Evaluation, Measurement & Verification Report

Idaho Home Energy Report Program

2020-2021

Prepared for

Rocky Mountain Power

December 2022

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Acronyms

The following acronyms are used throughout this report.

ADM – ADM Associates, Inc.

CDD – Cooling Degree Days

CI – Confidence Interval

EM&V – Evaluation, Measurement and Verification

EOY – End of Year

HER – Home Energy Report

HDD – Heating Degree Days

kWh – kilowatt hours

PPR – Post Period Regression

PSM – Propensity Score Matching

RCT – Randomized Control Trial

RMP – Rocky Mountain Power

VIA – Variance in Adoption

Glossary of Terms

The following terms are used throughout this report.

Claimed savings – Energy savings calculated based on forecasts rather than actual results; used for program and portfolio planning purposes; energy savings included in RMP's annual reports. Used interchangeably with ex-ante savings.

Control or control group – Customers who were not treated by the HER Program and use a similar amount of energy as treated customers.

Cooling Degree Days – The degrees that a day's average temperature is above 65 degrees Fahrenheit to quantify the demand for energy.

Deemed savings – An estimate of energy savings for an adopted efficiency measure or practice developed from a set of assumptions that should reflect an average scenario applied without further measurement or verification after program implementation. For the HER Program, deemed savings were derived from prior program year savings estimates.

Downstream programs – Programs that offer incentives to purchase energy efficient products or services directly to customers (for example after completing a rebate application). The incentive is paid at the end, or downstream, point in the distribution channel.

Ex-ante savings – Energy savings calculated based on forecasts rather than actual results; used for program and portfolio planning purposes; energy savings included in RMP's annual reports. Used interchangeably with claimed savings.

Ex-post savings – Savings estimates based on program results rather than forecasts. Used interchangeably with evaluated savings.

Evaluated savings – Savings estimates based on program results rather than forecasts. Used interchangeably with ex-post savings.

Gross savings – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, regardless of why they participated.

Heating Degree Days – The degrees that a day's average temperature is below 65 Fahrenheit (18 Celsius), used to quantify the demand for energy.

Pre-treatment – Period ending prior to the intervention date for the customer (e.g., pre-treatment billing periods are billing periods that end prior to treatment).

Post-treatment – Period starting after the intervention date for the customer (e.g., post-treatment billing periods are billing periods that start after treatment).

Realization rate – The ratio of measured evaluated savings to predicted savings (ex-post savings divided by ex-ante savings).

Treatment – Participation in the HER Program; treated customers periodically received personalized energy reports aimed at reducing the customer's residential energy use.

Untreated – Customers who have not received reports from the HER Program.

Uplift – The increased savings generated in other energy efficiency programs because of the evaluated program.

Upstream programs – Programs that offer discounts on energy efficient products or services by paying incentives to retailers, distributors, or manufacturers who pass incentives on to customers. The incentive is paid at the beginning, or upstream, point in the distribution channel.

1 Executive Summary

ADM Associates, Inc. (ADM) is under contract with PacifiCorp to perform evaluation, measurement, and verification (EM&V) services to determine the energy savings (kWh) that resulted from Rocky Mountain Power's (RMP) Home Energy Report (HER) Program in Idaho during 2020 and 2021.

ADM collected data for the evaluation through review of program materials, acquisition of program tracking data, collection of historical billing data, program staff interviews, and a survey of program participants. ADM estimated the energy impacts of the HER Program using a regression analysis of customer billing data and found positive and statistically significant program savings for both 2020 and 2021.

1.1 Program Impact

During 2020, the average evaluated annual household savings was 106.71 kWh with a total program savings of 3,002,739 kWh. During 2021, the average evaluated annual household savings was 111.87 kWh with a total program savings of 3,885,893 kWh. Table 1-1 summarizes total evaluated program savings.

Table 1-1: 2020-2021 Idaho HER Program Evaluated Savings

Year	Participant Count[1]	Average Evaluated Annual Household Savings (kWh)	Total Evaluated Program Savings (kWh)
2020	28,140	106.71	3,002,739
2021	34,737	111.87	3,885,893

The HER Program resulted in a realization rate of 84 percent during the evaluation period (see Table 1-2).

Table 1-2: Program Energy Savings (kWh) and Realization Rate

Year	Claimed Savings (kWh)	Ex-post Deemed Savings (kWh)	Ex-post VIA Savings (kWh)	Ex-post Realization Rate	Evaluated Savings (kWh)	Program Realization Rate
2020	3,947,830	3,908,197	3,002,739	77%[2]	3,002,739	76%
2021	4,238,790	5,057,662	N/A	77%[3]	3,885,893	92%
Total	**8,186,620**	**8,965,859**	**N/A**	**77%**	**6,888,632**	**84%**

[1] Participant count is the sum of all billing days in the post-period for the given year divided by 365.25. This accounts for customers who participated in the program for less than a full year.

[2] 2020 Ex-post Deemed Savings/2020 Ex-post VIA Savings.

[3] Applied 2020 Ex-post Realization Rate.

1.2 Discussion of Deemed Savings Model

RMP's adoption of a deemed approach to estimating savings for their HER Program is novel, innovative and inclusive. RMP adopted the deemed savings program design to increase the number of customers who can take advantage of individualized energy consumption analysis and savings recommendations included in HERs, regardless of their baseline consumption levels. Standard HER programs using a randomized control trial (RCT) design typically select high energy consumers as participants. As a result, low energy consumers (for example, residents living in multifamily complexes and smaller homes) often miss the benefits of the program. In addition, customers that belong to control groups with a RCT miss the benefits of program participation. By switching to a deemed savings approach, RMP is more inclusive in delivering valuable, customized efficiency data to virtually all its customers.

RMP's transition from an RCT to a deemed savings program design also introduces a significant evaluation challenge. The *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*[4] does not include an evaluation methodology for a deemed approach to HER program savings. As such, a novel, rigorous and defensible evaluation methodology is necessary to support the program design's sustainability.

When it made the transition, RMP began treating previously untreated control group customers, which eliminated the ability to use standard methods to verify the savings generated by the program (comparing treated and untreated customers' energy consumption).

ADM identified Variance-in-Adoption (VIA) as a viable method to calculate ex-post savings for 2020 without RCT control groups. VIA was viable because pre-treatment participant consumption data was available within 2020 since new participants were added in late 2020. In addition, for all but the first wave, untreated customers were available to act as a baseline.

Unfortunately, VIA was not a viable methodology to calculate ex-post savings for 2021 because there were not enough untreated customers in 2021 to serve as a comparison group. In addition, because most customers have now been treated, 2020 is the last year that VIA is a viable evaluation method given the lack of valid post-2020 comparison data.

Therefore, ADM calculated 2020 savings using the deemed savings method proposed by Cadmus[5] and compared it to savings calculated using the VIA method to arrive at an ex-post realization rate. ADM then calculated 2021 savings using the Cadmus deemed

[4] National Renewable Energy Laboratory *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures,* Golden, CO, August 2018, Chapter 17: Residential Behavior Evaluation Protocol.

[5] Cadmus, "Deemed Savings for Rocky Mountain Power Idaho HER Program," June 3, 2020. Included as Appendix B.

saving approach and applied the 2020 ex-post realization rate to it to arrive at 2021 evaluated savings.

Without changes to the current program implementation, methods such as VIA which help to minimize estimation bias will not be viable because virtually all customers have been treated.

Deemed savings values for standard energy efficiency measures such as appliances, weather proofing, light bulbs, etc. are calculated using fixed, objective specifications (e.g., capacity, wattage, hours of use, etc.). In contrast, the deemed values for the RMP HER Program are based on past program performance. They do not account for factors that influence program savings such as changes in program implementation (HER contents, format, delivery frequency and consistency), savings degradation caused by energy efficiency improvement trends, differences between legacy and recently added participants' response to HER treatment, and external events such as the COVID pandemic, economic shock events, climate change, introduction of energy efficiency tax incentives, etc. The Cadmus deemed savings values are based on past program performance, but verifiable program results have many external influences that are not captured in past performance.

ADM proposes that RMP create a control group that is untreated and unbiased for use in future evaluations. ADM believes that RMP can designate a percentage of new RMP customers to add to the control group each year to create a viable and sustainable control group that will enable robust program evaluations.

1.3 Conclusions

ADM reached the following conclusions based on its impact and process evaluations.[6]

Customer survey responses indicate that customers were satisfied with the program. Most of HER Program participants were satisfied with the reports and found the various components useful. Further, participants said receiving the reports had improved their opinion of RMP.

The program generated positive, statistically significant savings in 2020 and 2021. Savings fell within expected industry norms and resulted in an 84 percent realization rate during the evaluation period.

The transition to the deemed saving program design eliminated legacy control groups that had been used to calculate program energy savings. Establishing a new comparison group will reestablish the ability of independent third-party program evaluators to complete program EM&V.

[6] See Section 6 for additional discussion of ADM's conclusions.

The contents of the HERs reflected several improvements made during the evaluation period. Several changes to the content and format improved the HERs and likely contributed to the generally high program satisfaction reported by program participants.

RMP used a conservative approach to estimate lower-consumption tier savings. Cadmus was unable to provide deemed savings recommendations for the lower-consumption tier of customers, not because there were no savings generated by program treatment, but because the population was too small at the time to calculate savings. Therefore, RMP based its lower-consumption tier ex-ante savings calculations on Cadmus' results in Utah for the lower-consumption tier with a slight downward adjustment. Utah results for the lower tier were 0.6 percent (year 1), 1.0 percent (year 2) and 1.0 (year 3 and beyond)[7]. RMP used 0.6 percent (year 1), 0.6 percent (year 2), and 1.0 percent (year 3 and beyond) to conservatively calculate lower-consumption tier ex-post savings. **Program implementation reflects the need for improved program data management.** Datasets received for the evaluation reflected inconsistent and sometimes ambiguous data with less granularity than ADM would expect to receive for an evaluation. The inconsistent data quality led to concerns about data accuracy, created challenges for program evaluators, and increased the cost of program evaluation.

Realization rates lower than 100 percent were caused by the following factors.

- Ex-ante savings were calculated using deemed values, whereas ex-post savings were calculated using a regression analysis of billing data.
- The ratio of paper to emailed reports was higher during years from which deemed savings were calculated than during the evaluation period. Paper HERs generally result in greater savings than emailed HERs.
- As reported in the 2018-2019 program evaluation, legacy participants may have degraded savings due to influences exogenous to the program.

[7] See footnote 13, page 75.

1.4 Recommendations

ADM provides the following recommendations to improve future program implementation.

Create a control group to use in billing analyses for future evaluations. The following steps could be taken to increase the quality of a control group for future savings estimates.

- As new customers reach eligibility for HERs treatment, add a percentage of randomly selected eligible customers to the control group.
- Add customers to control group with similar zip code distribution as customer distribution in the RMP service area.
- Once control groups reach 10,000 customers, continue adding new customers at a rate to replace customers lost through attrition, maintaining representative proportions of customer base zip code distribution.

Establish HER Program implementation specifications as one would for a deemed measure in other energy efficiency programs. Specifications should minimally include the report content and cadence (including minimum number per year) and the ratio of paper to email formats.

Continue using consistent deemed savings percentages to calculate ex-ante savings, at least for the 2022-2023 evaluation cycle. Table 1-3 includes the percentages used to calculate ex-ante savings during the 2020-2021 evaluation period.

Table 1-3: Deemed Savings Percentages

Annual Consumption	Year 1	Year 2	Year 3+
< 7,973 kWh/yr	0.60%	0.60%	1.00%
>= 7,973 kWh/yr	1.13%	1.22%	1.27%

Improve program data management. Accurate, unambiguous, timely and complete program data should be recorded and maintained by the implementation contractor to ensure accurate ex-ante and ex-post program savings calculations as well as program efficacy.

2 Introduction and Purpose of Study

ADM Associates, Inc. (ADM) is under contract with PacifiCorp to perform evaluation, measurement, and verification (EM&V) services to determine the energy savings (kWh) that resulted from RMP's HER Program in Idaho during 2020 and 2021.

This report presents ADM's impact evaluation of the energy savings (kWh) that resulted from the program and ADM's process evaluation of the program focusing on participant and program staff perspectives regarding the program's implementation and ADM's observations about the program.

2.1 HERs Program Description

The purpose of the program is to reduce home energy use by providing residential customers with personalized reports about their home energy consumption and information to help them reduce their energy use.

Customers receive either digital reports via email or paper reports via traditional mail. Participants who received digital reports receive two reports per month: one includes the customer's energy use broken down by appliance type, the other compares the customer's energy use to comparable homes and provides behavioral energy tips. Emailed reports also contained information about RMP's other energy efficiency programs and incentivized measures. Participants who receive paper reports received them quarterly; paper reports compare the customer's energy use to comparable homes and report the customer's energy use trends.

RMP reported claimed savings for the evaluation period based on a deemed model that estimated energy savings that resulted from the program for each treated customer based on the customer's baseline consumption and the length of time they have received treatment reports.

2.2 Program Background

RMP began sending HERs to residential customers in 2014. From 2014 through 2017, Oracle Utilities Opower served as the implementation contractor and delivered HERs to customers using the industry-standard RCT program design.

In 2018, RMP contracted with a new implementation contractor, Bidgely, who added cohorts in 2019 using the RCT program model. By 2018, customers with a valid email address received the HERs via email while customers without a valid email address receive print HERs via mail.

In 2020, RMP contracted with energy consultant Cadmus to determine if a deemed savings approach to calculate program savings was feasible. Cadmus proposed a deemed approach to estimating kWh savings based on an analysis of program results from several HER programs that used an RCT model, including RMP's past HERs program evaluations. Cadmus proposed a deemed approach to calculating program savings per customer based on annual baseline consumption and length of treatment. A deemed savings approach does not require a control group of untreated customers to compare with the treated group to estimate program savings. Thus, a deemed approach provides a framework for expanding the program to all customers; that is, it does not require keeping a portion of customers untreated as a control group.

To provide more customers with HERs, during 2020, RMP shifted from the RCT design to the deemed savings model proposed by Cadmus. By including all RMP Idaho customers with an email address on file and a minimum of four months of metering data, the program implementer, Bidgely, substantially increased the number of HER program participants. Program participant numbers are included in Table 2-1.

Table 2-1: Program Participation Summary

Treatment Cohort	Treatment Start Date	Treatment Group Size	
		Original number of treated customers[8]	Number remaining at EOY 2021
2014	12/1/2014	11,195	10,293
2019	Variable	6,361	5,302
2020	Variable	23,931	17,252
2021	Variable	99	74
Total		**41,586**	**32,921**

At the time of the mid-2020 expansion, RMP transitioned to all emailed reports; since then, no Idaho customers have received paper HERs through the mail.

[8] With variable intervention dates, defining the number of treatment customers at the start of a year is problematic since new customers are added throughout the program year. ADM estimated the number of treatment customers for a given year of treatment as the number of customers with billing data during the evaluation period (2020-2021). In addition, ADM assigned the treatment year for the original cohorts from the original RCT intervention date.

2.3 Data Provided

RMP provided ADM with the following data to support the analysis:

- Pre- and post-treatment monthly electric billing data for program participants. The data started on January 2013 and ended April 2022.
- Customer move-in and account move-out dates.
- Program tracking data for participants in downstream rebate programs, including date of installation and verified kWh savings for each measure installed.

2.4 Evaluation Objectives

ADM identified the following research objectives for the 2020 and 2021 HER Program evaluation:

- Evaluate program savings impacts to gain insight on program performance.
- Calculate or remove lift from other RMP energy efficiency program participation.
- Assess customers satisfaction with the HER Program and awareness of their individual energy consumption and other energy efficiency programs.
- Identify program highlights and opportunities for program improvement.

3 Impact Evaluation Approach

RMP's transition from a randomized control trial (RCT) program design to a deemed savings model also introduces a significant evaluation challenge. The *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*[9] does not include an evaluation methodology for a deemed approach to a HER program. As such, a novel, rigorous and defensible evaluation methodology is necessary to support the program design's sustainability.

When it made the transition, RMP began treating previously untreated control group customers, which eliminated the ability to use standard methods to verify the savings generated by the program (comparing treated and untreated customers' energy consumption).

ADM tested multiple regression models using customer billing data to identify an evaluation methodology to verify program savings in absence of a previously identified control group (as would have been available for a program run using an RCT model). ADM identified Variance-in-Adoption (VIA) as a viable method for 2020 for which pre-treatment consumption data exists for participants.

Unfortunately, VIA was not a viable methodology to calculate ex-post savings for 2021 because there were not enough untreated customers in 2021 to serve as the comparison group. Therefore, ADM calculated 2020 savings using the proposed deemed savings values and compared them to savings calculated using the VIA method to arrive at an ex-post realization rate. ADM then calculated 2021 deemed savings and applied the 2020 ex-post realization rate to it to arrive at 2021 evaluated savings. ADM notes that because most customers have already been treated, 2020 will be the last year that VIA will be a viable evaluation method if a control group is not created.

3.1 Methodology

ADM analyzed the billing data of customers who received HERs during 2020 - both pre-period (before the household starts receiving HERs and post-period (after household starts receiving HERs) data - to estimate 2020 program impacts. ADM then applied 2020 results to 2021 program data to determine 2021 energy savings. In addition, ADM performed a literature review to estimate joint savings from upstream energy efficiency programs offered to RMP's residential customers. The work effort was divided into four distinct steps:

[9] National Renewable Energy Laboratory *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures,* Golden, CO, August 2018, Chapter 17: Residential Behavior Evaluation Protocol.

1. Prepare and clean data, including true-up and calendarization
2. Estimate monthly and annual billed consumption differences before and after treatment via regression modeling
3. Estimate and remove joint savings from other programs
4. Estimate program attrition

ADM used a Linear Fixed Effects Regression (LFER) model with VIA design to estimate savings. The model included all treated customers across all years of treatment. The model adjusts for individual customers' differences, month, weather, and COVID impacts.

ADM presents savings estimates in three formats for each program year:

- Daily and annual energy savings per home
- Annual percent savings per home
- Program-level savings

ADM used a VIA design because no comparable untreated cohort exists from which to form a control group. Data from untreated customers was too biased to use as an accurate control group. With VIA, customers who have yet to be treated serve as controls for customers who have already received treatment. New customers were added to the program in 2019, 2020, and 2021 (see Table 3-1), making VIA design an appropriate approach to estimate savings for the program.

3.2 Data Preparation and Cleaning

ADM began the impact evaluation by preparing and cleaning the billing data for analysis.

To make monthly billing data consistent between participants and to represent each month accurately, ADM calendarized the data into monthly bills. Customers' monthly billing periods are not all the same. For example, one customer's June bill may run from May 16th to June 17th, while another customer may run from May 20th to July 5th. Calendarization is the process of correcting monthly billing data to match calendar dates. For example, if 15 days in a billing period belonged to June and 15 days belonged to July; 50 percent of the billed usage would be attributed to June and 50 percent to July. The proportionated usage and number of days in each calendar month are then summed to generate a calendarized usage value and the number of billed days for that month. Equation 3-1 provides the method for calculating the monthly use by calendar month:

Equation 3-1: Monthly Billing Data Calculation

$$Monthly\ usage_m = \sum_{i}^{n} \left(Adjusted\ usage_i \times \frac{Month\ days_i}{Billing\ days_i} \right)$$

Where:

i	=	First bill containing the month of interest
n	=	Last bill containing the month of interest
m	=	Month of interest
$Monthly\ usage$	=	Calendarized monthly usage for a given month
$Month\ days$	=	Number of days belonging to the month of interest in a billing period
$Billing\ days$	=	Number of days in a billing period

After calendarization was completed, an average daily usage value was calculated by dividing the monthly usage by the number of billed days in a month. Additionally, data was filtered using the following criteria:

- Customer months that had less than one billed day or exceed the total number of days in that calendar month for that year were excluded from analysis—months that meet these criteria have overlapping bills and are unreliable for analysis.
- Months that were present after a customer's move out date were also excluded from analysis.
- Customers with fewer than nine months of pre-period data, and six month of post-period data were removed from the analysis.
- Customer months in which average daily usage exceeded 200 kWh were excluded from analysis. This level of consumption is unrealistic for residential households; thus, ADM stipulates that the data is erroneous for these outliers.

Table 3-1 displays the original and final number of HER Program participants used in the analysis. Program attrition accounts for lower participant counts in 2020 and 2021.

Table 3-1: Participant Count by Cohort for Evaluation Period

Year Cohort Treatment Began	Original Cohort Participant Count	Participant Count during Evaluation Period	
		2020	2021
2014	11,195	11,054	10,501
2019	6,361	6,198	5,544
2020	23,931	10,888	18,644
2021	99	N/A	47
Total	**41,586**	**28,140**	**34,737**

Participant count is the sum of all billing days in the post-period for the given treatment year divided by 365.2 (this accounts for customers who received reports for less than a full year).

3.3 Linear Regression Modeling

ADM ran the following regression model to determine the impact of the HER Program on customer energy use. The following sections summarize the model specification ADM used to estimate impact savings for the program.

3.3.1 Regression Model Specification

ADM estimated savings using a VIA approach due to the lack of a comparable cohort from which to form a control group. With VIA, customers who have not yet been treated serve as controls for customers who have already been treated. ADM observed that new customers were added to the treatment pool in 2019, 2020 and 2021, providing the opportunity to use the VIA method.

ADM used a LFER model to estimate savings, with the model including all treated customers in every year during which customers were treated. The model adjusts for individual customers differences, the treatment effect, month, weather, and COVID impacts, to estimate savings per treated customer.

The model combines both cross-sectional and time series data in a panel dataset and uses all available pre- and post-program data. ADM used Heating Degree Days (HDD) and Cooling Degree Days (CDD) in the regression model to account for any weather-related effects not captured by the monthly dummies or each customer's average energy use. The model also includes a dummy variable for COVID to account for changes in the average customer's usage patterns that resulted from the pandemic (e.g., increased telecommuting). The regression model is specified in Equation 3-2.

Equation 3-2: Regression Model

$$Usage_{it} = \beta_0 + \sum_{m=1}^{12} \beta_m * I_m + (\beta_1 * HDD_{it)} + (\beta_2 * CDD_{it}) + (\beta_3 * Post_{it}) + (\beta_4 * Post_{it} * Program\,Year_{it}) + (\beta_5 * COVID_{it}) + (\delta_i * Customer_i) + \varepsilon_{imy}$$

Where:

$Usage_{it}$	=	Customer i's average daily energy usage at time t
β_0	=	Intercept of the regression equation
I_m	=	Indicator variable equal to one for each monthly bill month m
β_m	=	Coefficient on the bill month m
β_1, β_2	=	Coefficients on HDD and CDD
HDD_{it}	=	HDD for customer I at time t
CDD_{it}	=	CDD for customer i at time t
$Post_{it}$	=	Indicator variable equal to one for each monthly bill in the post-period, and zero otherwise
β_3	=	Coefficient on the Post variable
$Program\,Year_{it}$	=	Indicator variable equal to one for each monthly bill in the evaluated program year, and zero otherwise
β_4	=	Coefficient on Post and Program Year indicator variables. Measures treatment effect in program year, independent of weather
β_5	=	Coefficient on the COVID dummy variable
$COVID_{it}$	=	Indicator variable equal to one for each monthly bill during the COVID pandemic, and zero otherwise, with the date range beginning March 15, 2020[10], through December 31, 2021 (the end of the evaluation period)
δ_i	=	Coefficients on customer dummy variables
$Customer_i$	=	Dummy variable for each customer. This measures the customer fixed effect over time
ε_{imy}	=	Error term

[10] March 15, 2020 was the date of the initial COVID-related stay-at-home orders and restrictions in Idaho.

Regional temperature data was obtained from the National Oceanic and Atmospheric Administration using the closest weather stations with complete data and matched to each customer's zip code. Using the historical weather data, ADM calculated HDD and CDD to use in the regression analysis. HDDs are calculated as temperature values under the heating setpoint (65°F), while CDDs are calculated as temperature values over the cooling setpoint (65°F). The setpoint values for HDDs and CDDs were determined by running regressions with multiple setpoints from 65°F through 75°F. ADM chose the setpoint combination with the highest adjusted R-squared value, demonstrating the best fit for the data. Monthly savings were calculated using Equation 3-3.

Equation 3-3: Annual kWh Savings for the Regression Model

$$Annual\ kWh\ Savings = (\beta_3 + \beta_4) * 365.25$$

3.3.2 COVID Impacts

ADM ran the regression model with a COVID dummy variable to determine whether inclusion of a COVID-specific effect in the model was feasible or warranted. The first restrictions for COVID in Idaho occurred on March 15, 2020, and the effects were apparent in customer bills through the end of the 2021 program year. The COVID dummy was defined to equal one from March 15, 2020, through December 31, 2021, and zero otherwise. The COVID dummy was statistically significant at the 99 percent level; therefore, it was included in the final model to estimate savings.

3.4 Double Count Savings Approach

Some treated customers participated RMP's Wattsmart Homes programs. The RMP HER Program reports may increase customers' likelihood to participate the program. Additional participation that results from HER Program treatment is known as uplift. HERs include information about other RMP incentives and programs, which may lead to customers adopting more energy efficient upgrades for their home.

When a household participates in an efficiency program because of this encouragement, the utility might count their savings twice: once in the regression-based estimate of HER Program savings using observed customer billing data and again in the estimate of savings for the other program. Although uplift rarely displays a statistically significant difference with an RCT design, this may not be the case with a treatment only analysis.

Double counted savings, whether positive or negative, are subtracted from program savings estimates from the regression analysis to get total verified savings. The approach for removing double-counted savings differs based on whether the other program is a downstream or upstream program; both are described below.

3.4.1 Downstream

ADM corrected for cross-program participation in downstream programs by removing customers that participated in downstream energy efficiency programs in 2020 and 2021 from the billing analysis. The number of customers removed was roughly 0.5 percent of the total number of treated customers. Alternative methods that use a control group were not used due to the lack of a comparable control group from which to compare downstream program savings. Without a control group, downstream uplift cannot be calculated for the HERs program because there is no group to compare downstream program participation; however, it is quite common for HER programs to have statistically significant downstream uplift in a range of one to three percent of the estimated annual HERs savings.

3.4.2 Upstream

Due to the lack of a comparable cohort to form a control group, ADM was unable to use survey data to estimate upstream uplift. However, the VIA analysis framework provides estimates that are mostly free of upstream program savings by comparing usage for treated customers with customers that have yet to be treated. The remaining upstream uplift caused by treatment customers participating in upstream programs at a higher rate than untreated customers was determined through a literature review.[11]

3.5 Attrition Analysis Approach

The tracking of treatment households can be affected by either move-outs or opt-outs (known collectively as 'attrition'). If a household's final bill falls before the end of the evaluated post-period, it is considered a move-out; bills occurring after move-out were removed from the analysis. Opt-outs (customers who request to be removed from the program), however, remain in the regression analysis, as the program savings estimated is the "intent-to-treat" savings. It remains useful to estimate attrition to gather information on persistence of savings.

The cumulative level of move-outs by month for each program year was summarized. This information can be useful for RMP and the implementer to track the size of the remaining treatment group and to determine if there are issues in the billing data (e.g., missing bills over certain time intervals that could lead to higher-than-expected attrition rates).

[11] Avoiding the Double-Counting of Savings in Michigan's Behavioral EWR Programs: Current Practice & Future Options. April 16, 2019. https://www.michigan.gov/documents/mpsc/Avoiding_Double_Counting_-20190416_652854_7.pdf

4 Impact Evaluation Results

ADM calculated the percent savings per home by dividing the estimated average annual energy savings by the average annual energy consumption in the pre-period for each program year. Because customers participating in downstream programs were removed prior to the billing analysis, the estimated savings account for downstream uplift. Program-level savings were calculated by multiplying the average annual household impact estimate by the number program participants. Participant count is the sum of all billing days in the post-period for the given year divided by 365.25. This accounts for customers who participated in the program for less than a full year. The VIA methodology requires both treated and untreated customers to be present each year of the evaluation period. An insufficient number of untreated customers were available in 2021 to calculate savings using the VIA method.

4.1 Data Preparation and Cleaning

Prior to running regressions, ADM prepared and cleaned billing data provided by RMP. Table 4-1 present the number of unique program participants throughout the billing cleaning stages.

Table 4-1: Number of Participants Available to Include in Billing Analysis

Data Cleaning Step	Remaining Number of Program Participants after Data Cleaning Step
Start	41,986
After removing customers with multiple move-in dates for the same customer ID	41,934
After removing customers with multiple accounts per customer ID (no premise ID on older Opower bills)	41,953
After removing customers with multiple Bidgely intervention dates for the same customer ID	41,897
After removing customers missing street number (needed for matching with old Opower bills)	41,868
After restricting to bills in pre- or post-period	41,455
After removing outliers (anything over 200kWh/day)	41,453
After removing bills with less than 10 or more than 90 days duration	41,453
After removing customers with savings in downstream EE programs (e.g., uplift)	41,266
After keeping customers with at least 9 months of pre-period and 6 months of post-period bills	34,036

ADM conducted calendarization adjustments for each monthly bill. The resulting dataset contains adjusted monthly bill reads with associated consumption and bill duration for each month the customer remained active.

4.2 Linear Regression Modeling Results

As discussed in the evaluation approach section, savings are directly determined by coefficients β_3 and β_4 which are defined in Table 4-2.

Table 4-2: Regression Parameters

Variable	Parameter	Interpretation
Post	β_3	Average daily usage in the post-period
Post * Program Year	β_4	Average daily usage in the post-period of the given program year

Per-home results and percent savings by program year are presented for the HER Program. Customers who participated in downstream RMP programs were removed prior to the billing analysis. ADM found positive and statistically significant program savings in 2020.

4.3 Regression Model Results

Table 4-3 displays the annual kWh savings per treatment customer for all treatment customers in 2020, prior to any double counting adjustments. The savings are positive and statistically significant at the 95 percent confidence interval level. Table 4-4 displays the regression coefficients for 2020.

Table 4-3: Annual Savings for 2020

Program Year	Annual kWh Savings per Home	5% CI	95% CI
2020	106.71	66.21	147.21

Table 4-4: 2020 Regression Results

Coefficient	Estimate	Std Error	P Value	5% CI	95% CI
Feb	-1.568	0.051	0.000	-1.652	-1.485
Mar	-3.001	0.067	0.000	-3.111	-2.891
Apr	-5.945	0.089	0.000	-6.091	-5.799
May	-6.579	0.107	0.000	-6.755	-6.403
Jun	-5.037	0.126	0.000	-5.245	-4.829
Jul	-3.808	0.156	0.000	-4.065	-3.552
Aug	-4.016	0.146	0.000	-4.257	-3.775
Sep	-6.329	0.117	0.000	-6.522	-6.137
Oct	-7.064	0.084	0.000	-7.203	-6.925
Nov	-4.041	0.057	0.000	-4.134	-3.947
Dec	-1.028	0.048	0.000	-1.108	-0.949
HDD	0.486	0.004	0.000	0.480	0.491
CDD	1.470	0.022	0.000	1.434	1.505
Post-period	-0.667	0.034	0.000	-0.722	-0.611
Program Year	1.130	0.051	0.000	1.047	1.213
COVID Dummy	0.798	0.089	0.000	0.651	0.945
Post * Program Year	0.375	0.059	0.000	0.278	0.471

The regression model was a good fit for the data, as seen by the Adjusted R-square in Table 4-5.

Table 4-5: Regression Model Fit

Evaluation Period	Adjusted R^2	F Statistic	Number of Observations	Participant Count[12]
2020	0.692	143	2,106,335	28,140

Table 4-6 presents annual savings for HER Program treated customers calculated using Equation 4-1.

Equation 4-1: Annual Savings

$$Annual\ kWh\ Savings = (\beta_3 + \beta_4) * 365.25$$

[12] Participant count is the sum of all billing days in the post-period for the given year divided by 365.25. This accounts for customers who participated in the program for less than a full year.

Table 4-6: 2020 Treatment Impact

Treatment Period	Average Pre-Period Usage per Customer (kWh/month)	Average Treatment Period Consumption per Customer (kWh/year)	Average Reduction in Usage after treatment per Customer (kWh/month)	Percent Savings
2020 Calendar Year (365 days)	11,998.91	11,892.20	106.71	0.89%

The gross kWh savings from VIA for the average customer and for the program overall are summarized in Table 4-7 and Table 4-8.

Table 4-7: 2020 Average Annual kWh Savings per Customer, VIA

Program Year	Annual Savings Per Home (kWh/year)	5% CI Annual Savings Per Home (kWh/year)	95% CI Annual Savings Per Home (kWh/year)	Average Pre-Period Usage per Customer (kWh/month)	Annual Percent Savings Per Home
2020	106.71	66.21	147.21	11,998.91	0.89%

Table 4-8: Total 2020 Program Savings, VIA

Program Year	Annual Savings Per Home (kWh)	Participant Count	Program Year Savings (kWh)	Program Year Savings (kWh) 5% CI	Program Year Savings (kWh) 95% CI
2020	106.71	28,140	3,002,738.84	1,863,078.11	4,142,399.57

The average customer saved 0.89 percent or 107 kWh in 2020. Household savings estimates were extrapolated using the post-period participant count.

4.4 Upstream Program Double Counting Analysis Results

In a recent secondary literature review presented to the Michigan utilities, a Guidehouse evaluation found ten evaluations of HER programs from 2013 to 2018 that addressed the effects of upstream programs.[13] Three reported no difference in purchases between treatment and control customers. Others ranged from -0.9 kWh/household/year to 11.1 kWh/household/year. The Guidehouse team concluded that most efforts to calculate the uplift rate of upstream programs result in 0 percent or negative results or that the differences are statistically insignificant.

Table 4-9 provides additional upstream uplift results from evaluations performed for PacifiCorp HER programs in Idaho, Wyoming, Washington, and Utah. The average upstream uplift value is close to zero for each metric and in most cases the results are not statistically significant. Based on the experience of these programs, ADM made no uplift adjustment for upstream programs.

Table 4-9: Upstream Uplift Benchmark Results

Utility/State	Program Year	Cohort	Upstream Uplift Metric	Upstream Uplift Value	Statistically Significant
RMP Idaho	2015-2016	All Waves	LEDs installed/year	-0.37	No
RMP Idaho	2015-2016	All Waves	CFLs installed/year	0.02	No
RMP Wyoming	2015-2016	All Waves	CFLs installed/year	-0.06	No
RMP Wyoming	2015-2016	All Waves	LEDs installed/year	-0.14	No
RMP Wyoming	2018-2019	Legacy	LEDs installed/year	7.4	Yes
RMP Wyoming	2019	Expansion	LEDs installed/year	3.5	No
RMP Utah	2018	Legacy, Expansion 1-2	kWh/year	-5.7	No
RMP Utah	2018	Expansion 3	kWh/year	6.8	Yes
RMP Utah	2019	Legacy, Expansion 1-2	kWh/year	-15.3	No
RMP Utah	2019	Expansion 3	kWh/year	18.5	Yes
Pacific Power WA	2020	All Waves	kWh/year	-1.7	No
Pacific Power WA	2021	All Waves	kWh/year	-4.84	No
RMP Utah	2017	Legacy	CFLs installed/year	0.11	No
RMP Utah	2017	Expansion 1	CFLs installed/year	0.28	No
RMP Utah	2017	Expansion 2	CFLs installed/year	0.01	No
RMP Utah	2017	Legacy	LEDs installed/year	0.3	No
RMP Utah	2017	Expansion 1	LEDs installed/year	-0.37	No
RMP Utah	2017	Expansion 2	LEDs installed/year	-0.25	No

[13] Avoiding the Double-Counting of Savings in Michigan's Behavioral EWR Programs: Current Practice & Future Options. April 16, 2019. https://www.michigan.gov/documents/mpsc/Avoiding_Double_Counting_-_20190416_652854_7.pdf

4.5 Comparison to Deemed Savings

To calculate evaluated saving for 2021, ADM calculated savings using the deemed savings method for the HER Program developed by Cadmus for the state of Idaho[14] for both 2020 and 2021. ADM then calculated the 2020 ex-post realization rate using Equation 4-2 and applied that rate to 2021 estimated savings calculated using deemed savings values.

Equation 4-2: Ex-post Realization Rate

$$\textit{Ex-post Realization Rate} = \frac{\textit{Evaluated Saving Calculated Using VIA}}{\textit{Estimated Saving Using Deemed Savings Values}}$$

The deemed savings method was based on prior RCT analyses performed on programs run in Idaho and other states. The deemed savings methodology relies on estimating percent savings as a function of the number of years of treatment and the annual consumption for each customer. Table 4-10 provides Cadmus' recommended deemed percent savings.

Table 4-10: Recommended Deemed Percentage Savings Values[15]

Pre-Treatment Annual Consumption Range (kWh/yr)	Program Year 1	Program Year 2	Program Year 3+
< 7973 kWh/yr[16]	0.60%	0.60%	1.00%
>= 7973 kWh/yr	1.13%	1.22%	1.27%

The savings estimated using deemed values is 16 percent higher than the savings calculated using VIA billing analysis, as shown in Table 4-11. However, the deemed savings estimate is contained within the 95 percent confidence interval of the VIA billing analysis for 2020 (see Table 4-8).

Table 4-11: Deemed vs VIA Results

Year	Evaluated Deemed Results (kWh) B	Evaluated Savings Calculated Using VIA (kWh) C	Ex-post Realization Rate: C/B
2020	3,908,197	3,002,739	77%

[14] Cadmus, "Deemed Savings for Rocky Mountain Power Idaho HER Program," June 3, 2020.

[15] Ibid.

[16] Cadmus assigned 0 percent savings to this consumption tier due to lack of sufficient data for this group.

The difference between VIA and deemed savings calculations is relatively small given the uncertainties associated with each method. For instance, the deemed savings method assumes that newly treated customers (those treated in year 2018 and 2020) will respond to treatment like previously treated customers in the original RCT cohorts. However, newly treated customers were more likely to have lower consumption than previously treated customers on average (see Table 4-12).

Table 4-12: Average Pre-period Annual Usage by Year of Treatment

Original Opower RCT Cohort	Year of Treatment	Average Pre-period Annual Usage (kWh)
✓	2014	15,899.50
	2019	8,809.49
	2020	12,415.40
	2021	5,964.96

The lack of a control group and RCT design for the billing analysis will always mean some level of bias is present in the billing analysis estimate, which could lead to savings being underestimated or overestimated.

Additional factors driving differences between deemed results and the billing analysis are listed in the section 4.5.

ADM also compared claimed savings to evaluated deemed values to determine if claimed savings were appropriately calculated using the proposed Cadmus methodology. The differences in these values stem from 1) different assumptions about years of treatment, and 2) different calculations for annual usage. Claimed and evaluated deemed savings are reported in Table 4-13.

Table 4-13: Deemed Realization Rates

Year	Claimed Savings (kWh)	Evaluated Deemed Savings (kWh)	Deemed RR
2020	3,947,830	3,908,197	99%
2021	4,238,790	5,057,662	105%

4.6 Evaluated Savings

ADM calculated 2020 evaluated savings using VIA results (see Table 4-8) and 2021 evaluated savings using Equation 4-3.

Equation 4-3: 2021 Evaluated Savings

$$2021\ Evaluated\ Savings\ 2021\ (kWh) = 2021\ Ex\ post\ Deemed\ Savings\ (kWh) * 2020\ Ex\ post\ Realization\ Rate$$

The HER Program resulted in a program realization rate of 84 percent during the evaluation period (see Table 4-14).

Table 4-14: Program Energy Savings (kWh) and Realization Rate

Year	Ex-post Deemed Savings (kWh)	Ex-post VIA Savings (kWh)	Ex-post Realization Rate	Evaluated Savings (kWh)	Claimed Savings (kWh)	Program Realization Rate
2020	3,908,197	3,002,739	77%[17]	3,002,739	3,947,830	76%
2021	5,057,662	N/A	77%[18]	3,885,893	4,238,790	92%
Total	**8,965,859**	**N/A**	**77%**	**6,888,632**	**8,186,620**	**84%**

4.7 Discussion of Realization Rates

The difference between the claimed and evaluated annual kWh savings per customer, as reflected in the realization rate, is due to the following factors:

- ADM used a billing analysis regression model to estimate savings while the claimed savings are based on a deemed savings approach.
- The deemed savings approach is based on the average percent savings for a typical HER program; therefore, there will always be some year-to-year variation when compared to a billing analysis.
- The share of customers receiving paper reports is lower than in prior years which may have resulted in lower savings per customer. For 2014 and 2015, 100 percent of treated customers received paper reports (see Table 5-2), while in 2020 and 2021 less than eight percent of customers received paper reports. Previous studies have shown that paper report delivery results in higher savings per customer when compared to email report delivery.[19]
- The previous evaluation by Cadmus in 2020 found that savings degradation was occurring for Legacy cohort customers due to increasing home energy efficiency unrelated to Idaho's HER Program. Savings degradation will result in lower savings each year for Legacy customers and may also impact newer cohorts.

[17] 2020 Ex-post VIA Savings/2020 Ex-post Deemed Savings.

[18] Applied 2020 Ex-post Realization Rate

[19] Sussman, R. and Chikumbo, M. "Behavior Change Programs: Status and Impact," Report B1601, American Council for an Energy-Efficient Economy. Washington, DC. October 2016. p. 11.

4.7.1 Baseline Bias

The elimination of the RCT program and the lack of a suitable control group necessitated using a VIA evaluation approach, as discussed in Section 3.1. Programs using an RCT research design will have less variability in realization rates than programs using a deemed savings model that require a quasi-experimental evaluation method (e.g., VIA or PSM) in which baseline bias is inherently present.

Baseline bias, in the context of estimating a HERs program savings impact, is the degree to which a control group accurately predicts average treatment group usage in the post-period in the absence of any treatment (the counterfactual). With the RCT method, estimates derived from the control group are unbiased. However, with quasi-experimental methods such as PSM and VIA, estimates are biased. Bias occurs due to the lack of randomization in terms of treatment and control assignment. With PSM for example, customers can be matched only on observable characteristics (e.g., zip code or consumption), while other unobservable factors contribute to differences between the treatment and control groups.

The distribution of bias generally follows a bell curve, with lower bias being more likely to occur than higher bias. Prior studies have shown that for a sample size over 1,000, bias for PSM-derived estimates ranges from -5 percent to 5 percent. For measures with savings as a percent of annual consumption below 5 percent, the presence of bias leads to a large increase in the variability of savings estimates (and therefore realization rates).

At the cohort level, variability in the estimates will increase significantly due to bias. When cohorts are aggregated, some of the variability due to bias may be smoothed due to positive and negative bias canceling out.

For a HERs program, the presence of a small amount of bias has a significant impact on savings estimates due to the small size of the treatment effect. For instance, if the treatment effect for a cohort was known to be 1 percent of annual usage, positive bias of 2 percent in the baseline would lead to a savings estimate of 3 percent of annual usage. Therefore, the bias would overstate the savings by 300 percent and lead to a realization rate of a similar magnitude, holding other factors constant.

4.7.2 Expected Realization Rates

The main factors affecting realization rates in a program year include the weather, the economy, ex-ante assumptions, research design (e.g., RCT vs. PSM), program implementation, customer mix, regression model specification, and data cleaning.

At the cohort level, realization rates for programs analyzed using RCTs typically range from 75 percent to 125 percent. Because the treatment effect is small (typically less than 2 percent of annual consumption), small changes in the savings estimates have large impacts on realization rates.

Quasi-experimental methods increase the variability in savings estimates due to bias, which increases the variability in realization rates, holding other factors constant. For quasi-experimental research designs, realization rates typically ranging from 25 percent to 200 percent.

Additionally, programs with multiple cohorts tend to average out realization rates at the program level. However, with a VIA research design, all treatment customers are pooled into a single cohort. When combined with increased bias from the quasi-experimental research design, VIA leads to increased variability in the realization rate for the program overall, relative to RCT and PSM. Therefore, a low realization rate is not an indicator of poor program performance in a single program year in this context. Conversely, a high realization rate does not indicate program over-performance.

4.8 Attrition Analysis Results

ADM calculated the cumulative attrition rates of the treatment group customers who moved out of the service area for each year of treatment and for each program year. In addition, the following table displays the total move-out rate aggregating all treatment customers. Attrition since inception of each year of treatment, in aggregate, equals approximately 21 percent. However, attrition for the program years 2020 and 2021 is 9 and 12 percent, respectively (see Table 4-15).

Table 4-15: Program Move-out Rates by Program Year

Year of Treatment	Treatment Start Date	Treatment Group Size			Attrition Rate		
		Number of Treatment Customers	Number at EOY 2020	Number at EOY 2021	2020	2021	Cumulative
2014	12/1/2014	11,195	10,848	10,293	3%	5%	8%
2019	Variable	6,361	5,905	5,302	7%	9%	17%
2020	Variable	23,931	21,112	17,252	12%	16%	28%
2021	Variable	99	79	74	20%	5%	25%
Total		**41,586**	**37,944**	**32,921**	**9%**	**12%**	**21%**

5 Process Evaluation

ADM's process evaluation reflects insights gained through completing the impact evaluation, through interviews with RMP and Bidgely implementation staff, and through participant survey results.

5.1 Program Operations Perspective

ADM interviewed RMP and Bidgely implementation staff to learn about the program's design and implementation in 2020 and 2021. The interview focused on the program's progress toward energy savings goals, strengths and challenges, and planned changes for the future. The following summarizes key findings from the interviews.

- **The program shifted from a randomized-control trial model to serving all eligible customers.** Implementation staff stated that all eligible customers with email addresses began receiving HERs reports in July 2020. All customers begin receiving email HERs after four months of their service start date so that baseline usage can be determined to calculate deemed savings. RMP does not send paper HERs to Idaho customers.
- **Implementation staff confirmed email report delivery frequency and content.** Participants receive semi-monthly email reports – for a total of 24 reports per year. One of the monthly emails summarizes customer's energy use and provides a breakdown of energy use by appliance type. The other monthly email provides a comparison of energy use in comparable homes and provides behavioral energy tips. Emails also contain information on RMP programs and incentivized measures. The implementer meets with utility staff on a quarterly basis to determine marketing efforts and report content.
- **Implementation staff indicated the HERs program had several upgrades in Fall 2020.** The upgrades included improved email aesthetics, mobile compatibility, and additional portal web pages with interactive graphs, and revised energy efficiency recommendations. Additionally, the upgrade included easier access to the online portal with a "lazy log on" feature. Beginning in October 2020, customers could click a link in their HER email and go directly to the website without needing to provide login information. Before this, customers could only get to the online portal through the RMP website. Implementation staff observed that this change had increased traffic to the online portal.
- **Program communication is sufficient.** Implementation staff provides utility program staff with monthly reports and access to interactive online tools with program metrics. Further, implementation staff said they worked closely with RMP staff and neither implementation nor utility staff expressed concerns regarding the frequency or quality of program communication.

- **Implementation staff identified three key report design strengths.** Implementation staff observed that when Bidgely began administering the reports they altered the report design to show customers a similar home comparison rather than a neighborhood comparison. Staff indicated that several factors in addition to geography are used to make the home comparison (e.g., home square footage and heating type). Additionally, the implementation staff indicated that reports used a less aggressive, more palatable, and friendly approach. They specifically cited the inclusion of an animated lightbulb ("Bulby") as an illustration of this effort. Lastly, the staff noted that the report's disaggregation of energy use by appliance type and customer-specific recommendations was a key strength of the report design.
- **Increased reach and focus on digital reports were also noted as successes by utility and implementation staff.** The program shifting from a RCT design to treating all eligible customers with email addresses enabled the reports to reach a larger audience, more frequently. Moreover, eliminating paper reports improved the cost-effectiveness of the program.
- **Staff identified smart meter data as an opportunity to improve HERs.** Using smart meter data would allow the program to improve appliance disaggregation and provide richer insights to customers about their energy use and ways they could save energy.

5.2 HER Participant Survey Results

ADM surveyed RMP customers who received HERs in 2020 and 2021. The survey collected information about the customers' experiences with HERs and their satisfaction with RMP. The survey also collected responses about the participants' use of RMP's online energy portal and about energy-saving actions customers have taken (e.g., behavioral changes, or installed energy efficient appliances or equipment). Table 5-1 includes survey response data for the Idaho RMP HER participant survey. A total of 232 customers completed the survey. Unless otherwise stated, the calculations, graphs, and tables in this section use the complete sample of respondents (n=232).

Table 5-1: Summary of Email Survey Response

Metric	Total
Initial contact list	4,659
Invalid email addresses	579
Invalid email (%)	12%
Email invitations sent	4,080
Total completions	232
Response rate (%)	6%

5.2.1 Participants' Perceptions of HERs

The survey collected participants' perceptions on several aspects of the HERs.

5.2.1.1 Reading HERs

Seventy-three percent of respondents reported that they read most or all the HERs they received in 2021 (Table 5-2).[20]

Table 5-2: How often did you read the HERs in 2021?

Portion Read	Percentage (n=232)
All the reports	38%
Most of the reports	34%
About half of the reports	11%
Only a couple of the reports	12%
None of the reports	1%
Don't know	3%

Fifteen percent of survey respondents reported that someone else in their household had read the HERs. Of those who said someone else was reading reports as well (n=34), 91 percent said they themselves had read all or most of the reports. Therefore, respondents' accounts of how many HERs they had read were a good indication of the extent to which they were being read by others in the household.

Those who indicated that they had not read any of the reports (1 percent) or only read a few of the reports (12 percent) were asked why they chose not to read them. Of these respondents, 38 percent reported that the primary reason for not reading the reports was that they did not have the time.

[20] The portion of respondents who indicated they read all or most of the reports does not sum to 73 percent due to rounding.

Table 5-3 displays other reasons that customers cited for not reading reports.

Table 5-3: Why didn't you read more of the reports?

Response	Percentage (n=29)
Prompted Responses – Selected All That Apply	
Do not have the time	38%
The suggested tips were not applicable to my home	21%
Not interested	17%
I did not understand them	3%
I don't know	21%
Unprompted Responses – Open-end or "Other" Reasons	
Did not open the HERs emails	3%
Live in rental housing	3%
Prefer not to log into account	3%

5.2.1.2 Perceptions Regarding HERs

Respondents provided feedback on how easy or difficult it was to understand the information in their HERs, how accurate and valuable they believed the information was, and their satisfaction with the report. Most survey respondents (86 percent) found the HER information on their home's energy use easy to understand.[21]

Customers who indicated they read the HERs more frequently were more likely to report that they were easy to understand. Among survey respondents who indicated they read all the reports, 90 percent reported the information as easy to understand compared to 67 percent who indicated they read only a couple reports.

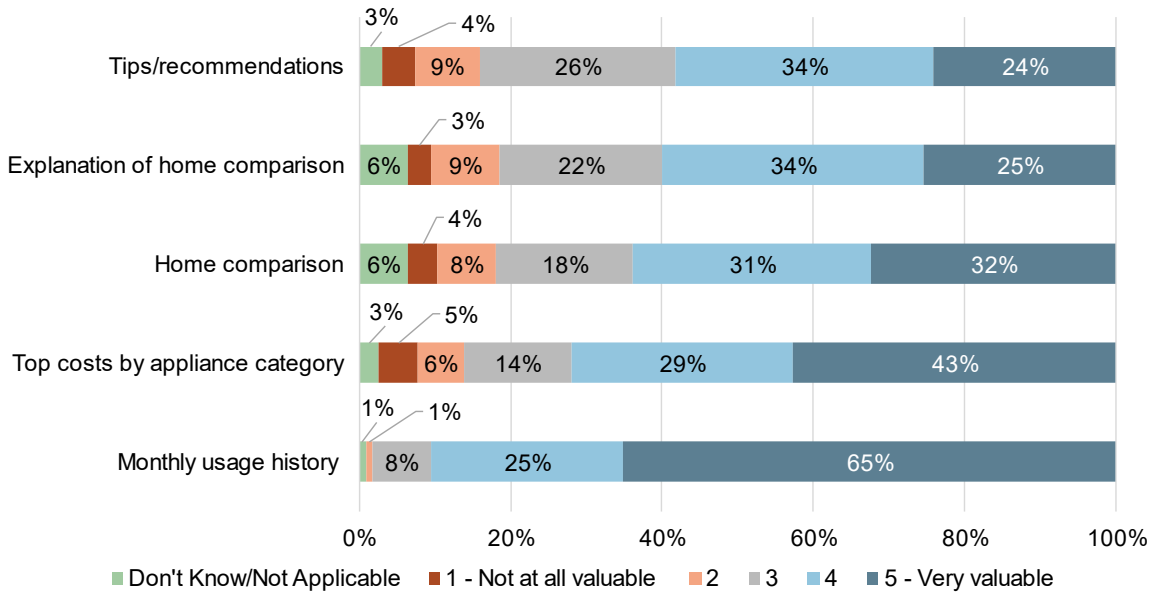
5.2.1.3 Perceived Value of Information on Home Energy Use

Most respondents perceived the various components of the HERs to be valuable, though ratings for each component varied. For instance, 58 percent scored tips and recommendations as valuable, compared to 72 percent that rated the top costs by appliance as valuable (see Figure 5-1).[22]

[21] Rated the ease of understanding the reports a 4 (31%) or 5 (55%) on a scale from 1 (very difficult) to 5 (very easy).

[22] Rated the value a 4 or 5 on a scale from 1 (not at all valuable) to 5 (very valuable).

Figure 5-1: Rated Value of HER Information



5.2.1.4 Perceived Accuracy of Information on Home Energy Use

Survey respondents largely found the information on their home's energy use to be accurate (see Table 5-4).

Table 5-4: Rated Accuracy of HER Information

Answer	Percentage (n=232)
1 - Not at all accurate	2%
2	3%
3	28%
4	40%
5 - Very accurate	20%
I don't know	6%

The respondents who said the HER information was inaccurate (rated as a 1 or 2 on a 5-point scale) had an opportunity to explain why (n=13). Two customers did not provide additional detail beyond reiterating their perception of the report overestimating usage or only providing a "guess" of usage. Eleven customers provided various comments regarding their perceptions of the reports as inaccurate:

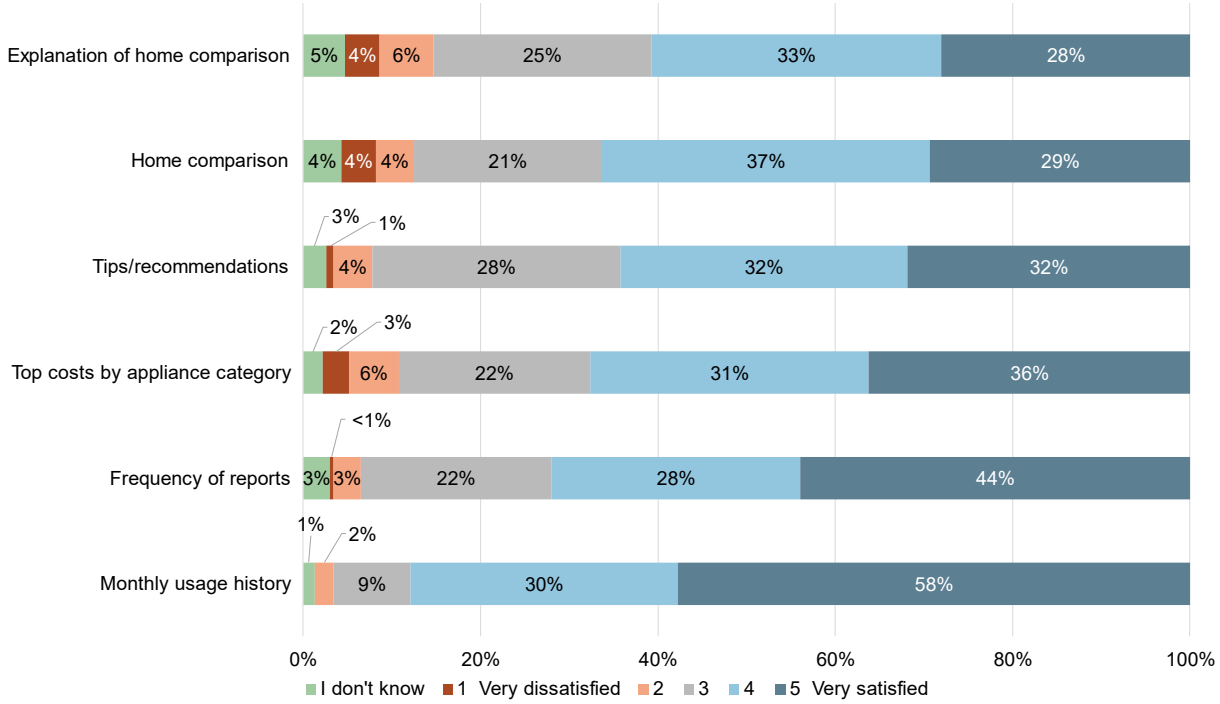
- Five respondents commented on the accuracy of the appliance disaggregation and/or indicated they were uncertain how this information was obtained
- Three made comments related to the HERs having inaccurate information regarding appliance or home heating fuel type

- Three customers felt the home comparison was inaccurate. Two of these customers mentioned requiring power to draw well water. The other noted that their home is much smaller than comparison homes.

5.2.1.5 Satisfaction with HERs

Seventy-four percent of respondents said they were satisfied with the HERs overall.[23] Most respondents were satisfied with the method and frequency of receiving the HERs, the information provided in them, and the number of other emails they receive about their home's energy use (see Figure 5-2). Fifty-three percent of respondents said that they would be likely to recommend the HERs to a friend, colleague, or relative.[24]

Figure 5-2 Satisfaction with HERs



The survey offered respondents an opportunity to recommend improvements to the reports and to comment on reasons for dissatisfaction with their reports. Thirty-one percent respondents provided comments or suggestions on how to improve the HERs. These respondents offered various comments, critiques, and suggestions for the reports.[25]

- Twenty-eight percent of respondents commented about the home comparison.[26]

[23] Rated their satisfaction a 7 or higher on a scale from 0 (extremely dissatisfied) to 10 (extremely satisfied).

[24] Rated their likelihood of recommending a 7 or higher on a scale from 0 (extremely unlikely) to 10 (extremely likely).

[25] n=74.

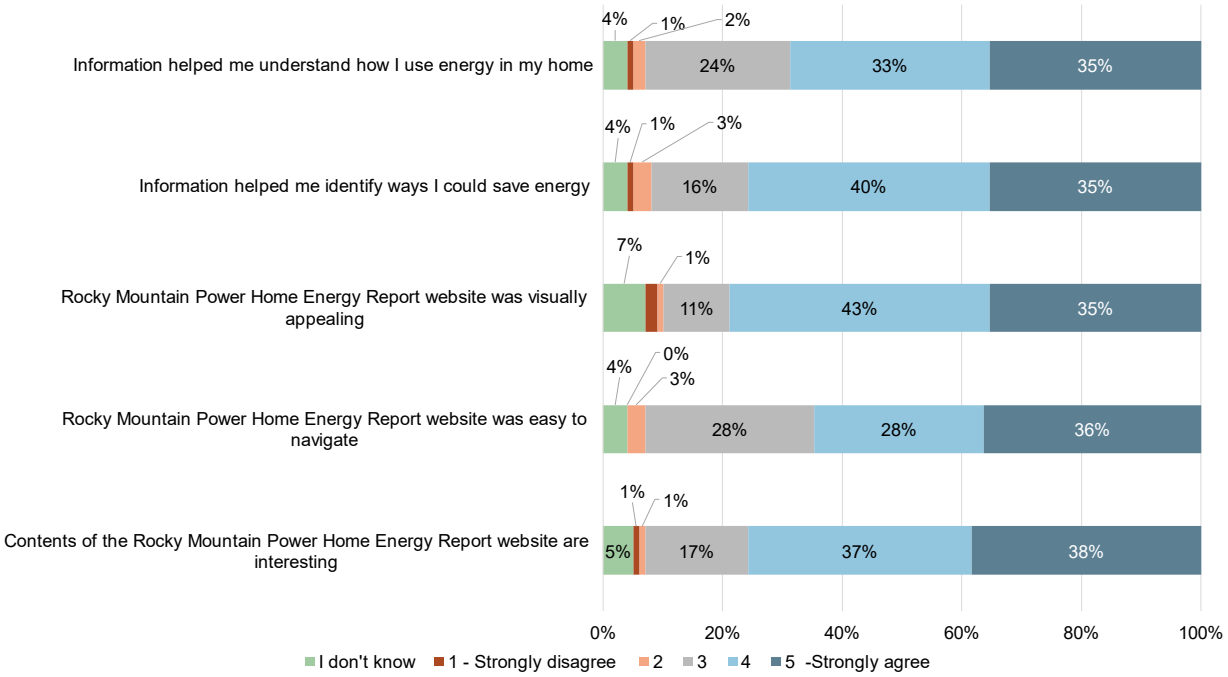
[26] Does not sum to 28 percent due to rounding.

- Twenty-two percent of these respondents suggested improving the comparison and included notes regarding being compared to other households with similar occupancy levels, lifestyles, appliances/features, heating type, home age, and square footage. Customers cited opportunities to improve the home comparison with consideration of electric vehicle charging, well pump usage, and details about home construction.
- Seven percent requested the comparison be removed or indicated they did not find this aspect of the report useful.
- Twenty-six percent recommended the reports be updated to improve their accuracy or applicability to their home energy use. These customers mentioned the reports being too generic, not applicable to their situation, or noted their actual home characteristics not aligning with the report. Several of these customers requested additional detail or information be added to help understand the reports' methodology and accuracy.
- Thirty-two percent identified ways to improve the report with additional features or other suggestions related to report content including:
  - allow customers to update appliance types and other information to increase report accuracy and personalize report
  - provide additional or more relevant recommendations, tips, and rebate information
  - include more educational or explanatory information
  - ensure tips or recommendations are budget-sensitive
  - add coupons to promote improvements through local service companies
  - provide reminders for needed services such as (e.g., filter changes, HVAC tune ups)
  - include incentives or gifts for customers that make recommended improvements
  - provide usage history for a longer time horizon
  - improve ease of report navigation
  - provide all information in HER email rather than requiring logging into portal for additional information
- Fifteen percent observed that the appliance disaggregation was inaccurate or requested more information on its methodology.
- Eight percent commented on the frequency of the reports. Seven percent of these customers requested increasing the frequency of reports. One percent requested less frequent reports.
- Seven percent requested the reports be sent in a different format (four percent physical mail, three percent preferred email).

5.2.2 Experience with Online Portal

Forty-three percent of participants recalled logging onto the online portal that is available for Home Emery Report recipients. Most of these customers agreed that the information available through the portal helped them understand their home energy use, that the portal was easy to navigate, and that the portal helped them identify ways they could save energy (see Figure 5-3).

Figure 5-3: HER Participant Online Portal Experience[27]



Most respondents who said they had not logged on to the online portal indicated they were not aware of the portal. Table 5-5 displays reasons customers noted for not having logged onto the portal.

[27] n=99.

Table 5-5: Primary Reason why Customers had not *logged onto Portal*

Reason	Percentage of Respondents (n = 133)
Prompted Responses – Selected All That Apply	
Were not aware of the portal	46%
Did not have the time to use the portal	15%
Did not know how to access the portal	17%
Did not think the portal would provide useful information	10%
Experienced technical difficulties trying to access the portal	3%
Not interested in my energy use	2%
Other (reason not specified)	2%
I don't know	12%
Unprompted Responses – Open-end or "Other" Reasons	
Prefer not to log in	1%
Use the app instead	1%

5.2.3 RMP Online Customer Experience

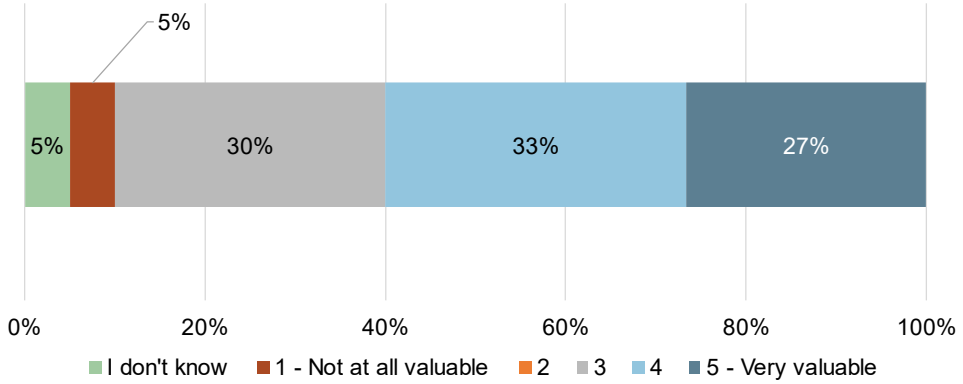
ADM also asked several questions about customers' experience with the RMP website (rockymountainpower.net). Twenty-eight percent of respondents confirmed they had been to RMP's main website. Of these respondents (n=65), 94 percent said they had created an online account.

Of the four respondents who had been to the website but not created an online account, two were not aware of it, one did not know how to create an account, and one indicated they had technical difficulties.

Of the respondents who said they had created an online account (n=61), 82 percent said they had logged in multiple times, 3 percent said they had logged in once and the remaining 13 percent did not know the number of times they had logged in.[28] Most indicated that the energy-saving tips and information available on the website were valuable (see Figure 5-4).

[28] Two percent of respondents (one customer) that created an account did not provide a response to the question asking about frequency of website usage.

Figure 5-4: Perceived Value of RMP Website's Tips and Information[29]



5.2.4 Opinion Toward RMP

Eighty-two percent of respondents indicated they were satisfied with RMP overall as their electric utility.[30] Respondents provided feedback on whether and how receiving the HER had affected their opinion of RMP. Twenty percent indicated that receiving the report had changed their opinion of RMP. Of those who indicated receiving the report had changed their opinion, most indicated it had improved their opinion (see Table 5-6). Sixty-nine percent of respondents said they would be likely to recommend RMP to a friend, relative, or relative (n=228).[31]

Table 5-6: Rated Change in Satisfaction with RMP

Rating	Percentage of All Respondents (n = 47)
5 - Greatly improved	0%
4	2%
3	11%
2	55%
1 - Greatly worsened	32%
Don't know	0%

[29] n=60.

[30] n=226. Rated their level of satisfaction a 7 or higher on a scale from 0 (extremely dissatisfied) to 10 (extremely satisfied).

[31] n=228. Rated their likelihood of recommending Rocky Mountain Power to a friend, relative, or colleague a 7 or higher on a scale from 0 (not at all likely) to 10 (extremely likely).

5.2.5 Energy Saving Actions

Fifty-nine percent of HERs recipients reported they had made changes or taken actions to save energy in 2020 or 2021. Sixty-five percent of respondents said that the information provided in the HERs was important in their decision to take energy-saving actions.[32] Table 5-7 summarizes all energy-saving actions recommended on HERs that respondents reported adopting.

Table 5-7: Number of Energy-Saving Recommendations Adopted

	Percentage (n=232)
Made changes/took actions to reduce energy use	59%
Number of Actions Taken to Reduce Energy Use – All Respondents	
None	41%
1 to 5	9%
6 to 10	38%
11 to 15	13%

Table 5-8: Actions Recommended in HERs that Respondents Adopted

Action	**Percentage (n=232)**
Allowed sun to heat home	53%
Washed clothes using cold water versus hot water	44%
Let dishes air dry	43%
Kept refrigerator full to better maintain cold temperatures	42%
Made sure refrigerator had minimum clearance to allow operating at maximum efficiency	42%
Checked seal on refrigerator to ensure appropriate tightness	35%
Dried clothes at lower temperature	33%
Ran ceiling fans in reverse during the winter	28%
Turned off game consoles when not in use instead of leaving in stand-by mode	25%
Optimized display on television	25%
Adjusted freezer temperature settings	24%
Replaced old cookware with flat-bottomed cookware	24%
Used an electric kettle instead of a pot on the stove	20%
Installed a dimmer switch to control lighting levels	19%
Unplugged stereo when not in use	15%
Unplugged second refrigerator when not in use	9%
Shut flue damper on fireplace or wood stove after usage	8%
Wrapped water heater in an insulating blanket	6%

[32] n=138. Rated the importance of the HERs a 4 (35%) or 5 (30%) on a scale from 1 (not at all important) to 5 (very improved).

ADM also asked customers if they had enrolled in RMP's time-of-use residential billing plan that rewards off-peak electricity consumption with lower rates. Eleven percent of all survey respondents indicated that they had enrolled in a time-of-use plan in 2021.

5.2.6 Energy Saving Purchases

Sixty-seven percent of HERs participants said they had installed one or more energy efficient items in 2020 or 2021. Sixty-eight percent of participants said that the information provided in the HERs was important (rating of 4 or 5) in their decision to purchase or install the energy efficient equipment or appliances.[33]

Table 5-9: Number of Energy-Saving Items Installed

	Percentage (n = 232)
Installed energy saving item(s)	67%
Number of Items Installed– All Respondents	
None	32%
1 to 5	57%
6 to 10	7%
11 to 15	2%

The most common items respondents purchased and installed were ENERGY STAR® lightbulbs and fixtures, smart thermostats, and advanced power strips (see Table 5-10). Of the respondents who indicated that they had purchased a thermostat, water heater, insulation, dryer, washer, heat pump water heater, or heat pump in 2020 or 2021 (n=80), 15 percent said they received a rebate or discount.

Among those participants who purchased LED bulbs, 8 percent bought 3 or fewer, 26 percent bought 4 to 7 bulbs, and 66 percent purchased 8 or more bulbs.

[33] n=158. Rated the importance of the HERs a 4 (38%) or 5 (30%) on a scale from 1 (not at all important) to 5 (very improved).

Table 5-10: Energy Efficient Items Purchased or Installed

Equipment or Appliance	Percentage of Respondents (n=232)
ENERGY STAR LED light bulbs	48%
ENERGY STAR LED fixtures	16%
Smart thermostat (e.g., Nest, Lyric, Ecobee, Sensi)	16%
Advanced power strips	15%
Low flow faucet aerators or showerheads	15%
ENERGY STAR clothes dryer	14%
ENERGY STAR clothes washer	14%
ENERGY STAR television	15%
ENERGY STAR stand-alone freezer	14%
ENERGY STAR refrigerator	11%
Energy efficient windows or doors	8%
Attic, floor, or wall insulation	8%
ENERGY STAR computer or computer monitor	6%
ENERGY STAR scanner or printer	5%
ENEGY STAR central air conditioner	4%
ENERY STAR room air conditioner	3%
ENERGY STAR heat pump	2%
ENERGY STAR heat pump water heater	2%

5.2.7 Energy Savings Actions Before 2020

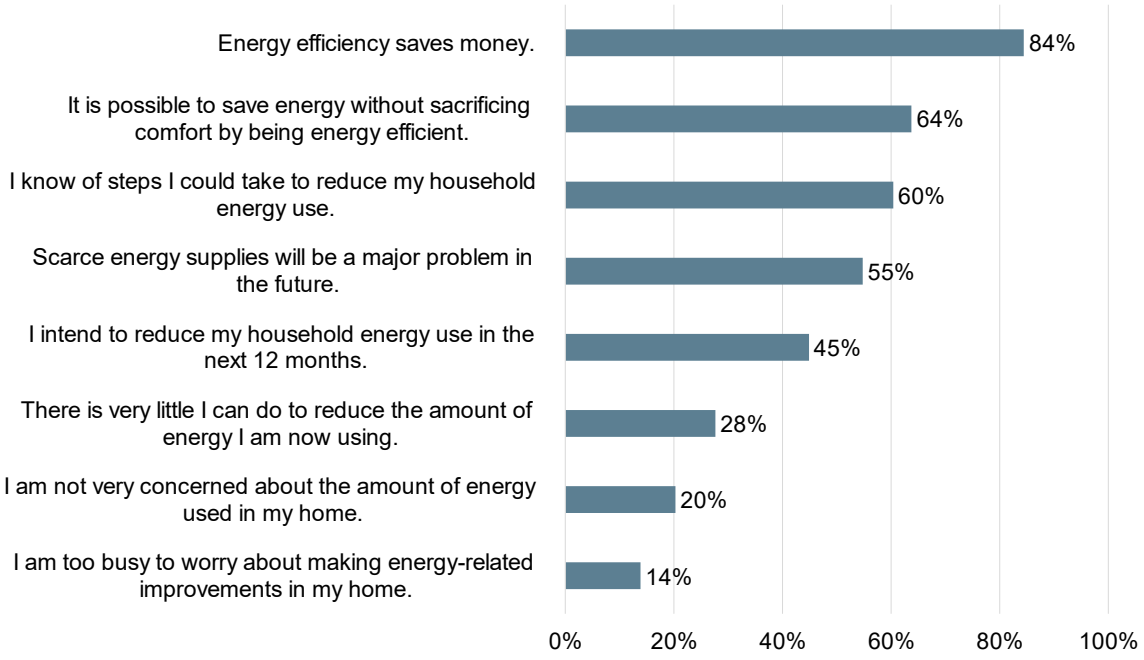
ADM also asked if respondents had taken any energy saving actions before 2020. Fifty percent of respondents said they had taken some action to reduce energy use in their home before 2020. Half of the respondents who said that they had taken action to reduce energy use before 2020 indicated they had made less expensive energy efficient improvements such as installing LEDs, window shrink film, or weatherstripping.[34] Forty-eight percent noted some kind of behavior change (e.g., unplugging appliances, turning off lights). Thirty-seven percent noted installing a major measure or making a substantial investment in their home's efficiency such as purchasing an ENERGY STAR certified appliance, windows, doors, smart thermostat, attic insulation, furnace, or water heater.

[34] n=116.

5.2.8 Beliefs and Attitudes Relating to Energy Efficiency

Survey respondents generally endorsed positive beliefs and attitudes about energy efficiency. See Figure 5-5 for more details.

Figure 5-5: Pro-Energy Efficiency Beliefs and Attitudes[35]



5.2.9 Demographics

Participants were asked about their home characteristics, including ownership, building type, and heating fuel (see Table 5-11).

[35] Respondents who rated their level of agreement a 7 or higher on scale from 0 (strongly disagree) to 10 (strongly agree).

Table 5-11: Respondent Home Characteristics

Response	All Respondents (n=232)
Ownership	
Own	82%
Rent	16%
Prefer not to answer	2%
Building Type	
Single-family home	79%
Manufactured or mobile home	6%
Duplex or triplex	1%
Apartment in an apartment building or complex	9%
Condominium or townhome	3%
Don't know	1%
Heating Fuel	
Electricity	25%
Natural Gas	56%
Propane	14%
Wood	2%
Heating Oil	1%
Don't know	2%

ADM also asked respondents about their household demographics. Most identified as white or Caucasian (see Table 5-12). Ninety-seven percent said English was the primary language spoken at home. The other respondents indicated either Spanish (1 percent), Russian (<1 percent), or Chinese (< 1 percent) was the primary language spoken at home.[36] On average, about three people lived at each respondent's residence and 62 percent of respondents said that three or fewer lived at their home in 2022.

Fifty-two percent of respondents characterized their communities as rural, 26 percent as suburban, and 14 percent as urban. The remainder either did not know how to characterize their community (5 percent) or provided a written description (2 percent). Twenty-one percent of respondents indicated their household income was less than 200 percent of the federal poverty line.

[36] One percent of respondents preferred not to provide the primary language spoken in their home.

Table 5-12: Respondent Race or Ethnicity[37]

Response	Percentage (n = 232)
Asian	1%
Caucasian/White	89%
Hispanic or Latino	4%
Native American or Alaska Native	1%
Prefer not to answer	9%

5.2.10 Home Occupancy, Renovations, and Changes to Energy Use

The survey included questions to assess the effect of the coronavirus pandemic on time spent at home, as well as any other home changes made from 2019-2022 that may have impacted usage, outside of receiving HERs. Twenty-three percent of respondents indicated that in 2020 or 2021 they updated or renovated their home in a way that affected their energy use. Nineteen percent of these respondents indicated the renovations or updates had increased their energy use (see Table 5-13).

Table 5-13: How have your updates or home renovations affected your energy use?

Response	Percentage (n=54)
Increased	19%
Decreased	50%
Stayed the same	15%
Don't Know	17%

As noted in above, on average about three people lived at each respondent's residence in 2022 and 62 percent of respondents said three or fewer people lived at their home. The number of people that lived in each respondent's residence remained largely consistent from 2019-2022; 70 percent of respondents indicated that the same number of people lived in their home in 2019 and 2022, while 14 percent said the number increased and 16 percent said the number decreased.

To gauge home occupancy, ADM asked customers whether they or their family members had worked or gone to school in person or from home (at least one full day a week, Monday-Friday) or had been without employment at any point from 2019-2022. Results indicate a higher portion of respondents working remotely from 2020-2022 compared to

[37] Sums to more than 100% because respondents could select more than one ethnicity.

2019. A larger portion of respondents reported someone attending school remotely in 2020 compared to 2019, 2021, or 2022 (see Figure 5-6 and Figure 5-7).

Figure 5-6: Home Occupancy Changes 2019-2022 (Survey Respondent)

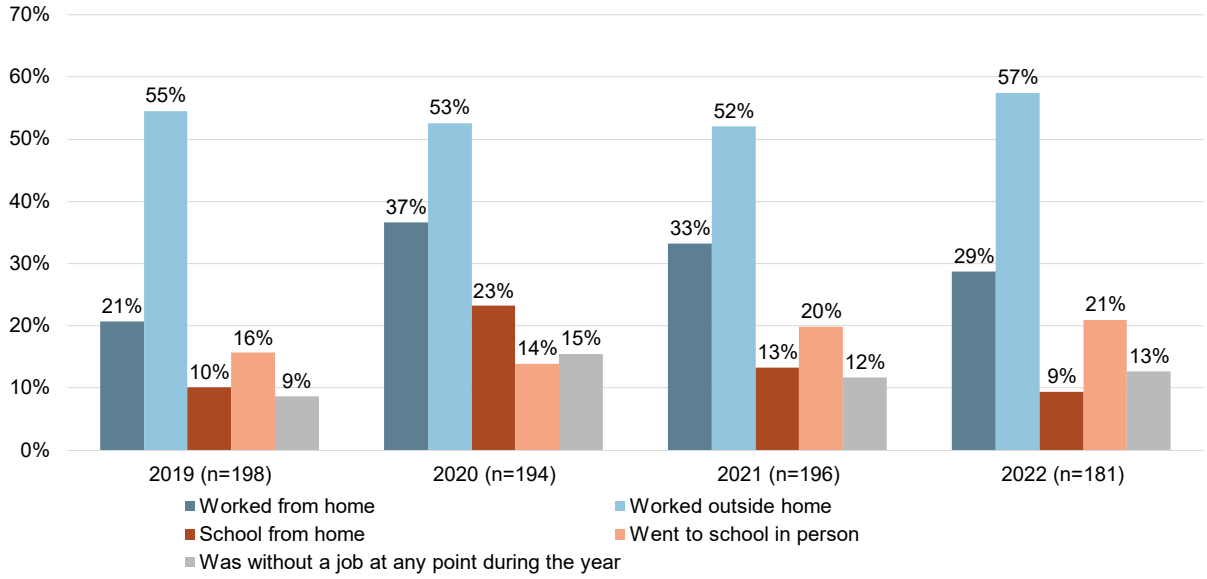
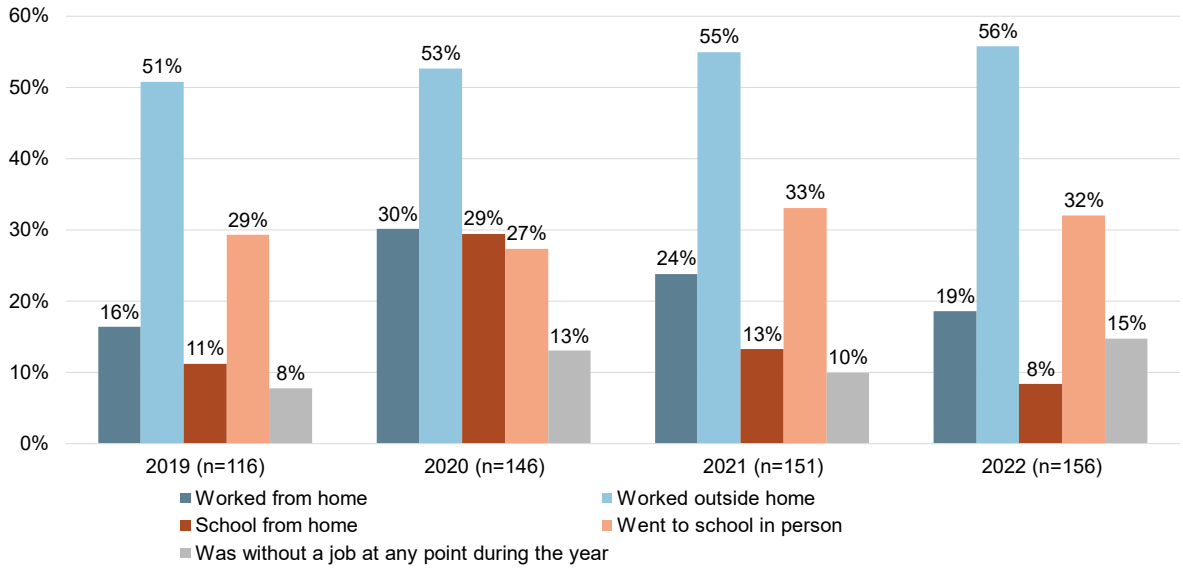


Figure 5-7: Home Occupancy Changes 2019-2022 (Other Household members)



6 Conclusions and Recommendations

Based on the preceding impact and process analyses and evaluations, ADM offers the following discussion, conclusions, and recommendations for consideration in planning future program cycles.

6.1 Discussion of Deemed Savings Model

RMP's adoption of a deemed approach to estimating savings for their HER Program is novel, innovative and inclusive. RMP adopted the deemed savings program design to increase the number of customers who can take advantage of individualized energy consumption analysis and savings recommendations included in HERs, regardless of their baseline consumption levels. Standard HER programs using a randomized control trial (RCT) design typically select high energy consumers as participants. As a result, low energy consumers (for example, residents living in multifamily complexes and smaller homes) often miss the benefits of the program. In addition, customers that belong to control groups with a RCT miss the benefits of program participation. By switching to a deemed savings approach, RMP is more inclusive in delivering valuable, customized efficiency data to virtually all its customers.

RMP's transition from an RCT to a deemed savings program design also introduces a significant evaluation challenge. The *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*[38] does not include an evaluation methodology for a deemed approach to HER program savings. As such, a novel, rigorous and defensible evaluation methodology is necessary to support the program design's sustainability.

When it made the transition, RMP began treating previously untreated control group customers, which eliminated the ability to use standard methods to verify the savings generated by the program (comparing treated and untreated customers' energy consumption).

ADM identified Variance-in-Adoption (VIA) as a viable method to calculate ex-post savings for 2020 without RCT control groups. VIA was viable because pre-treatment participant consumption data was available within 2020 since new participants were added in late 2020. In addition, for all but the first wave, untreated customers were available to act as a baseline.

Unfortunately, VIA was not a viable methodology to calculate ex-post savings for 2021 because there were not enough untreated customers in 2021 to serve as a comparison

[38] National Renewable Energy Laboratory, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Golden, CO, August 2018, Chapter 17: Residential Behavior Evaluation Protocol.

group. In addition, because most customers have now been treated, 2020 is the last year that VIA is a viable evaluation method given the lack of valid post-2020 comparison data.

Therefore, ADM calculated 2020 savings using the deemed savings method proposed by Cadmus[39] and compared it to savings calculated using the VIA method to arrive at an ex-post realization rate. ADM then calculated 2021 savings using the Cadmus deemed saving approach and applied the 2020 ex-post realization rate to it to arrive at 2021 evaluated savings.

Without changes to the current program implementation, methods such as VIA which help to minimize estimation bias will not be viable because virtually all customers have been treated.

Deemed savings values for standard energy efficiency measures such as appliances, weather proofing, light bulbs, etc. are calculated using fixed, objective specifications (e.g., capacity, wattage, hours of use, etc.). In contrast, the deemed values for the RMP HER Program are based on past program performance. They do not account for factors that influence program savings such as changes in program implementation (HER contents, format, delivery frequency and consistency), savings degradation caused by energy efficiency improvement trends, differences between legacy and recently added participants' response to HER treatment, and external events such as the COVID pandemic, economic shock events, climate change, introduction of energy efficiency tax incentives, etc. The Cadmus deemed savings values are based on past program performance, but verifiable program results have many external influences that are not captured in past performance.

ADM proposes that RMP create a control group that is untreated and unbiased for use in future evaluations. ADM believes that RMP can designate a percentage of new RMP customers to add to the control group each year to create a viable and sustainable control group that will enable robust program evaluations.

[39] Cadmus, "Deemed Savings for Rocky Mountain Power Idaho HER Program," June 3, 2020. Included as Appendix B.

6.2 Conclusions

ADM reached the following conclusions based on its impact and process evaluations.

Customer survey responses indicate customers were satisfied with the program. Most of HER Program participants were satisfied with the reports and found the various components useful. Further, participants said receiving the reports had improved their opinion of RMP.

The program generated positive, statistically significant savings in 2020 and 2021. Savings fell within expected industry norms and resulted in an 84 percent realization rate during the evaluation period.

The transition to the deemed saving program design eliminated legacy control groups that had been used to calculate program energy savings. Creating a new control group will reestablish the ability of independent third-party program evaluators to complete program EM&V.

The contents of the HERs reflected several improvements made during the evaluation period. Several changes to the content and format improved the HERs and likely contributed to the generally high program satisfaction reported by program participants.

RMP used a conservative approach to estimate lower-consumption tier savings. Cadmus was unable to provide deemed savings recommendations for the lower-consumption tier of customers, not because there were no savings generated by program treatment, but because the population was too small at the time to calculate savings. Therefore, RMP based its lower-consumption tier ex-ante savings calculations on Cadmus' results in Utah for the lower-consumption tier with a slight downward adjustment. Utah results for the lower tier were 0.6 percent (year 1), 1.0 percent (year 2) and 1.0 (year 3 and beyond)[40]. RMP used 0.6 percent (year 1), 0.6 percent (year 2), and 1.0 percent (year 3 and beyond) to conservatively calculate lower-consumption tier ex-post savings.

Program implementation reflects the need for improved program data management. Datasets received for the evaluation reflected inconsistent and sometimes ambiguous data with less granularity than ADM would expect to receive for an evaluation. The inconsistent data quality led to concerns about data accuracy, created challenges for program evaluators, and increased cost of program evaluation.

Realization rates lower than 100 percent were likely caused by the following factors.

[40] See footnote 13, page 75.

- Ex-ante savings were calculated using deemed values, whereas ex-post savings were calculated using a regression analysis of billing data.
- The ratio of paper to emailed reports was higher during years from which deemed savings were calculated than during the evaluation period. Paper HERs generally generating greater savings than emailed HERs.
- As reported in the 2018-2019 program evaluation, legacy participants may have degraded savings due to influences exogenous to the program.

There is potential to expand use of the online portal. About one-quarter of HER Program participants who responded to the survey said they had logged into the online portal. Those who had accessed the portal generally found the information useful and the website easy to navigate. Customer write-in comments included requests for information that is already included on the portal, suggesting that the program may benefit from developing more customer awareness of the online portal and its contents.

Survey responses indicate customers are buying energy efficient items outside of RMP's rebate programs. Two-thirds of survey respondents indicated purchasing an energy-efficient product in 2020 or 2021. Of those respondents, 15 percent said that they had not received a rebate or discount for their purchase.

Customers generally perceive the information provided in the HERs to be valuable, though the perceived value varied by section. Fifty-eight percent scored tips and recommendations as valuable compared to 90 percent that rated the monthly usage history as valuable.

Home occupancy and changes to energy use questions suggest a portion of respondents have changed their energy needs or consumption behaviors from 2019-2022, independent of receiving HERs. A portion of survey respondents indicated that they had updated or renovated their home in a way that increased energy usage. A higher portion of respondents indicated that they worked from home in 2020 compared to 2019; this shift persisted in 2021 and 2022.

6.3 Recommendations

Based on these conclusions, ADM provides the following recommendations to improve future program implementation.

Create a control group to use in billing analyses for future evaluations. The following steps could be taken to increase the quality of a control group for future savings estimates.

- As new WY customers reach eligibility for HERs treatment, add a percentage of randomly selected eligible customers to the control group.
- Add customers to control group with similar zip code distributions as customer distribution in the RMP service area.
- Once control groups reach 10,000 customers, continue adding new customers at a rate to replace customers lost through attrition, maintaining representative proportions of customer base zip code distribution.

Establish program and report specification as one would for a deemed measure in other energy efficiency programs. Specifications should minimally include the report content and cadence (including minimum number per year) and the ratio of paper to email formats.

Continue using consistent deemed savings percentages to calculate ex-ante savings, at least for the 2022-2023 evaluation cycle. Table 1-3 includes the percentages used to calculate ex-ante savings during the 2020-2021 evaluation period.

Table 6-1: Deemed Savings Percentages

Annual Consumption	Year 1	Year 2	Year 3+
< 7,973 kWh/yr	0.60%	0.60%	1.00%
>= 7,973 kWh/yr	1.13%	1.22%	1.27%

Improve program data management. Accurate, unambiguous, timely and complete program data should be recorded and maintained by the implementation contractor to ensure accurate ex-ante and ex-post program savings calculations as well as program efficacy.

Emphasize the benefits of the online portal. The participants that have accessed the portal find it useful, easy to navigate, and visually appealing. Greater engagement with the online portal could continue to improve customer engagement with energy efficiency.

Expand and continue to improve methodology explanations provided in the reports. Participant responses indicate a desire for a deeper understanding of how the home comparison as well as the appliance disaggregation. Providing additional

information and methodology could improve customer perceptions about report applicability and accuracy.

Highlight new and customized tips and recommendations. Though customers generally find tips and recommendations useful, survey responses suggest an opportunity to continue to refresh and customize the reports to include new tips and recommendations (or exclude tips and recommendations that have already been taken) to further promote energy efficiency.

Continue to focus on the HER user experience. Customer write-in responses provided several ways to improve the report-related contents, user experience, or features such as adding hyperlinks to the reports in their utility bill and incorporating a comparison to highly efficient home with details regarding what sets these homes apart.

Appendix A: Participant Survey

1. Do you recall receiving Home Energy Reports like the one below from Rocky Mountain Power? They include information about your home energy use and tips on how you can save energy. You would have received them either by email or mail.

   [INSERT EXAMPLE HOME ENERGY REPORT]

   1. Yes
   2. No [TERMINATE SURVEY]

2. How did you receive your Home Energy Reports? [MULTI-SELECT]

   1. Paper copies in the mail
   2. Email
   3. I did not receive any Home Energy Reports [TERMINATE SURVEY]
   98. I don't know [TERMINATE SURVEY]

3. About how many Home Energy Reports do you recall receiving in 2021? Your best guess is fine. [NUMERIC VALUE]

   [OPEN-ENDED]

4. How often did you read the Home Energy Reports in 2021?

   1. I read all the reports
   2. I read most of the reports
   3. I read about half of the reports
   4. I read a few of the reports
   5. I haven't read any of the reports
   98. I don't know

   [DISPLAY Q5 IF Q4 = 4 OR 5]

5. Why didn't you read more of the Home Energy Reports? [MULTI-SELECT] [RANDOMIZE 1-5]

   1. Do not have the time
   2. Not interested
   3. The suggested tips were not applicable to my home
   4. I did not find the information on the report to be valuable
   5. I did not find the information in the report to be accurate
   6. I didn't understand them
   96. Other (Please specify) [OPEN-ENDED]
   98. I don't know

6. Has anyone else in your household read the reports?

    1. Yes
    2. No
    97. Not applicable
    98. I don't know

7. Using the scale below, please rate how easy or difficult it is to understand the information in your Home Energy Reports. [INSERT 1-5 SCALE, WHERE 1 = VERY DIFFICULT AND 5 = VERY EASY, WITH 98=I DON'T KNOW]

8. How accurate do you believe the information in your Home Energy Reports is about your home energy usage? [INSERT 1-5 SCALE AS DEFINED 1=NOT AT ALL ACCURATE AND 5=VERY ACCURATE, WITH 98 = I DON'T KNOW]

    [DISPLAY Q9 IF Q8 < 3]

9. What do you think is inaccurate in your Home Energy Reports?

    [OPEN-ENDED]

10. How valuable are the following types of information included in your Home Energy Reports?

11. [RANDOMIZE ORDER, INSERT 1-5 SCALE AS DEFINED IS 1=NOT AT ALL VALUABLE TO 5=VERY VALUABLE, WITH 97 = NOT APPLICABLE AND 98 = I DON'T KNOW]

12. Please rate your satisfaction with the following aspects of the home energy reports: [RANDOMIZE ORDER, INSERT 1-5 SCALE AS DEFINED 1=VERY DISSATISFIED AND 5=VERY SATISFIED, WITH 98 = I DON'T KNOW]

    1. Home comparison
    2. Explanation of home comparison
    3. Monthly usage history
    4. Tips/recommendations
    5. Top costs by appliance category
    6. Frequency of reports
    7. Report overall

    [DISPLAY Q12 IF ANY ROW IN Q11 <3]

13. How could we improve the Home Energy Reports?

    [OPEN-ENDED]

14. Have the Home Energy Reports changed your opinion of Rocky Mountain Power?

    1. Yes
    2. No
    98. I don't know

    [DISPLAY Q14 IF Q13 = 1]

15. How have the Home Energy Reports changed your opinion of Rocky Mountain Power?

    [SCALE 1-5, WHERE 1 = GREATLY WORSENED, 5 = GREATLY IMPROVED, WITH 98 = I DON'T KNOW]

16. 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, I visited the portal within the last 30 days
    2. Yes, I visited the portal more than 30 days ago
    3. No, I do not recall visiting the portal

    [DISPLAY Q16 IF Q15= 3]

17. Why haven't you visited the online portal? (Please select all that apply) [MULTISELECT]

    1. Was not aware of the portal
    2. Not interested in my energy use
    3. Did not know how to access the portal
    4. Did not think the portal would provide useful information
    5. Did not have the time to use the portal
    6. Experienced technical difficulties trying to access the portal
    96. Other (Please describe)
    98. Don't know [MAKE EXCLUSIVE]

    [DISPLAY Q17 IF Q15 = 1 OR 2]

18. Using the scale below, how much do you agree or disagree with the following statements about the portal? [SCALE: 1 = 1 (Strongly disagree), 2 = 2, 3 =3, 4 = 4, 5 = 5 (Strongly agree), 98 = Don't know]

    1. The Rocky Mountain Power Home Energy Reports website was easy to navigate
    2. The information helped me understand how I use energy in my home
    3. The information helped me identify ways that I could save energy
    4. The contents of the Rocky Mountain Power Home Energy Reports website are interesting
    5. The Rocky Mountain Power Home Energy Reports website was visually appealing

[DISPLAY BLOCK IF GROUP = 1]

19. Have you changed how you do things to save energy based on information you learned from your Home Energy Reports in 2020 or 2021?

    1. Yes
    2. No
    98. I don't know

[DISPLAY Q19 IF Q18 = 1]

20. What have you changed? [INSERT OPTIONS DEFINED AS 1 = HAVE DONE THIS, 2 = HAVE NOT DONE THIS, 97 = THIS IS NOT APPLICABLE TO MY HOME] [RANDOMIZE]

    1. Allowed sun to heat home (opened curtains on south/west facing windows in winter)
    2. Ran ceiling fans in reverse in winter
    3. Let dishes air dry
    4. Dried clothes at lower temperature
    5. Unplugged second refrigerator when not in use
    6. Adjusted freezer temperature settings
    7. Washed clothes using cold water versus hot water
    8. Replaced old cookware with flat-bottomed cookware
    9. Kept refrigerator full to better maintain cold temperatures
    10. Shut flue damper on fireplace or wood stove after usage
    11. Made sure refrigerator had minimum clearance to allow operating at maximum efficiency
    12. Wrapped hot water heater in an insulating blanket
    13. Installed a dimmer switch to control lighting levels
    14. Turned off game consoles when not in use instead of leaving in stand-by mode
    15. Unplugged stereo when not in use
    16. Optimized display on television
    17. Used an electric kettle instead of a pot on the stove
    18. Checked seal on refrigerator to ensure appropriate tightness

[DISPLAY Q20 IF Q19<>1 AND Q18 = 1]

21. What did you do to change how you save energy?

[OPEN-ENDED]

22. Did you install these or any other energy saving products in 2020 or 2021? (Please select all that apply) [MULTI-SELECT] [RANDOMIZE 1-7]

    1. ENERGY STAR LED light bulbs

2. ENERGY STAR LED fixtures
3. Smart thermostat (e.g., Nest, Lyric, Ecobee, Sensi)
4. Energy efficient windows or doors
5. Attic, floor, or wall insulation
6. Advanced power strips
7. Low flow faucet aerators or showerheads
8. ENEGY STAR central air conditioner
9. ENERY STAR room air conditioner
10. ENERGY STAR clothes dryer
11. ENERGY STAR clothes washer
12. ENERGY STAR refrigerator
13. ENERGY STAR stand-alone freezer
14. ENERGY STAR heat pump water heater
15. ENERGY STAR dehumidifier
16. ENERGY STAR computer or computer monitor
17. ENERGY STAR scanner or printer
18. ENERGY STAR television
19. ENERGY STAR heat pump
96. Other (Please specify) [OPEN-ENDED]
20. None of the above [EXLUSIVE]

[DISPLAY Q22 IF Q21<>20 OR Q18 = 1]

23. How important was the information on your Home Energy Reports when you decided to…

[INSERT 1-5 SCALE AS DEFINED 1=NOT AT ALL IMPORTANT TO 5=VERY IMPORTANT, WITH 98 = I DON'T KNOW]

[DISPLAY IF Q18 = 1] TAKE NEW STEPS TO SAVE ENERGY

[DISPLAY IF Q21 <> 20] PURCHASE ENERGY EFFICIENT APPLIANCE(S) AND/OR EQUIPMENT.

[DISPLAY Q23 IF Q21=1]

24. How many LEDs did you purchase in the last 12 months?

[OPEN-ENDED]

[DISPLAY Q24 IF Q23>0]

25. Of those LEDs you purchased, how many are currently installed?

[OPEN-ENDED]

[DISPLAY Q25 IF Q21 = 3, 5, 10, 11, 14, 19]

26. Did you get a rebate or discount for the [ANSWER Q21]?

    1. Yes
    2. No
    98. I don't know

[DISPLAY BLOCK IF GROUP = 0]

27. Did you take any action to reduce energy use in your home in 2020 or 2021?

    1. Yes
    2. No
    98. I don't know

[DISPLAY Q27 IF Q26 = 1]

28. What actions did you take? [INSERT OPTIONS DEFINED AS 1 = HAVE DONE THIS, 2 = HAVE NOT DONE THIS, 97 = THIS IS NOT APPLICABLE TO MY HOME]

    1. Allowed sun to heat home (opened curtains on south/west facing windows in winter)
    2. Ran ceiling fans in reverse in winter
    3. Let dishes air dry
    4. Dried clothes at lower temperature
    5. Unplugged second refrigerator when not in use
    6. Adjusted freezer temperature settings
    7. Washed clothes using cold water versus hot water
    8. Replaced old cookware with flat-bottomed cookware
    9. Kept refrigerator full to better maintain cold temperatures
    10. Shut flue damper on fireplace or wood stove after usage
    11. Made sure refrigerator had minimum clearance to allow operating at maximum efficiency
    12. Wrapped hot water heater in an insulating blanket
    13. Installed a dimmer switch for to control lighting levels
    14. Turned off game consoles when not in use instead of leaving in stand-by mode
    15. Unplugged stereo when not in use
    16. Optimized display on television
    17. Used an electric kettle instead of a pot on the stove
    18. Checked seal on refrigerator to ensure appropriate tightness

[DISPLAY Q28 IF Q27<>1 AND Q18 = 1]

29. What did you do to change how you save energy?

[OPEN-ENDED]

30. Did you install these or any other energy saving products in 2020 or 2021? (Please select all that apply) [MULTI-SELECT] [RANDOMIZE 1-17]

    1. ENERGY STAR LED light bulbs
    2. ENERGY STAR LED fixtures
    3. Smart thermostat (e.g., Nest, Lyric, Ecobee, Sensi)
    4. Energy efficient windows or doors
    5. Attic, floor, or wall insulation
    6. Advanced power strips
    7. Low flow faucet aerators or showerheads
    8. ENEGY STAR central air conditioner
    9. ENERY STAR room air conditioner
    10. ENERGY STAR clothes dryer
    11. ENERGY STAR clothes washer
    12. ENERGY STAR refrigerator
    13. ENERGY STAR stand-alone freezer
    14. ENERGY STAR heat pump water heater
    15. ENERGY STAR dehumidifier
    16. ENERGY STAR computer or computer monitor
    17. ENERGY STAR scanner or printer
    18. ENERGY STAR television
    19. ENERGY STAR heat pump
    96. Other (Please specify) [OPEN-ENDED]

    [DISPLAY Q30 IF Q29 = 1, 2, 3 OR 5] [REPEATED FOR EACH 3, 4, 10, 11, 13, 18]

31. Did you apply for the [ANSWER Q29] Rocky Mountain Power rebate?

    1. Yes
    2. No
    98. I don't know

    [DISPLAY Q31 IF Q26 = 1 OR Q1 = 1]

32. How important was any information provided by Rocky Mountain Power when you decided to… [INSERT 1 5 SCALE, 1 = NOT AT ALL IMPORTANT AND 5 = VERY IMPORTANT, WITH 98 = I DON'T KNOW AND 99 = NOT APPLICABLE]

    [DISPLAY IF Q26 = 1] TAKE NEW STEPS TO SAVE ENERGY

    [DISPLAY IF Q1 = 1] PURCHASE ENERGY EFFICIENT APPLIANCE(S) AND/OR EQUIPMENT.

33. Did you take action to reduce energy use in your home before 2020?

    1. Yes
    2. No
    98. I don't know

    [DISPLAY Q33 IF Q26=1]

34. What did you do save energy before 2020?

    [OPEN ENDED]

35. In 2021 did your household enroll in a Time of Use energy plan with Rocky Mountain Power?

    1. Yes
    2. No
    98. Don't know

36. Rocky Mountain Power offers energy saving tips and usage information on its website (https://www.pacificpower.net/). Have you ever visited this website?

    1. Yes
    2. No
    98. Don't know

37. Have you created an online account at the Rocky Mountain Power website?

    1. Yes
    2. No
    98. Don't know

    [DISPLAY Q37 IF Q36=2 OR 98]

38. Why haven't you created an online account at the Rocky Mountain Power website? Please select all that apply.

    1. I didn't know about it
    2. I don't know how to
    3. I have concerns about internet privacy
    4. I don't think it would provide valuable or interesting information
    5. Technical difficulties
    96. Other [OPEN ENDED]

    [DISPLAY Q38 IF Q37=5]

39. What kind of technical difficulties did you have?

[OPEN ENDED]

[DISPLAY Q39-Q41 IF Q36=1]

40. How often do you log in to Rocky Mountain Power's website to view information on your home's energy use?

    1. I've logged in multiple times
    2. I've logged in just once
    98. Don't know

41. Using a scale from 1 to 4, where 1 is "not at all valuable" and 4 is "very valuable", how valuable would you say the energy-savings tips and information, available on the website, are? [SCALE: 1 (NOT AT ALL VALUABLE) – 5 (VERY VALUABLE), 98 = DON'T KNOW]

42. Do you have any suggestions for improving the energy-savings tips and information provided on the program website or via email?

43. How much do you agree or disagree with the following statements? [INSERT 0-10 SCALE 0 = STRONGLY DISAGREE, 10 = STRONGLY AGREE, WITH 98 = I DON'T KNOW] [RANDOMIZE 1 7]

    1. Energy efficiency saves money.
    2. I am not very concerned about the amount of energy used in my home.
    3. I am too busy to worry about making energy-related improvements in my home.
    4. Scarce energy supplies will be a major problem in the future.
    5. There is very little I can do to reduce the amount of energy I am now using.
    6. It is possible to save energy without sacrificing comfort by being energy efficient.
    7. I know of steps I could take to reduce my household energy use
    8. I intend to reduce my household energy use in the next 12 months

44. Including yourself, how many people are living in your household? [DROP DOWN BOX – 1-12, 13 or more, 99. Prefer not to answer]

45. How many people in your household worked or attended school from home BEFORE the pandemic? [DROP DOWN BOX – 1-12, 13 or more, 99. Prefer not to answer]

46. How many people in your household work or attend school from home now? [DROP DOWN BOX – 1-12, 13 or more, 99. Prefer not to answer]

47. How, if at all, has the coronavirus pandemic affected the amount of time you spend at home? [INSERT 1-5 SCALE, WHERE 1 = GREATLY DECREASED, 3 = DID NOT

CHANGE, AND 5 = GREATLY INCREASED, WITH 98 = I DON'T KNOW, 99 = PREFER NOT TO ANSWER]

48. How, if at all, has the coronavirus pandemic affected the amount of time others spend at your home? [INSERT 1-5 SCALE, WHERE 1 = GREATLY DECREASED, 3 = DID NOT CHANGE, AND 5 = GREATLY INCREASED, WITH 98 = I DON'T KNOW, 99 = PREFER NOT TO ANSWER]

49. How, if at all, has your electricity bill changed since the coronavirus pandemic began? [INSERT 1-5 SCALE, WHERE 1 = GREATLY DECREASED, 3 = DID NOT CHANGE, AND 5 = GREATLY INCREASED, WITH 98 = I DON'T KNOW, 99 = PREFER NOT TO ANSWER]

50. Finally, please answer a few questions about your household. As a reminder, your responses will remain confidential.

51. Do you rent or own your home?

    1. Rent
    2. Own
    99. Prefer not to answer

52. Which of the following best describes your home?

    1. Single-family home
    2. Manufactured or mobile home
    3. Duplex or triplex
    4. Apartment in an apartment building or complex
    5. Condominium or townhome
    96. Other (Please specify) [OPEN-ENDED]
    98. I don't know

53. When was your home built?

    1. Before 1960
    2. 1960-1979
    3. 1980-1999
    4. 2000-2009
    5. 2010 or later
    98. Don't know

54. What is the main fuel used for heating your home?

    1. Electricity
    2. Natural Gas

3. Propane
4. Heating Oil
5. Wood
6. Don’t heat home
7. Other (Please specify)
8. I don’t know

55. What kind of water heating system do you have?

1. Natural gas storage tank water heater
2. Electric storage tank water heater
3. Heat pump water heater
4. Natural gas tankless water heater
5. Electric tankless water heater
96. Other (please specify)
98. I don’t know

56. Approximately how much is your average monthly electric bill?

1. $0-$50
2. $51-$100
3. $101-$150
4. $151-$200
5. $201-$250
6. $251-$300
7. $301-$350
8. $351-$400
9. $401-$450
10. $450 or more
98. Don’t know
99. Prefer not to say

57. What is the primary language spoken in your home?

1. English
2. Spanish
3. Chinese
4. German
5. Native American language
6. Vietnamese
7. Russian
8. Tagalog
9. Hmong

10. Korean
11. African language
12. French
13. Japanese
96. Other (Please specify)
99. Prefer not to answer

56. How would you characterize the community that you live in?

1. Urban (relatively densely populated area)
2. Rural (sparsely populated open area)
3. Suburban (area outside downtown of city, primarily residential area)
96. Other (Please specify)
98. I don't know

58. How old are you?

1. Under 18 years old
2. 18-24 years old
3. 25-34 years old
4. 35-44 years old
5. 45-54 years old
6. 55-64 years old
7. 65-74 years old
8. 75-85 years old
9. 86 years old or older
10. Prefer not to answer

59. Which of the following best describes the highest level of education you've completed in school?

1. Less than high school
2. High school graduate/GED
3. Associates degree, vocation/technical school, or some college
4. Four-year college degree
5. Graduate or professional degree
98. I don't know
99. Prefer not to answer

60. Part of our goal in this survey is to help Rocky Mountain Power ensure it is serving everyone in its territory. To help us better understand who Rocky Mountain Power is serving, we are interested in the ethnicity of survey respondents. I identify my ethnicity as… (Please Select All that Apply)

1. Asian

2. Black/African American
3. Caucasian/White
4. Hispanic or Latino
5. Native American or Alaska Native
6. Pacific Islander or Native Hawaiian
7. Middle Eastern or North African

96. Other (Please specify)
99. Prefer not to answer

61. Including yourself, how many people are living in your household? [DROP DOWN BOX – 1-12, 13 or more, 99. Prefer not to answer]

62. Is your annual household income over or under [CUTOFF]?

IF Q60 = 1 CUTOFF = $27,180
IF Q60 = 2 CUTOFF =$36,620
IF Q60 = 3 CUTOFF = $46,060
IF Q60 = 4 CUTOFF = $55,500
IF Q60 = 5 CUTOFF = $64,940
IF Q60 = 6 CUTOFF = $74,380
IF Q60 = 7 CUTOFF = $83,820
IF Q60 = 8 CUTOFF = $93,260
IF Q60 = 9 CUTOFF = $102,700
IF Q60 = 10 CUTOFF = $112,140
IF Q60 = 11 CUTOFF = $121,580
IF Q60 = 12 CUTOFF = $131,020
IF Q60 = 13 CUTOFF = $140,460
IF Q60 = 14 CUTOFF = $149,900

1. Over
2. Under
3. I don’t know

99. Prefer not to answer

Appendix B: Memo Establishing Deemed Savings

Memorandum

To: Rocky Mountain Power [Staff names redacted]

From: Cadmus [Staff names redacted]

Subject: Deemed Savings for Rocky Mountain Power Idaho HER Program

Date: December 18, 2020

Introduction

Rocky Mountain Power operates a home energy reports (HER) program in Idaho. The program has consistently delivered energy savings and high customer satisfaction since the program was launched in 2014. In Idaho in 2019, Rocky Mountain Power delivered energy reports to 34,960 customers belonging to two waves, and the program saved between 0.8% and 2.0% of electricity consumption, depending on the wave.[1] While Rocky Mountain Power has recently expanded its Idaho HER program, many of its residential customers still do not receive energy reports.[2]

Rocky Mountain Power is considering expanding its HER program to serve all residential customers in Idaho.[3] This would require changing the program evaluation approach. Currently, Rocky Mountain Power implements the HER programs as opt-out randomized controlled trials (RCT), in which eligible residential customers are randomly assigned to the program treatment or control group. Control group customers do not receive energy reports and provide the baseline for measuring the energy savings of treatment group customers. Delivering energy reports to all residential customers would require abandoning the RCT approach, which is the industry gold standard for evaluating HER programs.

Rocky Mountain Power asked Cadmus to investigate whether its HER program in Idaho could reliably be evaluated with a deemed savings approach given that the program has a record of five years of consistently delivering energy savings of between 1.2% and 1.6%.[4] With a deemed savings approach, Rocky Mountain Power would claim savings equal to a percentage of a customer's consumption if the customer received a minimum number of energy reports during the program year.

[1] Based on Cadmus analysis of monthly billing consumption data for Rocky Mountain Power Idaho HER program participants. The Rocky Mountain Power Idaho HER program comprises two waves: Legacy (first reports delivered in 2014) and Expansion (2019). In 2019, The Legacy and Expansion waves saved 1.6% and 0.6% of control group consumption, respectively. Rocky Mountain Power Idaho HER treatment customers have been treated for six years (Legacy wave) and one year (Expansion wave).

[2] There were 52,597 Rocky Mountain Power residential customers in Idaho in 2019, according to billing consumption data.

[3] Some energy reports information modules are based on analysis of the customer's consumption over the previous 12 months. Customers may be required to reside at the same location for 12 months before the first report can be generated.

[4] See Cadmus (2020) for the most recent evaluation of Rocky Mountain Power Idaho's HER program.

Research Objectives

For a deemed savings approach to evaluating Rocky Mountain Power's HER program to be reliable, the following conditions must hold:

(1) **Accuracy**: the evaluated savings on which the deemed savings values would be based must be accurate;
(2) **Predictability:** the HER energy savings must be predictable, so that past evaluated HER program savings will be a good predictor of future program savings; and
(3) **Externally validity:** if Rocky Mountain Power plans to send reports to residential customers who have never received HERs, the deemed savings values must be applicable to these customers.

The rest of this memo presents Cadmus' assessment of whether these conditions are met and the validity of using a deemed savings approach for evaluating the Rocky Mountain Power Idaho HER program. The focus of this research is on assessing the second and third conditions, because, as discussed below, the accuracy of the evaluated RCT annual savings are not at issue. To assess the second and third questions, Cadmus analyzed the evaluated annual savings from Rocky Mountain Power's HER programs and the HER programs of other utilities as well as billing data for Rocky Mountain Power Idaho residential customers. All evaluated HER savings analyzed in this memo come from RCTs, so these data are of high quality.

Summary of Main Findings

Cadmus found that the Rocky Mountain Power Idaho RCT savings estimates are accurate indicators of past program performance and that these savings estimates could be used to develop deemed savings values. However, because of the small program size (there is only one long-running Rocky Mountain Power Idaho HER wave), it was not possible to test formally whether the savings from Idaho HER program reached a steady state. In fact, visual inspection of the annual percentage savings estimates suggests otherwise, that is, there is an upward trend in savings from year 3 through year 5. This implies that any deemed savings based on the RCT evaluation savings estimates may underestimate the true savings. The assessment also determined that customers participating in the HER experiment tend to have higher consumption than customers not participating. This means that the evaluated savings from the RCT experiments cannot be applied to the non-participant population without first testing whether the percentage HER savings differ between low and high consumption customers. Cadmus could not perform such a test because the Rocky Mountain Power Idaho program has not treated enough low consumption customers. This memo concludes with recommendations for deemed HER savings values for high consumption customers based on a regression analysis of Rocky Mountain Power Idaho customer billing consumption data. Cadmus was unable to develop deemed savings values for low consumption customers because not enough of them have received treatment. The assumption underlying the deemed savings values for the high consumption customers is that Rocky Mountain Power will continue to implement the HER program similarly, including that energy reports are delivered with the same frequency and cadence and that a similar mix of paper and electronic reports will be delivered to residential customers. Changes in program implementation could cause the realized savings to differ from the deemed values.

Deemed Savings Approach Assessment

Accuracy of Evaluated Savings

The first condition regarding the accuracy of the Rocky Mountain Power HER savings estimates is not in question. As noted above, RCTs are the gold standard in program evaluation, as they are expected to produce unbiased savings estimates.[5] All Rocky Mountain Power HER program evaluations were conducted as large RCTs involving thousands of residential customers.[6] The energy savings estimates from these evaluations are precise and of high quality and the evaluated savings or the billing data from these experiments can be used to construct deemed savings values.

Predictability of HER Savings

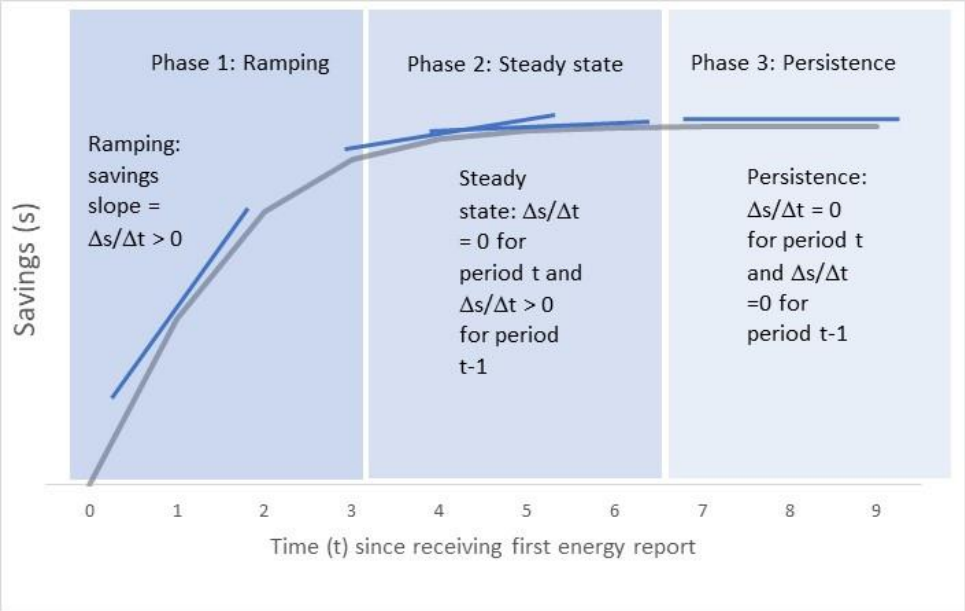
Most RCT impact evaluations from long-running utility HER programs suggest that savings reach a steady state after customers receive energy reports for two or three years (Khawaja and Stewart 2014). Figure 1 illustrates the hypothesized savings trend for a typical HER program since the time of first treatment. The horizontal axis shows time (in years) since the first reports were delivered and the vertical axis shows savings. Typically, during the first two years of a HER program, savings ramp up. After the third or fourth year of report delivery, the HER savings plateau and reach a steady state. HER savings usually persist while treatment continues.[7]

[5] See Stewart and Todd (2017), Allcott (2011), and Allcott (2015) about use of RCTs for evaluating HERs programs.

[6] For its evaluation of Rocky Mountain Power's Idaho HER program, Cadmus validated the research design by verifying that the sample sizes were sufficient and that customers had been properly randomized into treatment and control groups.

[7] Research about HER savings persistence suggests that persistence may be due to habit formation (Allcott and Rogers, 2014) and installation of energy savings measures (Brandon et al., 2017).

Figure 1. Typical HER Program Savings Time Path



Rocky Mountain Power Idaho HER Savings Trends

Cadmus analyzed savings trends for the Rocky Mountain Power Idaho HER program to demonstrate that savings follow the predictable trend shown in Figure 1, specifically, the savings reach a steady state after two years of treatment and that the steady state is maintained while customers receive reports. We collected and analyzed annual savings estimates from recent evaluations of Rocky Mountain Power's Idaho HER programs and the HER programs of other utilities to estimate how HER savings evolve over time.

To estimate the HER savings trends, we ran an ordinary least squares (OLS) regression of HER program annual percentage savings on a utility-wave fixed effects and separate indicator variables for each year of treatment.[8] Savings (the dependent variable) were expressed as percentages to normalize for differences between utility-waves in customer baseline consumption. The coefficients on the indicator variables show the percentage savings in each year of treatment. The utility-wave fixed effects control for differences in the program populations and program implementations and allow for the first-year percentage savings to vary between utilities and between waves of the same utility. This regression analysis abstracts from fluctuations in annual savings due to weather and other idiosyncratic factors to characterize the typical HER savings time path, that is, the rate at which savings ramp up over time, the steady-state savings level, and whether savings persist in the long run while treatment continues. This non-parametric regression analysis imposes no functional form assumptions about the relationship between HER percentage savings and year of treatment.

[8] The regression also included an indicator variable for years when delivery of energy reports was suspended. This variable equaled one in years with suspensions and zero otherwise.

In a second set of regressions, we attempted to test whether the savings trend for Rocky Mountain Power Idaho's HER program differs from the savings trend for the other utilities in the analysis sample. We did this by first re-running the first regression with an additional independent variable to indicate if the savings were from a Rocky Mountain Power Idaho HER program year that was year 3 or higher. We then ran a second regression with a set of year-of-treatment indicators interacted with a dummy variable for whether the savings estimate was from Rocky Mountain Power Idaho. If the coefficient in the first regression was not statistically different from zero, this would indicate that *on average* there were no differences in savings for year 3 or higher between Rocky Mountain Power Idaho and the other utilities. In this case, we then conducted a statistical test of the hypothesis that the coefficients on each of the interaction variables in the second regression for program years 3 and higher were equal to zero, which would indicate that any difference between Rocky Mountain Power Idaho's savings and the steady-state savings of other utilities did not vary across years. If the first-stage regression coefficient proved statistically significant, the test from the second stage regression was that the interaction variables in the second regression for program years 3 and higher were equal to coefficient from the first-stage regression. If it is not possible to reject this hypothesis, this would indicate that any difference in savings between Rocky Mountain Power Idaho and the other utilities for program years 3 and higher was constant over time, again suggesting Rocky Mountain Power Idaho savings reached a steady state.

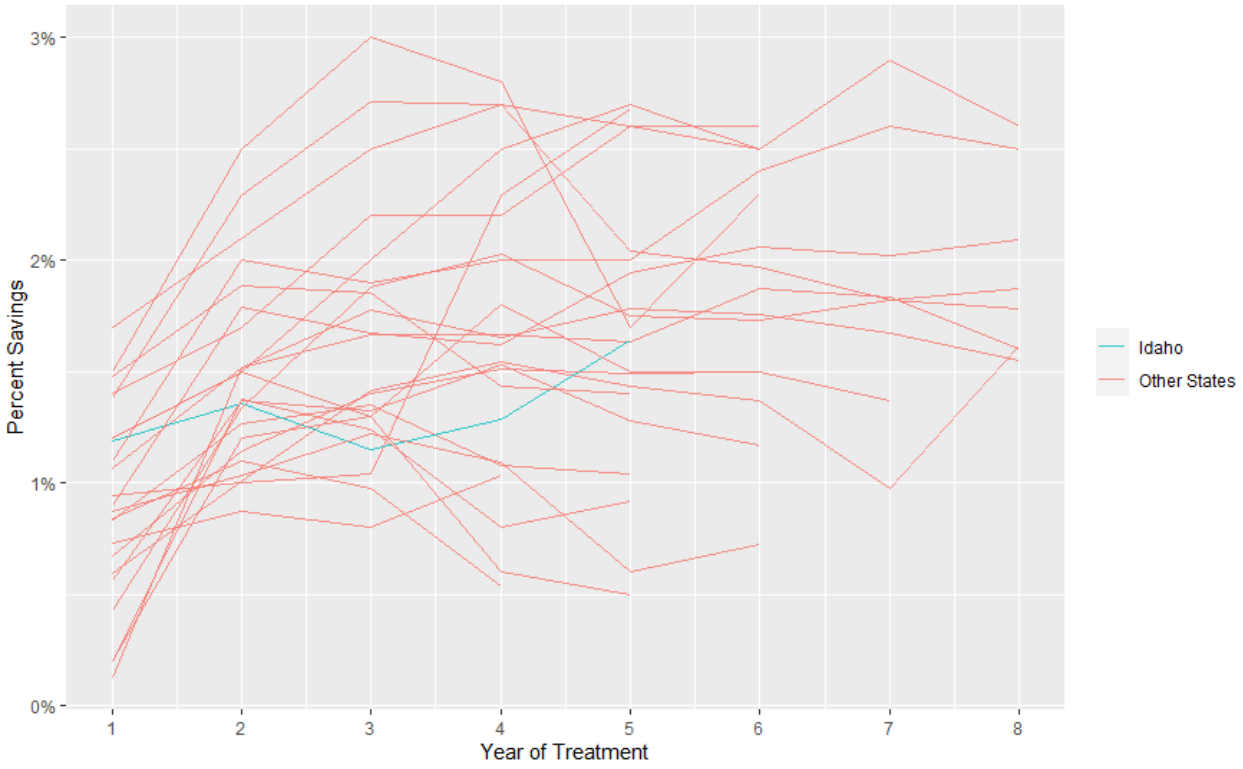
The analysis sample includes data for six utilities and 23 utility-waves and a total of 145 observations of annual percentage HER savings.[9] Specifically, we analyzed annual HER savings from the long running HER programs of Pacific Power (Washington), Rocky Mountain Power (Utah, Idaho, and Wyoming), Vectren (Indiana), PPL Electric (Pennsylvania), Commonwealth Edison (Illinois), and Indianapolis Power & Light (Indiana).[10] Like Rocky Mountain Power's Idaho program, many of these programs comprise multiple waves of customers, and we collected data for as many waves as possible. All annual savings estimates data came from publicly available reports. For both regressions, the analysis sample was restricted to utility-waves with at least four program years of annual savings and all data for program years greater than eight were dropped.

Figure 2 plots the annual HER percentage savings estimates from evaluations of Idaho's program and the programs of other utilities in the analysis sample. There are differences between utility waves in the percentage savings levels, but most waves show a year or two of ramping and then a leveling of savings. The savings for the Rocky Mountain Power Idaho Legacy wave is presented in blue. The Rocky Mountain Power Idaho Legacy wave savings trended upward after year three.

[9] There were not enough annual savings estimates from Rocky Mountain Power Idaho's HER program to develop a separate model for Idaho.

[10] The annual savings data were collected from evaluations Cadmus conducted of long-running HER programs.

Figure 2. HER Program Savings Trends for Utility Waves



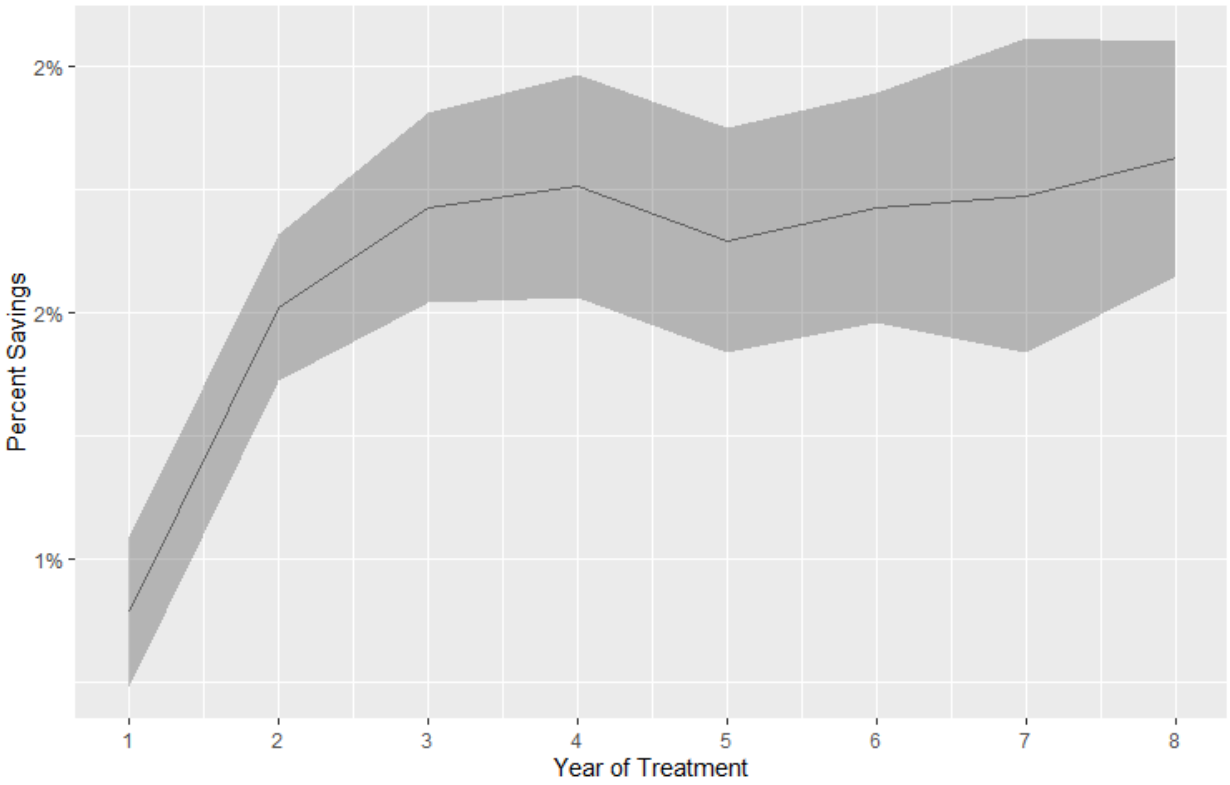
Results

Figure 3 shows the regression-based estimate of annual percentage savings for each year of treatment with a 90% confidence interval for treatment years one through eight. As shown by the 90% confidence intervals, all coefficients were precisely estimated and statistically different from zero. The R^2 of the model shows that the wave-year fixed effects and the year-of-treatment indicators can explain 85.1% of the variation in annual percentage savings around the mean.

The estimates of annual savings for each year of treatment follow a trend similar to that depicted in Figure 1. The savings appear to ramp for two years before reaching a steady state around the third year of treatment.[11]

[11] Cadmus ran several checks of this main result. These included (1) estimating a parametric version of the regression using a cubic polynomial in year of treatment rather than individual dummy variables; (2) varying the utilities included in the analysis sample; and (3) varying the sample selection criteria regarding the minimum number of annual savings estimates. The results did not change.

Figure 3. Estimated Conditional Mean HER Savings Trend



Notes: Dependent variable is HER annual percentage energy savings. Model was estimated by OLS with standard errors clustered on utility-waves. Observations were weighted by the number of treated customers in the wave.

To test formally for a savings steady state, we conducted an F test of the hypothesis that the savings for year 3 through year 8 of treatment were not statistically different conditional on wave-year fixed effects. The results of the F test in Table 1 show that we cannot reject this hypothesis. The F statistic equals 0.78 and the p-value equals 0.58, suggesting that the savings do not change after year 3 while treatment continues. Cadmus also estimated a model with utility-wave fixed effects, separate indicator variables for program year two, and program year three or greater of treatment, and a time trend variable that takes on the value of 0 in program years 1 and 2 and then that increases by one unit in each subsequent program years. The coefficient on the time trend was small and statistically insignificant (t stat = -0.67, p value = 0.511), again suggesting that savings did not trend up or down after reaching a steady state.

Table 1. Test for a HER Program Savings Steady State

F Statistic	Degrees of Freedom (num, den)	p value
0.78	5, 22	0.578

Notes: Table shows results of F test of hypothesis that the coefficients (savings) on the program years 3-8 indicator variables are equal. Dependent variable in the regression is HER annual percentage energy savings. Model was estimated with 135 utility wave-year observations by OLS with standard errors clustered on utility-wave.

Figure 1 and these statistical tests show that savings of HER programs in the analysis sample reach a steady state after the third year of treatment, but do the savings of Rocky Mountain Power Idaho's HER program behave similarly? Unfortunately, it was not possible to test formally for differences in savings between Rocky Mountain Power Idaho's HER program and the HER programs of the other utilities in the analysis sample by running the two-stage test described above. There is only one long-running Rocky Mountain Power Idaho HER wave with five observations of annual savings in the analysis sample. This is too few observations for testing the hypothesis. However, looking at the savings trend for the Idaho Legacy wave in Figure 2, an upward savings trend after year three is evident, suggesting that the savings for this wave may not have reached a steady state after year 5. If savings are still increasing and a steady-state has not been reached after year 5, deemed savings values obtained from analysis of consumption data for years 1 through year 5 may provide a conservative (smaller) estimate of HER savings in year six and higher than the savings actually achieved.

External Validity of the HER Savings Estimates

Cadmus assessed the extent to which Rocky Mountain Power Idaho HER savings estimates would be applicable to Rocky Mountain Power residential customers who are not participating in the HER program. This is important because existing participants (treatment and control group customers) in the HER program may be different than customers not in the program. Allcott (2015) estimated HER savings for over 100 HER deployments across the United States and found that savings from the first deployments were significantly greater than savings from subsequent deployments. A similar phenomenon could exist in Idaho in which the highest expected savers were selected for the program. We assessed the external validity of Rocky Mountain Power's HER savings estimates by comparing the energy consumption, demographic, and home characteristics of residential customers participating and not participating in the RCT evaluations.

Expanding the Idaho HER program would involve sending energy reports to three groups of customers, two of which have not previously received reports:

- **RCT customers who were randomly assigned to the HER program treatment group**. These customers received energy reports and prior RCT evaluations provide savings estimates for these customers. The analysis above demonstrated that the evaluated savings from the RCTs will be reliable indicators of future savings for this group.
- **RCT customers who were randomly assigned to the HER program control group.** Because of the random assignment, control group customers will be similar to customers currently receiving energy reports and are expected to have similar savings trends.
- **Customers not participating in the RCT**. The non-RCT customers may have different energy consumption characteristics and savings potential than RCT customers, and the evaluated savings of the Rocky Mountain Power Idaho program may not apply to this group.

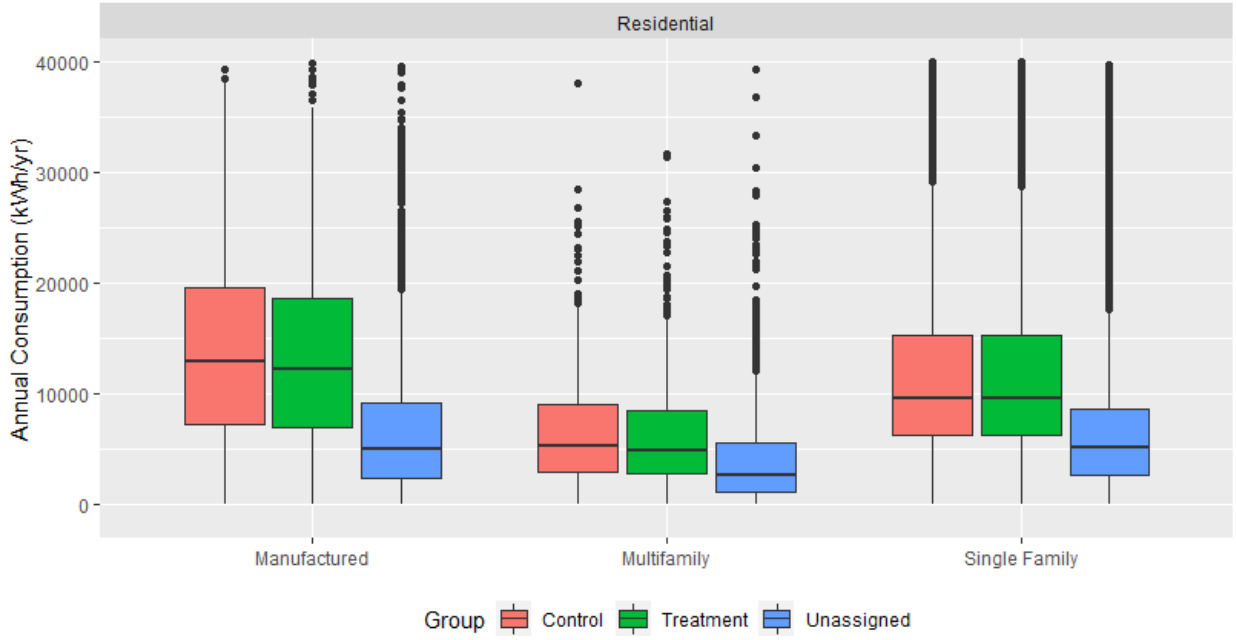
Cadmus collected energy consumption, demographic, and home characteristic data for all Rocky Mountain Power Idaho residential customers from Rocky Mountain Power's customer information system (CIS). Specifically, Cadmus collected the following data on customer characteristics shown to influence HER savings:

- Annual electricity consumption
- Type of household

Cadmus then assessed the magnitudes of the differences between RCT and non-RCT customers.

Figure 4 compares the annual electricity consumption of customers included in Rocky Mountain Power's Idaho's HER experiments (customers assigned to the treatment or control group of any wave) and customers who were not included (Unassigned). The figure is presented by home type (manufactured, multifamily, and single-family).

Figure 4. Annual Consumption Distributions for HER Experimental and Non-experimental Populations



Note: In the figure above, each box spans the 25th to 75th annual consumption percentiles. The horizontal line within each box shows the mean of the annual consumption. Lines extending vertically outside each box show the remaining 50% of customers within each group, and those who fall outside 1.5 times the range of the box are represented by dots and considered to be statistical outliers. Cadmus limited the statistical outliers shown in this figure to preserve the scale.

As expected, treatment and control groups had similar mean annual consumption and annual consumption distributions (shown by the bottom (25th percentile) and top (75th percentile) of the box). The figure also shows that the HER experiments tended to include residential customers with higher consumption and exclude residential customers with lower consumption, though the distributions of the experimental and Unassigned populations partially overlap. This overlap is important because it means that it may be possible to use the HER experiments to predict savings for customers who have not received reports. As explained below, Cadmus analyzed the monthly billing data from the HER experiments to obtain deemed savings values for Rocky Mountain Power's Idaho's residential customer population.

Cadmus formally tested if mean annual electricity consumption differed significantly for customers assigned to an existing HER program experiment control group and those who remained unassigned.

Table 2 shows the results of the two-sample t-test. Consistent with the boxplot shown in Figure 4, Cadmus found that unassigned customers in Rocky Mountain Power Idaho's territory consumed significantly less than customers assigned to a control group in one of its ongoing HER programs.

Table 6. Test for Difference in Average Pre-Treatment Consumption

Mean Annual Consumption (kWh/yr)			T Statistic	Degrees of Freedom	p value
Control	Unassigned	Difference			
11,860	7,182	4,678	36.62	24,373	< 0.0001

The differences between the experimental population and the unassigned population mean that Rocky Mountain Power Idaho should not directly apply the evaluated percentage savings from the RCT experiments without first checking if the HER savings in the experiment depended on annual consumption.

Deemed Savings Values

Using monthly billing consumption data for the customers in the Idaho HER experiments, Cadmus estimated HER savings as a function of customer pre-treatment annual consumption. If the percentage savings depend on consumption, the RCT evaluated savings will not have validity for the unassigned population and should not be used as deemed savings values.

We ran two separate regressions, one for the savings ramping phase (program years one and two) and the other for the steady state phase (program year three and subsequent years). In each regression, the dependent variable was the natural logarithm of average daily consumption in the month, so the coefficients in the regression can be interpreted as approximate percentage effects of HER treatment on consumption. Both regressions estimated savings conditional on a customer's annual pre-treatment consumption. Each customer in the HER experiments was assigned to a consumption bin based on their annual pre-treatment consumption. Cadmus defined the two bins by whether customers in the HER experiment were in the top 50% of Idaho's customer population's annual electricity consumption.

Given that customers in the Expansion wave were only treated beginning in June 2019 and comprised more than 80% of the low consumption group, we decided against using their first year of treatment in the ramp-up analysis, as estimates would not accurately reflect a full year's worth of savings. We used data from the first two program years of Rocky Mountain Power Idaho's Legacy wave to estimate the ramping phase regression. Legacy Wave data for program years three or higher from 2017 to 2019 were used to estimate the steady state phase regression.[12] The regressions pooled data from the two waves to estimate the average first-year saving for the higher-consuming group of customers.

Table 3 shows the number of customers in each consumption bin, by wave and group assignment. The Legacy wave largely comprised high-consuming customers, and few of them fell within the lower consumption bin. Expansion wave customers are more evenly distributed across the bins, but because

[12] PacifiCorp transitioned between HER vendors in 2018, which caused a four-month gap in treatment during the 2018 program year. Cadmus determined that HER savings observed during this year would not be reflective of future program savings and so did not include 2018 in its deemed savings analysis.

these customers had only received seven months of treatment in 2019, Cadmus did not include Expansion wave customers in the lower-consumption bin in the ramp-up analysis. As a result, Cadmus could not estimate first-year savings for customers in the lower consumption bin.

Table 3. Savings Analysis Sample Sizes by Consumption Bin

Wave	Group Assignment	Customer counts by consumption bin	
		Bottom 50% < 7,973 kWh/yr	Top 50% >= 7,973 kWh/yr
Legacy	Control	628	8,119
	Treatment	931	12,195
Expansion	Control	2,741	2,738
	Treatment	3,847	3,761
Total	Control	3,369	10,857
	Treatment	4,778	15,956

Cadmus ran regressions to estimate the ramp-up and steady-state savings values for the top and bottom 50% of customers. Table 4 and Table 5 show the regression-based estimates of the average treatment effects in ln(kWh) per customer per day (=-1*savings) and the standard errors for the ramping phase and steady state phases. As shown in Table 4, Cadmus could only detect statistically significant savings for customers in the higher consumption bin. Cadmus could not detect savings for lower-consuming customers in either ramp-up year because of the small number of Legacy and Expansion wave customers in the low consumption bin.

Table 4. Ramping Phase Savings Estimates by Consumption Quartile

Year of Treatment	Consumption Bin	Estimated Treatment Effect (ln(kWh) per customer per day)	Standard Error	p-value
1	< 7,973 kWh/yr	0.0019	0.0088	0.8331
	>= 7,973 kWh/yr	-0.0113	0.0027	< 0.0001
2	< 7,973 kWh/yr	-0.0068	0.0066	0.3019
	>= 7,973 kWh/yr	-0.0122	0.0028	< 0.0001

Source: Cadmus analysis of Rocky Mountain Power Idaho HER program customer data. See text for details.

Table 5 shows the estimated steady-state treatment effects (year 3+) for each consumption bin. Again, Cadmus could not detect significant savings for lower-consuming customers. Customers in the higher-consuming bin reduced their consumption by approximately 1.3%, a slight increase over their second-year ramp-up savings of approximately 1.2%.

Table 5. Steady State Phase Savings Estimates by Consumption Quartile

Consumption Bin	Estimated Treatment Effect (ln(kWh) per customer per day)	Standard Error	p-value
< 7,973 kWh/yr	-0.0041	0.0141	0.7718
>= 7,973 kWh/yr	-0.0128	0.0038	0.0008

Source: Cadmus analysis of Rocky Mountain Power Idaho HER program customer data. See text for details.

Recommended Deemed Savings Values

Cadmus recommends the deemed savings values in Table 6 to calculate HER savings if a control group cannot be established. The deemed savings values were obtained from the regression-based savings estimates in Table 4 and Table 5 and vary by the customer's length of treatment.

Table 6 does not provide deemed savings for the low consumption customers because the number of customers available to estimate the savings for this group was too small after removing customers in the Expansion Wave, who only received treatment for seven months in 2019 but made up more than 80% of the lower-consuming group.[13]

Table 6. Recommended Deemed Percentage Savings Values

Consumption Bin	Program Year 1	Program Year 2	Program Year 3+
< 7,973 kWh/yr	NA	NA	NA
>= 7,973 kWh/yr	1.13%	1.22%	1.27%

Note: Deemed savings values for program years 1 and 2 and consumption range were calculated from the regression coefficients in Table 4 as deemed savings = -1*[exp(est. reg. coefficient) -1], where exp is the exponential function.

It should be emphasized that these deemed savings values assume that Rocky Mountain Power Idaho will continue to implement the HER program similarly, including that energy reports are delivered with the same frequency and cadence and that a similar mix of paper and electronic reports will be delivered to residential customers. Changes in program implementation could cause the realized savings to differ from the deemed values.

[13] A similar deemed savings analysis conducted for customers in the Rocky Mountain Power Utah HER programs estimated that customers consuming less 4,047 kWh/yr reduced their consumption by 0.6% and 1.0% in their first two years of treatment, respectively, and 1.0% in year 3 and beyond, and that customers consuming between 4,047 kWh/yr and 7,027 kWh/yr reduced their consumption by 0.7% and 1.3% in their first and second years of treatment and 1.5% in year 3 and beyond. The deemed savings analysis conducted for customers in the Pacific Power Washington HER programs found that customers consuming less than 7,501 kWh/yr reduced their consumption by 1.0% in year 1, 1.24% in year 2, and 1.48% in year 3 and beyond.

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