actual sales.

After estimating variable coefficients, Cadmus used the resulting model to predict the following:

- Sales that would occur *without* the program's price impact; and
- Sales that would occur *with* the program (and should be close to actual sales with a representative model).

Once the model predicted sales that would occur with and without the program, Cadmus applied evaluated savings values, calculated as part of this evaluation.

Input Data

As the demand elasticity approach relies exclusively on program data, a model's robustness depends on data quality. Though, overall, available data achieved a sufficient quality to support the analysis, the data also presented several issues of note:

1. Inconsistent model numbers between 2013 and 2014.
2. Lack of schedule ID number in 2013 data.
3. Inconsistent bulb type designations within each model number (e.g., spiral and candelabra, reflector and general purpose spiral/a-line).
4. Inconsistent reported quantities within a given sales period.

Cadmus had to make the most reasonable assumptions possible when preparing the data to support the analysis (e.g., assessing whether two model numbers with different formats and detail levels were the same).

Price Variation

As desired for analysis, sales data displayed relatively high amounts of price variations. Variation was measured within unique part number/retailer location combinations: that is, a given bulb model within a unique retail location.

Promotional Displays

The program administrator, did not collect and could not provide detailed data on product merchandising (e.g., clip strips, end caps, pallet displays). Therefore, the model may not have captured all program impacts.[3]

Evaluations in other jurisdictions have found that product merchandising can generate sales lift between 60% and 120%. Capturing and providing this level of detail ensures that the program is credited for all activities.

Stocking Patterns

In preparing to model the sales data, Cadmus observed dramatic sales drops that did not correspond to programmatic activity or to expected seasonal variation. Cadmus' model implicitly assumed supply would meet demand at the given price. Analysis included screening the data for instances where this assumption appeared untrue.

[3] To the degree that product merchandising and prices co-vary, elasticity estimates may capture some sales lift generated by merchandising. However, as data were not available to incorporate into the model, it impossible to estimate separate impacts.

Cadmus looked for patterns in these drops that suggested changes in stocking patterns or retailers temporarily unable to stock certain products. The following criteria served to flag changes in stocking patterns:

1. **Average monthly sales for a product were greater than 10 packs**. For those fewer than 10 packs per month, Cadmus assumed it would be more likely that some months would have zero sales.[4]
2. **Two-thirds of monthly observations of the same product across multiple store locations proved less than one pack.**[5] For example, if a 13-watt GE spiral CFL was sold at 18 different store locations, and 14 locations had sales of less than one pack during the month of June.

If products met both criteria, Cadmus flagged them as out of stock and included a binary variable in the model to control for such drops and to separate this effect from price changes. Not doing so could have biased elasticity estimates.

Seasonality Adjustment

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

To adjust for seasonal variations in sales, Cadmus used a monthly seasonal trend provided by an evaluation partner. This represented national sales from a major lighting products manufacturer. Ideally, a trend would derive from historical data on aggregate sales of lighting products (e.g., inefficient and efficient, program and non-program). Such data would represent overall trends in lighting product sales and would not suffer from potential confounding with programmatic activity to the same degree as CFL sales.[6] The trend, however, indicated aggregated, nationwide CFL sales for a specific manufacturer.

Presumably, the trend included some activity from programs across the nation, which could affect the sales trend, potentially leading to underestimated program impacts. Cadmus assumed, however, that program activity would be somewhat random across all programs that could be included in the sales

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4 The 10 packs cutoff assumed that products with average monthly sales fewer than 10 would be more likely to have months with zero sales due to naturally occurring variability.

5 Because the sales data are reported at intervals that do not follow regular calendar months, the sales are transformed to daily sales and then aggregated by calendar month. This leads to fractional package sales within a given month though overall quantities remain the same.

6 This assumes aggregate lighting sales did not change due to promotions; that is, customers simply substituted an efficient product for an inefficient one. While bulb stockpiling could occur during programmatic periods, this should smooth out over time, as the program would not affect the number of sockets in the home.

data used to develop the trend. In that case, program activity would be spread through the year, and the variation between months would be driven primarily by non-program factors.

Nevertheless, not controlling for seasonal variations could lead to program impacts overestimated by falsely attributing seasonal trends to price impacts (to the degree that they co-varied) or vice versa.

For example, sales in July tend to be lower (presumably due to longer daylight hours); so if program activity increased sales in July, not controlling for seasonal variation would underestimate the program's impact. October, on the other hand, sees higher sales, and no control for seasonality would likely overestimate program activity impacts occurring in that month.

The trend, given the national aggregation level, covered non-program products and areas without programs, therefore limiting the degree that the trend correlated with program activity. Absent primary seasonal data from Wyoming's territory, Cadmus estimated model and subsequent freeridership ratios using the CFL trend.

Model Specification

Cadmus modeled bulb, pricing, and promotional data using an econometric model, addressing these data as a panel, with a cross-section of program package quantities modeled over time as a function of prices, promotional events, and retail channels. This involved testing a variety of specifications to ascertain price impacts—the main instrument affected by the program—on bulb demand. Cadmus estimated the following equation for the model (for bulb model *i*, in month *t*):

$$\ln(Q_{it}) = \sum_{\pi}(\beta_{\pi} ID_{\pi,\mathrm{i}}) + \sum_{\theta}(\beta_{\theta 1}[ln(P_{it}) * (Retail\ Channel_{\theta,\mathrm{i}})]) + \sum_{\theta}(\beta_{\theta 2}[ln(P_{it}) * (Bulb\ Type_{\theta,\mathrm{i}})]) + \beta_{\theta 3} ln(P_{it}) * (Specialty_{\theta,\mathrm{i}}) + \beta_{\theta 4}(Out\ of\ Stock_{\theta,\mathrm{i}}) + \alpha Seasonal\ Trend_t + \varepsilon_i$$

Where:

ln	=	Natural log
Q	=	Quantity of bulb packs sold during the month
P	=	Retail price (after markdown) in that month
Retail Channel	=	Retail category (Club or non-Club store)
Bulb Type	=	Product category (CFL or LED)
Specialty	=	Dummy variable equaling 1 for specialty bulbs and 0 for standard
Out of Stock	=	Dummy variable equaling 1 if a given product was assumed to have been out of stock in month t and 0 otherwise
ID	=	Dummy variable equaling 1 for each unique retail channel and SKU; 0 otherwise

Seasonal Trend = Quantitative trend representing the impact of secular trends not related to the program[7]

ε_{it} = Cross-sectional random-error term

The model specification assumed a negative binomial distribution, which served as the best fit of the plausible distributions (e.g., lognormal, poisson, negative binomial, gamma). The negative binomial distribution provided accurate predictions for a small number of high-volume sale bulbs, while the other distributions under predicted sales for those bulbs.

Cadmus adjusted the model to correct for the two factors discussed earlier:

- **Seasonality**: To account for baseline lighting sales tending to follow a seasonal pattern, unrelated to price or promotion, by inserting a seasonal trend into the model.
- **Stocking Patterns**: The model assumed supply would always meet demand; after investigating situations where this did not occur, Cadmus controlled for instances where two-thirds or more of monthly observations for the same product with less than one package within a given month.

Using the following criteria, Cadmus ran numerous model scenarios to identify the one with the best parsimony and explanatory power:

- Model coefficient p-values (keeping values less than <0.1);[8]
- Explanatory variable cross-correlation (minimizing where possible);
- Model Akaike's Information Criteria (AIC) (minimizing between models);[9]
- Minimizing multicollinearity; and
- Optimizing model fit.

The model's fit can be examined by comparing model-predicted sales with actual sales. As shown in Figure B7, the model-predicted sales matches very closely with actual sales. The model under predicted a couple of months, but it also over predicted a couple of months without persistent bias in a single direction (over- or under-predicting), indicating the model fit the data well. Overall, the model fell within 0.4% of actual sales.

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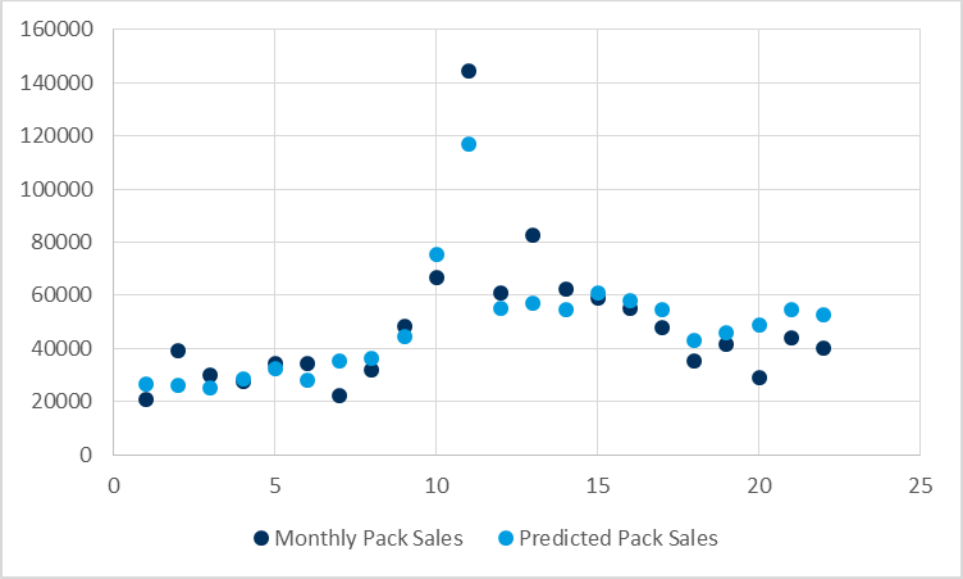
[7] The time trend for this analysis represented shifts in sales due to non-program-related seasonality.

[8] Where a qualitative variable had many states (such as bulb types), Cadmus did not omit variables if one state's was insignificant; rather, the analysis considered the joint significance of all states.

[9] The Team used AIC to assess model fit, as nonlinear models do not define the R-square statistic. AIC also offers a desirable property in that it penalizes overly complex models, similarly to the adjusted R-square.

Figure B7. Predicted and Actual Sales



Findings

Cadmus estimated a combined CFL freeridership of 58%. Table B14 shows the estimated freeridership ratio.

Table B14. Modeling Results by Bulb Type

Bulb Type	Freeridership
CFL	42%

Table B15 shows the incentive as a share of the original retail price and the estimated net of freeridership ratio. Typically, the proportional price reduction and freeridership trend correlate: the higher the incentive, the lower the freeridership.

Table B15. Modeling Results by Bulb Type

Bulb Type	Final Price per Bulb	Original Price per Bulb	Markdown %	Net of FR
CFL	$ 0.96	$ 2.21	57%	58%

Elasticities

The net of freeridership ratios derived from the estimate of a price elasticity of demand. Price elasticity of demand measures the percent change in the quantity demanded, given a percent change in price. Due to the model's logarithmic functional form, these simply represented the coefficients for each price variable. In previous, similar analyses, Cadmus had seen elasticities range from -1 to -3 for CFLs, meaning a 10% drop in price led to a 10% to 30% increase in the quantity sold. As shown in Table B16, non-club elasticity estimates fell a bit below the expected ranges, with some estimates less than one, but, on average, estimates fell within the expected range.

Table B16. Elasticity Estimates by Retail Channel and Bulb Type

Store Type	Bulb Type	Elasticity
Club Store	CFL-Specialty	-1.15
Club Store	CFL-Standard	-1.00
Club Store	LED-Specialty	-1.86
Club Store	LED-Standard	-1.71
Non-Club	CFL-Specialty	-0.92
Non-Club	CFL-Standard	-0.76
Non-Club	LED-Specialty	-0.90
Non-Club	LED-Standard	-0.74

Net of Freeridership Comparisons

Table B17 compares CFL net of freeridership estimates from several recent evaluations using the elasticity model approach. The table also shows the average, sales-weighted, original retail price of program bulbs and the incentive as a share of the original price, as the percent of markdown serves as a large driver to freeridership estimates.

Though the net of freeridership estimates for Rocky Mountain Power fell within the range of those observed in other programs, they decreased since the 2011–2012 modeling effort. The most likely factor is the decrease in the markdown levels from 68% of the original price down to 57% in 2103-2014. Since sales are modeled as a function of price, if the relative discount decreases we would expect the net increase in sales to decrease as well.

A lack of merchandising data could present another potential factor. Without data to explicitly control for sales lift due to merchandising, price elasticity estimates may absorb some impacts of product merchandising to a degree that merchandising and price changes co-vary. This could lead to larger elasticity estimates when merchandising and prices positively correlate or lower elasticity estimates when they negatively correlate.

Table B17. Comparisons of CFL Net of Freeridership and Incentive Levels

Utility	Bulb Type	Original Price per bulb	Markdown per bulb	Markdown %	Net of Freeridership
Rocky Mountain Power Wyoming 2013-2014	Standard	$2.58	$1.76	68%	66%
Mid-Atlantic Utility 1	Standard	$1.97	$1.41	72%	73%
Mid-Atlantic Utility 3	Standard	$2.10	$1.59	76%	73%
New England	Standard	$2.11	$1.00	47%	68%
Mid-Atlantic Utility 2	Standard	$2.14	$1.43	67%	65%
Mid-Atlantic Utility 4	Standard	$2.22	$1.46	66%	65%
Rocky Mountain Power Wyoming 2013-2014	**Standard**	**$2.21**	**$1.25**	**57%**	**58%**
Midwest Utility	Standard	$1.82	$1.13	62%	57%
Southeast	Standard	$2.15	$1.09	51%	52%

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)[1]

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.[2] Cadmus determined the savings estimate using a pooled, conditional savings analysis (CSA) regression model, which included the following groups:

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

The billing analysis resulted in a 102% 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 81,000 nonparticipating customers in Wyoming. 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 Wyoming residential accounts. Cadmus matched the 2013–2014 participant program data to the census of Wyoming'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

[1] Cadmus was not able to conduct a separate Wyoming billing analysis for duct sealing and insulation because the participants were mainly in multifamily residences, and there was only one single family participant remained after billing analysis screening. Instead, Cadmus applied the overall realization rate for Pacific Power's Washington home duct sealing and insulation (which had more participant data) for Wyoming.

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

from January 2012 through August 2015. The final sample used in the billing analysis consisted of 48 participants and 192 control customers.

- ***Wyoming weather data***, including daily average temperatures from January 2012 to August 2015 for 7 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 2012, before measure installations occurred. This meant defining the post-period as September 2014 through August 2015.[3]

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 2012).
3. More than 3,823 kWh per year or less than 28,364 kWh per year (the lowest and highest participant usage to remove very low- or high-usage nonparticipants).
4. Accounts showing a consumption change of less than 50% of pre-program usage, ensuring a better match between participants and the control group.
5. Expected savings under 70% of household consumption (i.e., accounts with a mismatch between participant database and billing data or with pre-period vacancies).

Cadmus also examined individual monthly billing data to check for vacancies, outliers, and seasonal usage changes. If the usage patterns remained inconsistent between pre- and post-periods, the analysis dropped accounts.

Table C1 shows participant and nonparticipant screening criteria used for the insulation billing analysis.

[3] As participants installing measures in late 2014 had less than 10 months of post-period data, the analysis excluded them. Similarly, the analysis excluded customers participating in 2013 with measure installation dates before November 2012 had less than 10 months of pre-period data.

Table C1. Screen for Inclusion in Billing Analysis

Screen	Attrition		Remaining	
	Nonparticipant	Participant	Nonparticipant	Participant
Original measures database (insulation installations only) and nonparticipant population	N/A	N/A	81,565	98
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).	46,605	15	34,960	83
Reject accounts with less than 300 days in pre- or post-period	10,457	29	24,503	54
Reject accounts with less than 5,369 kWh or more than 33,310 kWh in pre- or post-period	4,419	-	20,084	54
Reject accounts with consumption changing by more than 50%	955	-	19,129	54
Reject accounts with expected savings over 70% of pre-period consumption	-	3	19,129	51
Reject accounts with billing data outliers, vacancies, and seasonal usage	1,453	3	17,676	48
Nonparticipant sample selection (random sample of nonparticipants to match participant pre-period usage by quartile; four times more than participants)	17,484	-	192	48
Final Sample			**192**	**48**

Regression Model

After screening and matching accounts, the final analysis group consisted of 48 participants and 192 nonparticipants.

Of the final sample, 88% of participant homes installed attic insulation, 15% installed wall insulation, and 0% installed of the he participant homes installed floor insulation. As determining separate wall or floor insulation savings proved impossible, Cadmus estimated a combined realization rate for all insulation measures.

Cadmus used the following CSA regression specification to estimate HES Program insulation savings:

$$ADC_{it} = \alpha_i + \beta_1 HDD_{it} + \beta_2 CDD_{it} + \beta_3 POST_t + \beta_4 PARTPOST_{it} + \varepsilon_{it}$$

Where for customer (i) and month (t):

ADC_{it}	=	Average daily kWh consumption
HDD_{it}	=	Average daily HDDs (base 65)
CDD_{it}	=	Average daily CDDs (base 65)
$POST_t$	=	Indicator variable of 1 in the post-period for participants and nonparticipants, 0 otherwise
$PARTPOST_{it}$	=	Indicator variable of 1 in the post-period for participants, 0 otherwise

β_4 served as the key coefficient determining average insulation savings. The coefficient averaged daily insulation savings per program participant, after accounting for nonparticipant trends. Cadmus included individual customer intercepts (α_i) as part of a fixed-effects model specification to ensure no participants or nonparticipants exerted an undue influence over the final savings estimate; this resulted in a more robust model.[4]

Insulation Results

Cadmus estimated average insulation savings of 819 kWh per participant, translating to a 102% 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 12,391 kWh, savings represented a 7% 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*	**48**	**805**	**819**	**102%**	**±55%**	**45%–158%**
Electric Heat	7	3,448	2,492	72%	±44%	40%–104%
Gas Heat	41	354	537	152%	±87%	20%–284%

* Overall model includes both electric and gas heat

[4] 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.

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

Overall, homes with electric heat achieved insulation savings of 2,492 kWh per home. The expected insulation savings averaged 3,448 kWh, translating to a 72% realization rate. With an average participant pre-installation usage of 18,104 kWh, the savings for homes with electric heat represented a 14% reduction in energy use from insulation measures.

Overall, homes heated with gas achieved insulation savings of 537 kWh per home. Average expected insulation savings were 354 kWh, translating to a 152% realization rate. With an average participant pre-installation usage of 11,415 kWh, savings for homes heated with gas represented a 5% reduction in energy use from insulation measures.

Table C3, Table C4 and Table C5 summarize model outputs for the regression models Cadmus used to determine the insulation realization rates.

Table C3. Insulation Regression Model for Wyoming (Overall Model)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	148,238	37,060	285.16	<.0001
Error	5,738	745,723	129.96214		
Corrected Total	5,742	893,691			
Root MSE		11.40009	R-Square		0.1658
Dependent Mean		3.43392E-16	Adj. R-Square		0.1652
Coefficient of Variation		3.31985E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.3237	0.34097	0.95	0.3424
PartPost	**1**	**-2.2450**	**0.7561**	**-2.97**	**0.003**
AvgHdd	1	0.4511	0.0139	32.48	<.0001
AvgCdd	1	2.2621	0.0833	27.16	<.0001

Table C4. Insulation Regression Model for Wyoming (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	158,570	39,642	290.79	<.0001
Error	4,769	650,149	136.32813		
Corrected Total	4,773	808,719			
Root MSE		11.67596	R-Square		0.1961
Dependent Mean		2.70E-16	Adj. R-Square		0.1954
Coefficient of Variation		4.32E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.1162	0.34996	0.33	0.7399
PartPost	**1**	**-6.8271**	**1.84595**	**-3.70**	**0.0002**
AvgHdd	1	0.5267	0.01565	33.66	<.0001
AvgCdd	1	2.1471	0.09126	23.53	<.0001

Table C5. Insulation Regression Model for Wyoming (Gas Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	127,474	31,868	262.51	<.0001
Error	5,572	676.428	121.39771		
Corrected Total	5,576	803,902			
Root MSE		11.01806	R-Square		0.1586
Dependent Mean		4.45E-16	Adj. R-Square		0.1580
Coefficient of Variation		2.47E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.3563	0.32966	1.08	0.2798
PartPost	**1**	**-1.4713**	**0.77928**	**-1.89**	**0.0591**
AvgHdd	1	0.4178	0.01365	30.61	<.0001
AvgCdd	1	2.2423	0.08156	27.49	<.0001

Duct Sealing and Insulation Billing Analysis

Cadmus was not able to conduct a separate Wyoming billing analysis for duct sealing and insulation because the participants were mainly in multifamily residences, and there was only one single family participant remained after billing analysis screening. Instead, Cadmus applied the overall realization rate for Pacific Power's Washington home duct sealing and insulation (which had more participant data) for Wyoming. The detailed methodology, screening, and attrition results will be provided in the 2013-2014

Pacific Power Washington HES Evaluation Report. Only some selected summary results findings and their associated models are included in this appendix.

Duct Work Results

For Washington, Cadmus estimated average duct sealing and duct insulation savings of 2,183 kWh per home, translating to an 89% 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 18,300 kWh, savings represented a 12% reduction in total energy usage from duct sealing and duct insulation measures installed. Table C6 presents the overall savings estimate for duct sealing and duct insulation.

Table C6. 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*	**143**	**2,457**	**2,183**	**89%**	**±13%**	**77%–101%**
Electric Heat (All)	138	2,538	2,241	88%	±13%	77%-100%
Electric Heat (Heat Pump)	42	4,737	4,039	85%	±13%	74%-96%
Electric Heat (Non-Heat Pump)	96	1,576	1,456	92%	±23%	71%-114%

* Overall model includes both electric and gas heat

Cadmus only used overall Pacific Power Washington model results (electric and gas heat combined) to determine Wyoming measure-level net savings, but provided results by for all electric and electric heat type i.e.: heat pump and non-heat pump participants. Overall, participants with electric heat achieved savings of 2,241 kWh (12%), those with heat pumps achieved savings of 4,039 kWh (18%), while those without heat pumps achieved 1,576 kWh (9%).

Table C7, Table C8, Table C9 and Table C10 summarize model outputs for the regression models Cadmus used to determine the Washington duct sealing + insulation realization rates that were applied to Wyoming.

Table C7. Ductwork Regression Model for Washington (Overall)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,782,237	1,195,559	7,404	<.0001
Error	17,124	2,765,070	161.47336		
Corrected Total	17,128	7,547,307			
Root MSE		12.70722	R-Square		0.6336
Dependent Mean		3.52E-16	Adj. R-Square		0.6335
Coefficient of Variation		3.61E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	**1**	0.1255	0.21859	0.57	0.5661
PartPost	**1**	**-5.9803**	**0.48638**	**-12.30**	**<.0001**
AvgHdd	1	1.7802	0.01123	158.59	<.0001
AvgCdd	1	1.8334	0.02777	66.39	<.0001

Table C8. Ductwork Regression Model for Washington (Electric Heat)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,809,614	1,202,403	7,499	<.0001
Error	17,004	2,726,392	160.3383		
Corrected Total	17,008	7,536,006			
Root MSE		12.66248	R-Square		0.6382
Dependent Mean		3.42E-16	Adj. R-Square		0.6381
Coefficient of Variation		3.71E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	**1**	0.1518	0.21783	0.70	0.4858
PartPost	**1**	**-6.1404**	**0.49168**	**-12.49**	**<.0001**
AvgHdd	1	1.7887	0.01122	159.43	<.0001
AvgCdd	1	1.8424	0.02776	66.36	<.0001

Table C9. Ductwork Regression Model for Washington (Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,059,334	1,014,833	5,990	<.0001
Error	14,709	2,492,208	169.43421		
Corrected Total	14,713	6,551,542			
Root MSE		13.01669	R-Square		0.6196
Dependent Mean		3.52E-16	Adj. R-Square		0.6195
Coefficient of Variation		3.69E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.0467	0.22413	0.21	0.1628
PartPost	**1**	**-11.0655**	**0.85445**	**-12.95**	**<.0001**
AvgHdd	1	1.7593	0.01229	143.14	<.0001
AvgCdd	1	1.8776	0.03078	61.00	<.0001

Table C10. Ductwork Regression Model for Washington (Non-Heat Pumps)

Source	Analysis of Variance				
	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	4,425,724	1,106,431	6,959	<.0001
Error	16,008	2,544,982	158.98188		
Corrected Total	16,012	6,970,706			
Root MSE		12.6088	R-Square		0.6349
Dependent Mean		2.67E-16	Adj. R-Square		0.6348
Coefficient of Variation		4.72E+18			
Source	**Parameter Estimates**				
	DF	**Parameter Estimates**	**Standard Error**	**t value**	**Prob. t**
Post	1	0.1080	0.21870	0.50	.6187
PartPost	**1**	**-3.9902**	**0.56882**	**-7.01**	**<.0001**
AvgHdd	1	1.7709	0.01150	154.00	<.0001
AvgCdd	1	1.8216	0.02850	63.92	<.0001

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Appendix D. Self-Reported Net-to-Gross Methodology

Net-to-gross (NTG) estimates are a critical part of demand-side management program impact evaluations, because they allow utilities to determine portions of gross energy savings that were influenced by and are attributable to their DSM programs. Freeridership and participant spillover are the two NTG components calculated in this evaluation. True freeriders are customers who would have purchased an incented appliance or equipment without any support from the program (e.g. taking the incentive). Participant spillover is the amount of additional savings obtained by customers investing in additional energy-efficient measures or activities due to their program participation. Various methods can be used to estimate program freeridership and spillover; for this evaluation, Cadmus used self-reports from survey participants to estimate NTG for appliances, HVAC and weatherization measure categories, as this method can gauge net effects for many measures at once and enables Cadmus to monitor freeridership and spillover over several evaluation efforts.

Survey Design

Direct questions (such as: "Would you have installed measure X without the program incentive?") tend to result in exaggerated "yes" responses. Participants tend to provide answers they believe surveyors seek; so a question becomes the equivalent of asking: "Would you have done the right thing on your own?" An effective solution, and an industry standard, for avoiding such bias involve asking a question in several different ways, then checking for consistent responses.

Cadmus used industry tested survey questions to determine why customers installed a given measure, and what influence the program had on their decisions. We used the survey to establish what decision makers might have done in the program's absence, via five core freeridership questions:

1. Would participants have installed measures without the program?
2. Had participants ordered or installed the measures before learning about the program?
3. Would participants have installed the measures at the same efficiency levels without the program incentive?
4. Would participants have installed the same quantity of measures without the program?
5. In the program's absence, when would respondents have installed the measures?

Cadmus sought to answer three primary questions with our participant spillover survey design:

1. Since participating in the program evaluated, did participants install additional energy-efficient equipment or services incented through a utility program?
2. How influential was the evaluated program on the participants' decisions to install additional energy-efficient equipment in their homes?
3. Did customers receive incentives for additional measures installed?

Freeridership Survey Questions

The residential survey's freeridership portion included 12 questions, addressing the five core freeridership questions. The survey's design included several skip patterns, allowing interviewers to confirm answers previously provided by respondents by asking the same question in a different format. The freeridership questions (as asked in the survey format) included:

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?

Participant Spillover Survey Questions

As noted, Cadmus used the results of the spillover questions to determine whether program participants installed additional energy-saving measures since participating in the program. Savings that participants received from additional measures were spillover if the program significantly influenced their decisions to purchase additional measures, and if they did not receive additional incentives for those measures.

With the surveys, we specifically asked residential participants whether they installed the following measures:

- Clothes washers
- Refrigerators
- Dishwashers
- Windows
- Fixtures
- Heat pumps
- Ceiling fans
- Electric water heaters
- CFLs
- Insulation

If the participant installed one or more of these measures, we asked additional questions about what year they purchased the measure, if they received an incentive for the measure, and how influential (highly influential, somewhat influential, not at all influential) the HES Program was on their purchasing decisions.

Cadmus combined the freeridership and spillover questions in the same survey, asked over the telephone with randomly selected program participants. Prior to beginning the survey effort, Cadmus pre-tested the survey to ensure that all appropriate prompts and skip patterns were correct. Cadmus also monitored the survey company's initial phone calls to verify that:

- Survey respondents understood the questions; and
- Adjustments were not required.

Freeridership Methodology

Cadmus developed a transparent, straightforward matrix for assigning freeridership scores to participants, based on their responses to targeted survey questions. We assigned a freeridership score to each question response pattern, and calculated confidence and precision estimates based on the distribution of these scores (a specific approach cited in the National Action Plan for Energy Efficiency's *Handbook on DSM Evaluation*, 2007 edition, page 5-1).

Cadmus left the response patterns and scoring weights explicit so that they could be discussed and changed. We used a rules-based approach to assign scoring weights to each response from each freeridership question. This allows for sensitivity analysis to be performed instantaneously and test the

stability of the response patterns and scoring weights. Scoring weights can be changed for a given response option to a given question. This also provided other important features, including:

- Derivation of a partial freeridership score, based on the likelihood of a respondent taking similar actions in absence of the incentive.
- Use of a rules-based approach for consistency among multiple respondents.
- Use of open-ended questions to ensure quantitative scores matched respondents' more detailed explanations regarding program attribution.
- The ability to change weightings in a "what if" exercise, testing the stability of the response patterns and scoring weights.

This method offered a key advantage by including partial freeridership. Our experience has shown that program participants do not fall neatly into freerider and non-freerider categories. We assigned partial freeridership scores to participants who had plans to install the measure before hearing about the program, but for whom the program exerted some influence over their decisions. Further, by including partial freeridership, we could use "don't know" and "refused" responses rather than removing those respondents entirely from the analysis.

Cadmus assessed freeridership at three levels:

1. We converted each participant survey response into freeridership matrix terminology.
2. We gave each participant's response combination a score from the matrix.
3. We aggregated all participants into an average freeridership score for the entire program category.

Convert Responses to Matrix Terminology

Cadmus evaluated and converted each survey question's response into one of the following values, based on assessing 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 freeridership survey questions, their corresponding response options, and the values they converted to (in parentheses). "Don't know" and "refused" responses converted to "partial" for all but the first three questions. For those questions, if a participant was unsure whether they had already purchased or were planning to purchase the measure before learning about the incentive, we considered them as an unlikely freerider.

Table D1. Assignments of HES 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

After converting survey responses into matrix terminology, Cadmus created a freeridership matrix, assigning a freeridership score to each participant's combined responses. We considered all combinations of survey question responses when creating the matrix, and assigned each combination a freeridership score of 0% to 100%. Using this matrix, we then scored every participant combination of responses.

Program Category Freeridership Scoring

After assigning a freeridership score to every survey respondent, Cadmus calculated a savings-weighted average freerider score for the program category. We individually weighted each respondent's freerider scores by the estimated savings from the equipment they installed, using the following calculation:

$$Savings\ Weighted\ Freeridership = \frac{\sum(Respondent\ Score) * (Rebated\ Measure\ kWh\ Savings)}{\sum(Rebated\ Measure\ kWh\ Savings\ of\ All\ Respondents)}$$

The Cadmus Freeridership Scoring Model

Cadmus developed an Excel-based model to use for calculating freeridership, and to improve the consistency and quality of our results. The model translated raw survey responses into matrix terminology, and then assigned a matrix score to each participant's response pattern. Cadmus then aggregated the program participants into program categories to calculate average freeridership scores.

The model incorporated the following inputs:

- Raw survey responses from each participant, along with the program categories for their incented measures, and their energy savings from those measures, if applicable;
- Values converting raw survey responses into matrix terminologies for each program category; and
- Custom freeridership scoring matrices for each unique survey type.

The model displayed each participant's combination of responses and corresponding freeridership score, then produced a summary table with the average score and precision estimates for the program category. The model used the sample size and a two-tailed test target at the 90% confidence interval to determine the average score's precision.

Participant Spillover Methodology

For the HES Program, Cadmus measured participant spillover by asking a sample of participants about their purchases and whether they received an incentive for a particular measure (if they installed another efficient measure or undertook another energy-efficiency activity because of their program participation). We also asked these respondents to rate the HES Program's (and incentive's) relative influence (highly, somewhat, or not at all) on their decisions to pursue additional energy-efficient activities.

Participant Spillover Analysis

Cadmus used a top-down approach to calculate spillover savings. We began our analysis with a subset of data containing only survey respondents who indicated they installed additional energy-savings measures after participating in the HES Program. From this subset, we removed participants who said the program had little influence on their decisions to purchase additional measures, thus retaining only participants who rating the program as highly influential. We also removed participants who applied for an HES incentive for the additional measures they installed.

For the remaining participants with spillover savings, we estimated the energy savings from additional measures installed. Cadmus calculated savings values, which we matched to the additional measures installed by survey participants.

Cadmus calculated the spillover percentage by dividing the sum of additional spillover savings by the total incentivized gross savings achieved by all respondents in the program category:

$$Spillover\ \% = \frac{\sum Spillover\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}{\sum Program\ Measure\ kWh\ Savings\ for\ All\ Survey\ Respondents}$$

Appendix F. Wyoming Measure Category Cost-Effectiveness

Completed at the measure category level, cost-effectiveness was reported for evaluated net savings. Net results apply the evaluated NTG to evaluated gross savings. Table F1 shows cost-effectiveness inputs for net results.

Table F1. Wyoming Measure Category Cost-Effectiveness Inputs

Input Description	2013	2014	Total
Average Measure Life*			
Appliance	15	15	15
Home Electronics	6	6	6
HVAC	20	19	20
Lighting	5	5	5
Weatherization	30	30	30
Evaluated Net Energy Savings (kWh/year)**			
Appliance	202,812	214,649	417,461
Home Electronics	44,491	49,550	94,042
HVAC	542,605	287,444	830,049
Lighting	2,052,016	1,931,967	3,983,983
Weatherization	921,734	557,612	1,479,346
Total Utility Cost (including incentives)***			
Appliance	$128,644	$239,281	$367,925
Home Electronics	$64,910	$66,765	$131,675
HVAC	$112,746	$134,059	$246,805
Lighting	$325,570	$514,307	$839,877
Weatherization	$347,051	$306,602	$653,653
Incentives			
Appliance	$92,982	$161,059	$254,041
Home Electronics	$63,225	$62,835	$126,060
HVAC	$44,350	$58,800	$103,150
Lighting	$214,426	$295,195	$509,621
Weatherization	$172,475	$84,980	$257,455
Retail Rate	**$0.0943**	**$0.1007**	**N/A**

*Weighted average measure category lives are based on individual measure lifetimes and weighted by savings and the frequency of installations.

**Evaluated savings reflect impacts at the customer meter.

***Rocky Mountain Power provided program costs and incentives in annual report data, allocating program costs by weighted savings.

Appliances

Cost-effectiveness results for net savings are shown in Table F2, Table F3, and Table F4. The appliance measure category proved cost-effective from the PCT perspective (Table F2).

Table F2. Wyoming Appliance 2013-2014 Net
(2013 IRP East Residential Whole House 35% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.094	$405,136	$385,746	($19,389)	0.95
TRC	$0.094	$405,136	$350,678	($54,457)	0.87
UCT	$0.082	$352,518	$350,678	($1,839)	0.99
RIM		$812,805	$350,678	($462,126)	0.43
PCT		$548,682	$1,096,054	$547,372	2.00
Lifecycle Revenue Impacts ($/kWh)					$0.000003665
Discounted Participant Payback (years)					4.71

Table F3. Wyoming Appliance 2013 Net
(2013 IRP East Residential Whole House 35% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.090	$193,941	$190,277	($3,664)	0.98
TRC	$0.090	$193,941	$172,980	($20,962)	0.89
UCT	$0.059	$128,644	$172,980	$44,336	1.34
RIM		$355,252	$172,980	($182,272)	0.49
PCT		$293,110	$512,627	$219,517	1.75
Lifecycle Revenue Impacts ($/kWh)					$0.000001485
Discounted Participant Payback (years)					5.81

Table F4. Wyoming Appliance 2014 Net
(2013 IRP East Residential Whole House 35% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.099	$225,729	$208,921	($16,808)	0.93
TRC	$0.099	$225,729	$189,928	($35,801)	0.84
UCT	$0.105	$239,281	$189,928	($49,353)	0.79
RIM		$489,042	$189,928	($299,114)	0.39
PCT		$273,161	$623,579	$350,418	2.28
Lifecycle Revenue Impacts ($/kWh)					$0.000002403
Discounted Participant Payback (years)					2.75

Home Electronics

Table F5, Table F6, and Table F7 show Home Electronics measure category cost-effectiveness results for net evaluated savings. The Home Electronics measure category proved cost-effective from no perspectives (Table F5).

Table F5. Wyoming Home Electronics 2013-2014 Net
(2013 IRP East Residential Whole House 35% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.971	$493,866	$39,178	($454,688)	0.08
TRC	$0.971	$493,866	$35,616	($458,250)	0.07
UCT	$0.251	$127,376	$35,616	($91,760)	0.28
RIM		$178,267	$35,616	($142,651)	0.20
PCT		$488,822	$172,970	($315,852)	0.35
Lifecycle Revenue Impacts ($/kWh)					$0.000002451
Discounted Participant Payback (years)					0.00

Table F6. Wyoming Home Electronics 2013 Net
(2013 IRP East Residential Whole House 35% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$1.023	$254,747	$18,843	($235,905)	0.07
TRC	$1.023	$254,747	$17,130	($237,618)	0.07
UCT	$0.261	$64,910	$17,130	($47,780)	0.26
RIM		$89,289	$17,130	($72,159)	0.19
PCT		$253,286	$87,634	($165,652)	0.35
Lifecycle Revenue Impacts ($/kWh)					$0.000001412
Discounted Participant Payback (years)					0.00

Table F7. Wyoming Home Electronics 2014 Net
(2013 IRP East Residential Whole House 35% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.922	$255,575	$21,734	($233,840)	0.09
TRC	$0.922	$255,575	$19,759	($235,816)	0.08
UCT	$0.241	$66,765	$19,759	($47,006)	0.30
RIM		$95,101	$19,759	($75,343)	0.21
PCT		$251,746	$91,209	($160,537)	0.36
Lifecycle Revenue Impacts ($/kWh)					$0.000001450
Discounted Participant Payback (years)					0.00

HVAC

Table F8, Table F9, and Table F10 show HVAC measure category cost-effectiveness results for net evaluated savings. The HVAC measure category proved cost-effective from all perspectives except the RIM (Table F8).

Table F8. Wyoming HVAC 2013-2014 Net
(2013 IRP East Residential Cooling 10% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.025	$250,829	$1,414,944	$1,164,115	5.64
TRC	$0.025	$250,829	$1,286,313	$1,035,484	5.13
UCT	$0.024	$238,173	$1,286,313	$1,048,140	5.40
RIM		$1,336,405	$1,286,313	($50,092)	0.96
PCT		$111,438	$1,216,253	$1,104,816	10.91
Lifecycle Revenue Impacts ($/kWh)					$0.000000397
Discounted Participant Payback (years)					1.07

Table F9. Wyoming HVAC 2013 Net
(2013 IRP East Residential Cooling 10% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.019	$125,684	$945,624	$819,940	7.52
TRC	$0.019	$125,684	$859,658	$733,974	6.84
UCT	$0.017	$112,746	$859,658	$746,913	7.62
RIM		$841,997	$859,658	$17,662	1.02
PCT		$54,139	$778,883	$724,744	14.39
Lifecycle Revenue Impacts ($/kWh)					($0.000000144)
Discounted Participant Payback (years)					0.53

Table F10. Wyoming HVAC 2014 Net
(2013 IRP East Residential Cooling 10% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.038	$133,757	$501,618	$367,861	3.75
TRC	$0.038	$133,757	$456,017	$322,259	3.41
UCT	$0.038	$134,059	$456,017	$321,957	3.40
RIM		$528,434	$456,017	($72,417)	0.86
PCT		$61,242	$467,470	$406,228	7.63
Lifecycle Revenue Impacts ($/kWh)					$0.000000582
Discounted Participant Payback (years)					0.67

Lighting

Table F11, Table F12, and Table F13 show cost-effectiveness results for net savings. The lighting measure category proved cost-effective from all perspectives except for the RIM (Table F11).

Table F11. Wyoming Lighting 2013-2014 Net
(2013 IRP East Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.059	$1,098,581	$1,346,456	$247,875	1.23
TRC	$0.059	$1,098,581	$1,224,051	$125,470	1.11
UCT	$0.043	$806,762	$1,224,051	$417,289	1.52
RIM		$2,648,386	$1,224,051	($1,424,335)	0.46
PCT		$1,343,548	$3,652,944	$2,309,396	2.72
Lifecycle Revenue Impacts ($/kWh)					$0.000027867
Discounted Participant Payback (years)					1.80

Table F12. Wyoming Lighting 2013 Net
(2013 IRP East Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.046	$451,404	$708,087	$256,683	1.57
TRC	$0.046	$451,404	$643,715	$192,312	1.43
UCT	$0.033	$325,570	$643,715	$318,145	1.98
RIM		$1,285,369	$643,715	($641,654)	0.50
PCT		$584,274	$1,862,536	$1,278,262	3.19
Lifecycle Revenue Impacts ($/kWh)					$0.000014705
Discounted Participant Payback (years)					1.01

Table F13. Wyoming Lighting 2014 Net
(2013 IRP East Residential Lighting 48% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.074	$691,716	$682,302	($9,414)	0.99
TRC	$0.074	$691,716	$620,274	($71,441)	0.90
UCT	$0.055	$514,307	$620,274	$105,967	1.21
RIM		$1,456,820	$620,274	($836,546)	0.43
PCT		$811,527	$1,913,623	$1,102,096	2.36
Lifecycle Revenue Impacts ($/kWh)					$0.000018854
Discounted Participant Payback (years)					1.48

Weatherization

Table F14, Table F15, and Table F16 show weatherization measure category cost-effectiveness results for net evaluated savings. The weatherization measure category proved cost-effective from all perspectives except for the RIM (Table F14).

Table F14. Wyoming Weatherization 2013-2014 Net
(2013 IRP East Residential Cooling 10% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.041	$862,499	$3,204,919	$2,342,420	3.72
TRC	$0.041	$862,499	$2,913,562	$2,051,063	3.38
UCT	$0.030	$633,911	$2,913,562	$2,279,651	4.60
RIM		$3,087,643	$2,913,562	($174,080)	0.94
PCT		$480,746	$2,706,901	$2,226,155	5.63
Lifecycle Revenue Impacts ($/kWh)					$0.000001076
Discounted Participant Payback (years)					1.94

Table F15. Wyoming Weatherization 2013 Net
(2013 IRP East Residential Cooling 10% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.038	$514,509	$2,028,107	$1,513,598	3.94
TRC	$0.038	$514,509	$1,843,733	$1,329,224	3.58
UCT	$0.026	$347,051	$1,843,733	$1,496,682	5.31
RIM		$1,888,114	$1,843,733	($44,380)	0.98
PCT		$339,989	$1,713,902	$1,373,913	5.04
Lifecycle Revenue Impacts ($/kWh)					$0.000000274
Discounted Participant Payback (years)					1.79

Table F16. Wyoming Weatherization 2014 Net (2013 IRP East Residential Cooling 10% Medium LF Decrement)

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PTRC (TRC + 10% Conservation Adder)	$0.045	$371,938	$1,257,800	$885,861	3.38
TRC	$0.045	$371,938	$1,143,455	$771,516	3.07
UCT	$0.037	$306,602	$1,143,455	$836,853	3.73
RIM		$1,282,080	$1,143,455	($138,626)	0.89
PCT		$150,445	$1,061,337	$910,892	7.05
Lifecycle Revenue Impacts ($/kWh)					$0.000000853
Discounted Participant Payback (years)					1.10

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. This is generally called nonparticipant spillover (NPSO)—results in energy savings caused by, but not rebated through, utilities' demand-side management activities.

To understand whether 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 customers who self-reported that they participated in a Rocky Mountain Power residential program during 2013 or 2014. When estimating NPSO, Cadmus excluded these customers from analysis, focusing on identified nonparticipants; thus the analysis avoided potential double-counting program savings and/or program-specific spillover.

Cadmus limited the NPSO analysis to the same efficiency measures rebated through Rocky Mountain Power programs (known as "like" spillover). Examples included installing a high-efficiency clothes washer and installing high-efficiency insulation for which participants (for whatever reason) did not apply for and receive an incentive. Cadmus did exclude one notable category of "like" measures: lighting products. This precluded potentially double-counting NPSO lighting savings already captured through the upstream lighting incentives.

Using a 1 to 4 scale, with 1 meaning "not at all important" and 4 meaning "very important," the survey asked customers to rate the importance of several factors on their decisions to install energy efficient equipment without receiving an incentive from 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; and
- Their 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 energy-efficient actions or installations reported.

Cadmus leveraged measure-level estimated gross savings from the 2013–2014, residential wattsmart evaluation activities for the reported NPSO measures.

Using the variables shown in Table E1, Cadmus determine total NPSO generated by Rocky Mountain Power's marketing efforts during the 2013–2014 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 Population	PacifiCorp December 2014 305 Report
E	NPSO kWh Savings Applied to Population	[(A÷B)×C)] × D
F	Total Gross Reported Savings	2013-2014 Evaluation
G	NPSO as a Percentage of Total residential Portfolio Reported Savings	E ÷ F

Results

Of 250 Rocky Mountain Power Wyoming customers surveyed, four nonparticipant respondents reported installing three different measure types attributed to Rocky Mountain Power's influence. Table E2 presents measures and gross evaluated kWh savings Cadmus attributed to Wyoming Rocky Mountain Power, generating average savings per NPSO measure of 239 kWh.

Table E2. NPSO Response Summary

Reported Spillover Measures	Mentions/Quantity	Unit Energy Savings (kWh)*	Total Savings (kWh)	Average Savings Per Spillover Measure (kWh)
Efficient Evaporative Cooler	1	153.6 per unit	110	
Efficient Wall Insulation	1 (48 sqft)	3.8 per sqft	182.4	
Efficient Showerhead	2	163.8 per unit	327.6	
Total	**4**		**620**	**239 (Variable C)**

*Unit energy savings (kWh) estimated for each measure were generated from average 2013–2014 HES evaluated gross savings by measure.

Table E3 presents variables used to estimate overall NPSO for the HES Program, a figure Cadmus estimated as 2% of total Rocky Mountain Power residential wattsmart program reported savings.

Table E3. NPSO Analysis Results

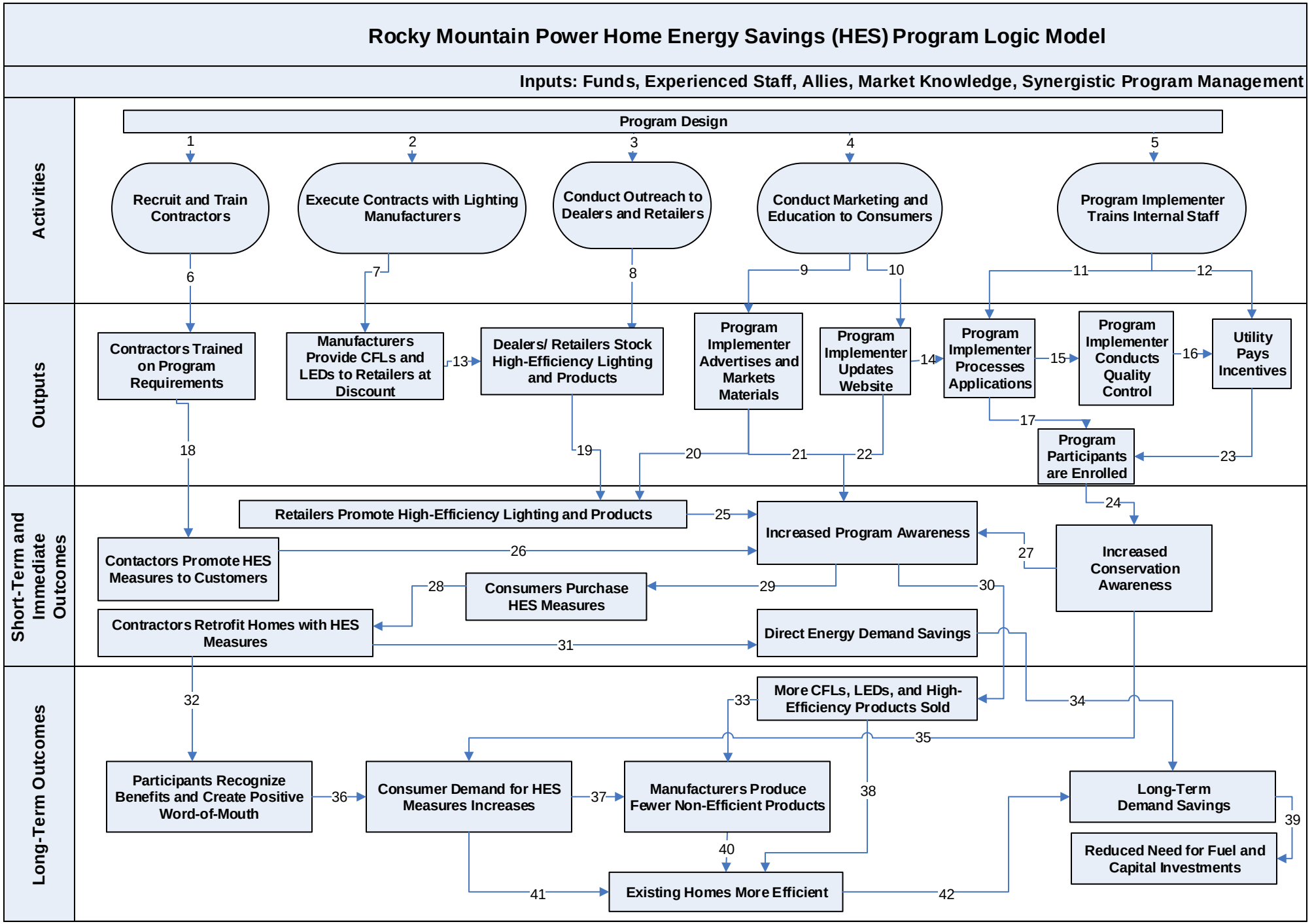
Variable	Metric	Value	Source
A	Number of Like Spillover Nonparticipant Measures	4	Survey data
B	Total Nonparticipant Customers Surveyed	239	Survey disposition
C	Weighted Average of Per Unit Measures Savings in kWh	155	Calculated in Table E2
D	Total Residential Customer Population	112,972	PacifiCorp December 2014 305 Report
E	NPSO kWh Savings Applied to Population	293,047	((A÷B)×C)) × D
F	Total Gross Reported Savings	15,555,744	2013-2014 Residential wattsmart Reported Savings
G	NPSO as a Percentage of Total Residential Portfolio Reported Savings	2%	E ÷ F

Cadmus then distributed the residential, portfolio-level result of 293,047 kWh NPSO to Rocky Mountain Power's residential programs, based on each program's size in terms of total gross reported kWh savings. Two programs were credited with achieving the greatest NPSO: Home Energy Savings (accounting for over 87% of total reported energy savings) at 256,365 kWh; and Refrigerator Recycling (accounting for 12% of total energy savings) at 34,042 kWh. The distribution of NPSO savings for each program, based on their percentage of the combined residential reported portfolio savings, resulted in a 2% NPSO percentage for each program relative to their total reported gross savings.

Table E4. NPSO by Residential Program

Residential wattsmart Program	Program Reported Gross Savings (kWh)	Total NPSO (kWh)	Percentage of Combined Savings	Program-Specific NPSO (kWh)
Home Energy Savings	13,608,554	293,047	87%	256,365
Low Income Weatherization	140,169		1%	2,641
Refrigerator Recycling	1,807,021		12%	34,042
Total	**15,555,744**	**293,047**	**100%**	**293,047**

Appendix G. HES Logic Model


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
Conduct Outreach to Dealers and Retailers
Conduct Marketing and Education to Consumers
Program Implementer Trains Internal Staff
6
7
8
9
10
11
12
Contractors Trained on Program Requirements
Manufacturers Provide CFLs and LEDs to Retailers at Discount
13
Dealers/ Retailers Stock High-Efficiency Lighting and Products
Program Implementer Advertises and Markets Materials
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
28
Consumers Purchase HES Measures
29
30
Contractors Retrofit Homes with HES Measures
31
Direct Energy Demand Savings
32
More CFLs, LEDs, and High-Efficiency Products Sold
33
34
35
Participants Recognize Benefits and Create Positive Word-of-Mouth
36
Consumer Demand for HES Measures Increases
37
Manufacturers Produce Fewer Non-Efficient Products
38
Long-Term Demand Savings
39
40
Reduced Need for Fuel and Capital Investments
41
Existing Homes More Efficient
42