



## Evaluation Report of 2018-2019 Home Energy Reports Program

**ROCKY MOUNTAIN POWER UTAH**

December 3, 2020

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## Table of Contents

<b>Executive Summary</b> .....	<b>1</b>
Conclusions and Recommendations .....	2
<b>Program Description</b> .....	<b>7</b>
<b>Evaluation Objectives and Methodology</b> .....	<b>9</b>
Program Manager Interviews.....	9
Customer Surveys.....	9
Savings Estimation.....	11
Uplift Analysis.....	14
Cost-Effectiveness Evaluation .....	16
<b>Process Evaluation Findings</b> .....	<b>18</b>
Program Delivery.....	18
2016-2017 Recommendation Status.....	19
Readership and Perceptions of the Home Energy Reports.....	19
Online Engagement .....	20
Awareness of Rocky Mountain Power Programs .....	21
Adoption of Energy-Saving Practices.....	23
Satisfaction with the Home Energy Reports.....	24
Net Promoter Score: Likelihood to Recommend the Home Energy Reports.....	25
Satisfaction with Rocky Mountain Power and Energy Services .....	26
Survey Result Comparisons by First Report Vendor.....	28
<b>Impact Evaluation Findings</b> .....	<b>30</b>
Savings Estimation.....	30
Uplift Analysis.....	33
Cost-Effectiveness .....	36
<b>Appendix A. Customer Survey Instrument</b> .....	<b>A-1</b>
<b>Appendix B. Impact Evaluation Details</b> .....	<b>B-1</b>

Figures

Figure 1. Copy of 2018-2019 Print Home Energy Report (Front and Back) ..... 18

Figure 2. Agreement Level to Statements about the Home Energy Reports ..... 20

Figure 3. Self-Reported Visits to Online Resources in the Past 12 months ..... 21

Figure 4. Familiarity with Energy Efficiency Programs..... 22

Figure 5. Programs Customers Have Heard About ..... 23

Figure 6. Adoption of Energy-Saving Practices in the Past 12 Months..... 24

Figure 7. Satisfaction with the Home Energy Reports ..... 25

Figure 8. Satisfaction with Rocky Mountain Power ..... 27

Figure 9. J.D. Power Categories ..... 28

Figure 10. Percentage Average Daily Savings by Months Since First Treatment..... 33

Figure B-1. Difference-in-Differences and Post-Only Treatment Effects by Wave and Program Year ..... B-4

Figure B-2. Average Daily Savings (%) Since Program Launch—Legacy Wave..... B-6

Figure B-3. Average Daily Savings (%) Since Program Launch—Expansion 1 Wave ..... B-6

Figure B-4. Average Daily Savings (%) Since Program Launch—Expansion 2 Wave ..... B-7

## Tables

Table 1. 2018-2019 Program Total Reported and Evaluated Savings.....	2
Table 2. 2018 Home Energy Reports Program Design and Implementation .....	8
Table 3. 2019 Home Energy Reports Program Design and Implementation .....	8
Table 4. Customer Survey Sampling and Response Rates .....	10
Table 5. PY10 Tests for Significant Differences in Annual Pretreatment Consumption .....	13
Table 6. Lighting Uplift Data Sources and Estimation Approach .....	16
Table 7. Comparison of Benefits and Costs Included in the Cost-Effectiveness Tests .....	17
Table 8. Status of 2016-2017 HER Program Evaluation Recommendations.....	19
Table 9. Net Promoter Score: Likelihood to Recommend the Home Energy Reports.....	26
Table 10. Survey Result Comparisons between First Report Vendor .....	29
Table 11. Program Savings by Wave and Program Year .....	30
Table 12. Program Savings Compared to Reported Savings .....	31
Table 13. Average Daily Savings per Customer by Wave and Program Year .....	32
Table 14. Downstream Savings Uplift Summary .....	34
Table 15. Upstream Lighting Savings Uplift Summary .....	34
Table 16. Program Total Uplift Summary .....	35
Table 17. Downstream Participation Uplift Summary .....	35
Table 18. Cost-Effectiveness of Residential Home Energy Report Program (2018, 2019, 2018 + 2019) ...	36
Table B-1. Sample Attrition for Billing Analysis.....	B-2
Table B-2. Treatment Effects (kWh/Day per Customers) by Model Specification.....	B-5
Table B-3. Upstream Lighting Savings Uplift Estimation.....	B-9
Table B-4. Incented Proportion of Total LEDs Purchased .....	B-10

## Executive Summary

Since 2012, the Home Energy Reports (HER) program has been sending energy reports to residential customers of Rocky Mountain Power Utah. The reports contain information about the customer's home energy consumption and encourage the adoption of energy-saving behaviors and home improvements.

The HER program evaluation used a randomized controlled trial (RCT) design to randomly assign eligible customers to either a treatment group (that receives the home energy reports) or a control group (nonrecipients). Treatment group customers were either mailed or emailed the HERs.<sup>1</sup> The program also provided all residential customers (including those in the control group) access to an online energy management portal where they can view details and insights about their home energy use. Treatment group customers received specific encouragement in the HERs to use the online portal. Control group customers did not receive the HERs or any encouragement to use the portal; therefore, this group's consumption provides a baseline for measuring the HER program's energy savings.

From 2012 through 2017, Oracle served as the implementation contractor and delivered the HERs to customers. In 2018, the HER program transitioned to a new implementation contractor, Bidgely. For the 2018-2019 program, Bidgely maintained the treatment and control group assignments that Oracle had established and launched a fourth HER experiment in 2018.

All treatment and control group customers belonged to one of four cohorts known as "waves" that were based on when customers began receiving the HERs:

- Legacy wave received first report in 2012
- Expansion 1 wave received first report in 2014
- Expansion 2 wave received first report in 2016
- Expansion 3 wave received first report in 2018

Except for Expansion 3 wave, all treatment group customers received either four print HERs or seven email HERs in 2018 (depending on the availability of a valid email address). Treatment group customers in the Bidgely email-only Expansion 3 wave received two email HERs in 2018. In 2019, all treatment group customers received either four print HERs or 12 email HERs.

The new HERs contained a similar homes comparison, end-use disaggregation by appliance, historical energy consumption trends, and personalized energy-saving tips. All but the end-use disaggregation information were found in the previous implementation contractor's HERs.

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<sup>1</sup> Customers with a valid email address receive the HERs via email while customers without a valid email address receive print HERs via mail.

Cadmus and PacifiCorp identified the following research objectives for evaluating Rocky Mountain Power Utah’s 2018 and 2019 HER program:

- Evaluate program impacts on energy consumption and gain insight on program performance
- Investigate the lift in other Rocky Mountain Power energy efficiency program participation and energy savings from the HER program (program uplift)
- Understand customers’ satisfaction with the HER program and awareness of their energy consumption and other energy efficiency programs
- Determine if the HER program was cost-effective each year and across both years
- Review the extent to which PacifiCorp implemented recommendations from previous evaluations

Cadmus addressed these evaluation research objectives through interviews with program staff, customer surveys, billing analysis, uplift (energy efficiency program participation and savings) analysis, and cost-effectiveness analysis.

## Conclusions and Recommendations

Table 1 shows the program total savings reported by the HER implementation contractor and the program total savings and total uplift savings evaluated by Cadmus for 2018, 2019, and both years combined. Before adjusting savings for uplift, Cadmus evaluated 110% of the reported savings. However, the reported savings fell within the 90% confidence interval around evaluated savings, indicating that the two estimates are not statistically different. Across both 2018 and 2019 program years, savings uplift contributed 5.7% to the evaluated savings.

**Table 1. 2018-2019 Program Total Reported and Evaluated Savings**

Program Year	Reported Savings (MWh/yr) [A]	Evaluated Savings (MWh/yr) [B]	Realization Rate [B/A]	Program Uplift Savings		Evaluated Savings Adjusted for Uplift (MWh/yr) [B – C]
				(MWh/yr) [C]	(%) [C/B]	
2018	35,934	40,078	112%	1,425	3.6%	38,654
2019	33,215	35,788	108%	2,894	8.1%	32,894
<b>2018-2019 Program</b>	<b>69,149</b>	<b>75,867</b>	<b>110%</b>	<b>4,319</b>	<b>5.7%</b>	<b>71,548</b>

<sup>(1)</sup> Reported savings were estimated by Bidgely, the implementation contractor.

Cadmus’ evaluation drew the following conclusions and recommendations.

## Savings and Uplift

### **Rocky Mountain Power’s HER Program in Utah saved significant amounts of energy in 2018 and 2019.**

Across the four waves of treatment, the program saved 40,078 MWh/yr in 2018 and 35,788 MWh/yr in 2019 before adjusting for uplift. The three longest-running waves, which launched in 2012, 2014, and 2016, each achieved significant savings compared to the control group in 2018 and 2019. The newest wave, Expansion 3, achieved significant savings in 2019 after its first full year of treatment, having launched in November 2018.

**Legacy, Expansion 1, and Expansion 2 waves may be experiencing savings degradation resulting from the gap in treatment customers experienced during the first four months of 2018.** Customers treated in the Legacy wave saved 1.9% of consumption in both program years, a decrease from 2.3% in 2017. Expansion 1 wave customers achieved savings of 1.4% in 2018 and 1.2% in 2019. Their savings decreased slightly from 2017 (1.6%). Expansion 2 wave customers maintained 2017 savings levels at 1.1% in 2018, but their savings decreased to 0.7% in 2019. There is some evidence that the decrease in savings for these three waves is attributable in part to the gap in treatment at the beginning of 2018 when PacifiCorp changed HER vendors.

**Customers in the Expansion 3 wave achieved lower savings in 2019 compared to the previous waves after one year of treatment; however, this wave also has the smallest control group average daily consumption.** Treatment customers in the Expansion 3 wave saved 0.3% of electricity consumption in 2019, its first full year of treatment. This is lower than the savings achieved by the Legacy wave (1.3%), but similar to first-year savings achieved by Expansion 1 (0.6%) and Expansion 2 (0.7%) treatment customers. In most HER programs, percentage savings are positively correlated with customer baseline consumption. Expansion 3 control group customers had the lowest average daily consumption of all the waves in their first years of treatment (19.8 kWh/day compared to 46.3 kWh/day, 25.7 kWh/day, and 34.1 kWh/day in the Legacy, Expansion 1, and Expansion 2 waves, respectively), which likely explains the smaller first-year savings.

**Electricity savings for Legacy wave customers may be degrading because of increasing home energy efficiency unrelated to Utah’s HER Program.** Control group customers randomly selected into the Legacy wave consumed on average 46.3 kWh per day in 2012 but only 39.6 kWh per day in 2019, a 15% decrease. Consumption decreased at its highest rate (7%) between 2013 and 2014 without a large rate of attrition or change in heating or cooling degree days between the years. Even though Legacy treatment customers continued to generate energy savings each year, this increasing efficiency likely affected the size of savings customers were able to generate, resulting in savings degradation. None of the control group customers in other waves experienced a similarly large decrease in consumption.

**HERs caused a small lift in participation in Rocky Mountain Power’s downstream rebate programs, and this cross-participation only resulted in a small amount of savings.** Across all waves of treatment group customers, average savings per customer from participation in downstream programs ranged between 0.02 kWh/yr and 3.86 kWh/yr in 2018, and between 0.04 kWh/yr and 5.21 kWh/yr in 2019. Total uplift from downstream programs remained small as a percentage of evaluated program total savings—in 2018, 1.9% of evaluated program savings resulted from downstream program participation, and in 2019 this increased only slightly to 3.0%. In 2018 and 2019, the HERs did not actively promote Rocky Mountain Power Utah’s other energy efficiency programs, although they did promote renewables programs.

## Report Engagement and Influence

**Almost all customers read the HERs, but opportunity exists to increase customer engagement by improving the relevancy of the tips and the presentation of information in the HERs.** Nearly all treatment group respondents (97%) said they read or skimmed the last HER they received; specifically, 40% of respondents said they read the report thoroughly, 32% read some of the report, and 25% skimmed the report.<sup>2</sup> A high proportion of respondents agreed with the following statements: the reports are easy to understand (91%), the information in the reports is helpful (73%), the tips were relevant to their home (69%), they did some of the everyday tips recommended in the reports (68%), and they believed the usage information shown in the reports was accurate (66%). However, more respondents tended to say they *somewhat agreed* than *strongly agreed* with these statements, suggesting that the HERs could still be improved to further increase customer engagement.

**The results of the impact analysis showing energy savings from HERs notwithstanding, treatment group customers reported adopting energy-saving practices at similar rates as control group customers.** The evaluation found no significant differences between treatment and control group respondents for all 10 energy-saving practices listed in the survey.<sup>3</sup> Even though Cadmus could not detect any differences in energy-saving practices between groups from the survey, the impact evaluation clearly showed that on average treated customers reduced their energy consumption compared to control customers. Although the survey took steps to minimize bias, such as randomly selecting customers to survey, it is possible that survey response bias explains this finding. If control group customers who responded to the survey were more energy-efficient than control group who did not respond, this form of self-selection could produce this null result.

## Customer Awareness of Rocky Mountain Power Programs

**The new HERs raised customers' general awareness of Rocky Mountain Power's energy efficiency programs.** The 2018-2019 HERs did not promote Rocky Mountain Power energy efficiency programs but did promote its renewable energy programs. When asked about their general familiarity with energy efficiency programs from Rocky Mountain Power, significantly more treatment group respondents (59%) than control group respondents (44%) said they were familiar. However, when asked to identify specific programs they had heard of, treatment and control group respondents did not differ in their identification of programs. Treatment and control group respondents identified specific energy efficiency, renewable energy, and demand response programs at statistically similar rates. These survey

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<sup>2</sup> Cadmus only asked this of respondents who remembered receiving the reports.

<sup>3</sup> The energy-saving practices include the following: changed the furnace or air conditioner filter every couple of months; unplugged/turned off electronics or appliances when not in use; kept the heating thermostat to 68 degrees or lower in winter; kept the air conditioning thermostat to 78 degrees or higher in summer; installed a programmable or smart thermostat; weatherized the home; installed an energy-efficient washer or dryer, low-flow showerhead, or aerator; installed high-efficiency heating or cooling equipment; and installed a high-performance heat pump water heater.

results were consistent with findings from the uplift analysis, which found that the HERs had small impacts on participation in and savings from Rocky Mountain Power’s downstream rebate programs.

## Customer Satisfaction

**Seventy-five percent of HER customers were satisfied with the HERs, but improving the relevancy of the tips and the accuracy of the similar homes comparison may increase satisfaction.** In comparison to opt-in, rebate programs, behavior programs that automatically enroll customers and do not provide incentives typically receive some of the lowest customer satisfaction results. Other utilities’ HER programs that Cadmus has evaluated in recent years have yielded 65% to 78% customer satisfaction. For Rocky Mountain Power Utah’s 2018-2019 HER program, 75% of treatment group respondents said they were satisfied with the HERs, and the mean satisfaction rating was 7.1.<sup>4</sup> Fewer respondents said they were *very satisfied* (27%) than *somewhat satisfied* (48%). Those who were satisfied frequently said the HERs are useful, helpful or informative (18%), bring awareness about their usage (14%), and save money (12%). Customers also liked the similar homes comparison (11%). Those who were not satisfied frequently said they disliked the similar homes comparison (19%), the tips were not relevant to them (15%), they saw no change in their bills (7%), the report was a waste or junk mail (7%), and the report was not accurate (5%).

Rocky Mountain Power Utah had concerns about customer perception of the accuracy of the similar homes comparison because, at the time of program relaunch, some of the customers’ HERs showed inaccurate similar home comparison information. Bidgely temporarily suspended the HERs after relaunch to correct the error. Cadmus asked customers about their belief in the accuracy of the similar homes comparison in the survey. From the survey, 53% of respondents agreed with the statement *I believe the similar homes comparison in the reports was accurate*. Although this was a majority, fewer respondents *strongly agreed* (10%) than *somewhat agreed* (43%) with the statement. These results suggest that the similar homes comparison component of the HERs could be improved to raise customer confidence and satisfaction.

**The HERs did not impact the high satisfaction customers have with Rocky Mountain Power.** Cadmus found that a large proportion of treatment group respondents (90%) and control group respondents (93%) were satisfied with Rocky Mountain Power and could not detect any statistically significant differences in satisfaction with Rocky Mountain Power between the two groups. Even when comparing the proportions of *very satisfied* and *somewhat satisfied*, responses were not statistically significant between treatment and control groups.

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<sup>4</sup> Cadmus could not compare the current survey’s results to the 2016-2017 survey results due to differences in methodology such as the survey mode and analysis.

## Cost-Effectiveness

**Based on the utility cost test (UCT) test, Rocky Mountain Power Utah’s HER program was cost-effective in 2018, 2019, and both program years combined.** Cadmus evaluated UCT ratios of 1.38 in 2018 (inclusive of program start-up costs), 1.22 in 2019, and over the two-year period, 1.31. That is, for every dollar spent on HER program costs, Rocky Mountain Power Utah will receive \$1.31 in benefits. The TRC test also yielded cost-benefit ratios above 1.0.

### Recommendations

- Consider promoting energy efficiency programs in the HERs to increase customer awareness of program offerings and participation in energy efficiency programs. The HER program could better support savings across the portfolio by generating savings in other energy efficiency programs that would not have been achieved without the reports’ influences.
- Work with the implementation contractor on diversifying and refining the energy-saving tips to increase customer engagement and relevancy. Some ideas include tracking the status of tips at the customer level (e.g., complete, incomplete, or irrelevant), framing tips as social or environmental activities rather than energy-saving activities, and integrating customer segmentation and demographic data (e.g., housing type, income, early adopter).
- Work with the implementation contractor on ways to improve the wording or presentation of the similar homes comparison to increase customer confidence in its accuracy. Consider providing customers with more detail about what goes into the similar homes comparison, A/B testing words or phrases, or provide customers with a quick and easy way to update their home information.
- Consider working with the implementation contractor on adapting the HERs to the changing needs of customers in light of COVID-19. More customers are spending their time at home and have limited opportunities and funds to go out and purchase energy-efficient products. The HER’s messaging and tips should reflect this situation, for example by providing no- and low-cost energy-saving tips that customers can easily do while staying at home.
- HER Program savings are likely to change because of the COVID-19 pandemic, and these changes may be long-lasting. Continue to track program performance on a frequent basis to monitor the impacts of COVID-19 and the observed savings degradation.

## Program Description

Since 2012, Rocky Mountain Power’s Home Energy Reports (HER) program has been sending energy reports to residential customers in Utah. The HERs contain information about the customer’s home energy consumption and encourage the adoption of energy-saving behaviors and home efficiency improvements.

The HER program evaluation used a randomized controlled trial (RCT) design to randomly assign customers to either a treatment group (who received HERs) or a control group (who did not receive them). Treatment group customers were either mailed or emailed the HERs.<sup>5</sup> The program also provided all residential customers (including those in the control group) access to an online energy management portal where they could view details and insights about their home energy use; however, treatment group customers received specific encouragement in the HERs to use the online portal. Control group customers did not receive the HERs nor encouragement to use the portal; therefore, this group’s consumption can provide an accurate baseline for measuring the HER program’s energy savings.

From 2012 through 2017, Oracle served as the implementation contractor and delivered the HERs to customers. In 2018, the HER program transitioned to a new implementation contractor, Bidgely, and customers began receiving new revised HERs in May 2018. During this transition, customers did not receive any HERs for four months from January 2018 to April 2018. Upon relaunch, Bidgely maintained the treatment and control group assignments that Oracle had established and launched a fourth HER experiment.

Customers were assigned to four cohorts known as “waves” that are based on when they began receiving the HERs:

- Legacy wave received first report in 2012
- Expansion 1 wave received first report in 2014
- Expansion 2 wave received first report in 2016
- Expansion 3 wave received first report in 2018

Table 2 and Table 3 summarizes the program design and implementation for 2018 and 2019, showing the number of customers who received the reports and the number and type of reports sent annually. Rocky Mountain Power’s HER Program in Utah is large and treated over 325,000 customers in 2018 and 2019. Bidgely began treating participants with electronic reports in place of paper reports when email addresses were available, and designed Expansion 3 to only treat electronically.

Cadmus estimated program savings for each wave and program year in the 2018-2019 evaluation. The estimated savings included the effects of any targeted treatment customers received over the control

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<sup>5</sup> Customers with a valid email address receive the HERs via email while customers without a valid email address receive print HERs via mail.

customers. For the 2018-2019 program year, savings included the effects from customers receiving HERs and the effects from customers receiving encouragement to use the portal.

**Table 2. 2018 Home Energy Reports Program Design and Implementation**

Group and Wave	Program Treatments	Customers
<b>Treatment Group</b>		
Legacy Wave	4 print HERs; 7 email HERs; encouragement to use online portal	64,698
Expansion 1 Wave	4 print HERs; 7 email HERs; encouragement to use online portal	145,611
Expansion 2 Wave	4 print HERs; 7 email HERs; encouragement to use online portal	31,219
Expansion 3 Wave	0 print HERs; 2 email HERs; encouragement to use online portal	101,453
<b>Total Treatment Group</b>		<b>342,981</b>
<b>Control Group</b>		
Legacy Wave	None	20,605
Expansion 1 Wave	None	34,702
Expansion 2 Wave	None	14,812
Expansion 3 Wave	None	31,335
<b>Total Control Group</b>		<b>101,454</b>

**Table 3. 2019 Home Energy Reports Program Design and Implementation**

Group and Wave	Program Treatments	Customers
<b>Treatment Group</b>		
Legacy Wave	4 print HERs; 12 email HERs; encouragement to use online portal	62,540
Expansion 1 Wave	4 print HERs; 12 email HERs; encouragement to use online portal	137,817
Expansion 2 Wave	4 print HERs; 12 email HERs; encouragement to use online portal	28,440
Expansion 3 Wave	0 print HERs; 12 email HERs; encouragement to use online portal	99,475
<b>Total Treatment Group</b>		<b>328,272</b>
<b>Control Group</b>		
Legacy Wave	None	19,848
Expansion 1 Wave	None	32,948
Expansion 2 Wave	None	13,628
Expansion 3 Wave	None	29,866
<b>Total Control Group</b>		<b>96,290</b>

## Evaluation Objectives and Methodology

Cadmus and PacifiCorp identified the following research objectives for evaluating Rocky Mountain Power Utah's 2018 and 2019 HER program:

- Evaluate program impacts on energy consumption and gain insight on program performance
- Investigate the lift in other Rocky Mountain Power energy efficiency program participation and energy savings from the HER program
- Understand customers' satisfaction with the HER program and awareness of their energy consumption and other energy efficiency programs
- Determine if the HER program was cost-effective each year and across both years
- Review the extent to which PacifiCorp implemented recommendations from previous evaluations

The subsequent sections provide an overview of the evaluation tasks Cadmus conducted.

### Program Manager Interviews

In April 2020, Cadmus conducted interviews with the HER program manager from Rocky Mountain Power and the project manager from Bidgely. Interviews focused on capturing any changes to program design and delivery from the previous implementation contractor, how the program performed during 2018-2019, and any implementation challenges and successes.

### Customer Surveys

Cadmus conducted an online survey with treatment and control group customers from May 18 to May 31, 2020. A copy of the customer survey instrument is provided in *Appendix A*.

### Survey Design

Cadmus designed the survey to assess the influence of HERs on customers' energy efficiency awareness, engagement with online energy-saving resources, adoption of energy-saving practices, and satisfaction with Rocky Mountain Power. To make reasonable comparisons between treatment and control group customers, we drafted a single survey instrument, with appropriate skip patterns, such that the survey included identical questions for both groups. However, only treatment group customers were asked questions about their engagement and satisfaction with the HERs.

Cadmus minimized any potential response bias from self-reporting by doing the following:

- Drafting clear and concise questions that are not leading, ambiguous, or double-barreled (asked about two or more unique concepts in the same question)
- Randomizing list-based survey items to reduce order effects
- Designing the survey to last no more than nine minutes to minimize survey fatigue and attrition

Despite efforts to minimize survey response bias, some bias is likely present in who and how a customer responded to the survey. For example, it may have been that the most environmentally conscious

customers in the control group were most likely to respond to the survey, likely biasing towards zero many of the estimated HER impacts on customer behaviors and attitudes.

## Survey Mode and Administration

The survey was administered online. Contacting customers solely through email would not have provided a representative sample of the customers in the program because Rocky Mountain Power does not have valid email addresses for all HER program customers. Treatment group customers for whom the utility did not have email addresses only received HERs via mail.

To ensure a representative sample, Cadmus contacted customers by email and postcard. Customers received an email survey invitation with a link to the online survey if Rocky Mountain Power had a valid email address for them and they received the email HERs. Customers received a postcard survey invitation with a link to the online survey if Rocky Mountain Power did not have a valid email address for them and they received only print HERs.

The survey took five minutes to complete. To encourage customers to respond, Cadmus offered customers who completed the survey the opportunity to enter a drawing for a chance to win a gift card.

## Survey Sampling and Response Rates

Cadmus contacted a random sample of customers stratified by group (treatment or control), channel (email or postcard), and first report vendor wave (Oracle or Bidgely). Table 4 shows the number of customers contacted as well as response rates by group, channel, and vendor wave.

**Table 4. Customer Survey Sampling and Response Rates**

Group, Channel, and First Report Vendor Wave	Qualified Survey Population	Customers Contacted	Target Completes	Achieved Completes	Response Rate
Treatment-Email-Oracle	68,090	600	35	57	10%
Treatment-Postcard-Oracle	110,143	1,300	35	11	1%
Treatment-Email-Bidgely	66,800	1,000	65	72	7%
Control-Email-Oracle	36,190	600	35	77	13%
Control-Postcard-Oracle	22,892	1,300	35	23	2%
Control-Email-Bidgely	20,738	1,000	65	71	7%
<b>Total</b>	<b>324,853</b>	<b>5,800</b>	<b>270</b>	<b>311</b>	<b>5%</b>

Because of an inadvertent printing error, approximately 50% of treatment group customers received the postcard with a link to the control group survey and vice versa. Cadmus identified and removed any mis-assigned postcard responses from the survey analysis, which reduced the number of postcard completes. To make up for this loss of postcard responses, we gathered more completes from the email channel. In the end, the customer survey reached its overall completion target and group completion target. The final sample of survey completes produced estimates with  $\pm 4\%$  precision at 90% confidence.

## Survey Analysis

For the survey analysis, Cadmus compiled frequency outputs, coded open-end survey responses according to the thematic similarities, and ran statistical significance tests. To determine whether survey

results significantly differed between group (treatment or control) and first report vendor wave (Oracle or Bidgely), we compared survey results at the 90% confidence level (or  $p \leq 0.10$  significance level). Statistical weights were applied to the survey results by group, report delivery channel (email or mail), and first report vendor wave to reflect actual program population proportions. Weighted survey results are indicated by the notation “nw” in this report.

Cadmus could not compare survey results from this 2018-2019 evaluation to the 2016-2017 evaluation, submitted August 2018,<sup>6</sup> for the following reasons:

- **Differences in survey mode.** This evaluation conducted online surveys while the 2016-2017 evaluation conducted telephone surveys. Each survey mode can introduce self-selection bias. For example, older customers and/or those who engage in traditional media are more likely to respond to telephone surveys. Younger customers and/or those who engage in online media are more likely to respond to online surveys. We attempted to lessen this bias in the 2018-2019 evaluation by using email and postcard methods of contact.
- **Differences in level of analysis.** This evaluation compared results between treatment and controls and between waves according to customers’ first report vendor (Oracle or Bidgely). The 2016-2017 evaluation compared results at the group-wave level. Because of these differences, we could not make year-to-year program comparisons. Instead, we cited satisfaction comparisons to other similar, long-running HER programs.
- **Differences in analytical approach.** This evaluation randomly sampled customers representative of the four waves and applied statistical weights to the survey results by group, report delivery channel, and vendor wave, thus factoring in all program stratifications. The 2016-2017 evaluation did not appear to have weighted the survey results, though the report does not provide details of its survey analysis methodology. Moreover, survey items that used a rating scale are reported in the 2016-2017 evaluation as statistical means rather than proportions. Cadmus’ 2018-2019 evaluation reports proportions for survey items that use a rating scale. We follow best practices to use proportions rather than means to report qualitative and/or categorical constructs like satisfaction, engagement, and awareness.

## Savings Estimation

Cadmus estimated HER program savings following industry best practices for evaluating residential behavior change programs. These methods use panel regression analysis of customer bills to estimate the program’s electricity savings and to control for differences between customers and all naturally occurring, non-programmatic changes in energy consumption. With adequate sample sizes, these models yield robust, unbiased estimates of savings under a randomized controlled trial (RCT) program design, wherein customers from a population of eligible customers are randomized into treatment and

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<sup>6</sup> ADM Associates, Inc. August 2018. *Evaluation of Utah 2016-2017 Home Energy Reports Program*. Submitted to Rocky Mountain Power.  
[https://www.pacificorp.com/content/dam/pacorp/documents/en/pacificorp/environment/dsm/utah/RMP\\_UT\\_HER\\_EMV\\_Report-Revised\\_Draft\\_2018-08-27.pdf](https://www.pacificorp.com/content/dam/pacorp/documents/en/pacificorp/environment/dsm/utah/RMP_UT_HER_EMV_Report-Revised_Draft_2018-08-27.pdf)

control groups. Using these methods, we estimated electricity savings during the 2018 and 2019 program years separately for each wave in the Rocky Mountain Power Utah HER program.

## Data Collection and Preparation

Cadmus collected monthly billing data from PacifiCorp, program tracking data including wave and group assignments from the program implementer, and weather data from the National Oceanic and Atmospheric Administration (NOAA). Billing data covered all customers in the experimental design and ranged from July 2011, 12 months prior to the launch of Utah’s first wave of treatment, through January 2020. Weather data, which included daily temperature readings from weather stations nearest to each customer, spanned the same date range. We calculated total heating- and cooling-degree days (HDDs and CDDs) within billing cycles.<sup>7</sup> We then normalized billing usage and monthly HDDs and CDDs to the calendar month for analysis.

Because of the randomized control trial design of the program and the high quality of the utility billing consumption data, we performed limited data screening and customer filtering. We removed customers from the analysis only if the home had fewer than six months of pretreatment monthly consumption bills or did not have any bills in the posttreatment period. We also dropped a small number of monthly billing consumption readings. Details including an attrition table are provided the in *Appendix B*.

## Verification of Group Balance

Cadmus verified that customers who had been randomly assigned to the program treatment group or control group by the program implementers were statistically equivalent in pretreatment energy consumption. Specifically, we compared average annual pretreatment usage between treatment and control groups in each wave and calculated two-sample t-tests to determine if differences were significant. The randomized design of the program should have resulted in groups with statistically indistinguishable average annual usage before treatment begins.

Table 5 provides the results of the t-tests for significant differences in treatment and control group annual pretreatment consumption. We found that the Expansion 1, Expansion 2, and Expansion 3 waves were balanced—no statistically significant differences existed between the pretreatment consumption of treatment and control groups in these waves. We did find statistically significant differences in pretreatment consumption between groups in the Legacy wave at the 10% significance level. However, this difference was a small percentage of pre-treatment consumption (less than 1%), and we modeled energy consumption to control for any differences in pretreatment energy consumption that arose through the randomization procedure.

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<sup>7</sup> Cadmus used 65°F as the base temperature for HDD and CDD calculations.

Table 5. PY10 Tests for Significant Differences in Annual Pretreatment Consumption

Wave	Customers		Average Annual Electricity Use per Customer (kWh/yr)			p-value <sup>(1)</sup>
	Treatment Group	Control Group	Treatment Group	Control Group	Difference	
Legacy Wave	59,409	19,078	16,953	17,024	71	0.0923
Expansion 1 Wave	131,728	31,409	9,402	9,399	-3	0.8726
Expansion 2 Wave	27,398	13,048	11,651	11,670	19	0.7247
Expansion 3 Wave	100,068	30,332	7,251	7,249	-2	0.9408

<sup>(1)</sup> A p-value >0.05 indicates an insignificant difference at the 5% significance level.

### Billing Analysis

Cadmus used regression analyses of monthly billing data from customers in the treatment and control groups to estimate HER program energy savings. The billing analysis conformed to IPMVP Option C, whole facility,<sup>8</sup> and the approach described in the Uniform Methods Project.<sup>9,10</sup>

More specifically, we used a multivariate regression to analyze the energy consumption of customers who had been randomly assigned to treatment and control groups. We tested and compared two general model specifications to check the robustness of savings results:

- The **post-only** model regresses customer average daily consumption on a treatment indicator variable and includes as regressors customers’ pretreatment energy use, month-by-year fixed effects and weather.<sup>11</sup> The model is estimated only with posttreatment customer bills.
- The **difference-in-differences (D-in-D) fixed effects** model regresses average daily consumption on a treatment indicator variable, month-by-year fixed effects, customer fixed effects, and weather. The model is estimated with pretreatment and posttreatment customer bills.

<sup>8</sup> Efficiency Valuation Organization. January 2012. *International Performance Measurement and Verification Protocol, Concepts and Options for Determining Energy and Water Savings, Volume 1*. Page 25. (EVO 10000 – 1:2012) <http://www.evo-world.org/>

<sup>9</sup> Agnew, K., and M. Goldberg. April 2013. *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*. U.S. Department of Energy, National Renewable Energy Laboratory. (NREL/SR-7A30-53827) [http://www1.eere.energy.gov/office\\_eere/de\\_ump\\_protocols.html](http://www1.eere.energy.gov/office_eere/de_ump_protocols.html)

<sup>10</sup> Stewart, J., and A. Todd. August 2014. *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 17: Residential Behavior Protocol*. U.S. Department of Energy, National Renewable Energy Laboratory. (NREL/SR-7A40-62497) Available online: [http://www1.eere.energy.gov/office\\_eere/de\\_ump\\_protocols.html](http://www1.eere.energy.gov/office_eere/de_ump_protocols.html)

<sup>11</sup> Allcott, H., and T. Rogers. 2014. “The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation.” *American Economic Review* 104 (10), 3003-3037.

We estimated separate program effects for 2018 and 2019 using ordinary least squares and reported Huber-White standard errors adjusted for correlation within homes. The model specification is provided in *Appendix B*.<sup>12</sup> Both models yielded savings estimates that were within each other’s confidence intervals, meaning that their results were not statistically different (as illustrated in Figure B-1 in *Appendix B*). We reported the results of the post-only model, consistent with previous evaluations of Rocky Mountain Power Utah’s HER program.<sup>13</sup>

## Program Total Savings Estimation

Cadmus estimated savings for the 2018 and 2019 programs years for each wave as the product of average daily savings per treatment group customer and the total number of days treatment group customer accounts were active in each evaluated program year. We multiplied the estimate of average daily savings per customer by the total number of active account days because the savings were estimated across all treatment group customers, including the small number of customers not explicitly flagged as having received treatment according to the program tracking data.

## Uplift Analysis

Rocky Mountain Power Utah’s HER program encourages customers to participate in its other energy efficiency programs. The increase in participation in and savings from other efficiency programs is known as efficiency program uplift. Cadmus estimated the lift in efficiency program participation and savings from the HER program.

Because savings from efficiency program uplift were measured in both the regression-based estimate of savings (described in the *Savings Estimation* section) and in the impact evaluations of Rocky Mountain Power Utah’s other efficiency programs, the uplift savings will be double-counted unless the savings are subtracted from either the HER program in Utah or the other efficiency programs. We estimated efficiency program uplift and savings for each of the three participant waves and by program year. We subtracted uplift savings from the evaluated HER program savings to avoid double-counting.

The following sections describe how Cadmus estimated uplift from downstream and upstream rebate programs. Definitions of uplift participation and savings are provided in *Appendix B*.

## Estimating Uplift for Downstream Rebate Programs

To estimate the lift in participation and savings from Rocky Mountain Power Utah’s HER program, Cadmus matched the treatment and control group customers to Rocky Mountain Power Utah’s efficiency program tracking data. Because many measures in energy efficiency program portfolios have

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<sup>12</sup> Evaluators prefer this “post-only” or lagged dependent variable model (over the fixed effects *difference-in-differences* model because the *post-only* model tends to estimate program effects with better precision.

<sup>13</sup> ADM Associates, Inc. August 2018. Evaluation of Utah 2016-2017 Home Energy Reports Program. Submitted to Rocky Mountain Power. Available online at: [https://www.pacificorp.com/content/dam/pacorp/documents/en/pacificorp/environment/dsm/utah/RMP\\_UT\\_HER\\_EMV\\_Report-Revised\\_Draft\\_2018-08-27.pdf](https://www.pacificorp.com/content/dam/pacorp/documents/en/pacificorp/environment/dsm/utah/RMP_UT_HER_EMV_Report-Revised_Draft_2018-08-27.pdf)

multiyear measure lives, we collected PacifiCorp’s efficiency program tracking data from when the HER program launched in 2012 through the end of 2019.<sup>14</sup> Each row of the tracking database corresponded to the installation of a specific efficiency measure (e.g., heat pump water heater, attic ceiling insulation) at a premise on a specific date and included premise ID, customer account, location (e.g., street address, city, zip code), PacifiCorp program name, program measure name, installation date, and verified annual savings.

To estimate savings uplift, we calculated the difference in average program savings per customer between treatment group and control group customers, after having made a few adjustments to verified annual savings for measures in the tracking data:

- Prorated savings of non-weather-sensitive measures based on the installation date
- Prorated savings of weather-sensitive measures based on the installation date
- Prorated savings for customers with accounts becoming inactive during the calendar year

We aggregated the measure-tracking data to the customer, energy efficiency program, and evaluation year, and calculated the impacts on participation and efficiency program savings using the definitions described in *Appendix B*.

## Estimating Uplift for Upstream Rebate Programs

Unlike for downstream programs, Cadmus could not obtain customer-level program tracking data from Rocky Mountain Power Utah’s upstream lighting rebate program because such data were not collected at the point-of-sale. To estimate the lift in upstream lighting savings due to the HER program, we surveyed HER program treatment and control group customers about their LED bulb purchases and installations in the last 12 months. The impacts of HERs on the number of bulbs purchased and installed were calculated by taking differences between the treatment and control groups. We adjusted the treatment effect by scaling it by the estimated proportion of LED bulb sales for which the program provided incentives and the expected portion of the year that each bulb was installed.<sup>15</sup>

Table 6 shows the variables required to calculate upstream lighting (see *Appendix B* for the full equation) and Cadmus’ estimation approach.

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<sup>14</sup> The billing analysis captured savings effects from measures that had not exceeded their estimated useful life in the performance period under evaluation.

<sup>15</sup> Cadmus excluded a 98% in-service rate embedded in the Regional Technical Forum (RTF) per-unit savings values.

**Table 6. Lighting Uplift Data Sources and Estimation Approach**

Variable	Data	Estimation Approach
TE(Q)	Survey responses about quantities of LEDs purchased in the previous 12 months	Compare results from randomized treatment and control group customer surveys
ISR	Survey responses about quantities of LEDs installed in the previous 12 months	Calculate the ratio of the number of installed bulbs over the number of purchased bulbs by group
kWh Savings/Bulb	Rocky Mountain Power Utah’s upstream lighting program tracking data	Use the average energy savings per bulb claimed in Rocky Mountain Power Utah’s upstream lighting tracking data
Time Installed	Assumption	Assume six months, as if bulbs were installed at a constant rate over the year
Percentage of Bulbs Provided Incentives	Survey responses about the number of LEDs purchased and PacifiCorp Utah’s upstream lighting program tracking data	Estimate the total number of bulbs purchased by the PacifiCorp residential customer population using survey responses and compare to the total number of incented bulbs
Treated Customers	PacifiCorp program tracking data	Determine the average number of customers treated, where a customer is considered treated in each month he or she is assigned to the treatment group and has an active account

### Cost-Effectiveness Evaluation

For this report, Cadmus conducted five common cost-effectiveness tests: the total resource cost (TRC) test; the program administrator cost (PAC) test; the ratepayer impact measure (RIM) test; the participant cost test (PCT); and the PacifiCorp-TRC (P-TRC) test, which includes a 10% electric benefit environmental adder. PacifiCorp Utah program stakeholders can use the results of these tests to inform discussions on program planning. Any cost-effectiveness test benefit/cost (B/C) ratio greater than 1.0 indicates a cost-effective program.

Cadmus assessed cost-effectiveness for the 2018 program year, the 2019 program year, and for the two-year period combined. The 2018 program year includes program start-up fees with a new contractor.

We estimated cost-effectiveness based on methods described in the California Standard Practice Manual for assessing energy efficiency programs’ cost-effectiveness.<sup>16</sup> We supplemented this information with PacifiCorp program expenditures, utility-provided economic parameters, and verified energy savings.

PacifiCorp focuses on TRC when considering program design and portfolio decision-making. The TRC test estimates the net present value of financial costs and benefits to utilities administering programs and to program participants. The P-TRC serves as the other key test for utility staff when evaluating programs. The PCT, PAC, and RIM test are helpful for benchmarking program cost-effectiveness from other stakeholder perspectives.

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<sup>16</sup> California Public Utilities Commission. July 2002. *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*.

Table 7 summarizes the five tests used in this evaluation, their benefits and/or costs, and the perspective from which each test assesses cost-effectiveness.

**Table 7. Comparison of Benefits and Costs Included in the Cost-Effectiveness Tests**

Test	Perspective	Benefits	Costs
TRC	Society	Present value of electric avoided energy and capacity costs <sup>(1)</sup>	Program administrative and marketing costs, and incremental measure costs (defined as contractor fees to deliver reports to customers)
P-TRC	Society & Environment	All TRC plus a 10% environmental adder benefit	Same as TRC
PCT	Program Participants	Electric bill savings	None (program is provided free to customer)
PAC	Program Administrator	Present value of electric avoided energy and capacity costs <sup>(1)</sup>	Program administrative, marketing, and incentive costs (defined as contractor fees to deliver reports to customers)
RIM	All Ratepayers (participants and nonparticipants)	Present value of electric avoided energy and capacity costs <sup>(1)</sup>	Program administrative, marketing, and incentive costs, plus the present value of lost revenues

<sup>(1)</sup> The present value of electric avoided energy costs includes avoided capacity benefits.

The cost-effectiveness analysis used the following program and measure-level inputs to assess cost-effectiveness:

- Program impacts (energy savings and utility expenditures)
- Avoided energy costs<sup>17</sup>
- Residential electric rates
- Annual discount rates
- Annual inflation rates
- Residential energy load shapes
- Effective useful measure life (EUL) of one year

We used Cadmus’ cost-effectiveness tool, PortfolioProPlus, to calculate the HER program’s cost-effectiveness. PortfolioProPlus is a web-based application that sits on top of a relational database that maintains a single source of data for ease of auditing results from prior analyses; modeling measures, programs, and portfolios; and customizing reports and data visualization.

Cadmus’ PortfolioProPlus model employs the California Standard Practice Manual methodology to evaluate cost-effectiveness, utilizing a SQL Server database of measures, hourly end-use load shapes, and hourly avoided costs. Its analyses accommodate use of secondary fuel benefits, externalities, and other energy and non-energy benefits.

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<sup>17</sup> Avoided energy costs used in PacifiCorp’s 2017 Integrated Resource Plan, specific to the 2018-2019 biennial evaluation, include capacity price mitigation.

## Process Evaluation Findings

The following provides detailed process evaluation findings on Rocky Mountain Power Utah's 2018-2019 HER program.

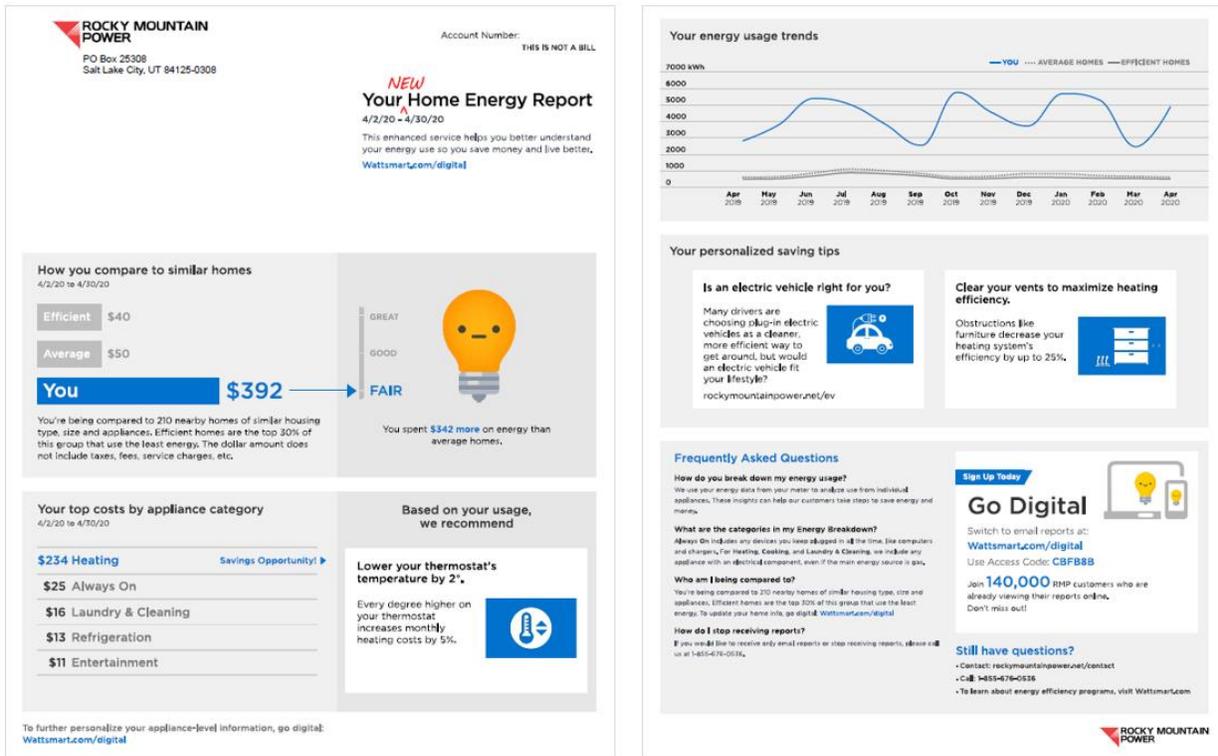
### Program Delivery

Three major program delivery changes occurred since the 2016-2017 program. They involved a new implementation contractor, a new HER product, and a new treatment wave.

In 2018, the HER program made the transition to a new implementation contractor, Bidgely. Treatment group customers received the last HERs under the previous implementation contractor (Oracle) in December 2017 and began receiving new HERs from Bidgely in May 2018. Customers experienced a four-month gap in which they did not receive any HERs. Rocky Mountain Power's program manager reported that the program did not meet its 2018 and 2019 savings goal.

The new HERs contained a similar homes comparison, end-use disaggregation cost by appliance, historical energy consumption trends, and personalized energy-saving tips (Figure 1). All but the end-use disaggregation information were found in the previous implementation contractor's HERs. The new HERs connect one of the tips to the end-use disaggregation information to help customers understand where they are using energy and what they can specifically do to reduce consumption.

Figure 1. Copy of 2018-2019 Print Home Energy Report (Front and Back)



Bigdely used the same RCT design and the three waves as the previous implementation contractor and launched a new wave in November 2018 (Expansion 3 wave) to increase program savings. With the exception of Expansion 3 wave, all treatment group customers received either four print HERs or seven email HERs in 2018, depending on the availability of a valid email address for the customer. Treatment group customers in the new Expansion 3 wave received two email HERs in 2018. In 2019, all treatment group customers received either four print HERs or 12 email HERs.

Overall, Rocky Mountain Power’s program manager was mostly satisfied with the HERs and the new implementation contractor. One area of concern was with customer perception of the accuracy of the similar homes comparison. At the relaunch of the program in May 2018, Bigdely said it encountered issues in which some customers’ HERs showed inaccurate similar home comparison information. Bigdely temporarily halted report delivery to fix the issue and resumed delivery in October, a three-month suspension. This and the four-month gap earlier in 2018 during the change in implementation contractors may have impacted program savings as savings did not return to the level prior to the program relaunch. Expansion 3 wave did not ramp up savings as strongly as did the other three waves during the first 12 months of treatment. Its lower than expected savings performance may have also contributed to the program not meeting its saving goal in 2018 and 2019.

## 2016-2017 Recommendation Status

As part of the process evaluation, Cadmus reviewed the extent to which PacifiCorp implemented recommendations from the previous evaluation. Table 8 lists Rocky Mountain Power Utah’s 2016-2017 HER program evaluation recommendations and progress toward addressing those recommendations. To date, PacifiCorp has not implemented the recommendations from the previous evaluation.

**Table 8. Status of 2016-2017 HER Program Evaluation Recommendations**

Recommendation	Status
Where possible, tailor program recommendations to demographics.	<b>Recommendation not implemented.</b> Bigdely’s algorithm for generating tips factors in the customer’s energy consumption data, heating/cooling type, and appliances used.
Consider cross-referencing treatment customers with known low-income screening tools to spur outreach for Rocky Mountain Power low-income programs.	<b>Recommendation not implemented.</b> The 2018-2019 HERs did not promote low-income programs from Rocky Mountain Power. Instead, Rocky Mountain Power decided to promote renewable energy programs in the HERs. Low-income customer segmentation was not used in the HERs.

## Readership and Perceptions of the Home Energy Reports

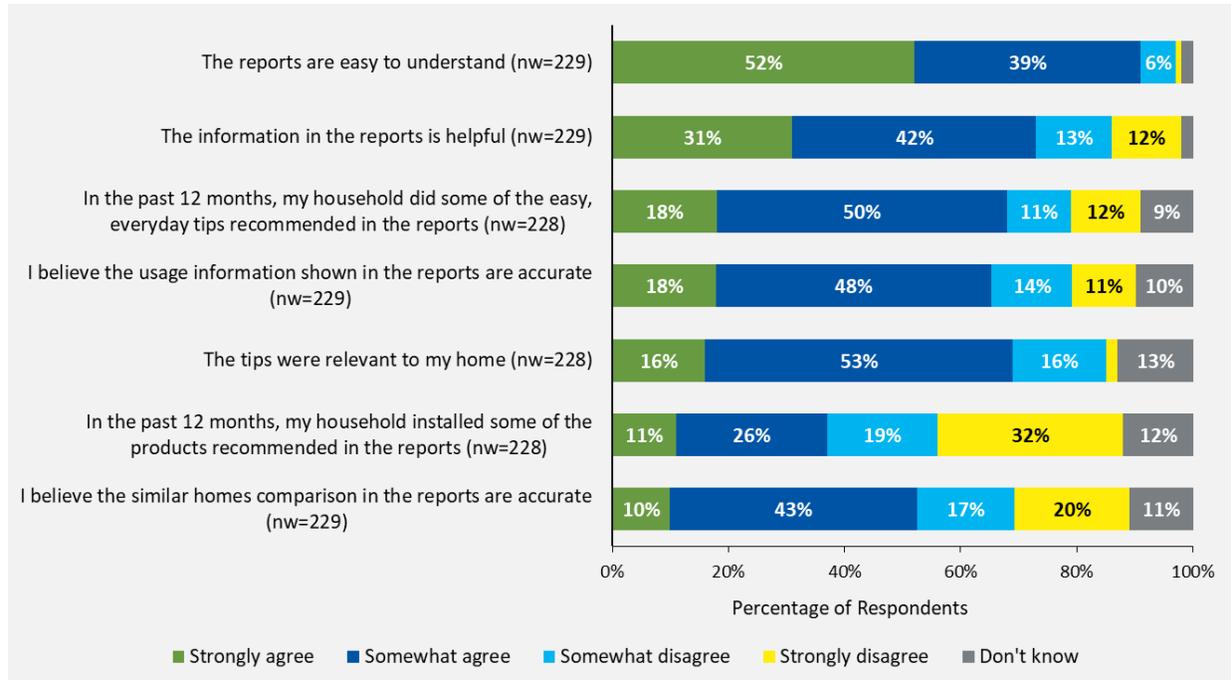
Nearly all treatment group respondents (97%) said they read or skimmed the last HER they received (nw=229).<sup>18</sup> Specifically, 40% of respondents said they read the report thoroughly, 32% read some of the report, and 25% skimmed the report. Three percent said they did not read the report.

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<sup>18</sup> Weighted survey results are indicated by the notation “nw” in this report.

The survey asked treatment group respondents to indicate their level of agreement on seven positive statements about the helpfulness and relevance of the HERs. Figure 2 shows that the majority of respondents agreed with six of the seven statements.

**Figure 2. Agreement Level to Statements about the Home Energy Reports**



Source: Survey Question, “To what extent do you agree or disagree with the following statements about the Home Energy Reports?”

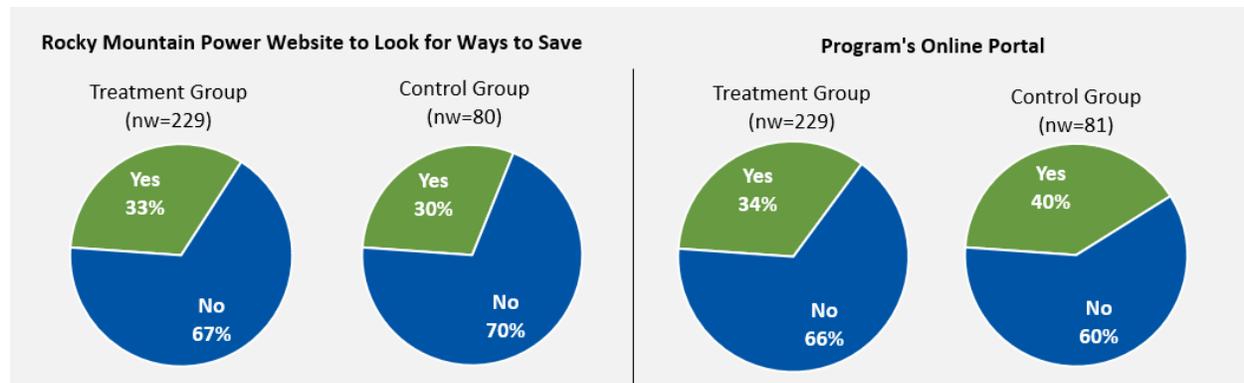
Of the seven statements, the highest proportion of respondents agreed that the reports are easy to understand (91%), the information in the reports is helpful (73%), the tips were relevant to their home (69%), they had applied some of the everyday tips recommended in the reports (68%), and they believed the usage information shown in the reports was accurate (66%). Fewer respondents agreed with the statements that they believed the similar homes comparison in the reports was accurate (53%) and they had applied some of the products recommended in the reports (37%). Notably, more respondents tended to say they *somewhat agreed* than *strongly agreed*, which suggests that the HERs could still be improved to further increase customer engagement and confidence.

## Online Engagement

Treatment group customers received encouragement in the HERs to visit the Rocky Mountain Power website to look for ways to save money on their utility bills and the program’s online portal to view their home’s energy usage and insights. Control group customers did not receive this encouragement but had access to these same online resources. The survey asked treatment and control group customers whether they visited the Rocky Mountain Power website and the online portal in the past 12 months. The evaluation expected to see a higher proportion of visits among the treatment group.

Figure 3 shows that the proportion of treatment and control group respondents who visited the two online resources did not significantly differ. Treatment group respondents (33%) and control group respondents (30%) showed similar proportions of visits to the Rocky Mountain Power website to look for ways to save. A smaller proportion of treatment group respondents (34%) than control group respondents (40%) reported visiting the program’s online portal, however, this difference was not statistically significant. The lack of significant differences may be because treatment and control group customers had equal access to these online resources.

**Figure 3. Self-Reported Visits to Online Resources in the Past 12 months**



Source: Survey Questions, “In the past 12 months, have you visited the Rocky Mountain Power website to look for ways to save money on your utility bills?” and “Rocky Mountain Power offers its customers access to an online portal where you can see your home’s energy usage along with insights and tips. In the past 12 months, have you accessed this online portal?”

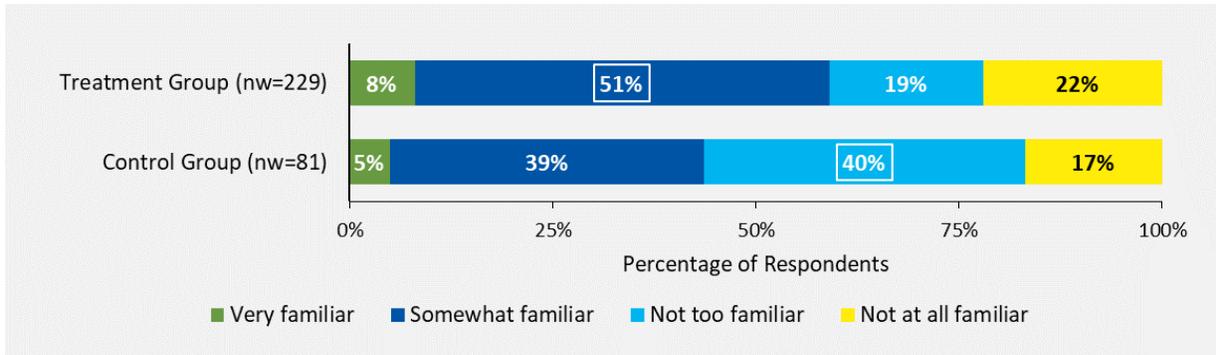
## Awareness of Rocky Mountain Power Programs

The 2018-2019 HERs did not promote Rocky Mountain Power energy efficiency programs but did promote its renewable energy programs. Additionally, the treatment and control groups had access to the same online resources where they could discover energy efficiency, renewable energy, and demand response programs. Hence, the evaluation did not expect to see any large differences in awareness of programs between treatment and control group.

When asked about their general familiarity with energy efficiency programs from Rocky Mountain Power, more treatment group respondents than control group respondents said they were familiar (Figure 4). A significantly higher proportion of treatment group respondents (51%) than control group respondents (39%) said they were *somewhat familiar*. Also, when *very familiar* and *somewhat familiar* responses were combined, a significantly higher proportion of treatment group respondents (59%) said they were familiar compared to control group respondents (44%).<sup>19</sup>

<sup>19</sup> A significant difference between groups at the 90% confidence level ( $p \leq 0.10$ ).

Figure 4. Familiarity with Energy Efficiency Programs

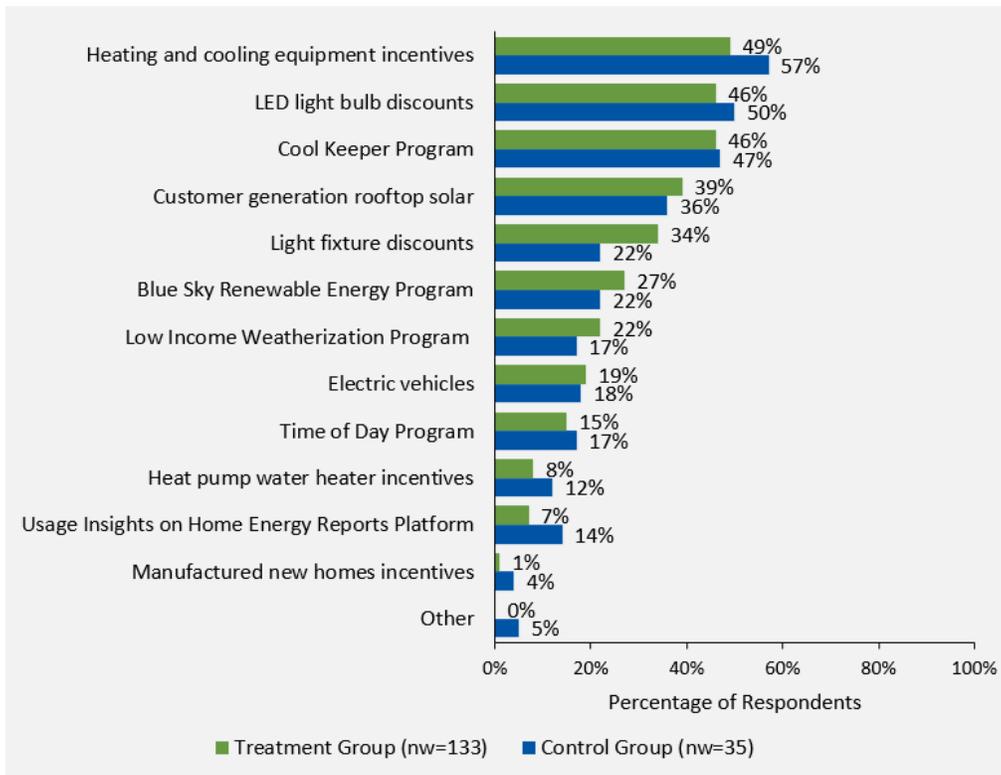


The box indicates a significant difference between groups at the 90% confidence level ( $p \leq 0.10$ ).

Source: Survey Question, “How familiar are you with energy-efficiency rebates or programs offered by Rocky Mountain Power to help you use less energy?”

Respondents who said they were *very familiar* or *somewhat familiar* with Rocky Mountain Power programs were asked a follow-up question to identify from a list the energy efficiency programs they had heard of. Though the question specifically asked about energy efficiency programs, the list included renewable energy and demand response programs.

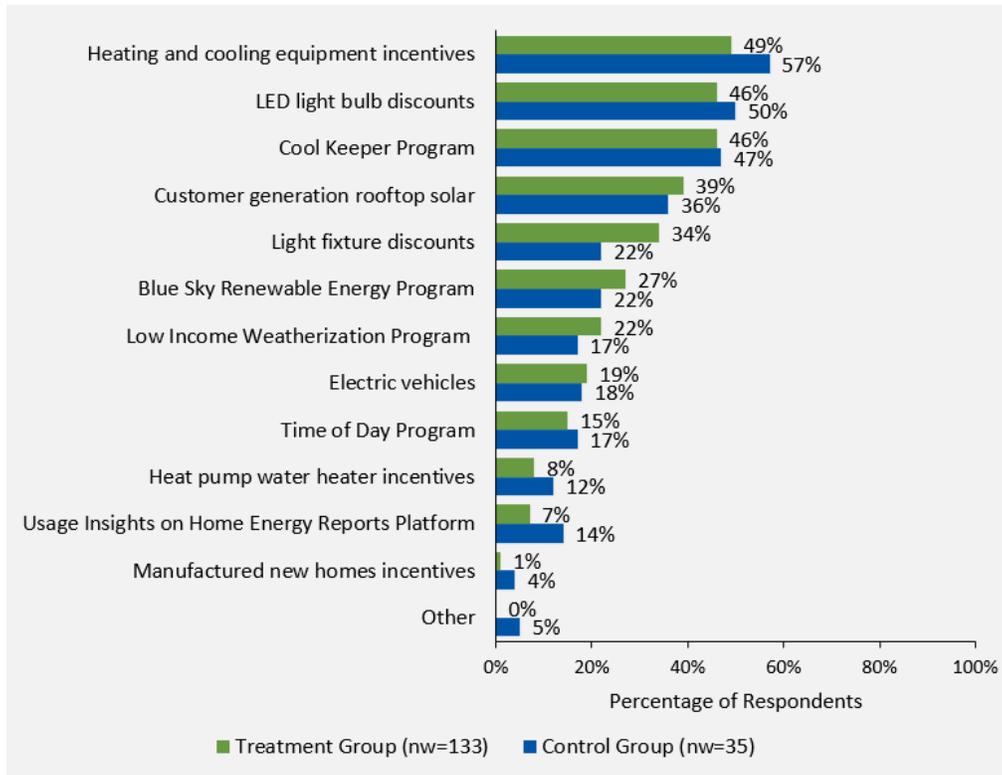
When the question was asked this way, treatment and control group respondents did not differ in their identification of programs. Figure 5. Programs Customers Have Heard About



shows that conditional on having been familiar with the programs treatment and control group respondents identified energy efficiency, renewable energy, and demand responses programs at

statistically similar rates. Although in the figure some programs may show a wide difference between treatment and control group respondents, these differences were not statistically significant.

Figure 5. Programs Customers Have Heard About



Source: Survey Question, “Which energy-efficiency rebates or programs from Rocky Mountain Power have you heard about? Select all that apply.”

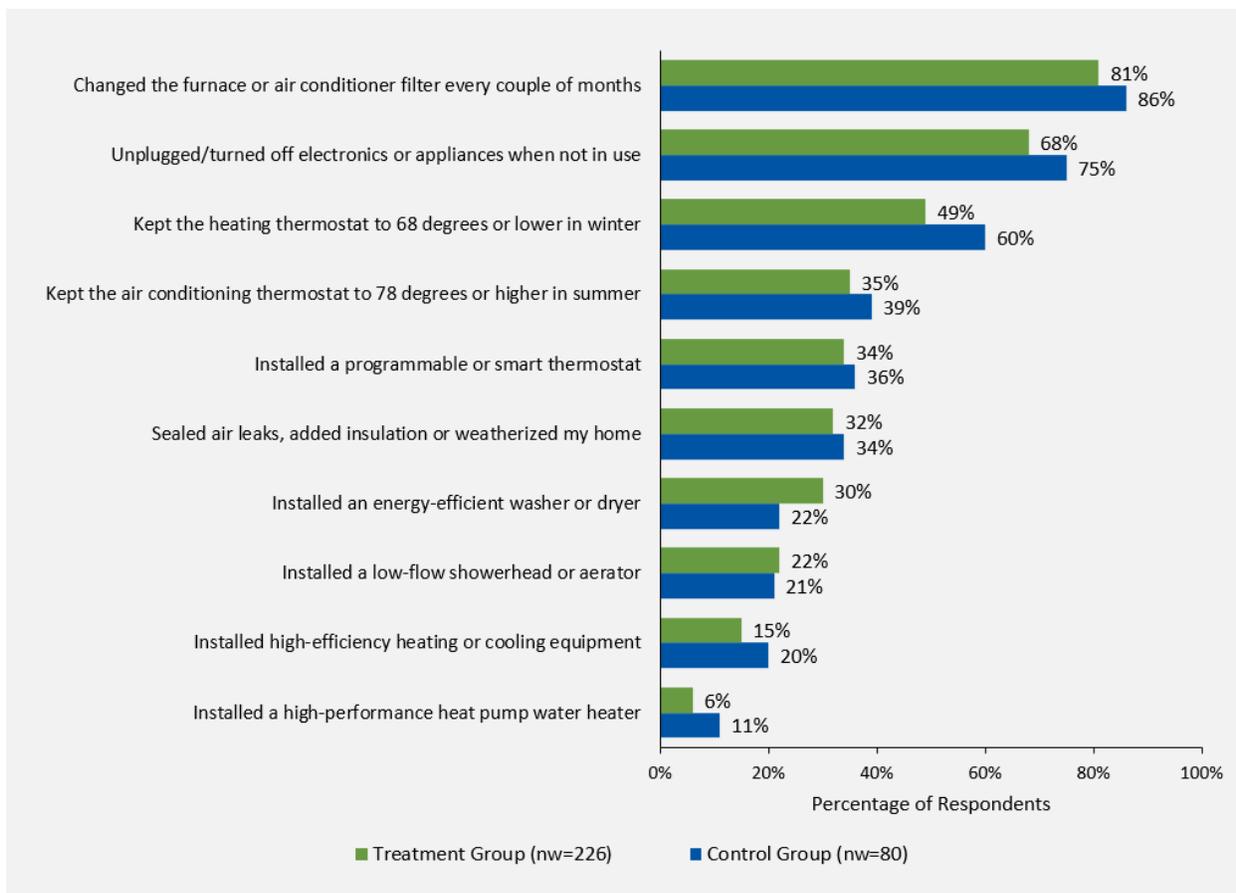
### Adoption of Energy-Saving Practices

The survey asked treatment and control group respondents if in the last 12 months they had adopted any of the 10 energy-saving practices listed in Figure 6. Because the HERs provided treatment group customers with personalized energy-saving tips, Cadmus expected to see higher self-reported adoption rates from the treatment group.

For all 10 of the energy-saving practices, we found no significant differences between treatment and control group respondents.

These self-reported adoption rates of energy-saving practices do not align with the evaluation’s impact analysis results, which found significant savings for the treatment group. Survey response bias could be a reason. Even though we used random sampling to select the survey sample frame, the decision to complete the survey was up to the customer and was not random, so it is possible that control group customers who responded to the survey practiced more energy-efficient activities than the treatment group customers who responded.

Figure 6. Adoption of Energy-Saving Practices in the Past 12 Months



Source: Survey Question, “For each item, please answer yes or no whether you have done this in the past 12 months.”

### Satisfaction with the Home Energy Reports

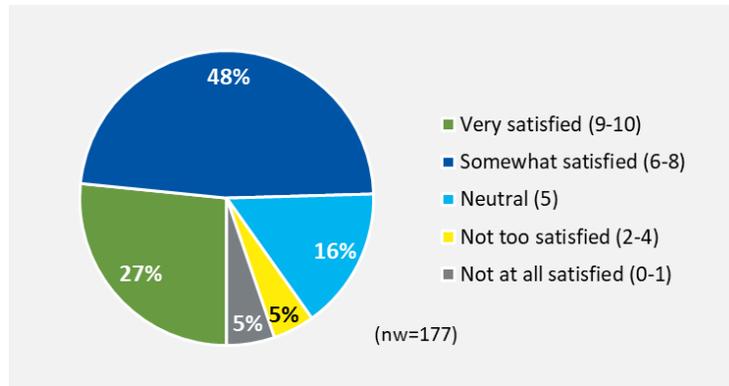
As shown in Figure 7, 75% of treatment group respondents said they were satisfied with the HERs, and the mean satisfaction rating was 7.1 on a scale from 0 to 10. Fewer respondents said they were *very satisfied* (27%) than *somewhat satisfied* (48%).

This type of program typically receives some of the lowest customer satisfaction results because customers are automatically enrolled and because it does not offer the incentives that traditional rebate programs offer. Rocky Mountain Power Utah’s 2018-2019 HER program achieved similar customer satisfaction compared to other utilities’ HER programs that Cadmus has evaluated in recent years. These other programs have yielded 65% to 78% customer satisfaction.<sup>20</sup> As noted in the *Survey Analysis*

<sup>20</sup> The comparison includes long-running HER programs from one Midwest utility and one Mid-Atlantic utility. Oracle implemented the Midwest utility’s HER program, which achieved 78% customer satisfaction for 2019. Uplight (formerly Tendril) implemented the Mid-Atlantic utility’s HER program, which achieved 65% customer satisfaction for 2018 and 66% customer satisfaction for 2019.

section, Cadmus could not compare the current survey’s results to the 2016-2017 survey results because of differences in methodology.

Figure 7. Satisfaction with the Home Energy Reports



Source: Survey Question, “Overall, how satisfied are you with the Home Energy Reports?”

We found through customer open-end comments that the similar homes comparison, personalized energy-saving tips, and perceived accuracy were key areas for improvement. The survey asked respondents open-end questions about their reasons for satisfaction, and 160 respondents answered. Those who were satisfied frequently said the HERs are useful, helpful or informative (18%), bring awareness about their usage (14%), save money (12%), and they like the similar homes comparison (11%). Those who were not satisfied frequently said they dislike the similar homes comparison (19%), the tips are not relevant to them (15%), they see no change in their bills (7%), the report is a waste or junk mail (7%), and the report is not accurate (5%).

Reasons for customer dissatisfaction with the HERs are not unique to Rocky Mountain Power Utah’s program. Other evaluations conducted by Cadmus have found that customer dissatisfaction with the HERs’ similar homes comparison, tips, and accuracy are very common for this type of behavior program.

### Net Promoter Score: Likelihood to Recommend the Home Energy Reports

The net promoter score (NPS) is a metric of brand loyalty that measures how likely customers are to recommend the program (or product in this case) to others. Respondents rate their likelihood to recommend the product on a 0-10 scale where 0 means “not at all likely” and 10 means “extremely likely.” Respondents giving a rating of 9 or 10 are known as promoters, a rating of 7 or 8 are known as passives, and a rating of 0 to 6 are known as detractors. The NPS is expressed as a number between -100 and +100 that represents the difference between the percentage of promoters and detractors. The passives are excluded from the calculation. An excellent NPS is +50 and above.<sup>21</sup>

<sup>21</sup> Net Promoter, NPS, and Net Promoter Score are trademarks of Satmetrix Systems, Inc., Bain & Company, and Fred Reichheld.

As shown in Table 9, the HERs achieved an NPS of -17, indicating there are more detractors (43%) than promoters (31%) among the respondents. According to our research and evaluation of other similar behavior programs, this low NPS is not atypical. We have observed NPS values ranging from -14 to -25.<sup>22,23</sup> HER programs often experience a lower NPS than traditional rebate programs, possibly because of the opt-out program design and lack of an incentive or equipment-based product.

**Table 9. Net Promoter Score: Likelihood to Recommend the Home Energy Reports**

Rate Classification	Percentage of Respondents (nw=229)
Promoters (9-10)	26%
Passives (7-8)	31%
Detractors (0-6)	43%
<b>NPS</b>	<b>-17</b>

## Satisfaction with Rocky Mountain Power and Energy Services

Because treatment group customers received the HERs, the evaluation expected to see higher customer satisfaction with Rocky Mountain Power from this group than from the control group. However, no significant differences emerged between groups. A similar proportion of treatment group respondents (90%) and control group respondents (93%) said they were satisfied with Rocky Mountain Power.

Even when comparing the proportions of *very satisfied* and *somewhat satisfied*, responses were not statistically significant between treatment and control groups (Figure 8). Also, when calculated as a mean, treatment group (8.0) and control group (8.2) did not significantly differ. Cadmus observed similar results as the 2016-2017 evaluation in which there was no statistically significant difference between treatment (7.7) and control (7.9) group on satisfaction with Rocky Mountain Power.<sup>24</sup>

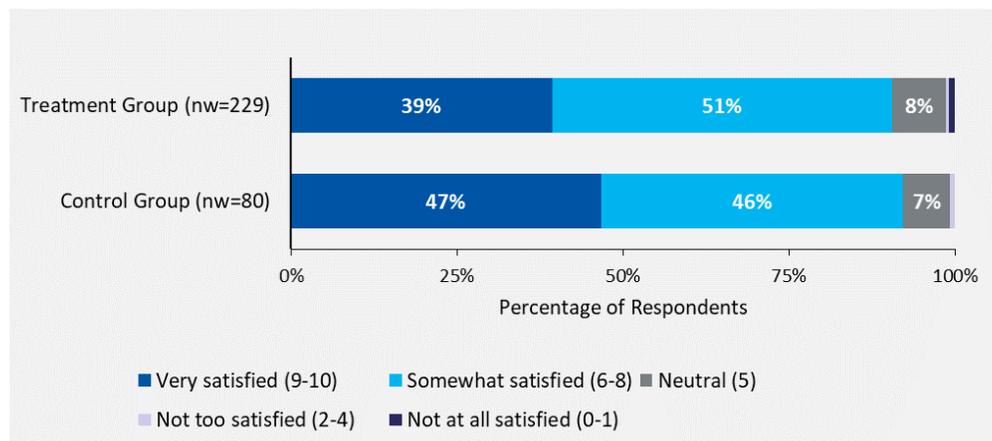
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<sup>22</sup> PPL Electric Utilities. November 15, 2018. *Annual Report Program Year 9: June 1, 2017–May 31, 2018*. Presented to Pennsylvania Public Utility Commission. Prepared by Cadmus. <http://www.puc.pa.gov/pcdocs/1595564.pdf>

<sup>23</sup> PPL Electric Utilities. November 15, 2017. *Annual Report Program Year 8: June 1, 2016–May 31, 2017*. Presented to Pennsylvania Public Utility commission. Prepared by Cadmus. <http://www.puc.pa.gov/pcdocs/1544671.pdf>

<sup>24</sup> ADM Associates, Inc. August 2018. *Evaluation of Utah 2016-2017 Home Energy Reports Program*. Submitted to Rocky Mountain Power. [https://www.pacificorp.com/content/dam/pacorp/documents/en/pacificorp/environment/dsm/utah/RMP\\_UT\\_HER\\_EMV\\_Report-Revised\\_Draft\\_2018-08-27.pdf](https://www.pacificorp.com/content/dam/pacorp/documents/en/pacificorp/environment/dsm/utah/RMP_UT_HER_EMV_Report-Revised_Draft_2018-08-27.pdf)

Figure 8. Satisfaction with Rocky Mountain Power

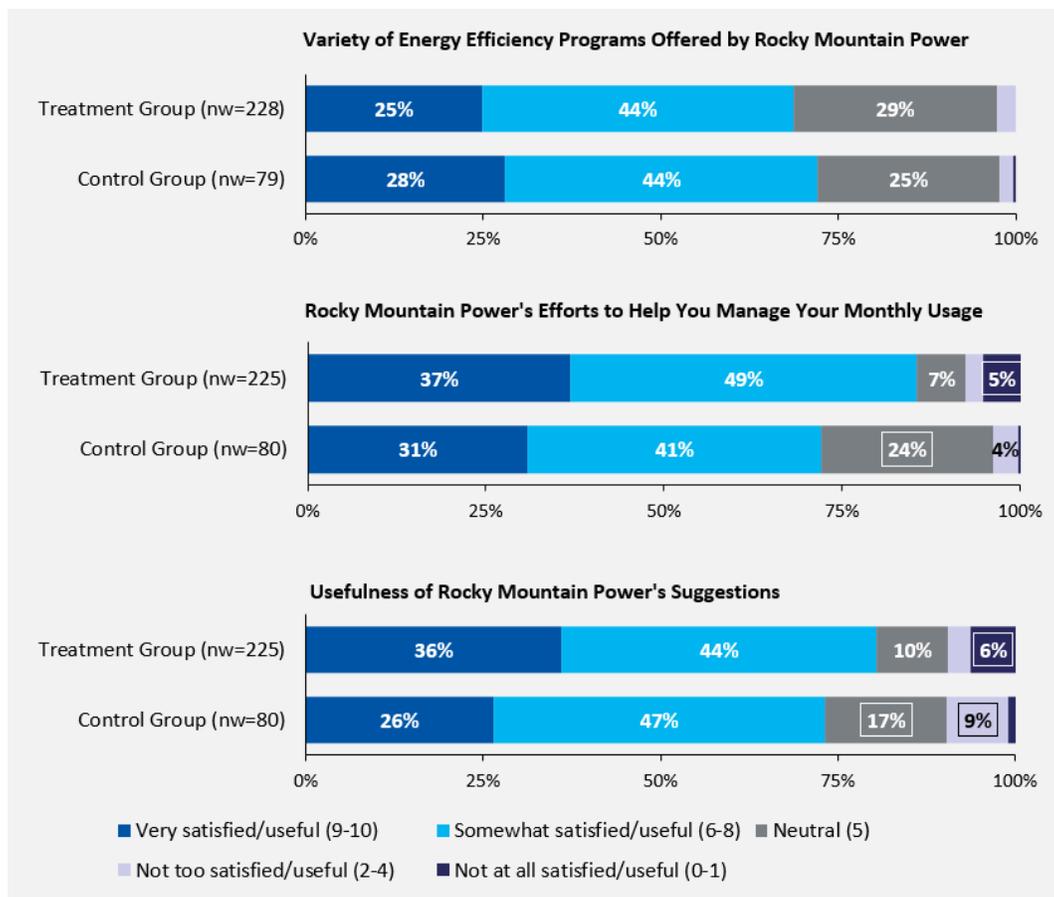


Source: Survey Question, “Overall, how satisfied are you with Rocky Mountain Power?”

The survey also asked respondents to rate Rocky Mountain Power based on the variety of energy efficiency programs it offers, its efforts to help manage monthly usage, and the usefulness of its suggestions to reduce energy usage—collectively known as the J.D. Power categories. We expected to see treatment group respondents give better ratings compared to the control group respondents because the treatment group received the HERs, which informs energy efficiency, usage, and suggestions.

Figure 9 shows the rating results for the three J.D. Power categories. In two of the three categories, a slightly higher proportion of treatment group respondents than control group respondents gave better ratings. Notably, the J.D. Power rating questions yielded many *neutral* responses from treatment group respondents (7% to 29%) and control group respondents (17% to 25%), especially for the category of the variety of energy efficiency programs offered by Rocky Mountain Power.

Figure 9. J.D. Power Categories



The box indicates a significant difference between groups at the 90% confidence level ( $p \leq 0.10$ ).

Source: Survey Questions, “How satisfied are you with the variety of energy efficiency programs offered by Rocky Mountain Power?”, “How satisfied are you with Rocky Mountain Power's efforts to help you manage your monthly usage?”, and “How would you rate the usefulness of Rocky Mountain Power's suggestions on ways you can reduce your energy usage and lower your monthly bills?”

### Survey Result Comparisons by First Report Vendor

Cadmus compared treatment group survey results by the vendor that delivered the customers’ first reports. This allowed the evaluation to compare the older waves to the newest wave. Oracle sent the first reports to the Legacy, Expansion 1, and Expansion 2 waves. Treatment group customers in these waves were switched to receiving the Bidgely HERs in May 2018. Bidgely sent the first reports to the Expansion 3 wave. Treatment group customers in this wave have only received the HERs generated by Bidgely.

Table 10 shows key survey results by the customers’ first report vendor. Several significant differences emerged in the survey responses of customers in the Oracle waves and Bidgely wave. More Bidgely wave respondents than Oracle wave respondents tended to believe the similar homes comparison were accurate, were satisfied with the HERs, and were likely to recommend the HERs to others. These significant differences were similar to other Cadmus evaluations of HER programs where customers in the older waves were less satisfied and less engaged with the HERs compared to customers in the newer

waves.<sup>25,26</sup> The lower satisfaction and engagement with the HERs among older waves may be an indication of report fatigue.

**Table 10. Survey Result Comparisons between First Report Vendor**

Which of the following statements best describes what you did with the last Home Energy Report you received?	Oracle Treatment Waves (nw=173)	Bigdely Treatment Wave (nw=56)
Read the report	97%	97%
Did not read the report	3%	3%
To what extent do you agree or disagree with the following statements? - The tips were relevant to my home	Oracle Treatment Waves (nw=173)	Bigdely Treatment Wave (nw=55)
Agree	67%	76%
Disagree	19%	15%
To what extent do you agree or disagree with the following statements? - In the past 12 months, my household did some of the easy, everyday tips recommended in the reports	Oracle Treatment Waves (nw=173)	Bigdely Treatment Wave (nw=55)
Agree	66%	75%
Disagree	25%	18%
To what extent do you agree or disagree with the following statements? - In the past 12 months, my household installed some of the products recommended in the reports	Oracle Treatment Waves (nw=173)	Bigdely Treatment Wave (nw=55)
Agree	35%	44%
Disagree	53%	44%
To what extent do you agree or disagree with the following statements? - I believe the similar homes comparison in the reports are accurate	Oracle Treatment Waves (nw=173)	Bigdely Treatment Wave (nw=56)
Agree	46%	75%
Disagree	43%	14%
Overall, how satisfied are you with the Home Energy Reports?	Oracle Treatment Waves (nw=173)	Bigdely Treatment Wave (nw=56)
Very satisfied (9-10)	21%	43%
Somewhat satisfied (6-8)	49%	44%
Mean Rating	6.8	7.9
Net Promoter Score: How likely would you be to recommend the Home Energy Reports to a friend, family member, or colleague?	Oracle Treatment Waves (nw=173)	Bigdely Treatment Wave (nw=56)
Promoters (9-10)	22%	37%
Detractors (0-6)	46%	36%
NPS	-24	1

Note: Yellow shading indicates a significant difference between vendor waves at the 90% confidence level (p<0.10).

<sup>25</sup> PPL Electric Utilities. Annual Report Program Year 9: June 1, 2017–May 31, 2018. Presented to Pennsylvania Public Utility Commission. Prepared by Cadmus. November 15, 2018. Available online: <http://www.puc.pa.gov/pdocs/1595564.pdf>

<sup>26</sup> PPL Electric Utilities. Annual Report Program Year 8: June 1, 2016–May 31, 2017. Presented to Pennsylvania Public Utility commission. Prepared by Cadmus. November 15, 2017. Available online: <http://www.puc.pa.gov/pdocs/1544671.pdf>

## Impact Evaluation Findings

The following provides detailed impact evaluation findings on Rocky Mountain Power Utah’s 2018-2019 HER program, including results from the program savings, uplift, and cost-effectiveness analyses.

### Savings Estimation

The following details the results of Cadmus analysis of program energy savings.

### Program Total Savings

Table 11 shows the estimates of the average daily savings per customer and program total savings per year with 90% confidence bounds. Cadmus evaluated 40,078 MWh/yr for the 2018 program year and 35,788 MWh/yr for the 2019 program year.

**Table 11. Program Savings by Wave and Program Year**

Program Year	Wave	Average Daily Savings per Customer		Program Total Savings (MWh/yr) <sup>(1)</sup>		
		kWh/day	Percentage <sup>(2)</sup>	Program Savings	90% Lower Bound	90% Upper Bound
2018	Legacy Wave	0.768	1.9%	17,759	14,223	21,295
	Expansion 1 Wave	0.356	1.4%	18,349	14,644	22,054
	Expansion 2 Wave	0.366	1.1%	3,959	2,266	5,652
	Expansion 3 Wave	0.002	0.0%	12	-381	404
	<b>Program Total</b>	-	-	<b>40,078</b>	<b>34,670</b>	<b>45,487</b>
2019	Legacy Wave	0.745	1.9%	16,554	12,872	20,236
	Expansion 1 Wave	0.307	1.2%	14,901	11,117	18,685
	Expansion 2 Wave	0.248	0.7%	2,434	627	4,240
	Expansion 3 Wave	0.058	0.3%	1,899	360	3,438
	<b>Program Total</b>	-	-	<b>35,788</b>	<b>30,000</b>	<b>41,577</b>
<b>2018-2019 Program</b>		-	-	<b>75,867</b>	<b>67,945</b>	<b>83,788</b>

<sup>(1)</sup> Program total savings have not yet been adjusted for uplift.

<sup>(2)</sup> Percentage average daily savings per customer are relative to control group consumption.

Notable findings are these:

- The Legacy, Expansion 1, and Expansion 2 waves experienced a decrease in savings in 2018 and 2019 compared to prior levels after treatment ceased for these customers during the first seven months of 2018 (see *Program Description* section for details).
- Average daily savings per treatment customer were highest in the Legacy wave (1.9% of consumption in both 2018 and 2019) in its seventh and eighth years of treatment. Customers in the Legacy wave had the highest electricity consumption.
- The Expansion 1 wave, which launched two years after the Legacy wave, achieved the second-highest savings per customer, at 1.4% in 2018 and 1.2% in 2019.

- The Expansion 2 wave achieved small savings in its third and fourth years of treatment, at 1.1% in 2018 and 0.7% in 2019.
- The Expansion 3 wave achieved the smallest savings per customer in its first two years compared to the other waves. In 2018, savings were statistically indistinguishable from 0 kWh/day: Table 11 shows that the 90% confidence interval around the Expansion 3 wave’s program savings in 2018 include 0 MWh/yr. Savings per customer increased to 0.3% of consumption in 2019, the wave’s second year of treatment.

We compared evaluated savings to PacifiCorp’s reported savings for the 2018-2019 biennial program. Table 12 shows the evaluated and reported savings for each wave and program year along with the realization rate. We evaluated realization rates between 104% and 120% in 2018 and over 100% (ranging from 104% to 115%) for all but the Expansion 2 wave (96%) in 2019. The 90% confidence intervals around evaluated savings (shown in Table 11 above) include the reported savings estimates for each wave and program year, indicating that evaluated and reported savings were not statistically different.

**Table 12. Program Savings Compared to Reported Savings**

Program Year	Wave	Reported Savings (MWh/yr)	Evaluated Savings (MWh/yr) <sup>(1)</sup>	Realization Rate
2018	Legacy Wave	17,036	17,759	104%
	Expansion 1 Wave	15,341	18,349	120%
	Expansion 2 Wave	3,557	3,959	111%
	Expansion 3 Wave	0	12	-
	<b>Program Total</b>	<b>35,934</b>	<b>40,078</b>	<b>112%</b>
2019	Legacy Wave	15,890	16,554	104%
	Expansion 1 Wave	12,955	14,901	115%
	Expansion 2 Wave	2,548	2,434	96%
	Expansion 3 Wave	1,822	1,899	104%
	<b>Program Total</b>	<b>33,215</b>	<b>35,788</b>	<b>108%</b>
<b>2018-2019 Program</b>		<b>69,149</b>	<b>69,149</b>	<b>75,867</b>

<sup>(1)</sup> Program total savings have not yet been adjusted for uplift.

Program total savings evaluated for 2018 and 2019 were lower than savings evaluated in the 2016-2017 evaluation, which the previous evaluator estimated as 48,022 MWh/yr for 2016 and 49,620 MWh/yr for 2017. This is mostly driven by the decrease in average daily savings per customer estimated in 2018 and 2019 compared to 2017, which is discussed in the next section.

Note that customers were dropped when the HER program changed implementers during the 2018 program year. According to the interview, the new implementor removed several customers from the program data because of duplicate premise identifiers and addresses and bad mailing or email addresses.

### Savings over Time

Table 13 shows the average daily savings per customer by wave for each year of treatment. Savings in the Legacy, Expansion 1, and Expansion 2 waves decreased in 2018 and 2019 compared to prior program years. Absolute savings and savings as a percentage of control group consumption decreased in 2018, which could be a result of the suspension of treatment for the first four months during selection of a new implementation contractor. Before 2018, the Legacy wave experienced some degradation in savings that may have been driven by improvements in efficiency unrelated to the HER program. The average consumption per control group customer dropped 15% between 2012 and 2019. Note that lower baseline consumption leads to a lower capacity for treatment customers to save and often results in lower savings compared to higher baselines. Savings in the Expansion 3 wave increased in 2019 and will likely continue to grow as the wave matures beyond its first full program year.

**Table 13. Average Daily Savings per Customer by Wave and Program Year**

Program Year	Legacy		Expansion 1		Expansion 2		Expansion 3	
	kWh/day <sup>(1)</sup>	% <sup>(2)</sup>						
2012	0.62*** (0.06)	1.33%	-	-	-	-	-	-
2013	1.11*** (0.06)	2.42%	-	-	-	-	-	-
2014	1.10*** (0.07)	2.58%	0.15*** (0.03)	0.59%	-	-	-	-
2015	1.07*** (0.08)	2.55%	0.34*** (0.03)	1.33%	-	-	-	-
2016	0.91*** (0.08)	2.18%	0.35*** (0.03)	1.35%	0.24*** (0.08)	0.70%	-	-
2017	0.93*** (0.09)	2.27%	0.42*** (0.04)	1.61%	0.39*** (0.08)	1.14%	-	-
2018	0.77*** (0.09)	1.87%	0.36*** (0.04)	1.36%	0.37*** (0.10)	1.05%	0.00 (0.04)	0.01%
2019	0.75*** (0.10)	1.88%	0.31*** (0.05)	1.21%	0.25** (0.11)	0.73%	0.06** (0.03)	0.29%

<sup>(1)</sup> Standard errors clustered on customers are in parentheses. \*\*\* indicates statistically significant at 1% level; \*\* significant at 5%; and \* significant at 10%. The treatment effects represent the average daily savings per treatment group customer.

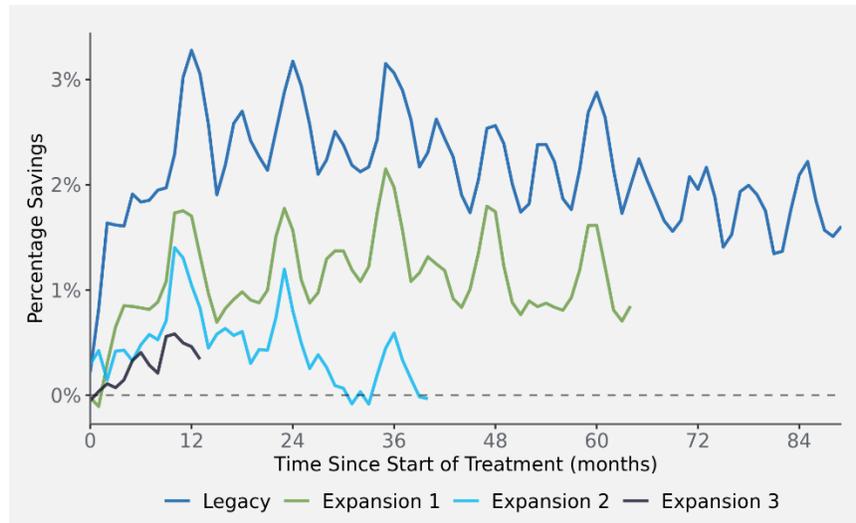
<sup>(2)</sup> Percentage average daily savings per customer are relative to control group consumption.

Cadmus investigated how savings for each of the waves compared as a function of time since first treatment, as shown in Figure 10. The Legacy wave ramped up savings the fastest after receiving treatment for 12 months. The Expansion waves took longer to ramp up—the slower ramp-up period is likely because Expansion wave customers had lower consumption than customers in the Legacy wave. The savings for the Legacy and Expansion 1 waves stabilized through their third year of treatment and then experienced a moderate decline.

As mentioned, the Legacy wave control group customers experienced a decline in their average daily consumption of 15% from the Legacy wave’s first year of treatment to 2019, which probably explains some of the savings degradation. This decrease in consumption may have been due to increasing home energy efficiency unrelated to Utah’s HER Program, such as rate changes targeting high-consuming customers that encouraged customers to lower their energy consumption. The Expansion 2 wave was still ramping up when paper treatment was suspended in 2018, after which the savings degraded and

have not recovered. Savings for the Expansion 3 wave ramped up as expected in its first year of treatment.

**Figure 10. Percentage Average Daily Savings by Months Since First Treatment**



## Uplift Analysis

This section describes the evaluation analysis of the lift in participation and savings from customer cross-participation in other Rocky Mountain Power Utah efficiency programs. This lift in savings would not have occurred without the HERs, and the savings lift must be subtracted from the regression-based savings estimates to avoid double-counting.

## Savings Uplift

Table 14 shows the lift in savings from HER program customers who participated in other Rocky Mountain Power Utah downstream rebate programs. Consistent with findings from the process evaluation, Cadmus found low savings from cross-participation in each of the waves—average savings per customer from cross-participation ranged between 0.02 kWh/yr and 3.86 kWh/yr in 2018 and between 0.04 kWh/yr and 5.21 kWh/yr in 2019. Rocky Mountain Power’s reports in Utah did not promote its other energy efficiency programs, although the reports did promote Rocky Mountain Power’s renewable programs in Utah. As expected, the lift in downstream program savings was higher in 2019 than 2018, as savings from measures installed in 2018 persisted in 2019. Overall, according to the regression analysis, uplift from downstream programs remained small as a percentage of program total savings.

Table 14. Downstream Savings Uplift Summary

Program Year	Wave	Average Uplift Savings per Customer (kWh/yr)			Total Uplift Savings (MWh/yr)	Percentage of Program Total Savings <sup>(1)</sup>
		Treatment Group	Control Group	Difference		
2018	Legacy Wave	48.75	44.89	3.86	250	1.34%
	Expansion 1 Wave	39.90	36.86	3.03	442	2.68%
	Expansion 2 Wave	8.32	7.05	1.27	40	1.12%
	Expansion 3 Wave	0.06	0.04	0.02	2	4.47%
	<b>Program Total</b>	-	-	-	<b>733</b>	<b>1.90%</b>
2019	Legacy Wave	53.94	49.97	3.97	248	1.42%
	Expansion 1 Wave	47.44	42.23	5.21	719	5.34%
	Expansion 2 Wave	13.20	10.86	2.33	66	3.37%
	Expansion 3 Wave	2.86	2.81	0.04	4	0.21%
	<b>Program Total</b>	-	-	-	<b>1,038</b>	<b>2.96%</b>
<b>2019-2019 Program</b>					<b>1,771</b>	<b>2.47%</b>

(1) Percentage uplift savings are based on the program total savings shown in Table 11 and Table 12.

Table 15 lists the uplift results for upstream lighting programs (see *Appendix B* for details on the upstream savings uplift estimations methods). Cadmus estimated that 1.7% and 5.2% of 2018 and 2019 HER program savings came from upstream lighting program bulb purchases, which equates to roughly 3.4% of HER program savings overall.

Table 15. Upstream Lighting Savings Uplift Summary

Program Year	Treatment Customers	Program Savings (MWh/yr)	Upstream Uplift Savings per Customer (kWh/yr)	Upstream Uplift Savings (MWh/yr)	Upstream Uplift Savings (%) <sup>(1)</sup>
2018	101,453	40,078	6.81	691	1.7%
2019 <sup>(2)</sup>	99,475	35,788	18.66	1,856	5.2%
<b>2019-2019 Program <sup>(3)</sup></b>		<b>75,867</b>	<b>-</b>	<b>2,548</b>	<b>3.4%</b>

(1) Percentage upstream uplift savings are relative to program total savings (prior to adjusting for downstream uplift)

(2) 2019 upstream uplift includes savings from bulbs purchased in 2018 and 2019.

(3) Totals may not equal the sum of savings due to rounding

Table 16 shows the program savings prior to adjusting for uplift, the final downstream and upstream uplift savings, and the resulting program savings after making the uplift adjustments. Overall, uplift savings contributed 5.7% of HER program savings across the 2018 and 2019 program years and should be removed from PacifiCorp Utah’s portfolio of claimed residential program savings to avoid double counting. Across both program years, the HER program saved 71,548 MWh/yr not claimed in other programs.

Table 16. Program Total Uplift Summary

Program Year	Program Savings (MWh/yr) <sup>(1)</sup>	Downstream Uplift Savings (MWh/yr)	Upstream Uplift Savings (MWh/yr)	Total Program Uplift Savings (MWh/yr)	Total Program Uplift Savings (%) <sup>(2)</sup>	Program Savings Adjusted for Total Uplift (MWh/yr)
2018	40,078	733	691	1,425	3.6%	38,654
2019	35,788	1,038	1,856	2,894	8.1%	32,894
<b>2018-2019 Program</b>	<b>75,867</b>	<b>1,771</b>	<b>2,548</b>	<b>4,319</b>	<b>5.7%</b>	<b>71,548</b>

<sup>(1)</sup> Program total savings have not yet been adjusted for uplift.  
<sup>(2)</sup> Percentage uplift savings are relative to program total savings (prior to adjusting for uplift).

### Participation Uplift

Table 17 shows the lift in efficiency program participation from HERs. The lift is expressed as a rate (the increase per 1,000 treatment group customers) and as a percentage of control group participation rate. Across all waves and program years, we found that for every thousand control group customers, 5.18 customers participated in at least one of Rocky Mountain Utah’s energy efficiency programs. Cadmus defined participation in each year by whether a customer installed at least one measure for which an incentive was provided through a PacifiCorp program in Utah.

Across both 2018 and 2019 program years, we found that HERs lifted participation by 0.31 per 1,000 customers or 6%. The HER program had a larger impact on participation in 2018 than 2019—treatment customers’ participation was 8% higher than that of the control group in 2018 and 5% higher in 2019.

Participation uplift as a percentage of control group participation rates varies between waves, largely because control group participation rates are small. Actual participation uplift in magnitude is similar between waves and program years.

Table 17. Downstream Participation Uplift Summary

Program Year	Wave	Control Group Participation Rate (per 1,000 Customers)	Participation Uplift (Treatment Effect on Participation Rate)	Percentage Participation Uplift
2018	Legacy Wave	2.65	-0.03	-1%
	Expansion 1 Wave	2.85	0.33	12%
	Expansion 2 Wave	2.73	0.80	29%
	Expansion 3 Wave	2.48	-0.02	-1%
	<b>Program Total</b>	<b>2.68</b>	<b>0.21</b>	<b>8%</b>
2019	Legacy Wave	7.55	7.95	5%
	Expansion 1 Wave	7.65	8.37	9%
	Expansion 2 Wave	7.99	8.58	7%
	Expansion 3 Wave	8.11	8.12	0%
	<b>Program Total</b>	<b>7.82</b>	<b>0.41</b>	<b>5%</b>
<b>2018-2019 Program</b>		<b>5.18</b>	<b>0.31</b>	<b>6%</b>

## Cost-Effectiveness

Table 18 presents cost-effectiveness results for the residential HER program in program year 2018, program 2019, and 2018/2019 combined for the State of Utah. Based on the utility cost test (UCT), the HER program proved cost-effective in both 2018 and 2019 and will generate \$586,108 in net benefits over the life of the installed measures. The HER program was cost-effective in all but the RIM test for both 2018 and 2019. Over the two-year period, the HER program had a UCT of 1.31. That is, for every dollar spent on HER program costs, Rocky Mountain Power Utah will receive \$1.31 in benefits.

These results are higher than the 2016-2017 HER program cost-effectiveness results, which found a combined two-year UCT of 1.01. This is a result of more favorable acquisition costs (program costs per first-year net kWh savings) for the residential HER program for 2018/2019 compared to 2016/2017. In 2016/2017 the acquisition cost of the program was \$0.06/kWh saved, while in 2018/2019 the acquisition cost of the program was \$0.03/kWh saved.

**Table 18. Cost-Effectiveness of Residential Home Energy Report Program (2018, 2019, 2018 + 2019)**

Cost-Benefit Test	PV Cost (\$) [A]	PV Electric Benefit (\$) [B]	PV Non-Electric Benefit (\$) [C]	Net Benefit (\$) [B+C] - [A]	B/C Ratio [B+C] / [A]
<b>2018</b>					
TRC	\$1,033,101	\$1,430,760	-	\$397,659	1.38
P-TRC	\$1,033,101	\$1,430,760	\$143,077	\$540,736	1.52
PCT	-	\$5,952,659	-	\$5,952,659	N/A
UCT	\$1,033,101	\$1,430,760	-	\$397,659	1.38
RIM	\$9,520,792	\$1,430,760	-	(\$8,090,032)	0.15
<b>2019</b>					
TRC	\$858,307	\$1,046,756	-	\$188,449	1.22
P-TRC	\$858,307	\$1,046,756	\$104,675	\$293,124	1.34
PCT	-	\$4,959,804	-	\$4,959,804	N/A
UCT	\$858,307	\$1,046,756	-	\$188,449	1.22
RIM	\$8,240,268	\$1,046,756	-	(\$7,193,512)	0.13
<b>2018 + 2019</b>					
TRC	\$1,891,408	\$2,477,516	-	\$586,108	1.31
P-TRC	\$1,891,408	\$2,477,516	\$247,752	\$833,860	1.44
PCT	-	\$10,912,463	-	\$10,912,463	N/A
UCT	\$1,891,408	\$2,477,516	-	\$586,108	1.31
RIM	\$17,761,060	\$2,477,516	-	(\$15,283,544)	0.14

## Appendix A. Customer Survey Instrument

### PacifiCorp UT Home Energy Reports Program

### 2018-2019 Customer Survey

Research Topics	Item Number
Engagement with Rocky Mountain Power’s online energy efficiency resources	C1-C2
Awareness of energy efficiency offerings from Rocky Mountain Power	C3-C4
LED light bulb purchase and installation for upstream lighting	C5-C6
Satisfaction with Rocky Mountain Power	D1
Satisfaction with Rocky Mountain Power’s energy services (J.D. Power questions)	D2-D4
Readership of Home Energy Reports	E1
Behavior change and product adoption from Home Energy Reports	C7, E2C, E2D
Value and relevance of Home Energy Reports	E2A, E2B, E2E, E2F
Satisfaction with Home Energy Reports and Net Promoter Score	E3-E5

**Target Audience:** Rocky Mountain Power treatment and control group customers in the program

**Survey Mode:** Online survey using email and postcard distribution

**Target Number of Completes Per State:**

Assignment	Vendor Waves	Email Target	Postcard Target	Target Total
Treatment Group	Opower Waves	35	35	70
	Bidgely Wave	65	--	65
Control Group	Opower Waves	35	35	70
	Bidgely Wave	65	--	65
<b>Overall Total</b>		<b>200</b>	<b>70</b>	<b>270</b>

#### Variables to be Pulled into Sample

- PremiseID
- Utility = Rocky Mountain Power
- FirstName
- LastName
- Street Address
- City
- ZIP
- State = UT
- Email
- Phone
- Assignment = Treatment or Control
- VendorWave = Opower or Bidgely
- FirstReportDate
- Channel = Email or Postcard

## *Treatment Group's Email Invitation to Survey*

To: [Email]

From: Cadmus on behalf of Rocky Mountain Power

Subject: Rocky Mountain Power survey offers you a chance for \$100

Dear [FirstName],

Did you receive a Home Energy Report? It's a report that shows your household energy use, energy-savings tips and graphs. Please tell us what you think about the Home Energy Report in a short survey.

**When you qualify and complete the survey, you may enter a drawing for a chance to win a \$100 VISA gift card.** Two winners will be randomly selected. Your responses will be kept confidential and will never be shared with other parties.

**Follow this link to the Survey:**

[Survey Link]

Or copy and paste this URL into your internet browser:

[Survey Link]

Rocky Mountain Power has asked The Cadmus Group to administer this survey. If you have any questions about this survey or any difficulties taking the survey, please contact Jeff Abromowitz at (503) 467-7180 or jeff.abromowitz@cadmusgroup.com.

Sincerely,

Shawn Grant

Program Manager, Rocky Mountain Power

Follow the link to opt out of future survey emails:

#{!://OptOutLink?d=Click here to unsubscribe}

## *Control Group's Email Invitation to Survey*

To: [Email]

From: Cadmus on behalf of Rocky Mountain Power

Subject: Rocky Mountain Power survey offers you a chance for \$100

Dear [FirstName],

Will you participate in a short survey to help Rocky Mountain Power make improvements for customers? We understand your time and responses are valuable. **When you qualify and complete the survey, you may enter a drawing for a chance to win a \$100 VISA gift card.** Two winners will be randomly selected. Your responses will be kept confidential and will never be shared with other parties.

**Follow this link to the Survey:**

[Survey Link]

Or copy and paste this URL into your internet browser:

[Survey Link]

Rocky Mountain Power has asked The Cadmus Group to administer this survey. If you have any questions about this survey or any difficulties taking the survey, please contact Jeff Abromowitz at (503) 467-7180 or [jeff.abromowitz@cadmusgroup.com](mailto:jeff.abromowitz@cadmusgroup.com).

Sincerely,  
Shawn Grant  
Program Manager, Rocky Mountain Power

Follow the link to opt out of future survey emails:  
\${!://OptOutLink?d=Click here to unsubscribe}

## *Treatment Group's Postcard Invitation to Survey*

Side One:

<p><b>ROCKY MOUNTAIN POWER LOGO   CADMUS LOGO</b></p> <p>Rocky Mountain Power has partnered with The Cadmus Group on this research. For any questions about this research or any difficulties taking the survey, please contact Jeff Abromowitz at (503) 467-7180 or <a href="mailto:jeff.abromowitz@cadmusgroup.com">jeff.abromowitz@cadmusgroup.com</a></p>	<p><b>FirstName LastName StreetAddress City, State ZIP</b></p>
---	--

Side Two:

<p><b>Rocky Mountain Power survey offers you a chance for \$100</b></p>	<p>Did you receive a Home Energy Report? It's a report that shows your household energy use, energy-savings tips and graphs. You are part of a small group invited to give feedback about the Home Energy Report in a short survey. When you qualify and complete the survey, you may enter a drawing for a chance to win a \$100 VISA gift card. Two winners will be randomly selected. Can we count on your response?</p> <p>Take the survey at <b><a href="http://www.energy.cadmusgroup.com/tpowerut">www.energy.cadmusgroup.com/tpowerut</a></b></p> <p>Survey expires on end of day Sunday, May 31, 2020</p>
---	--

Control Group's Postcard Invitation to Survey

Side One:

<p><b>ROCKY MOUNTAIN POWER LOGO   CADMUS LOGO</b></p> <p>Rocky Mountain Power has partnered with The Cadmus Group on this research. If you have any questions about this research or any difficulties taking the survey, please contact Jeff Abromowitz at (503) 467-7180 or jeff.abromowitz@cadmusgroup.com</p>	<p><b>FirstName LastName StreetAddress City, State ZIP</b></p>
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Side Two:

<p><b>Rocky Mountain Power survey offers you a chance for \$100</b></p>	<p>Will you participate in a short survey to help Rocky Mountain Power make improvements for customers? You are part of a small group invited to give feedback. When you qualify and complete the survey, you may enter a drawing for a chance to win a \$100 VISA gift card. Two winners will be randomly selected. Can we count on your response?</p> <p>Take the survey at <a href="http://www.energy.cadmusgroup.com/cpowerut">www.energy.cadmusgroup.com/cpowerut</a></p> <p>Survey expires on end of day Sunday, May 31, 2020</p>
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A. Survey Start Screen



Welcome! This survey will take about 5 minutes to complete. Your responses will remain confidential and will only be used for research purposes. When you qualify and complete the survey, you may enter the drawing for a chance to win a \$100 VISA gift card.

## B. Screener

[Ask if Assignment=Treatment]

- B1. You should have received a document in the mail or your email called a Home Energy Report. This report shows graphs on your home's energy use, comparisons, and energy-savings tips. Do you remember seeing this Home Energy Report? [Forced response]
1. Yes
  2. No [Terminate]

[Ask if Assignment=Control]

- B2. Are you the person who manages or pays the utility bills? [Forced response]
1. Yes
  2. No [Terminate]

**Termination Message:** Those were all the questions. Thank you for your time.

## C. Energy Efficiency Engagement and Awareness

- C1. In the past 12 months, have you visited the Rocky Mountain Power website to look for ways to save money on your utility bills?
1. Yes
  2. No

- C2. Rocky Mountain Power offers its customers access to an online portal where you can see your home's energy usage along with insights and tips. In the past 12 months, have you accessed this online portal?
1. Yes
  2. No

- C3. How familiar are you with energy-efficiency rebates or programs offered by Rocky Mountain Power to help you use less energy?
1. Very familiar
  2. Somewhat familiar
  3. Not too familiar
  4. Not at all familiar

[Ask if C3=1 or 2]

- C4. Which energy-efficiency rebates or programs from Rocky Mountain Power have you heard about? Select all that apply. [Multiple answers allowed] [Randomize order 1-12]
1. Usage Insights on Home Energy Reports Platform
  2. Heating and cooling equipment incentives
  3. LED light bulb discounts
  4. Light fixture discounts
  5. Manufactured new homes incentives

6. Heat pump water heater incentives
7. Blue Sky Renewable Energy Program
8. Customer generation rooftop solar
9. Electric vehicles
10. Time of Day Program
11. Cool Keeper Program
12. Low Income Weatherization Program
13. Other (please describe) [Open-end text entry]
14. Don't know [Exclusive answer]

C5. In the past 12 months, about how many LED bulbs have you purchased? Please count the number of individual bulbs, not the number of boxes or packs.

1. [Numeric text entry 0-999]
2. Don't know

[Ask if C5 answer is greater than 0]

C6. Of the [Answer from C5] LED bulbs you purchased, how many are currently in use at your home?

1. [Numeric text entry 0-999]
2. Don't know

C7. For each item, please answer yes or no whether you have done this in the past 12 months.

[Response choices: 1=Yes, 2=No, 3=Not applicable/Don't know] [Randomize order A-J]

- A. Unplugged/turned off electronics or appliances when not in use
- B. Kept the heating thermostat to 68 degrees or lower in winter
- C. Kept the air conditioning thermostat to 78 degrees or higher in summer
- D. Changed the furnace or air conditioner filter every couple of months
- E. Installed an energy-efficient washer or dryer
- F. Installed high-efficiency heating or cooling equipment
- G. Installed a low-flow showerhead or aerator
- H. Sealed air leaks, added insulation or weatherized my home
- I. Installed a programmable or smart thermostat
- J. Installed a high-performance heat pump water heater

## D. Energy Service Experience

D1. Overall, how satisfied are you with Rocky Mountain Power?

1. 0 – Extremely dissatisfied
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8

- 10. 9
- 11. 10 – Extremely satisfied

D2. How satisfied are you with the variety of energy efficiency programs offered by Rocky Mountain Power?

- 1. 0 – Extremely dissatisfied
- 2. 1
- 3. 2
- 4. 3
- 5. 4
- 6. 5
- 7. 6
- 8. 7
- 9. 8
- 10. 9
- 11. 10 – Extremely satisfied

D3. How satisfied are you with Rocky Mountain Power’s efforts to help you manage your monthly usage?

- 1. 0 – Extremely dissatisfied
- 2. 1
- 3. 2
- 4. 3
- 5. 4
- 6. 5
- 7. 6
- 8. 7
- 9. 8
- 10. 9
- 11. 10 – Extremely satisfied

D4. How would you rate the usefulness of Rocky Mountain Power’s suggestions on ways you can reduce your energy usage and lower your monthly bills?

- 1. 0 – Extremely not useful
- 2. 1
- 3. 2
- 4. 3
- 5. 4
- 6. 5
- 7. 6
- 8. 7
- 9. 8
- 10. 9
- 11. 10 – Extremely useful

[Ask section E if Assignment=Treatment]

## E. Home Energy Reports

These next questions are about the Home Energy Reports. These are the reports you received in the mail or email that shows your household energy use, energy-savings tips and graphs.

E1. Which of the following statements best describes what you did with the last Home Energy Report you received?

1. I read the report thoroughly
2. I read some of the report
3. I skimmed the report
4. I did not read the report
5. Don't know

E2. To what extent do you agree or disagree with the following statements about the Home Energy Reports? [1=Strongly Agree, 2=Somewhat Agree, 3=Somewhat Disagree, 4=Strongly Disagree, 5=Don't know] [Randomize order A-G]

- A. The reports are easy to understand
- B. The information in the reports is helpful
- C. In the past 12 months, my household did some of the easy, everyday tips recommended in the reports
- D. In the past 12 months, my household installed some of the products recommended in the reports
- E. The tips were relevant to my home
- F. I believe the similar homes comparison in the reports are accurate
- G. I believe the usage information shown in the reports are accurate

E3. Overall, how satisfied are you with the Home Energy Reports?

1. 0 – Extremely dissatisfied
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8
10. 9
11. 10 – Extremely satisfied

E4. Please tell us why you gave that satisfaction rating for the Home Energy Reports.

[Open-end text entry]

E5. How likely would you be to recommend the Home Energy Reports to a friend, family member, or colleague?

1. 0 – Extremely unlikely
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8
10. 9
11. 10 – Extremely likely

## *F. Gift Card Drawing Entry*

F1. Thank you for your time! Before you go, please fill out your name and address to be entered in the drawing for a chance to win a \$100 VISA gift card. Your information will only be used to mail you the gift card in the event that you win. We will not use your information for marketing.

Please complete all the fields below to be entered for the drawing.

1. First and Last Name:
2. Street Address:
3. City:
4. State:
5. ZIP Code:
6. Email Address:
7. Phone Number:

### **End of Survey Message:**

Your responses have been submitted. Thank you!  
You will be notified in a few weeks if you are one of the lucky gift card winners.

## Appendix B. Impact Evaluation Details

### *Detailed Methodology and Findings*

The following section provide additional details on the evaluation methodology and findings.

### *Data Preparation*

After collecting the billing, weather, and program data, Cadmus took the following steps to prepare the data for analysis.

- *Step 1. Adjust billing data for estimated readings.* Though infrequent, a customer's bills may be based on the utility's estimates of monthly consumption when it cannot read the meter. The first meter reading following a set of consecutive estimated monthly bills includes the consumption for that month and any adjustments required for the previous estimated reads. We adjusted customer billing data for estimated meter readings by aggregated the full set of estimated and actual bills.
- *Step 2. Calculate billing cycle weather.* We collected daily weather data from NCDC and calculated the average degree days (cooling and heating degrees) during each customer billing cycle using average hourly temperature and billing cycle end dates.
- *Step 3. Calendarize consumption.* Using the number of days in the billing cycle, we allocated billing cycle electricity consumption and weather to calendar months and expressed each variable in average daily terms. We dropped any months that were only partially covered by the customers' bills.
- *Step 4. Integrate with program data.* We merged the billing and weather data with HER program and customer information, including the dates when the implementer generated and mailed the reports, dates when customer accounts went inactive, and state, group, and wave assignments.

Because PacifiCorp designed the HER program as an opt-out randomized control trial (RCT), where customers were randomly assigned and automatically enrolled in the program, we performed minimal data screening to maintain the integrity of the experiment. We only excluded homes from the analysis sample when the home had an insufficient number of pretreatment monthly consumption bills. We also dropped each customer's first and last bills, which may start or end at any point during a calendar month and may not cover electricity consumption for the whole month.

Table B-1 shows the attrition in the 2018 and 2019 analysis sample from the data cleaning steps. The final modeling sample included customers in the tracking data who were not dropped during the billing data cleaning process and included in the regression analysis. These customers had active accounts when delivery of HERs began but they did not necessarily have active accounts at the beginning of treatment in 2018 or 2019. Cadmus dropped between 4% and 14% of customers from each group. The main source of attrition was from dropping customers with fewer than six months of pre-treatment bills. Cadmus verified that the savings estimates were not sensitive to changes in the requirement for a customer to have a certain number of pre-treatment bills.

Table B-1. Sample Attrition for Billing Analysis

Step in Attrition	Legacy Wave		Expansion 1		Expansion 2		Expansion 3	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Included in tracking data	65,306 (100%)	20,974 (100%)	147,022 (100%)	35,418 (100%)	31,678 (100%)	15,233 (100%)	104,698 (100%)	31,744 (100%)
Included in billing data	64,502 (99%)	20,730 (99%)	145,424 (99%)	35,017 (99%)	31,195 (98%)	15,041 (99%)	103,853 (99%)	31,503 (99%)
At least one month of posttreatment bills	64,502 (99%)	20,730 (99%)	145,424 (99%)	35,017 (99%)	31,195 (98%)	15,041 (99%)	100,546 (96%)	30,467 (96%)
At least 6 months of pretreatment bills	59,409 (91%)	19,078 (91%)	131,728 (90%)	31,409 (89%)	27,398 (86%)	13,048 (86%)	100,068 (96%)	30,332 (96%)
<b>Final Modeling Sample</b>	<b>59,409 (91%)</b>	<b>19,078 (91%)</b>	<b>131,728 (90%)</b>	<b>31,409 (89%)</b>	<b>27,398 (86%)</b>	<b>13,048 (86%)</b>	<b>100,068 (96%)</b>	<b>30,332 (96%)</b>

### Model Robustness Checks

Cadmus conducted a billing analysis to estimate average daily savings per customer, as described in the *Billing Analysis* section. We checked if the estimates were robust to changes in model specification, including for the difference-in-differences with customer fixed effects model and the simple-differences post-only, both of which are acceptable methods in the UMP.<sup>27</sup> We tested the sensitivity of the estimates by comparing the resulting average daily saving.

### Model Specifications

The post-only model was specified assuming the average daily consumption ( $ADC_{it}$ ) of electricity of home ‘i’ in month-year ‘t’ as given by Equation B-1. This equation provides a separate estimate of average savings per customer per day for each year of the treatment period.

Equation B-1

$$ADC_{it} = \sum_j \beta_{1j} PART_i * PY_{jt} + \beta_2 Pre-kWh_{im} \times M_m + \gamma W' + \tau_t + \varepsilon_{it}$$

Where:

- $\beta_{1j}$  = Coefficient representing the conditional average treatment effect of the program on electricity use (kWh per customer per day) in program year  $j, j = 1, 2, \dots, J$ .
- $PART_i$  = Indicator variable that the customer was assigned to the program treatment group (which equals 1 if customer ‘i’ is in the treatment group and 0 otherwise).

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<sup>27</sup> Stewart, J., and A. Todd. August 2014. *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 17: Residential Behavior Protocol*. U.S. Department of Energy, National Renewable Energy Laboratory. (NREL/SR-7A40-62497) [http://www1.eere.energy.gov/office\\_eere/de\\_ump\\_protocols.html](http://www1.eere.energy.gov/office_eere/de_ump_protocols.html)

- $PY_{jt}$  = Indicator variable for each program year  $j, j = 1, 2, \dots, J$ . This variable is equal to 1 if the month-year 't' is in the program year j and 0 otherwise.
- $\beta_2$  = Coefficient representing the conditional average effect of pretreatment electricity consumption on posttreatment average daily consumption (kWh per customer per day).
- $Pre-kWh_{im}$  = Mean household energy consumption of customer 'i' in month 'm' of the pretreatment period.
- $M_m$  = Indicator variable for each month ( $m = 1, 2, \dots, 12$ ) in the posttreatment period. The variable  $M_m$  equals one if period t is in month m and equals zero otherwise.
- $W$  = Vector of heating degree days and cooling degree days variables to control for the impacts of weather on energy use. HDDs and CDDs were calculated using base temperatures of 65° F.
- $\gamma$  = Vector of coefficients representing the average impact of weather variables on energy use.
- $\tau_t$  = Average energy use in month-year 't' reflecting unobservable factors specific to the month. The analysis controls for these effects with month-by-year fixed effects.
- $\epsilon_{it}$  = Error term for customer 'i' in month-year 't.'

The D-in-D fixed effects model was specified assuming the average daily consumption ( $ADC_{it}$ ) of electricity of customer 'i' in month 't' as given by Equation B-2:

**Equation B-2**

$$ADC_{it} = \sum_j \beta_{1j} PART_i * POST_t * PY_{jt} + \alpha_i + \tau_t + W'\gamma + \epsilon_{it}$$

Where:

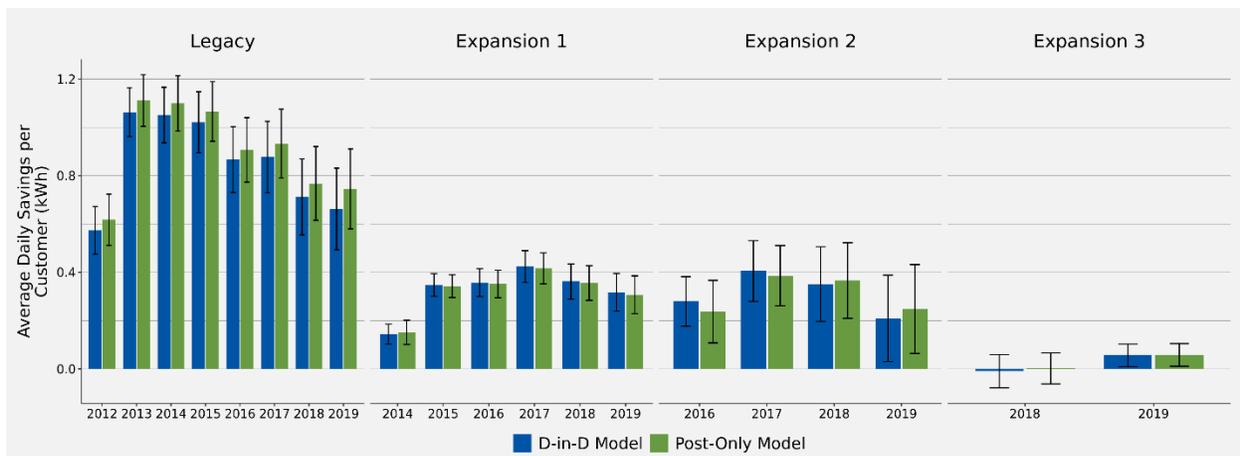
- $\beta_{1j}$  = Coefficient representing the conditional average treatment effect of the program on electricity use (kWh per customer per day) in program year  $j, j = 1, 2, \dots, J$ .
- $PART_i$  = Indicator variable for program participation (which equals 1 if customer 'i' was in the treatment group and 0 otherwise).
- $POST_t$  = Indicator variable for whether month 't' is pre- or posttreatment (which equals 1 if month 't' was in the treatment period and 0 otherwise).
- $W$  = Vector of heating degree days and cooling degree days variables to control for the impacts of weather on energy use. HDDs and CDDs were calculated using base temperatures of 65° F.
- $\gamma$  = Vector of coefficients representing the average impact of weather variables on energy use.

- $\alpha_i$  = Average energy use of customer ‘*i*’ reflecting unobservable, non-weather-sensitive, and time-invariant factors specific to the customer. The analysis controlled for these effects with customer fixed effects.
- $\tau_t$  = Average energy use in month-year ‘*t*’ reflecting unobservable factors specific to the month and year. The analysis controlled for these effects with month-by-year fixed effects.
- $\epsilon_{it}$  = Error term for customer ‘*i*’ in month ‘*t*’

## Comparison of Model Results

Figure B-1 shows the estimate of average daily savings per customer from both models. The error bars show the 90% confidence intervals. The post-only and the D-in-D estimates are very close, and the confidence intervals for the post-only models include the difference-in-differences estimates across all waves and program years and vice-versa, suggesting that the estimates from the two approaches are not significantly different.

**Figure B-1. Difference-in-Differences and Post-Only Treatment Effects by Wave and Program Year**



For each wave and program year, Table B-2 shows estimates of the average daily treatment effects per customer for both the D-in-D and post-only model specifications. Standard errors around treatment effects are shown in parentheses next to the treatment effects. Both models found statistically significant savings for most years across all waves with few exceptions—savings were not estimated precisely in 2018 for the Expansion 3 wave, which is likely because it was customers’ first program year, during which they only received two months of treatment. Cadmus was only able to detect significant savings at the 5% level for customers in the Expansion 2 wave and Expansion 3 wave in 2019.

Table B-2. Treatment Effects (kWh/Day per Customers) by Model Specification

Year	Legacy		Expansion 1	
	D-in-D <sup>(1)</sup>	Post-Only <sup>(1)</sup>	D-in-D <sup>(1)</sup>	Post-Only <sup>(1)</sup>
2012	0.57*** (0.06)	0.62*** (0.06)	-	-
2013	1.06*** (0.06)	1.11*** (0.06)	-	-
2014	1.05*** (0.07)	1.10*** (0.07)	0.14*** (0.02)	0.15*** (0.03)
2015	1.02*** (0.08)	1.07*** (0.08)	0.35*** (0.03)	0.34*** (0.03)
2016	0.87*** (0.08)	0.91*** (0.08)	0.36*** (0.03)	0.35*** (0.03)
2017	0.88*** (0.09)	0.93*** (0.09)	0.42*** (0.04)	0.42*** (0.04)
2018	0.71*** (0.10)	0.77*** (0.09)	0.36*** (0.04)	0.36*** (0.04)
2019	0.66*** (0.10)	0.75*** (0.10)	0.32*** (0.05)	0.31*** (0.05)
Year	Expansion 2		Expansion 3	
	D-in-D <sup>(1)</sup>	Post-Only <sup>(1)</sup>	D-in-D <sup>(1)</sup>	Post-Only <sup>(1)</sup>
2016	0.28*** (0.06)	0.24*** (0.08)	-	-
2017	0.41*** (0.08)	0.39*** (0.08)	-	-
2018	0.35*** (0.09)	0.37*** (0.10)	-0.01 (0.04)	0.00 (0.04)
2019	0.21* (0.11)	0.25** (0.11)	0.06** (0.03)	0.06** (0.03)

<sup>(1)</sup> Standard errors clustered on customers are in parentheses. \*\*\* indicates statistically significant at 1% level; \*\* significant at 5%; and \* significant at 10%. The treatment effects represent the average daily savings per treatment group customer.

### Savings over Time

Cadmus calculated program total savings for just the years under evaluation, 2018 and 2019, but investigated the changes in average daily savings per customers since each wave launched. The following figures show the point estimates (line) and 90% confidence intervals (blue shaded region) for each month and year of treatment. The vertical line indicates the end of the pretreatment period.

Figure B-2 shows the savings over time for treatment customers in the Legacy wave. The program launched in July 2012. After its first year of treatment, program savings begin to plateau. Although savings appear to trend downward beginning in 2016, some of this may result from improvements in home efficiency unrelated to the HERs program. The control group average daily consumption decreased 15% between 2012 and 2019, which indicates an efficiency improvement unrelated to HERs. Some of the savings degradation is also likely driven by the suspense of paper treatment for the first four months of 2018. Prior to this, savings degradation appears milder and may be weather-driven. The Legacy wave achieved 2.2% savings on average in 2019.

Figure B-2. Average Daily Savings (%) Since Program Launch—Legacy Wave

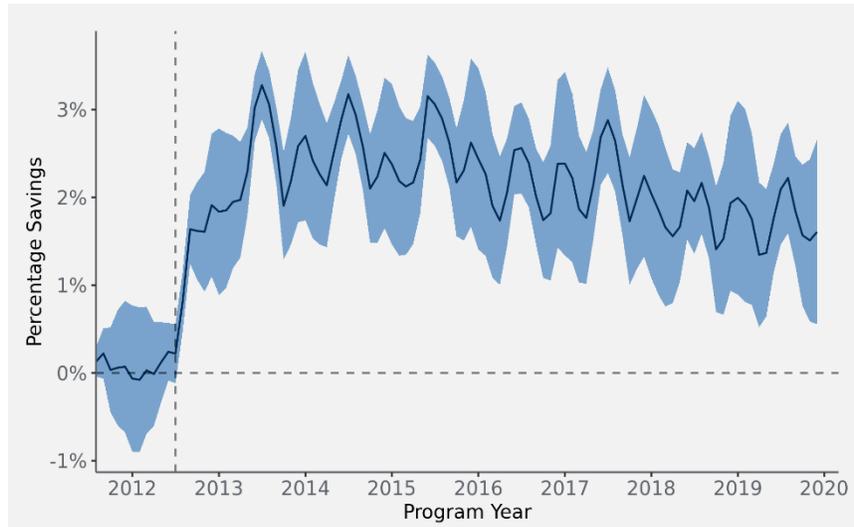


Figure B-3 shows the average daily savings for each month and year of treatment in the Expansion 1 wave. The program launched for these customers in August 2014, and customers ramped up their savings in the first 12 months of treatment. Savings remain stable in 2016 and increase slightly in the third year of treatment, 2017. Like customers in the Legacy wave, customers in the Expansion 1 wave appear to have experienced some degradation of savings in 2018 because of the lack of treatment, though the wave still achieved savings of 1.1% on average. Control group customers in this wave did not experience the same decline in average daily consumption over the years.

Figure B-3. Average Daily Savings (%) Since Program Launch—Expansion 1 Wave

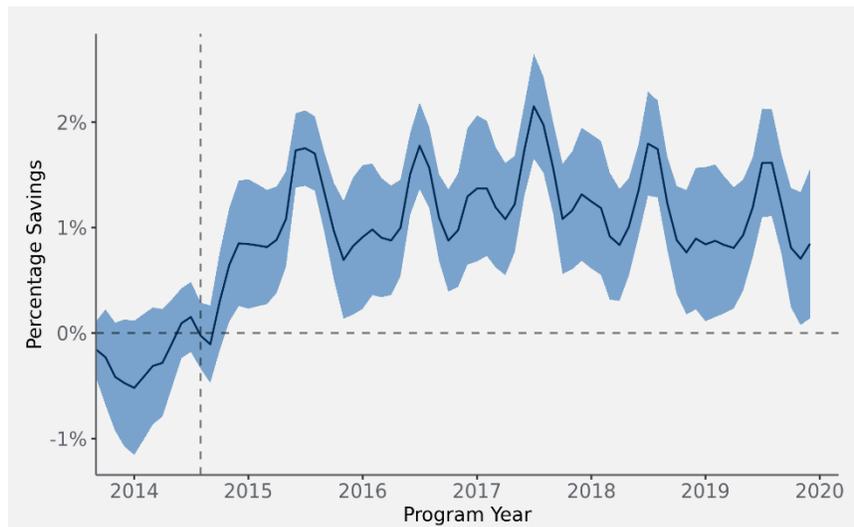


Figure B-4 shows the average daily savings per customer over time for the Expansion 2 wave, which launched in August 2016. The Expansion 2 wave ramped up savings in its first year of treatment, but savings quickly degraded after treatment was suspended in 2018. Customers in this wave have not been able to recover savings after the suspension in treatment.

**Figure B-4. Average Daily Savings (%) Since Program Launch—Expansion 2 Wave**

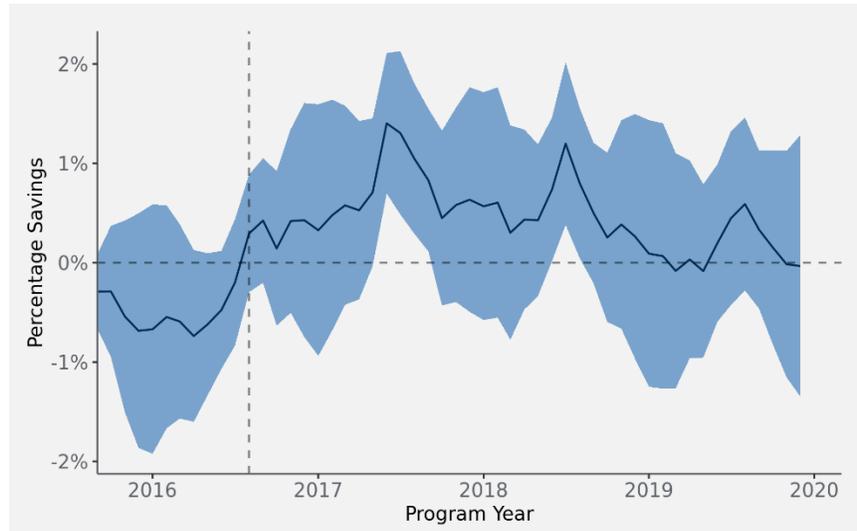
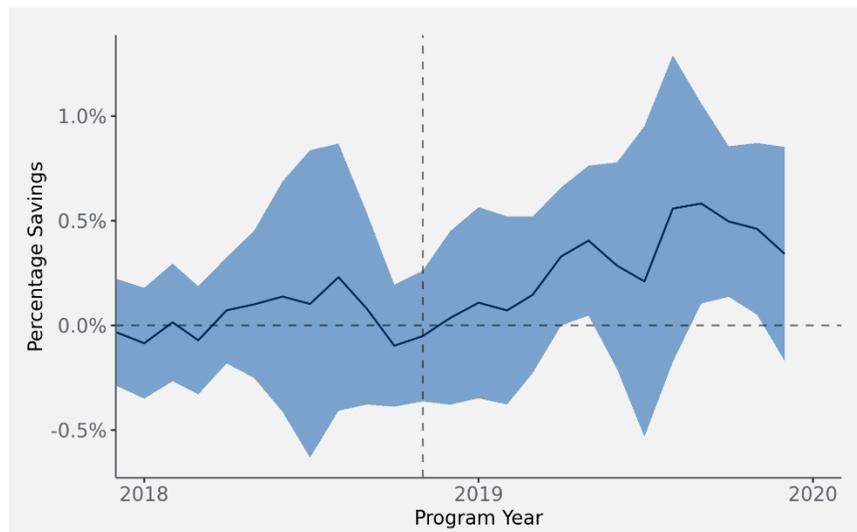


Figure B-5 shows the average daily savings per customer over time for the Expansion 3 wave. This wave launched in November 2018, and customers ramped up savings in their first year of treatment. Customers in the Expansion 3 wave consumed less on average per day (20 kWh/day) compared to customers in the Legacy (46 kWh/day), Expansion 1 (26 kWh/day), and Expansion 2 (34 kWh/day) waves in the pretreatment period. As a result, savings for customers in the Expansion 3 wave are lower in the first year of treatment relative to the other waves.

**Figure B-5. Average Daily Savings (%) Since Program Launch—Expansion 3 Wave**



## Uplift Participation and Savings Definitions

This section details Cadmus’ approach to estimating downstream savings and participation uplift and the uplift from PacifiCorp Utah’s upstream lighting program

### Downstream Participation and Savings Uplift

Cadmus measured the impact of HERs on efficiency program participation as the difference between treatment group customers’ and control group customers’ rates of program participation:

$$\text{Participation Uplift } (\Delta\rho) = \rho_T - \rho_C$$

Where:

$\rho_j$  = The efficiency program participation rate during treatment for group ‘j’ (where  $j = T$  for treatment customers and  $j = C$  for control customers), with the participation rate defined as the ratio of number of efficiency program participants in the treatment (or control) group to the total number of treatment (or control) group customers

Similarly, we estimated the savings from participation uplift using average efficiency program savings per customer in place of the program participation rate:

$$\text{Uplift savings per customer } (\Delta\sigma) = \sigma_T - \sigma_C$$

where  $\sigma_j$  is the average efficiency program savings per treated (or control) customer.

Multiplying uplift savings per customer by the number of customers assigned to the treatment group ( $N_T$ ) yielded an estimate of the savings from participation in PacifiCorp’s efficiency program:

$$\text{Program uplift savings} = \Delta\sigma \times N_T$$

### Upstream Lighting Uplift

To estimate savings uplift from PacifiCorp Utah’s upstream lighting rebates program, Cadmus used the equation shown below. Detail on the data sources is provided in the *Estimating Uplift for Upstream Rebate Programs* in the *Evaluation Objectives and Methodology* section.

$$\begin{aligned} &\text{Lighting Savings Uplift} \\ &= TE(Q) \times ISR \times kWh \frac{\text{savings}}{\text{bulb}} \times \text{Time Installed} \times \% \text{ incented} \\ &\times \text{Treated Customers} \end{aligned}$$

Where:

TE(Q)	=	Treatment effect of HER Program on quantity of LED bulbs purchased or received for free
ISR	=	In-service rate (the percentage of purchased LED bulbs installed in sockets in the home)
kWh savings/bulb	=	Annual expected savings per LED bulb

- Time installed = Average length of time (in years) that purchased bulbs were installed in the program year
- % incented = Percentage of LED bulbs sold to residential customers that were purchased with a rebate
- Treated customers = Average number of treated customers during the program year

Table B-3. shows the values Cadmus used to estimate upstream lighting uplift, including the HER treatment effect on bulbs purchased and installed, the proportion of purchased bulbs incented through the upstream program, and the annual savings per bulb. Uplift savings in 2019 included the savings from bulbs installed in 2018 in the homes of active HER program participants in 2019. We assumed that 2018-purchased bulbs failed uniformly across the 2019 program year at a rate of 8.3% using the average measure life of bulbs in PacifiCorp Utah’s upstream lighting program data.<sup>28</sup>

Cadmus estimated the HER treatment effect on installed bulbs using the results of the treatment and control group customer surveys, calculating separate effects for the wave launched by the new implementer (Expansion 3) and the older waves launched by the previous implementer (Legacy, Expansion 1, and Expansion 2). Cadmus could not detect significant differences in the number of bulbs purchased and installed between treatment and control customers in the older waves, but found that, on average, the Expansion 3 treatment group customers reported purchasing and installing 2.8 more bulbs than the control group.

**Table B-3. Upstream Lighting Savings Uplift Estimation**

Program Year	Year of Bulb Purchase	HER Effect on Bulbs Installed per Participant (Bulbs/yr)	Incented Bulbs (percent of total)	Savings per Bulb (kWh/yr)	Average Time Installed (percent of year)	Average Percent Failed	Upstream Lighting Uplift per Customer (kWh/yr)
<b>Legacy, Expansion 1, and Expansion 2</b>							
2018	2018	-2.3	23%	21.3	50%	2.1%	-5.7
2019	2018	-2.3	23%	21.3	100%	8.3%	-10.6
	2019	-2.3	21%	19.5	50%	2.1%	-4.7
<b>Expansion 3</b>							
2018	2018	2.8	23%	21.3	50%	2.1%	6.8
2019	2018	2.8	23%	21.3	100%	8.3%	12.8
	2019	2.8	21%	19.5	50%	2.1%	5.7

Cadmus calculated the incented proportion of purchased bulbs as the ratio of incented bulb sales from PacifiCorp Utah’s upstream lighting tracking data over the estimated total number of bulb purchases by PacifiCorp Utah’s residential customer population, shown in Table B-4. To estimate the population total bulb purchases in each year, Cadmus applied the survey-gathered LEDs purchased by control-group customers to number of purchased bulbs to PacifiCorp Utah’s residential customer population.

<sup>28</sup> Cadmus estimated the annual failure as one over by the measure life.

**Table B-4. Incented Proportion of Total LEDs Purchased**

Program Year	PacifiCorp WA Residential Electric Customers <sup>(1)</sup>	Estimated Total LED Bulbs Purchased	Total Incented Bulbs Purchased	Incented Percent of Purchased LEDs
2018	816,651	8,784,620	2,048,704	23%
2019	816,651	8,795,906	1,859,655	20%

<sup>(1)</sup> Source: EIA. Available online: <https://www.eia.gov/electricity/data/eia860/xls/eia8602018.zip>