# Evaluation, Measurement & Verification Report

# Utah Home Energy Report Program

# 2020-2021

Prepared for

Rocky Mountain Power

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# Table of Contents

# List of Tables

# 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** – 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 use 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 is 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.

**Ex-post savings** – Savings estimates based on program results rather than forecasts.

**Evaluated savings** – 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 as a result 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 is 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 Utah 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 146 kWh with a total program savings of 61,113,784 kWh. During 2021, the average evaluated annual household savings was 173 kWh with a total program savings of 94,397,149 kWh. Table 1-1 summarizes total evaluated program savings.

*Table 1-1: 2020-2021 Utah HER Program Evaluated Savings*

| Year | Participant Count[1] | Average Evaluated Annual Household Savings (kWh) | Total Evaluated Program Savings (kWh) |
|---|---|---|---|
| 2020 | 418,611 | 145.99 | 61,113,784 |
| 2021 | 545,521 | 173.04 | 94,397,149 |

The HER Program resulted in a realization rate of 93 percent during the evaluation period (see Table 1-2).

[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.

*Table 1-2: 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 | 67,689,105 | 61,113,784 | 90%[2] | 61,113,784 | 67,613,670 | 90% |
| 2021 | 104,553,475 | N/A | 90%[3] | 94,397,149 | 99,935,000 | 94% |
| **Total** | **172,242,580** | **N/A** | **90%** | **155,510,933** | **167,548,670** | **93%** |

## 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 the control group with a RCT miss out on 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).

To identify an evaluation methodology to verify program savings without the RCT control groups, ADM tested multiple research designs and modeling approaches using customer

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

[3] Applied 2020 Ex-post Realization Rate

[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.

billing data, including Propensity Score Matching (PSM), pre-post treatment only, and Variance-in-Adoption (VIA). ADM identified VIA as a viable method to calculate ex-post savings for 2020. 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 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 and PSM 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 can be reasonably identified as untreated and unbiased for use in future evaluations. An existing group of 132,000 customers was identified during the evaluation process that received very limited treatment. ADM believes that with careful consideration, a subset of 25,000 customers in this group can be identified to create a useful comparison group. This group, along with a designated percentage of new RMP customers to add to the comparison group each

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

year, would constitute a viable and sustainable cohort 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 fall within expected industry norms and resulted in a 93 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. A group of minimally-treated customers could be used as a pool from which to create a new, smaller comparison group of customers.** Reestablishing a comparison group will also 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.

**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.**

- 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.

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

- As reported in the 2018-2019 program evaluation, legacy participants may have degraded savings due to influences exogenous to the program.
- In 2021, over 132,000 customers were added to the pool of treated customers yet received treatment limited to only two paper reports. Deemed savings were claimed for these customers. Savings reflected in the billing analysis that included these customers was likely depressed by the inclusion of these minimally treated customers.

## 1.4 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.

- Restrict to the set of approximately 132,000 customers whose treatment was limited to two paper reports in 2021.[7]
- Restrict to customers who were not treated between 2011 and 2019.
- Restrict to customers with complete billing data from 2011 to present (or 2017 to present if earlier data is unavailable).
- Select a control group which could consist of approximately 15-20,000 customers using PSM and do not send them any HERs. ADM offers to collaborate with the implementer to check control group selection method and provide an EM&V perspective.
- Maintain the control group by annually adding a fixed percent of new RMP customers to sustain the group with characteristics similar to the treatment group.

**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.

**Improve program data management.** Accurate, unambiguous, timely and complete program data should be recorded and maintained by the implementation contractor in order to ensure accurate ex-ante and ex-post program savings calculations as well as program efficacy. Bidgely asserts that it has improved processes subsequent to the evaluation.

[7] If these customers have not received any additional treatment, they could reasonably be characterized as untreated for the 2022 evaluation because the treatment was limited to only two reports and treatment effect degrades with time. For discussion on savings degradation after treatment stops see "Statewide Evaluation Team (SWE). 2015. Residential Behavioral Program Persistence Study."

# 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 Rocky Mountain Power's (RMP) Home Energy Report (HER) Program in Utah 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 Home Energy Reports 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 similar 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 similar 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 2012. From 2012 through 2017, Oracle Utilities Opower served as the implementation contractor and delivered HERs to customers using the industry-standard RCT program design. During 2012-2015, all participants received paper reports. In 2016, electronic reports delivered through email were introduced for a portion of participants.

In 2018, RMP contracted with a new implementation contractor, Bidgely, who added cohorts in 2018 and 2019 using the RCT program model.

In 2020, RMP contracted with energy consultant Cadmus to determine if a deemed savings approach to calculating 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.

In Docket No. 20-035-31, the Public Service Commission of Utah approved RMP's decision to open the HER Program in 2020 to any customer with an email address on file, according to RMP's filed comments. RMP also asserted that it expanded the HER Program to meet customer requests and satisfaction, and to counter the impacts of COVID-19 by increasing RMP's direct outreach to customers.[8]

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 Utah 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[9] | Number remaining at EOY 2021 |
| 2012 | 7/1/2012 | 53,749 | 49,425 |
| 2014 | 9/1/2014 | 120,020 | 108,164 |
| 2016 | 8/1/2016 | 23,814 | 20,219 |
| 2018 | Variable | 83,746 | 63,756 |
| 2019 | Variable | 327 | 245 |
| 2020 | Variable; 99% after June 24, 2020 | 330,355 | 237,349 |
| 2021 | Variable; 99% after July 21, 2021 | 91,482 | 87,466 |
| **Total** | | **703,493** | **566,624** |

[8] See https://psc.utah.gov/2020/07/01/docket-no-20-035-31/.

[9] 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.

At the time of the mid-2020 expansion, RMP transitioned most customers who had been receiving paper reports to the emailed format, after which approximately 45,000 participating customers continued receiving paper HERs through the mail.

## 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 2011 and ended April 2022.
- Pre- and post-treatment monthly electric billing data for a group of non-participants. The data started on January 2017 and ended April 2022.
- Program tracking data including the numbers of HERs delivered to each program participant per year and the format of delivered reports.
- Participant and nonparticipant account 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*[10] 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). See ADM identified Variance-in-Adoption (VIA) as a viable method for 2020 for which pre-treatment consumption data exists for participants. See Appendix B for additional models tested in this analysis.

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. In addition, because most customers have already been treated, 2020 will be the last year that VIA will be a viable evaluation method. 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.

## 3.1 Methodology

ADM analyzed the billing data of customers who received HERs during 2020 - both pre-period (before the household starts receiving home energy reports) and post-period (after household starts receiving home energy reports) 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:

[10] 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 all but two years since 2012 (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 16$^{th}$ to June 17$^{th}$, while another customer may run from May 20$^{th}$ to July 5$^{th}$. 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. The following equation 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 |
| 2012 | 53,749 | 52,630 | 50,283 |
| 2014 | 120,020 | 116,713 | 110,594 |
| 2016 | 23,814 | 22,874 | 20,971 |
| 2018 | 83,746 | 77,621 | 67,117 |
| 2019 | 327 | 299 | 267 |
| 2020 | 330,355 | 148,475 | 257,982 |
| 2021 | 91,482 | N/A | 38,308 |
| **Total** | **703,493** | **418,611** | **545,521** |

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 all but two years since the program began in 2012, 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 as a result of the pandemic (e.g., increased telecommuting). The regression model is specified in Equation 3-2.

*Equation 3-2: Regression Model*

$$Usage_{it} = \beta_0 + \sum_{m=1}^{12} \beta_m * I_m + (\beta_1 * HDD_{it)} + (\beta_2 * CDD_{it}) + (\beta_3 * Post_{it}) + (\beta_4 * HDD_{it} * Post_{it}) + (\beta_5 * CDD_{it} * Post_{it}) + (\beta_6 * HDD_{it} * Post_{it} * Program\,Year_{it}) + (\beta_7 * CDD_{it} * Post_{it} * Program\,Year_{it}) + (\beta_8 * Post_{it} * Program\,Year_{it}) + (\beta_9 * COVID_{it}) + (\delta_i * Customer_i) + \varepsilon_{imy}$$

Where:

$Usage_{it}$ = Customer i's average daily energy usage at time t

$\beta_0$ = Intercept of the regression equation

$I_m$ = Indicator variable equal to one for each monthly bill month m

$\beta_m$ = Coefficient on the bill month m

$\beta_1, \beta_2$ = 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

$\beta_3$ = Coefficient on the Post variable

$\beta_4, \beta_5$ = Coefficients on HDD and CDD interacted with the Post indicator variable. This measures the treatment effect as a function of HDD and CDD (i.e., the change in usage per day due to treatment per HDD/CDD)

$Program\,Year_{it}$ = Indicator variable equal to one for each monthly bill in the evaluated program year, and zero otherwise

$\beta_6, \beta_7$ = Coefficients on HDD and CDD interacted with the Post and Program Year indicator variables. This measures the treatment effect as a function of HDD and CDD during the evaluated program year (i.e., the change in usage per day due to treatment per HDD/CDD)

$\beta_8$ = Coefficients on the Post and Program Year indicator variables. This measures the treatment effect in the program year, independent of the weather

$\beta_9$ = 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[11], through December 31, 2021 (the end of the evaluation period)

$\delta_i$ = Coefficients on customer dummy variables

$Customer_i$ = Dummy variable for each customer. This measures the customer fixed effect over time

$\varepsilon_{imy}$ = Error term

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: Monthly kWh Savings for the Regression Model*

$$Monthly\ kWh\ Savings = (\beta_3 + \beta_8) * Days\ in\ Month + (\beta_4 + \beta_6) * HDD\ in\ Month + (\beta_5 + \beta_7) * CDD\ in\ Month$$

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

### 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 Utah occurred on March 15, 2020, and the effects were apparent in customer bills through the end of the 2021 program year. ADM estimated that the average normalized annual usage in the summer increased by five percent, while in winter normalized annual usage increased by two percent. Therefore, 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 energy efficiency 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. The following sections detail ADM's methodology for each.

### 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 1.5 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 1 to 3 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.[12]

## 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).

[12] 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: Customers with bills in 2020 or 2021[13] | 704,525 |
| After removing bills missing street number or zip code | 704,224 |
| After removing customers missing intervention dates | 703,680 |
| After removing bills that overlap with intervention[14] date | 703,680 |
| After removing bills that occur after inactive date | 703,680 |
| After removing bills that occur before active date | 703,672 |
| After restricting to bills in the pre- or post-period | 703,672 |
| After removing outliers (anything over 200kWh/day) | 703,630 |
| After removing bills with less than ten or more than 90 days duration | 703,620 |
| After removing bills that occur outside study period (2011 to 2021) | 703,620 |
| After removing customers with savings in downstream programs (e.g., uplift) | 695,762 |
| After keeping customers with at least nine months of pre-period and six months of post-period bills | 489,769 |

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.

[13] This count includes customers treated in 2022 which falls outside the evaluation period.

[14] The intervention date represents the first date of treatment in HERS for a customer.

## 4.2 Linear Regression Modeling Results

As discussed in the evaluation approach section, savings are directly determined through model parameters, the coefficients, $\beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ and $\beta_8$ which are defined in Table 4-2.

*Table 4-2: Regression Parameters*

| Variable | Parameter | Interpretation |
|---|---|---|
| Post | $\beta_3$ | Average daily usage in the post-period |
| Post * HDD | $\beta_4$ | Average daily usage in the post-period per HDD |
| Post * CDD | $\beta_5$ | Average daily usage in the post-period per CDD |
| Post * HDD * Program Year | $\beta_6$ | Average daily usage in the post-period and given program year per HDD |
| Post * CDD * Program Year | $\beta_7$ | Average daily usage in the post-period and given program year per CDD |
| Post * Program Year | $\beta_8$ | Average daily usage in the post-period of the given program year |

Per-home results and percent savings by month and 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.

### 4.2.1 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 | 145.99 | 135.38 | 156.60 |

*Table 4-4: 2020 Regression Results*

| Coefficient | Estimate | Std Error | P Value | 5% CI | 95% CI |
|---|---|---|---|---|---|
| Feb | -1.25 | 0.01 | 0.00 | -1.26 | -1.24 |
| Mar | -2.10 | 0.01 | 0.00 | -2.12 | -2.08 |
| Apr | -3.31 | 0.01 | 0.00 | -3.33 | -3.29 |
| May | -1.96 | 0.02 | 0.00 | -1.99 | -1.93 |
| Jun | 2.28 | 0.02 | 0.00 | 2.25 | 2.32 |
| Jul | 6.79 | 0.03 | 0.00 | 6.75 | 6.84 |
| Aug | 5.93 | 0.03 | 0.00 | 5.89 | 5.97 |
| Sep | 1.18 | 0.02 | 0.00 | 1.15 | 1.22 |
| Oct | -2.42 | 0.02 | 0.00 | -2.45 | -2.40 |
| Nov | -1.57 | 0.01 | 0.00 | -1.59 | -1.55 |
| Dec | 0.44 | 0.01 | 0.00 | 0.42 | 0.45 |
| HDD | 0.21 | 0.00 | 0.00 | 0.21 | 0.21 |
| CDD | 0.62 | 0.00 | 0.00 | 0.62 | 0.62 |
| Post-period | -3.03 | 0.01 | 0.00 | -3.05 | -3.01 |
| Program Year | 2.43 | 0.04 | 0.00 | 2.37 | 2.49 |
| COVID Dummy | 1.34 | 0.01 | 0.00 | 1.32 | 1.37 |
| Post * Program Year | -0.34 | 0.04 | 0.00 | -0.41 | -0.28 |
| Post * HDD | 0.07 | 0.00 | 0.00 | 0.07 | 0.07 |
| HDD * Program Year | -0.09 | 0.00 | 0.00 | -0.09 | -0.08 |
| Post * CDD | 0.26 | 0.00 | 0.00 | 0.26 | 0.26 |
| CDD * Program Year | -0.31 | 0.00 | 0.00 | -0.31 | -0.30 |
| HDD * Post * Program Year | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 |
| CDD * Post * Program Year | 0.15 | 0.00 | 0.00 | 0.14 | 0.15 |

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[15] |
|---|---|---|---|---|
| 2020 | 0.711 | 194 | 38,429,035 | 418,611 |

Table 4-6 presents savings for HER Program treated customers by month calculated using Equation 4-1. ADM noted that percent savings in each month have a larger variability than what is normally seen with an RCT design; however, the total percent savings fall within the expected range for a HERs program. The larger monthly variability in percent savings is likely due to the larger bias in the individual coefficients that a VIA design has compared to an RCT design.

*Equation 4-1: Monthly Savings Equation*

$$Monthly\ kWh\ Savings = (\beta_3 + \beta_8) * Days\ in\ Month + (\beta_4 + \beta_6) * HDD\ in\ Month + (\beta_5 + \beta_7) * CDD\ in\ Month$$

[15] 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) | 9,981.82 | 9,835.83 | 145.99 | 1.46% |

The gross kWh savings from VIA for the average customer and for the program overall is summarized below for 2020.

*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 | 145.99 | 135.38 | 156.60 | 9,981.82 | 1.46% |

*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 | 145.99 | 418,611 | 61,113,784.24 | 56,672,794.27 | 65,554,774.21 |

The average customer saved 1.46 percent or 146 kWh in 2020. Household savings estimates were extrapolated using the post-period participant count.

## 4.3 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.[16] 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, primarily in 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.

[16] 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

*Table 4-9: Upstream Uplift Benchmark Results*

| Utility/State | Program Year | Cohort | Upstream Uplift Metric | Upstream Uplift Value | Statistically Significant |
|---|---|---|---|---|---|
| RMP Utah | 2018 | Legacy, Expansion 1, Expansion 2 | kWh/year | -5.7 | No |
| RMP Utah | 2018 | Expansion 3 | kWh/year | 6.8 | Yes |
| RMP Utah | 2019 | Legacy, Expansion 1, Expansion 2 | kWh/year | -15.3 | No |
| RMP Utah | 2019 | Expansion 3 | kWh/year | 18.5 | Yes |
| Pacific Power WA | 2020 | All Cohorts | kWh/year | -1.7 | No |
| Pacific Power WA | 2021 | All Cohorts | 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 |

## 4.4 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 Utah[17] 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 Utah 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.

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

*Table 4-10: Recommended Deemed Percentage Savings Values[18]*

| Pre-Treatment Annual Consumption Range (kWh/yr) | Program Year 1 | Program Year 2 | Program Year 3+ |
|---|---|---|---|
| < 4,047 | 0.6% | 1.0% | 1.0% |
| > 4,047 to < 7,027 | 0.7% | 1.3% | 1.5% |
| > 7,027 to < 10,356 | 1.2% | 2.4% | 2.4% |
| > 10,356 | 1.4% | 2.2% | 2.5% |

The saving estimated using deemed values is ten percent higher than the saving calculated using VIA billing analysis, as shown in Table 4-11. In addition, the deemed savings estimate is not 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 | 67,689,105 | 61,113,784 | 90% |

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).

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

*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) |
|---|---|---|
| ✓ | 2012 | 16,847.58 |
| ✓ | 2014 | 9,510.31 |
| ✓ | 2016 | 11,930.99 |
| | 2018 | 7,156.44 |
| | 2020 | 10,561.48 |

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 saving 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.

*Table 4-13: Deemed Realization Rates*

| Year | Claimed Savings (kWh) | Evaluated Deemed Savings (kWh) | Deemed RR |
|---|---|---|---|
| 2020 | 67,613,670 | 67,689,105 | 100% |
| 2021 | 99,935,000 | 104,553,475 | 105% |

## 4.5 Evaluated Savings and Realization Rates

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 93 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 | 67,689,105 | 61,113,784 | 90%[19] | 61,113,784 | 67,613,670 | 90% |
| 2021 | 104,553,475 | N/A | 90%[20] | 94,397,149 | 99,935,000 | 94% |
| **Total** | **172,242,580** | **N/A** | **90%** | **155,510,933** | **167,548,670** | **93%** |

The difference between the claimed and evaluated annual kWh savings per customer is likely 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.[21]
- 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 Utah's HER Program. Savings degradation will result in lower savings each year for Legacy customers and may also impact newer cohorts.

## 4.6 Attrition Analysis Results

ADM estimated 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 aggregation, equals

[19] 2020 Ex-post Deemed Savings/2020 Ex-post VIA Savings.

[20] Applied 2020 Ex-post Realization Rate

[21] 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.

approximately 19 percent. However, attrition for the program years 2020 and 2021 is approximately ten percent.

*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 |
| 2012 | 7/1/2012 | 53,749 | 51,701 | 49,425 | 4% | 4% | 8% |
| 2014 | 9/1/2014 | 120,020 | 114,275 | 108,164 | 5% | 5% | 10% |
| 2016 | 8/1/2016 | 23,814 | 22,104 | 20,219 | 7% | 8% | 15% |
| 2018 | Variable | 83,746 | 72,402 | 63,756 | 14% | 10% | 24% |
| 2019 | Variable | 327 | 279 | 245 | 15% | 10% | 25% |
| 2020 | Variable | 330,355 | 291,083 | 237,349 | 12% | 16% | 28% |
| 2021 | Variable | 91,482 | N/A | 87,466 | N/A | 4% | 4% |
| **Total** | | **703,493** | **551,844** | **566,624** | **10%** | **10%** | **19%** |

# 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 made the following observations about Utah HER Program operations during the evaluation period.

**Bidgely updated reports with the following changes in the fall of 2020**:

- improved report aesthetics and adopted a friendlier tone (for example, adding an animated lightbulb "Bulby"
- added mobile device compatibility
- added HER Program portal web pages with interactive graphs and revised energy efficiency recommendations
- added a "lazy log on" link in emailed HERs that takes customers directly to the HER Program portal website without requiring the customer to login or access through the main RMP website (rockymountainpower.net)
- refined selection of reference homes used to compare a customer's energy use to by adding several factors to geographical location, e.g., home square footage and heating type, to identify comparison homes
- disaggregated energy use by appliance type
- added customer-specific recommendations

**RMP delivered a consistent number of paper HERs and has steadily increased the number of emailed HERs annually.** RMP's HER Program has consistently delivered four paper reports per year and has increased the number of emailed reports to 24 per year. See Table 5-1. The number of paper reports delivered annually during the evaluation period align with standard industry practices[22] and complies with Cadmus' recommendation that a minimum number of reports is sent each year. The cadence of emailed reports meets or exceeds the industry standard.

[22] Dougherty et al. "Energy Efficiency Behavioral Programs: Literature Review, Benchmarking Analysis, and Evaluation Guidelines." Minnesota Department of Commerce Division of Energy Resources. May 4, 2015. Pg. 31.

*Table 5-1: Report Frequency by Year*

| Year | # of paper reports/year | # of emailed reports/year |
|---|---|---|
| 2014 | 6 | N/A |
| 2015 | 4 | N/A |
| 2016 | 4 | 4 |
| 2017 | 4 | 4 |
| 2018 | 4 | 7 |
| 2018 (new cohort only) | 0 | 2 |
| 2019 | 4 | 12 |
| 2020 | 4 | 24 |
| 2021 | 4 | 24 |

**The ratio of paper to emailed reports has declined over the course of the program.** The mix of paper to emailed reports is significant because paper reports generally result in more savings than emailed reports.[23] The deemed savings values Cadmus proposed relied on evaluated savings from 2012-2019 Utah HER Program. Though the exact ratio of paper to emailed reports was not available for 2016-2019, the trend has been to transition from paper to primarily email reports (see Table 5-2).

[23] 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.

*Table 5-2: Percentage of Paper and Emailed HERs by Years*

| Years | Paper | Emailed |
|---|---|---|
| 2012-2015 | 100% | 0% |
| 2016-2017 | Declining % | Format introduced, sent to portion of treated |
| 2018-2019 | Declining % | All new participants received |
| 2020-2021[24] | <8% | 91% |

**Bidgely, at the request of RMP, used Cadmus's proposed deemed savings values, while also implementing changes that Cadmus indicated may change expected program savings.** Cadmus stated in their deemed savings methodology memo, "It should be stressed that these deemed savings values assume that RMP Utah 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."[25] The program during the evaluation period reflects changes to both the cadence and ratio of paper to emailed reports.

**Program data management offers opportunities for improvement.** ADM received unusable program data in response to multiple data requests. Initially provided program data was inaccurate, incomplete, ambiguous, and not as granular as expected, complicating the ability to accurately evaluate program savings. For example:

- ADM requested a dataset of untreated customers; on analysis over 60 percent of the customers in the dataset that ADM received were also included in the treated customer dataset. Bidgely subsequently provided a corrected dataset.
- Claimed savings values included in program tracking data used for analysis were inconsistent across datasets, and inconsistent with RMP's filed claimed savings.
- ADM received a dataset which included approximately 132,000 customers who were identified as treated participants, and later received a revised dataset in which they were ambiguously labeled. ADM eventually received clarification about the treatment status of these customers.
- Data reporting details of treatment specification (numbers of reports per year and format received) was unclear and less detailed than expected.

[24] Customers who transitioned from paper to emailed reports during 2018-2021 were flagged with "both" formats in the dataset. Postal invoices were used as a proxy to determine the numbers of customers receiving paper reports since the date of transition to email was not made available to ADM.

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

**Open rates and positive feedback on reports.** Bidgely reported that slightly more than one-third of email report recipients opened emails and 84-85 percent of customers clicked on a "like" icon included in the report during 2020 and 2021.

**Bidgely identified smart meter data as an opportunity to improve HER Program performance.** Using smart meter data would allow the program to improve appliance disaggregation and provide richer insights for customers about their energy use and ways they could save energy.

## 5.2 Participant Survey Results

ADM surveyed RMP customers who received HERs in 2020 and 2021 and a sample of customers designated as untreated to compare with the treated customers' responses.

ADM administered a survey to a group of customers designated by the implementation contractor as customers who were "untreated" and did not receive home energy reports. However, after the survey was administered, ADM determined through its data quality review process that 61 percent of these customers were also included in the dataset of treated customers who had received HERs. Because of the large share of misidentified customers, ADM excluded the untreated group survey responses in the results presented below.

The survey collected information about the customers' experiences with HER Program and their satisfaction with RMP. The survey also inquired about the participants' use of RMP's online energy portal and about energy-saving actions customer have taken (e.g., behavioral changes, or installing energy efficient appliances and equipment). Table 5-3 includes survey response data for the Utah RMP Home Energy Report participant survey.

*Table 5-3: Summary of Email Survey Response*

| Metric | Total |
|---|---|
| Initial Invite | 6,975 |
| Complete | 194 |
| Response Rate | 3% |

### 5.2.1 Reading Home Energy Reports

Sixty-nine percent of respondents reported that they read most or all the HERs they received in 2021 (see Table 5-4).

*Table 5-4: How often did you read the Home Energy Reports in 2021?*

| Portion Read | Percentage (n = 194) |
|---|---|
| All the reports | 45% |
| Most of the reports | 24% |
| About half of the reports | 8% |
| Only a couple of the reports | 19% |
| None of the reports | 2% |
| Don't know | 3% |

Twenty-two 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, 86 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 (two percent) or only read a couple of the reports (19 percent) were asked why they chose not to read them. Of these respondents, 34 percent reported that the primary reason for not reading the reports was that they did not have the time. Table 5-5 displays other reasons that customers cited for not reading reports. These included emails being lost or filtered, not owning their home, and feeling the neighbor comparison did not consider number of occupants or square footage.

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

| Response | Percentage (n = 41) |
|---|---|
| **Prompted Responses – Selected All That Apply** | |
| Do not have the time | 34% |
| Not interested | 10% |
| The suggested tips were not applicable to my home | 24% |
| I did not find the information on the report to be valuable | 15% |
| I did not find the information in the report to be accurate | 12% |
| I did not understand them | 7% |
| I don't know | 7% |
| **Unprompted Responses – Open-end or "Other" Reasons** | |
| Neighbor comparison does not consider number of occupants or square footage | 5% |
| Report emails lost or filtered | 5% |
| I do not own my home | 2% |

### 5.2.2 Perceptions Regarding Home Energy Reports

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 (81 percent) found the HER information on their home's energy use easy to understand.[26]

Among survey respondents who indicated they read all the reports, 95 percent reported the information was easy to understand compared to 57 percent who indicated they read only a few of the reports.

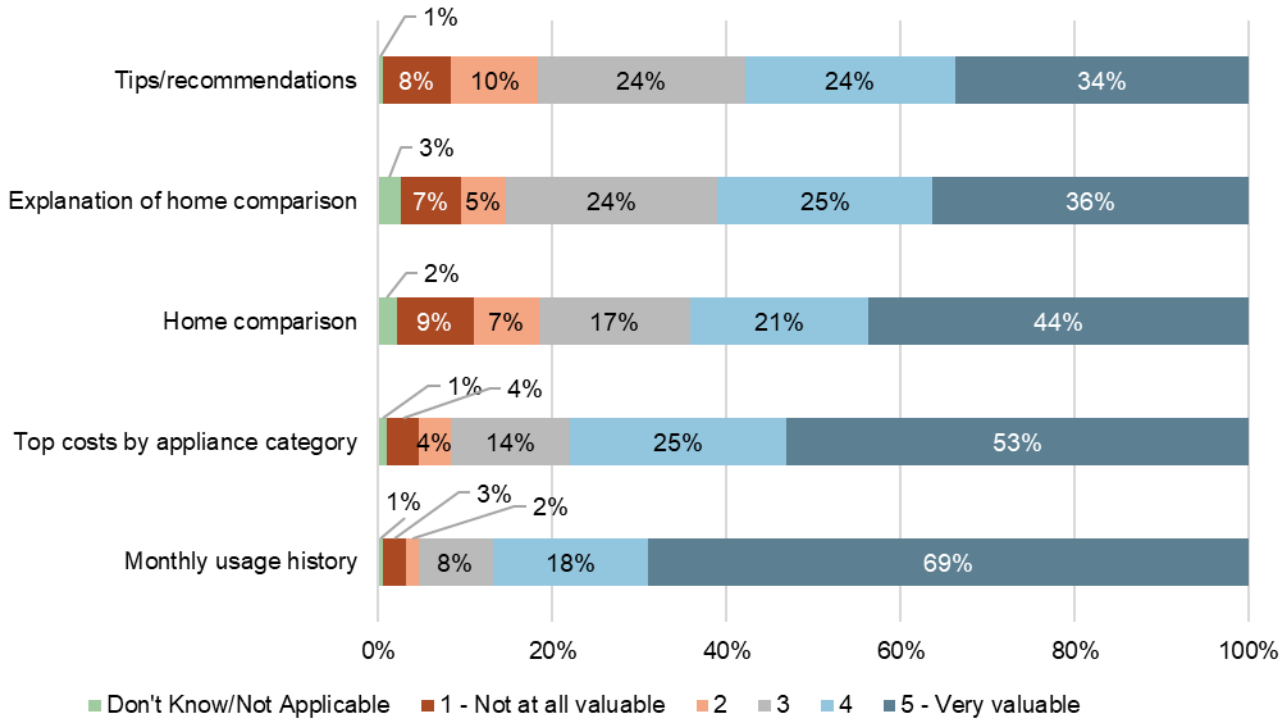
### 5.2.3 Perceived Value of Information on Home Energy Use

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 87 percent that rated the monthly usage history as valuable (see Figure 5-1).[27]

[26] n=185. Rated the ease of understanding the reports a four (26 percent) or five (55 percent) on a scale from one (very difficult) to five (very easy).

[27] n=190. Rated the value a four or five on a scale from one (not at all valuable) to five (very valuable).

*Figure 5-1: Rated Value of HER Information*




### 5.2.4 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 5-6).

*Table 5-6: Rated Accuracy of HER Information*

| Answer | Percentage (n=185) |
|---|---|
| 1 - Not at all accurate | 3% |
| 2 | 8% |
| 3 | 23% |
| 4 | 32% |
| 5 - Very accurate | 30% |
| I don't know | 4% |

The respondents who said the HER information was inaccurate (rated it as a one or two on a 5-point scale) had an opportunity to explain why. Three-quarters of these respondents (n=15) shared feedback about the report accuracy.

One stated that the comparison was inaccurate as they live in an area with a substantial number of homes occupied by tourists, and only on weekends. Another felt the home

comparison was inaccurate because of the number of occupants. Four customers felt their energy usage was not accurately reflected in the reports. One respondent commented on the accuracy of the appliance disaggregation and indicated they were uncertain how this information was obtained.

### 5.2.5 Satisfaction with HER Program

Seventy-four percent of respondents said they were satisfied with the home energy reports overall.[28] Most respondents were satisfied with the method and frequency of receiving the HER, the information provided in them, and the number of other emails they receive about their home's energy use (see Figure 5-2). Thirty-two percent of respondents said that receiving the home energy reports had changed their opinion of RMP, with 85 percent saying receiving the reports had improved their opinion.[29] Fifty-three percent of respondents said that they would be likely to recommend the Home Energy Reports to a friend, colleague, or relative.[30]

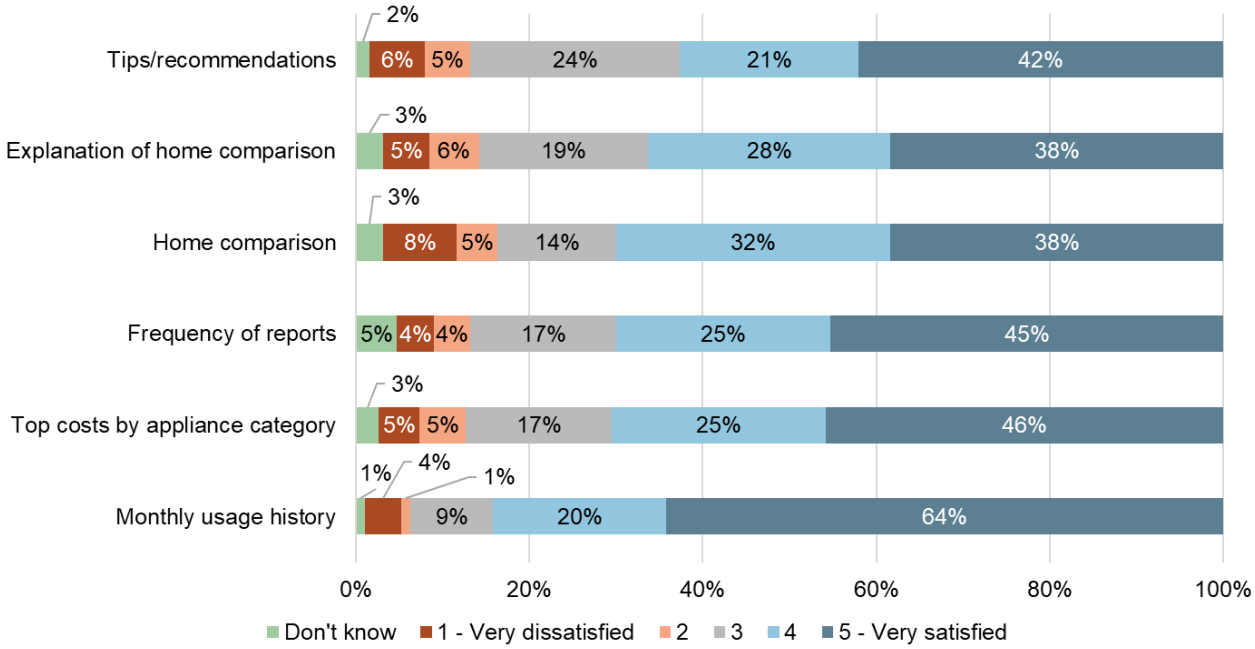
The survey offered respondents an opportunity recommends improvements to the reports and to comment on reasons

[28] n=190. Rated their satisfaction a seven or higher on a scale from zero (extremely dissatisfied) to ten (extremely satisfied).

[29] n=60. Rated their change in opinion a four (40 percent) or five (45 percent) on a scale from one (greatly worsened) to five (greatly improved).

[30] n=194. Rated their likelihood of recommending a seven or higher on a scale from zero (extremely unlikely) to ten (extremely likely).

*Figure 5-2 Satisfaction with HER Program*




for dissatisfaction with their reports. Thirty-four percent respondents (n=65) provided comments or suggestions on how to improve the HERs. These respondents offered various comments, critiques, and suggestions for the reports:

Twenty-nine percent of respondents commented about the home comparison.

- Seventeen percent of these respondents suggested improving the comparison and included notes regarding being compared to other households with similar occupancy levels, lifestyles, appliances, home age, square footage, and ownership status.
- Nine percent suggested that additional information on the home comparison's methodology would improve the reports.
- Three percent requested the comparison be removed.

Eighteen percent of customers made general comments or suggestions that alluded to adding more information (seven percent), improving the accuracy (seven percent), or improving the general applicability of the reports (four percent).

Sixteen percent of customers said the reports should incorporate more or updated promotional material about available incentives, ways to save energy, and recommended ENERGY STAR® appliances in the reports.

Fifteen percent commented on the frequency of the reports. Seven percent of these customers either requested reducing the frequency of reports or discontinuing them. Four percent requested more frequent reports. Three percent of customers requested that paper reports be discontinued.

Twelve percent identified ways to improve the report-related contents including the following suggestions:

- improve subject lines to garner more attention
- add hyperlink to report in customer bill
- include content “reads less like an advertisement”
- place energy saving tips earlier in the report
- add interactive elements
- incorporate more graphics and visual elements
- include information on solar power generation
- add comparison to highly efficient home with details regarding what sets these homes apart

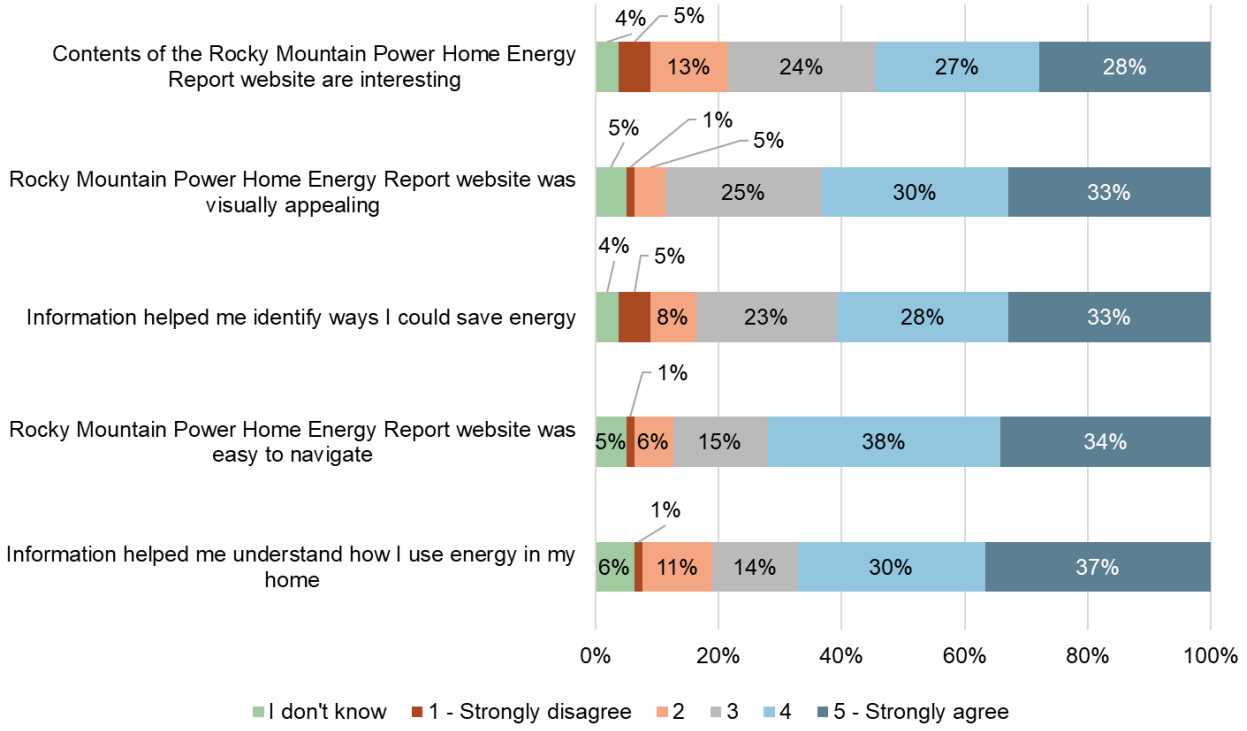
Six percent suggested that reports be updated according to information that customers provide either interactively in the report email or through some other mechanism (e.g., remove tips for actions they have already taken, update home characteristics).

Six percent requested more information on the appliance disaggregation methodology.

### 5.2.6 Experience with Online Portal

Forty-one percent of participants recalled logging onto the online portal which 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 Program Participant Online Portal Experience*




Most respondents who said they had not logged on to the online portal indicated they were not aware of the portal. Table 5-7 includes reasons customers noted for not having logged onto the portal.

*Table 5-7: Primary Reason why Customers had not logged onto Portal*

| Reason | Percentage (n = 115) |
|---|---|
| Was not aware of the portal | 62% |
| Did not have the time to use the portal | 15% |
| Did not know how to access the portal | 10% |
| Did not think the portal would provide useful information | 10% |
| Not interested in my energy use | 4% |
| Experienced technical difficulties trying to access the portal | 2% |
| I don't know | 7% |

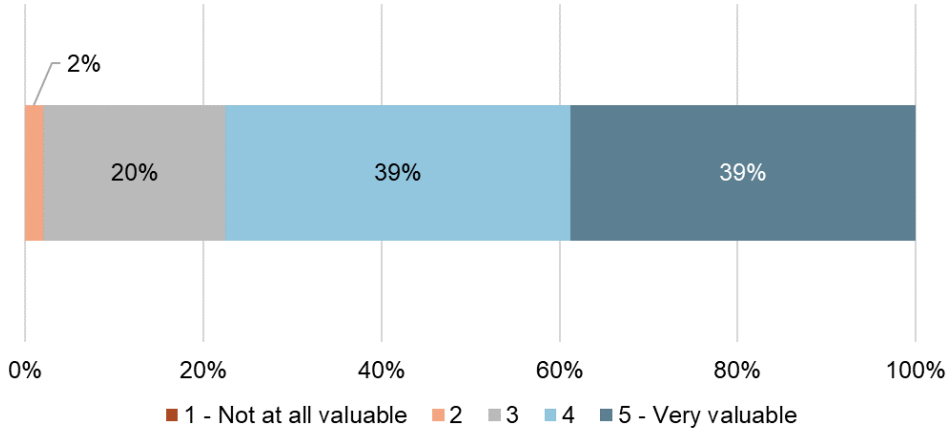
### 5.2.7 RMP Online Customer Experience

ADM also asked several questions about customers' experience with the RMP website (rockymountainpower.net). Twenty-seven percent of respondents confirmed they had been to RMP's main website. Of these respondents (n=53), 92 percent said they had created an online account.

Of the four respondents who had been to the website but not created an online account, three did not think it would provide valuable or interesting information; two cited privacy concerns; one wasn't aware of it and one did not know how to create an account.

Of the respondents who said they had created an online account, 61 percent said they had logged in multiple times, 16 percent said they had logged in once and the remaining 14 percent did not know the number of times they had logged in. Most indicated that the energy-saving tips and information available on the website were valuable (see Figure 5-4).

*Figure 5-4: Perceived Value of RMP Website's Tips and Information*




### 5.2.8 Opinion Toward RMP

Eighty-three percent of respondents indicated they were satisfied with RMP overall as their electric utility.[31] Respondents provided feedback on whether and how receiving HERs had affected their opinion of RMP. Thirty-two percent indicated that receiving the report had changed their opinion of RMP. Of those who indicated receiving the report had changed their opinion, nearly all indicated it had improved their opinion (see Table 5-8). Sixty-eight percent of respondents said they would be likely to recommend RMP to a friend, relative, or relative.

[31] n=192. Rated their level of satisfaction a seven or higher on a scale from zero (extremely dissatisfied) to ten (extremely satisfied).

*Table 5-8: Rated Change in Satisfaction with RMP*

| Rating | Percentage (n = 60) |
|---|---|
| 5 - Greatly improved | 45% |
| 4 | 40% |
| 3 | 10% |
| 2 | 2% |
| 1 - Greatly worsened | 2% |
| Don't know | 2% |

### 5.2.9 Energy Saving Actions

Fifty-nine percent of HERs recipients reported they had taken actions to save energy in 2020 or 2021. Seventy-one percent of respondents said that the information provided in the HERs was important in their decision to take energy-saving actions.[32] Table 5-9 summarizes actions recommended on HERs that participants reported adopting.

[32] n=115. Rated the importance of the HERs a four (35 percent) or five (37 percent) on a scale from one (not at all important) to five (very improved).

*Table 5-9: Actions Recommended in HERs that Respondents Adopted*

| Action | Percentage (n = 115) |
|---|---|
| Allowed sun to heat home (opened curtains on south/west facing windows in winter) | 86% |
| Washed clothes using cold water versus hot water | 82% |
| Kept refrigerator full to better maintain cold temperatures | 75% |
| Made sure refrigerator had minimum clearance to allow operating at maximum efficiency | 73% |
| Checked seal on refrigerator to ensure appropriate tightness | 73% |
| Let dishes air dry | 70% |
| Dried clothes at lower temperature | 66% |
| Turned off game consoles when not in use instead of leaving in stand-by mode | 55% |
| Replaced old cookware with flat-bottomed cookware | 49% |
| Ran ceiling fans in reverse during the winter | 48% |
| Adjusted freezer temperature settings | 48% |
| Optimized display on television | 45% |
| Installed a dimmer switch to control lighting levels | 42% |
| Unplugged stereo when not in use | 33% |
| Used an electric kettle instead of a pot on the stove | 33% |
| Shut flue damper on fireplace or wood stove after usage | 20% |
| Wrapped hot water heater in an insulating blanket | 16% |
| Unplugged second refrigerator when not in use | 15% |

*Table 5-10: Number of Energy-Saving Recommendations Adopted*

| | Percentage (n = 194) |
|---|---|
| Made changes/took actions to reduce energy use | 59% |
| **Number of Actions Taken to Reduce Energy Use – All Respondents** | |
| None | 41% |
| 1 to 5 | 6% |
| 6 to 10 | 35% |
| 11 to 15 | 16% |
| More than 15 | 2% |

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. Eight percent of all survey respondents indicated that they had enrolled in a time-of-use plan in 2021.

### 5.2.10 Energy Saving Purchases

Sixty-six percent of HER Program participants said they had installed one or more energy efficient items in 2020 or 2021, and 60 percent said the information in the HERs had been important in their decision-making to make their purchase(s). Sixty percent of participants said that the information provided in the HERs was important (rating of four or five) in their decision to purchase or install the energy efficient equipment or appliances.[33]

*Table 5-11: Number of Energy-Saving Items Installed*

| | **Percentage (n = 194)** |
|---|---|
| Made changes/took actions to reduce energy use | 66% |
| **Number of Items Installed– All Respondents** | |
| None | 34% |
| 1 to 5 | 53% |
| 6 to 10 | 12% |
| 11 to 15 | 2% |
| More than 15 | 0% |

The most common items respondents purchased and installed were ENERGY STAR lightbulbs and fixtures, smart thermostats, and televisions (see Table 5-12). Of the respondents who indicated that they had purchased an energy-saving item in 2020 or 2021 (n=128), 77 percent said they had not received a rebate or discount for the item.

Among those participants who purchased LED bulbs, 11 percent bought three or fewer, 27 percent bought four to seven bulbs, and 62 percent purchased eight or more bulbs.

[33] n=129. Rated the importance of the HERs a four (23 percent) or five (37 percent) on a scale from one (not at all important) to five (very improved).

*Table 5-12: Energy Efficient Items Purchased or Installed*

| Equipment or Appliance | Percentage (n = 194) |
|---|---|
| ENERGY STAR LED light bulbs | 44% |
| Smart thermostat (e.g., Nest, Lyric, Ecobee, Sensi) | 22% |
| ENERGY STAR LED fixtures | 20% |
| ENERGY STAR television | 19% |
| Low flow faucet aerators or showerheads | 18% |
| ENERGY STAR clothes washer | 14% |
| ENERGY STAR refrigerator | 13% |
| Energy efficient windows or doors | 12% |
| ENERGY STAR clothes dryer | 12% |
| ENEGY STAR central air conditioner | 11% |
| Attic, floor or wall insulation | 10% |
| ENERGY STAR computer or computer monitor | 8% |
| ENERGY STAR stand-alone freezer | 8% |
| Advanced power strips | 8% |
| ENERGY STAR scanner or printer | 4% |
| ENERGY STAR heat pump water heater | 4% |
| ENERY STAR room air conditioner | 2% |
| ENERGY STAR heat pump | 1% |

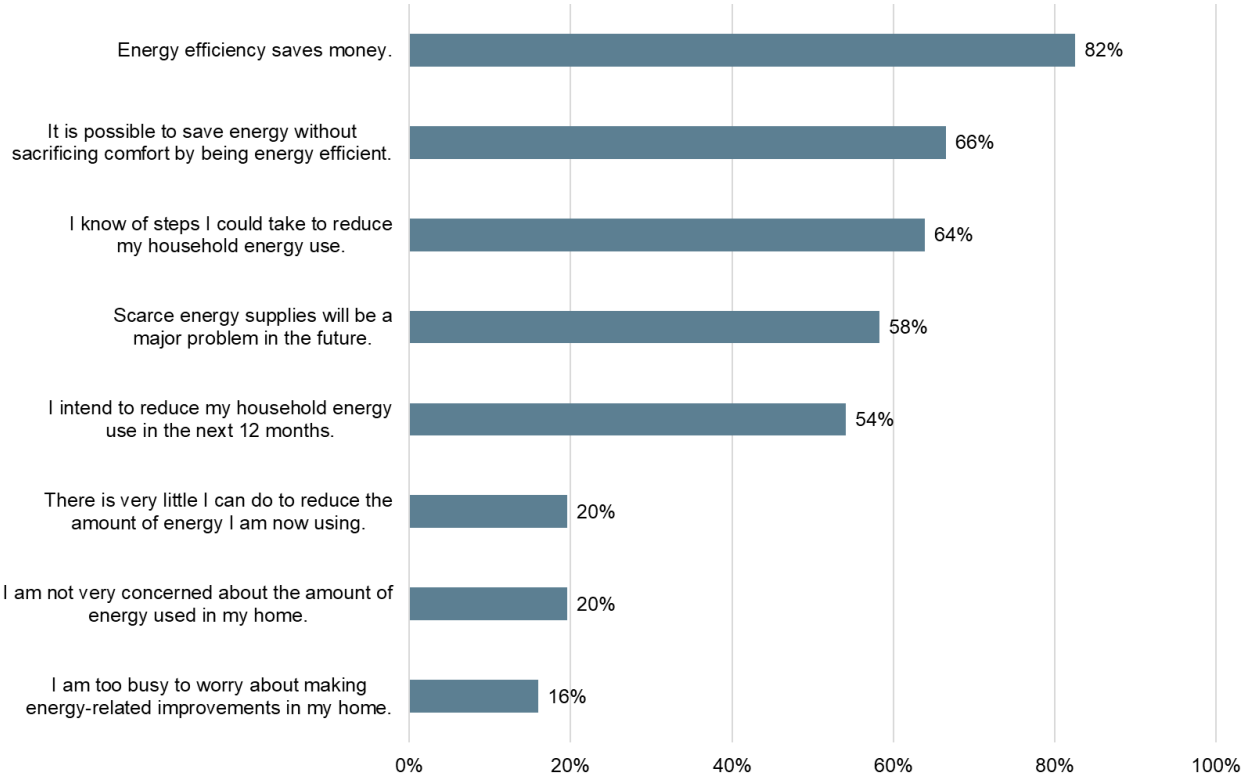
### 5.2.11 Energy Savings Actions Before 2020

ADM also asked if respondents had taken any energy saving actions before 2020. Fifty-eight percent of respondents said they had taken some action to reduce energy use in their home before 2020. Forty-eight percent of the respondents who responded that they had taken action to reduce energy use before 2020 noted behavior change (e.g., unplugging appliances, turning off lights). Forty percent noted installing a major measure such as an ENERGY STAR certified appliance, windows, smart thermostat, attic insulation, furnace, or hot water heater, while 31 percent indicated they had made other less expensive energy efficient improvements such as installing LEDs or weatherstripping.

### 5.2.12 Beliefs and Attitudes Relating to Energy Efficiency

Survey respondents generally endorsed positive beliefs and attitudes about energy efficiency. Figure 5-5 reflects the percentages of respondents who expressed agreement with a number of statements about energy efficiency.

*Figure 5-5: Pro-Energy Efficiency Beliefs and Attitudes*




### 5.2.13 Demographics

Participants were asked about their home characteristics, including ownership, building type, and heating fuel (see Table 5-13).

*Table 5-13: Respondent Home Characteristics*

| Response | Percentage (n = 194) |
|---|---|
| **Ownership** | |
| Own | 82% |
| Rent | 16% |
| Prefer not to answer | 2% |
| **Building Type** | |
| Single-family home | 76% |
| Manufactured or mobile home | 3% |
| Duplex or triplex | 5% |
| Apartment in an apartment building or complex | 7% |
| Condominium or townhome | 9% |
| Don't know | 1% |
| **Heating Fuel** | |
| Natural Gas | 24% |
| Electricity | 70% |
| Propane, heating oil, wood, other | 3% |
| Don't know | 1% |

ADM also asked respondents about their household demographics. Most identified as white or Caucasian (see Table 5-14). Ninety-three percent said English was the primary language spoken at home. The other respondents indicated either Spanish (five percent) or Chinese (>1 percent) was the primary language spoken at home.[34] 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. Eleven percent of respondents indicated their household income was less than 200 percent of the federal poverty line. Forty-eight percent of respondents characterized their communities as suburban, 34 percent as urban, and 13 percent as rural. The remainder either did not know how to characterize their community (three percent) or provided a written description (two percent).

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

*Table 5-14: Respondent Race or Ethnicity*

| Response | Percentage (n = 192) |
|---|---|
| Asian | 5% |
| Black/African American | 1% |
| Caucasian/White | 78% |
| Hispanic or Latino | 8% |
| Native American or Alaska Native | 1% |
| Pacific Islander or Native Hawaiian | 2% |
| Other, not specified | 1% |
| Prefer not to answer | 11% |

### 5.2.14 Home Occupancy 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 Home Energy Reports. Thirty-one percent of respondents indicated that in 2020 or 2021 they updated or renovated their home in a way that affected their energy use.[35] Twenty-four percent of these respondents indicated the renovations or updates had increased their energy use (see Table 5-15).

*Table 5-15: How have your updates or home renovations affected your energy use?*

| Response | Percentage (n = 58) |
|---|---|
| Increased | 24% |
| Decreased | 52% |
| Stayed the same | 16% |
| Don't Know | 9% |

As noted in Section 5.2.13, 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; 62 percent of respondents indicated that the same number of people lived in their home in 2019 and 2022, while equal portions (19 percent) said the number increased or decreased.

To gauge home occupancy, ADM asked customers whether they or their family members had worked or went to school in person or from home (at least one full day a week,

[35] n=194.

Monday-Friday) or had been without employment at any point from 2019-2022. Results indicate a higher portion of respondents working from home or attending school from 2020-2022 compared to 2019, though after an initial increase from 2019 to 2020, the portion of respondents that indicated remote work or education declined from 2020-2022. Trends were similar when ADM asked about other household members, though remote schooling trends diverged somewhat with over half of respondents indicating one or more members of their household attended school remotely in 2021 (see Figure 5-6).

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

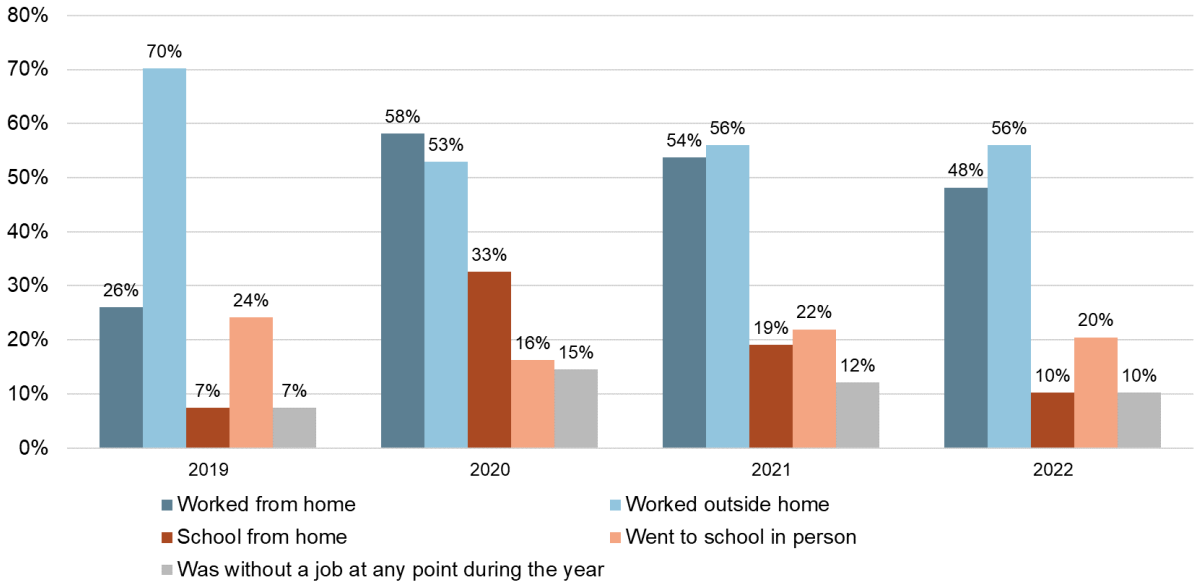
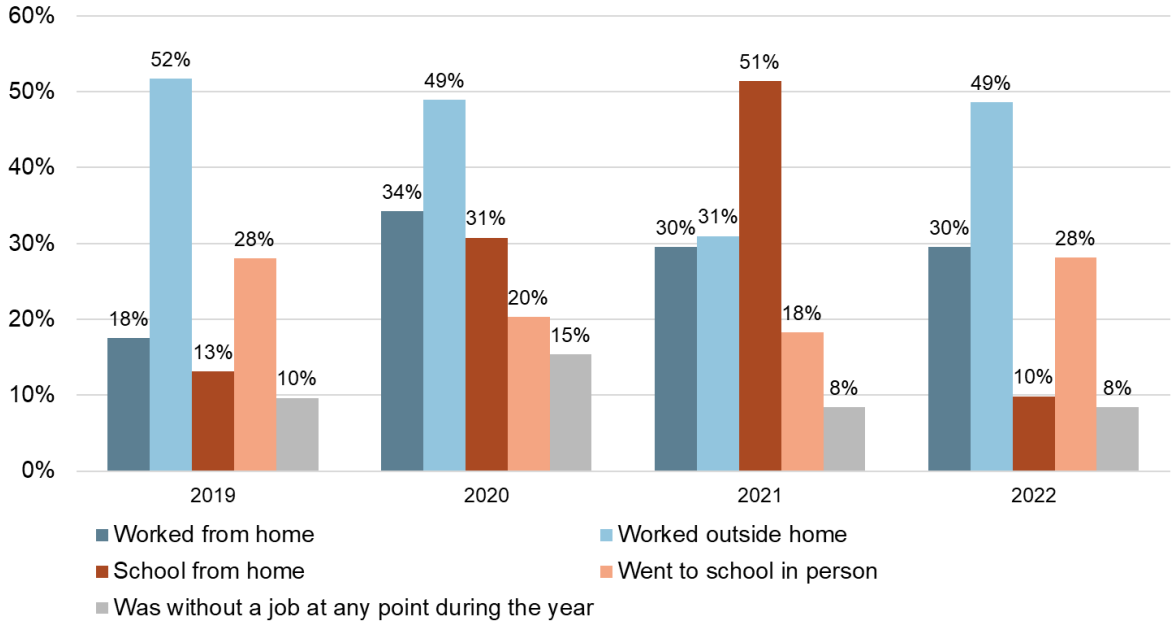



*Figure 5-7: Home Occupancy Changes 2019-2022 (other household members)*



# 6 Conclusions and Recommendations

Based on the preceding impact and process analyses and evaluations, ADM offers the following 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 the control group with a RCT miss out on 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*[36] 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).

To identify an evaluation methodology to verify program savings without the RCT control groups, ADM tested multiple research designs and modeling approaches using customer billing data, including Propensity Score Matching (PSM), pre-post treatment only, and Variance-in-Adoption (VIA). ADM identified VIA as a viable method to calculate ex-post savings for 2020. 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.

[36] 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.

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[37] 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 and PSM 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 can be reasonably identified as untreated and unbiased for use in future evaluations. An existing group of 132,000 customers was identified during the evaluation process that received very limited treatment. ADM believes that with careful consideration, a subset of 25,000 customers in this group can be identified to create a useful control group. This group, along with a designated percentage of new RMP customers to add to the control group each year, would constitute a viable and sustainable cohort that will enable robust program evaluations.

[37] Cadmus, "Deemed Savings for Rocky Mountain Power Utah HER Program," June 3, 2020. Included as Appendix C.

## 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 fall within expected industry norms and resulted in a 93 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. A group of minimally-treated customers could be used as a pool from which to create a new, smaller control group of customers.** Reestablishing a control group will also 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.

**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.**

- 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.
- In 2021, over 132,000 customers were added to the pool of treated customers yet received treatment limited to only two paper reports. Deemed savings were claimed for these customers. Savings reflected in the billing analysis that included these customers was likely depressed by the inclusion of these minimally treated customers.

**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, 77 percent said that they had not received a rebate or discount for their purchase.

**Customers generally perceive the information provided in the Home Energy Reports to be valuable, though the perceived value varied by section.** Fifty-eight percent scored tips and recommendations as valuable compared to 87 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.

- Restrict to the set of approximately 132,000 customers whose treatment was limited to two paper reports in 2021.[38]
- Restrict to customers who were not treated between 2011 and 2019.
- Restrict to customers with complete billing data from 2011 to present (or 2017 to present if earlier data is unavailable).
- Select a control group which could consist of approximately 15-20,000 customers using PSM and do not send them any HERs. ADM offers to collaborate with the implementer to check control group selection method and provide the EM&V perspective.
- Maintain the control group by annually adding a fixed percent of new RMP customers to help sustain the group with characteristics similar to the treatment group.

**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.

**Improve program data management.** Accurate, unambiguous, timely and complete program data should be recorded and maintained by the implementation contractor in order to ensure accurate ex-ante and ex-post program savings calculations as well as program efficacy. Bidgely asserts that it has improved processes subsequent to the evaluation.

**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

[38] If these customers have not received any additional treatment, they could reasonably be characterized as untreated for the 2022 evaluation because the treatment was limited to only two reports and treatment effect degrades with time. For discussion on savings degradation after treatment stops see "Statewide Evaluation Team (SWE). 2015. Residential Behavioral Program Persistence Study." http://www.puc.pa.gov/Electric/pdf/Act129/SWE_Res_Behavioral_Program-Persistence_Study.pdf

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 Home Energy Report 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 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: Supplementary Analyses

In addition to the VIA regression analysis completed to calculate program savings (kWh), ADM completed additional impact evaluation analyses. Each of these methodologies showed significant bias and were not used to estimate ex-post program savings. ADM determined the presence of significant bias by examining the direction and magnitude of savings. For instance, positive savings as a percent of annual consumption outside the range normally seen using a RCT indicated that savings had positive bias. In addition, statistically significant negative savings indicated that savings had negative bias because HER programs evaluated with an RCT design show that customers never use more energy because of the HER program.

## B.1 Propensity Score Matched Control Group Modeling

ADM created PSM control groups from a small group of untreated customers provided by Bidgely. The billing data for the untreated customers began in 2017, therefore, only customers treated after 2017 could be included in the PSM analysis. In addition, most untreated customers only had billing data in 2020, which prevented them from being used in the control group.[39] ADM created two cohorts of treated customers using the following definitions:

1) PSM Cohort 1: Customers treated in 2018
2) PSM Cohort 2: Customers treated from June 25, 2020, through July 15, 2020[40]

## B.2 Post Period Regression w/ Weather Model Specification

ADM used the post-program regression (PPR) with weather model to calculate savings for the PSM analysis. The model relies on modeling the interaction between time, weather, and the treatment effect to generate a regression coefficient that represents the average daily usage savings in each month post-treatment.

The PPR model combines both cross-sectional and time series data in a panel dataset. This model uses only post-program data, with lagged energy use for the same calendar month of pre-program period acting as a control for any small systematic differences between the participant and control customers. Energy use in calendar month *m* of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between participants and controls will be reflected in differences

[39] ADM requires at least nine months of pre-period and six months of post-period data for each customer.

[40] ADM restricted to customers treated during this timeframe to ensure at least four months of post-period billing data was available in 2020.

in their past energy use, which is highly correlated with their current energy use. The version we estimate includes monthly fixed effects and interacts these monthly fixed effects with the pre-program energy use variable. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

In addition, ADM used HDD and CDD in the regression model to account for any weather-related effects not captured by the monthly dummies or each customer's average pre-period seasonal usage. Regional temperature data was obtained from the National Oceanic and Atmospheric Administration using the closest weather stations in terms of customer zip code with complete data. Using the historical weather data, ADM calculated HDD and CDD for use in the regression analysis. HDDs are calculated as temperature values under the heating setpoint (65°F), while CDHs 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.

The PPR model is specified in Equation B-6.

*Equation B-6: PPR Model Specification*

$$Usage_{imy} = \beta_0 + \sum_{m=1}^{12} \sum_{y=1}^{n} I_{my} * \beta_{myp} * (AvgPre_{ip}) + \tau_{my} * treatment_{imy} + \beta_1 * HDD_{imy} + \beta_2 * CDD_{imy} + \beta_3 * HDD_{imy} * treatment_{imy} + \beta_4 * CDD_{imy} * treatment_{imy} + \varepsilon_{imy}$$

Where:

$Usage_{imy}$ = Customer i's average daily energy usage in bill month m in year y

$\beta_0$ = Intercept of the regression equation

$I_{my}$ = An indicator variable equal to one for each monthly bill month m, year y, and zero otherwise

$\beta_{myp}$ = Coefficient on the bill month m, year y indicator variable interacted with pre-period p, where p represents the post-period month m minus 12 months

$\beta_1, \beta_2$ = Coefficients on HDD and CDD

$AvgPre_{ip}$ = Average daily usage for customer i in the pre-treatment period p, where p represents the post-period month m minus 12 months

$treatment_{imy}$ = Treatment indicator variable. Equal to one when the treatment is in effect for the treatment group. Zero otherwise. Always zero for the control group.

$HDD_{imy}$ = HDD for customer i in month m

$CDD_{imy}$ = CDD for customer i in month m

$\tau_{my}$ = The estimated treatment effect in Usage per day per customer independent of weather

$\beta_3, \beta_4$ = The coefficients on HDD and CDD interacted with the treatment indicator variable. This measures the treatment effect as a function of HDD and CDD (i.e. the change in usage per day due to treatment per HDD/CDD)

$\varepsilon_{imy}$ = Error term

ADM tested additional models to determine whether the impacts found in the PPR model were consistent. Each of the models have different methods of controlling for individual differences and provide reliable estimates of program savings.

The LDV model is like the PPR described above with the exception that instead of regressing the three pre-usage values, the monthly usage from the pre-usage period one year prior to the treatment period for the corresponding month is used as the predictor. For example, the predictor for the month of July in the treatment period is the month of July in the 12-month period before treatment began.

In addition, ADM used CCD and HDD in the regression model to account for any weather-related effects not captured by the monthly dummies or each customer's average pre-period seasonal usage. See Equation B-6.

The LDV model is specified by the equation below:

*Equation B-6: LDV Model Equation*

$$Usage_{imy} = \beta_0 + \sum_{m=1}^{12} \sum_{y=1}^{n} I_{my} * \beta_{my} + Pre - Period\ Usage_{i,m,y-n} * \beta_{m,y-n} + \sum_{m=1}^{12} \sum_{y=1}^{n} I_{my} * \tau_{my} * treatment_{imy} + \beta_1 * HDD_{im} + \beta_2 * CDD_{im} + \varepsilon_{imy}$$

Where:

$Usage_{imy}$ = Customer i's average daily energy usage in bill month m in year y

$\beta_0$ = Intercept of the regression equation

$I_{my}$ = An indicator variable equal to one for each monthly bill month m, year y, and zero otherwise

$\beta_{my}$ = The coefficient on the bill month m, year y indicator variable

$\beta_1$ = The coefficient on Heating Degree Days

$\beta_2$ = The coefficient on Cooling Degree Days

$Pre-Period\ Usage_{\ i,m,y-n}$ = The billed usage for customer i in bill month m in the year prior to the assignment to treatment condition. The term n represents the number of years home i has been in the program. This term represents pre-period usage and would indirectly control for variability in customer characteristics such as home size and heating fuel.

$\beta_{m,y-n}$ = The coefficient on the home-specific pre-assignment usage term

$treatment_{imy}$ = The treatment indicator variable. Equal to one when the treatment is in effect for the treatment group. Zero otherwise. Always zero for the control group

$HDD_{im}$ = Heating Degree Days for customer i in month m

$CDD_{im}$ = Cooling Degree Days for customer i in month m

$\tau_{my}$ = The estimated treatment effect in Usage per day per customer; the main parameter of interest

$\varepsilon_{imy}$ = Error term

The fixed effects regression model is specified in Equation B-6.

*Equation B-6: Fixed Effects Regression Specification*

$$Usage_{imy} = \beta_i + \sum_{m=1}^{12}\sum_{y=1}^{n} I_{my} * \beta_{my} + \tau_{my} * \sum_{m=1}^{12}\sum_{y=1}^{n} I_{my} * treatment_{imy} + \beta_1 * HDD_{im} + \beta_2 * CDD_{im} + \varepsilon_{imy}$$

Where:

$Usage_{imy}$ = Customer i's average daily energy usage in bill month m in year y

$\beta_i$ = Intercept term for customer i, or the "fixed effect" term. Equal to the mean daily energy use for each customer

$I_{my}$ = Indicator variable that equals one during month m, year y, and zero otherwise. This variable models each month's deviation from average energy.

$\beta_{my}$ = Coefficient on the bill month m, year y indicator variable

$\beta_1$ = Coefficient on HDD

$\beta_2$ = Coefficient on CDD

$treatment_{imy}$ = Treatment indicator variable. Equal to one when the treatment is in effect for the treatment group. Zero otherwise. Always zero for the control group.

$HDD_{im}$ = HDD for customer i in month m

$CDD_{im}$ = CDD for customer i in month m

$\tau_{my}$ = Estimated treatment effect in Usage per day per customer; the main parameter of interest

$\varepsilon_{imy}$ = Error term

As can be seen above, the fixed effects regression model controls for individual differences by including a fixed term that is equal to the customer's average daily energy use that has been averaged across the pre- and post-treatment period. In addition, ADM used HDD and CDD in the regression model to account for any weather-related effects not captured by the monthly dummies.

## B.3 PSM Modeling Results

ADM successfully created a matched cohort for each PSM cohort. Customers were matched on their average pre-period seasonal usage, including summer, fall, winter, and spring for each control and treatment household.

ADM were provided a small pool of control customers to draw upon after billing data restrictions, as shown in Table B-1. Therefore, ADM randomly sampled treatment customers from each PSM cohort to improve the match between treatment and control customers. ADM used nearest neighbor matching with replacement with a one-to-one matching ratio. Therefore, each control customer was matched to one or more similar treatment customers. Also shown in Table B-1 is the impact of various restrictions on the number of treatment and control customers that were included in the final regression model. The “Starting Count” displays the beginning number of customers available prior to applying the data restrictions, while the “Ending Count” displays the number of customers after applying data restrictions and final matching.

*Table B-1: Cohort Restrictions, PSM Cohorts*

| Cohort | Restriction Detail | Treatment Customers | Control Customers |
|---|---|---|---|
| PSM Cohort 1 | Start | 83,740 | 6,424 |
| PSM Cohort 1 | After removing bills that occur after inactive date | 83,740 | 6,424 |
| PSM Cohort 1 | After removing bills that occur before active date | 83,740 | 6,424 |
| PSM Cohort 1 | Remove bills with less than ten or more than 90 days duration | 83,740 | 6,424 |
| PSM Cohort 1 | Remove outliers (anything over 200kWh/day) | 83,740 | 6,423 |
| PSM Cohort 1 | After removing duplicate bills | 83,740 | 6,423 |
| PSM Cohort 1 | After removing bills that occur before pre-period | 83,740 | 6,423 |
| PSM Cohort 1 | After restricting to bills in pre- or post-period | 83,740 | 6,423 |
| PSM Cohort 1 | Only keep customers with at least nine months pre and sufficient post | 62,616 | 5,171 |
| PSM Cohort 1 | Random sample of 2,000 customers | 2,000 | 5,171 |
| PSM Cohort 1 | Final Count: Matched customers w/ pre-period data for each season | 1,971 | 1,461 |
| PSM Cohort 2 | Start | 330,328 | 6,424 |
| PSM Cohort 2 | Keep treatment customers from 2020 cohort with treatment between 6/25 and 7/15 | 303,547 | 6,424 |
| PSM Cohort 2 | After removing bills that occur after inactive date | 303,547 | 6,424 |
| PSM Cohort 2 | After removing bills that occur before active date | 303,539 | 6,424 |
| PSM Cohort 2 | Remove bills with less than ten or more than 90 days duration | 303,530 | 6,424 |
| PSM Cohort 2 | Remove outliers (anything over 200kWh/day) | 303,502 | 6,423 |
| PSM Cohort 2 | After removing duplicate bills | 303,502 | 6,423 |
| PSM Cohort 2 | After removing bills that occur before pre-period | 303,474 | 6,423 |
| PSM Cohort 2 | After restricting to bills in pre- or post-period | 303,456 | 6,423 |
| PSM Cohort 2 | Only keep customers with at least nine months pre and sufficient post | 177,760 | 6,316 |
| PSM Cohort 2 | Random sample of 1,000 customers | 1,000 | 5,171 |
| PSM Cohort 2 | Final Count: Matched customers w/ pre-period data for each season | 988 | 812 |

The figures below display the density of each variable employed in propensity score matching for each cohort before and after conducting matching.

The distributions prior to matching do not overlap well, with control customers having a more peaked distribution during each pre-period season. After matching, the pre-period usage distribution is more similar between the groups, but differences still exist in each pre-period season.

*Figure B-1: Covariate Balance Before Matching, PSM Cohort 1*

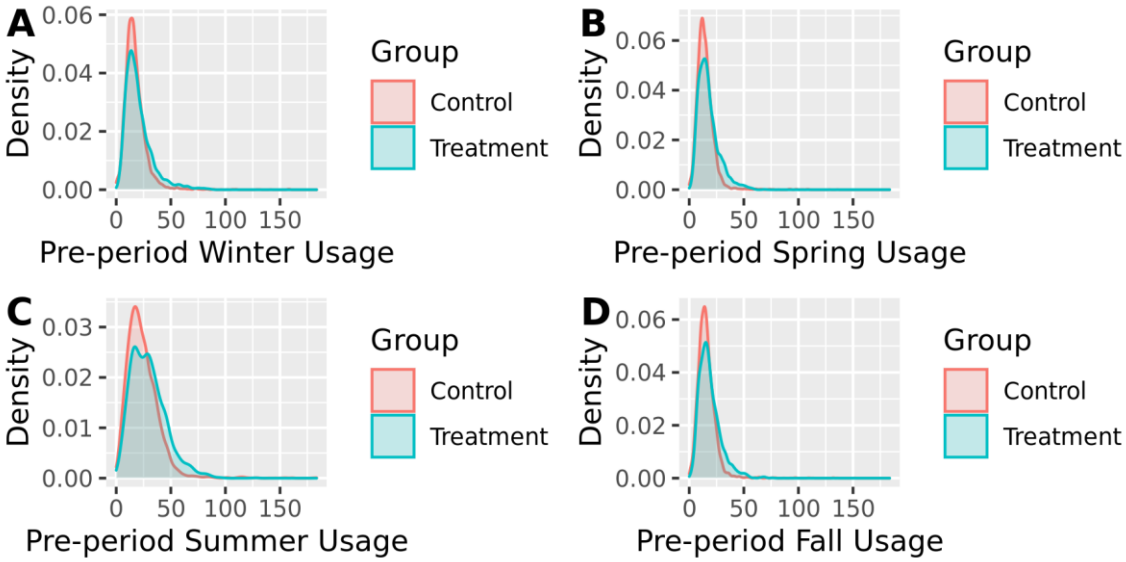



*Figure B-2: Covariate Balance After Matching, PSM Cohort 1*

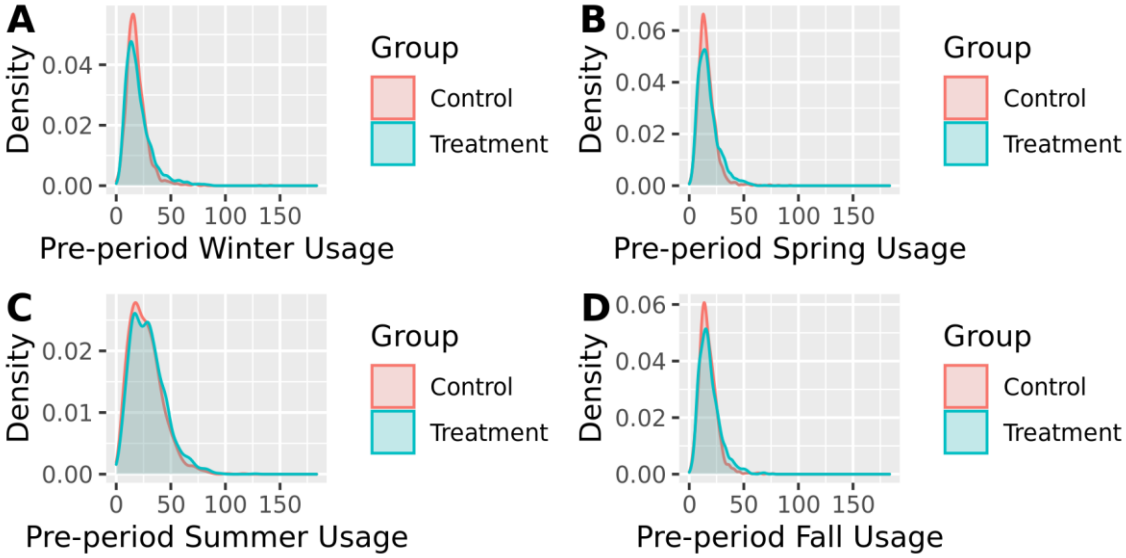


*Figure B-3: Covariate Balance Before Matching, PSM Cohort 2*

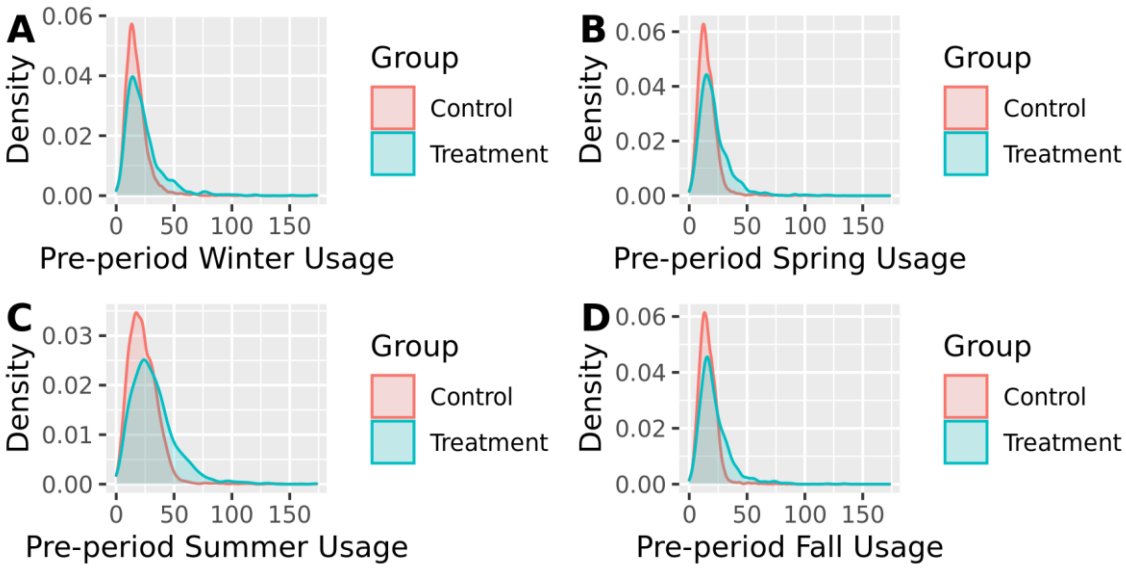
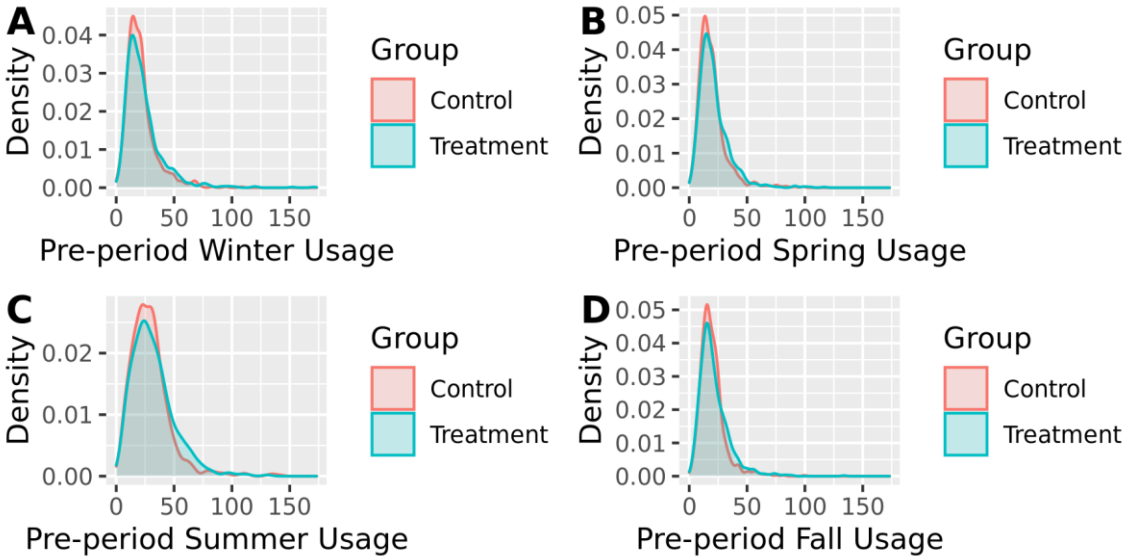



*Figure B-4: Covariate Balance After Matching, PSM Cohort 2*




ADM performed three tests to determine the success of PSM:

1. t-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

Most tests confirmed that PSM performed well for each measure. Twenty-three out of 24 monthly t-tests displayed no statistically significant differences at the 95 percent level in

average daily consumption between the treatment and control groups.[41] In addition, the chi-squared test returned a p-value well over 0.05 for all measures, indicating that pre-period usage was balanced between the groups. Lastly, the standardized difference test returned values under 18 (well under the recommended cutoff of 25), further indicating the groups were reasonably well matched on all included covariates.

Table B-2 provides results for the t-test on pre-period usage between the treatment and control groups after matching for each PSM cohort. The P-Value is over 0.05 for most months, indicating pre-period usage between treatment and control groups is similar at the 95 percent confidence level.

*Table B-2: Pre-period Usage T-test, PSM Cohort 1*

| Month | Average Daily Usage (kWh), Control | Average Daily Usage (kWh), Treatment | T Statistic | Std Error | P-Value | Reject Null? |
|---|---|---|---|---|---|---|
| Jan | 19.920 | 20.224 | -0.764 | 0.398 | 0.445 | No |
| Feb | 19.150 | 19.345 | -0.467 | 0.416 | 0.640 | No |
| Mar | 17.691 | 17.979 | -0.846 | 0.341 | 0.398 | No |
| Apr | 15.922 | 16.323 | -1.423 | 0.282 | 0.155 | No |
| May | 17.787 | 17.952 | -0.512 | 0.322 | 0.609 | No |
| Jun | 25.865 | 25.624 | 0.521 | 0.463 | 0.602 | No |
| Jul | 33.286 | 32.881 | 0.690 | 0.586 | 0.490 | No |
| Aug | 29.619 | 29.527 | 0.176 | 0.524 | 0.860 | No |
| Sep | 21.388 | 21.555 | -0.461 | 0.363 | 0.645 | No |
| Oct | 16.014 | 16.328 | -1.146 | 0.274 | 0.252 | No |
| Nov | 17.679 | 18.020 | -1.079 | 0.315 | 0.281 | No |
| Dec | 20.551 | 21.118 | -1.365 | 0.416 | 0.172 | No |

[41] Only one month for PSM cohort 2 showed statistically significant differences in pre-period usage between the treatment and control groups. However, one rejection of the null is likely to occur due to chance over 40 percent of the time according to a binomial test where the probability of rejecting the null hypothesis is 0.05 and 12 t-tests are performed (one for each month of the year).

*Table B-3: Pre-period Usage T-test, PSM Cohort 2*

| Month | Average Daily Usage (kWh), Control | Average Daily Usage (kWh), Treatment | T Statistic | Std Error | P-Value | Reject Null? |
|---|---|---|---|---|---|---|
| Jan | 23.626 | 23.725 | -0.137 | 0.727 | 0.891 | No |
| Feb | 22.607 | 22.213 | 0.560 | 0.704 | 0.576 | No |
| Mar | 21.013 | 20.565 | 0.708 | 0.633 | 0.479 | No |
| Apr | 20.567 | 20.234 | 0.543 | 0.614 | 0.587 | No |
| May | 23.234 | 22.909 | 0.476 | 0.680 | 0.634 | No |
| Jun | 28.569 | 26.830 | 2.092 | 0.831 | 0.037 | Yes |
| Jul | 33.081 | 34.635 | -1.655 | 0.939 | 0.098 | No |
| Aug | 32.868 | 34.294 | -1.562 | 0.912 | 0.118 | No |
| Sep | 23.865 | 24.452 | -0.902 | 0.650 | 0.367 | No |
| Oct | 18.794 | 18.971 | -0.348 | 0.511 | 0.728 | No |
| Nov | 20.754 | 21.240 | -0.799 | 0.608 | 0.424 | No |
| Dec | 23.471 | 24.084 | -0.851 | 0.721 | 0.395 | No |

As shown in Table B-4, treatment customers had statistically significant negative savings for each PSM cohort and program year. In addition, negative savings for PSM Cohort 1 are greater than five percent of annual consumption. These results indicate that while matching was successful, there are other factors influencing customer usage in the post-period and bias still exists between the treatment and control groups.

ADM tested whether the overall results for two other regression models (LDV and fixed effects) differed from the PPR model. The direction and magnitude of savings were generally consistent across all models tested. Table B-5 provides the additional results for the other models tested.

*Table B-4: Customer Savings by Cohort and Program Year*

| Cohort | Year | Model | Annual kWh Savings/ Customer | 90% Lower CI | 90% Upper CI | kWh Savings % of Annual | Adjusted R-Squared |
|---|---|---|---|---|---|---|---|
| PSM Cohort 1 | 2020 | PPR | -496.95 | -548.75 | -445.15 | -6% | 0.713 |
| PSM Cohort 1 | 2021 | PPR | -709.05 | -843.95 | -574.14 | -9% | 0.661 |
| PSM Cohort 2 | 2020 | PPR | -705.26 | -795.42 | -615.10 | -2% | 0.818 |
| PSM Cohort 2 | 2021 | PPR | -697.11 | -823.20 | -571.02 | -4% | 0.762 |

*Table B-5: Customer Savings from Additional Regression Models*

| Cohort | Year | Model | Annual kWh Savings/ Customer | 90% Lower CI | 90% Upper CI | kWh Savings % of Annual | Adjusted R-Squared |
|---|---|---|---|---|---|---|---|
| PSM Cohort 1 | 2020 | Fixed Effects | -489.06 | -612.53 | -365.58 | -6% | 0.142 |
| PSM Cohort 1 | 2020 | LDV | -472.51 | -526.70 | -418.32 | -6% | 0.691 |
| PSM Cohort 1 | 2021 | Fixed Effects | -696.21 | -821.90 | -570.51 | -9% | 0.147 |
| PSM Cohort 1 | 2021 | LDV | -695.30 | -756.24 | -634.37 | -9% | 0.639 |
| PSM Cohort 2 | 2020 | Fixed Effects | -100.25 | -389.53 | 189.04 | -1% | 0.093 |
| PSM Cohort 2 | 2020 | LDV | 12.65 | -118.13 | 143.42 | 0% | 0.769 |
| PSM Cohort 2 | 2021 | Fixed Effects | -225.27 | -443.55 | -7.00 | -3% | 0.102 |
| PSM Cohort 2 | 2021 | LDV | -285.22 | -373.69 | -196.75 | -3% | 0.730 |

ADM tested for differences in consumption following COVID-19 by including a COVID dummy variable in the model. In addition, the COVID dummy variable was interacted with the treatment dummy variable. While both groups showed statistically significant increased usage following COVID, treatment customer usage increased by 5-6 percent more on an annual basis when compared to control customers (statistically significant at 99 percent). This result indicates that treatment customers were more likely to work from home or increase their usage in other ways due to ongoing impacts from COVID-19 when compared to control customers. This result further points to the fact that control customers were different than treatment customers in ways that could not be accounted for with PSM.

## B.4 Pre-Post Treatment Only Modeling

ADM estimated savings using a treatment only, pre-post modeling framework. Treatment customers were selected from the VIA customer pool and categorized into separate

cohorts based on their initial year of treatment. In addition, ADM restricted billing data to one year of pre-period bills for each cohort. Table B-6 provides the regression model name and formulas for each pre-post regression model.

*Table B-6: Regression Model Formulas*

| Model Name | Regression Model Formula |
|---|---|
| Simple | $Usage_{it} \sim Post_{it} + \varepsilon_{it}$ |
| Simple Fixed | $Usage_{it} \sim Post_{it} \mid Customer_i + \varepsilon_{it}$ |
| Month Weather Fixed | $Usage_{it} \sim Month_{it} + HDD_{it} + CDD_{it} + Post_{it} + Post_{it} * HDD_{it} + Post_{it} * CDD_{it} \mid Customer_i + \varepsilon_{it}$ |

Regression model terms:

$Usage_{it}$ = Customer i's average daily energy usage at time t

$Month_{it}$ = Indicator variable equal to one for each month of the year at time t, and zero otherwise

$HDD_{it}$ = 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

$Customer_i$ = Dummy variable for each customer. This measures the customer fixed effect over time

$\varepsilon_{it}$ = Error term

Table B-7 provides customer savings by cohort, year, and regression model. Customers treated in 2012 and 2014 show statistically significant positive savings, while customers treated in 2016 onwards show statistically significant negative savings. Unbiased estimates from RCT return savings as a percent of annual consumption between 0 percent and five percent. However, savings as a percent of annual consumption range from -12 percent to 16 percent, indicating a large amount of bias for the treatment only models. In addition, the cohorts for customers treated in 2016 onwards all show statistically significant negative savings, which is another indication that bias is present because HER programs have never been shown to increase customer consumption when using an RCT design.

*Table B-7: Customer Savings by Cohort, Year, and Model*

| Wave Treatment Year | Year | Regression Model Formula | Annual kWh Savings/Customer | 90% Lower CI | 90% Upper CI | Savings % of Annual | Adjusted R-Squared |
|---|---|---|---|---|---|---|---|
| 2012 | 2020 | Simple | 1976.51 | 1951.11 | 2001.91 | 12% | 0.018 |
| 2012 | 2020 | Simple Fixed | 1958.01 | 1938.40 | 1977.61 | 12% | 0.417 |
| 2012 | 2020 | Month Weather Fixed | 2263.75 | 2243.03 | 2284.48 | 13% | 0.559 |
| 2014 | 2020 | Simple | 101.84 | 90.12 | 113.56 | 1% | 0.000 |
| 2014 | 2020 | Simple Fixed | 107.45 | 98.40 | 116.50 | 1% | 0.406 |
| 2014 | 2020 | Month Weather Fixed | 51.88 | 44.19 | 59.56 | 1% | 0.613 |
| 2016 | 2020 | Simple | -340.41 | -298.46 | -382.35 | -3% | 0.001 |
| 2016 | 2020 | Simple Fixed | -343.08 | -313.61 | -372.55 | -3% | 0.509 |
| 2016 | 2020 | Month Weather Fixed | -281.69 | -255.26 | -308.11 | -2% | 0.629 |
| 2018 | 2020 | Simple | -723.76 | -709.16 | -738.35 | -9% | 0.005 |
| 2018 | 2020 | Simple Fixed | -678.93 | -669.67 | -688.18 | -9% | 0.602 |
| 2018 | 2020 | Month Weather Fixed | -429.60 | -421.26 | -437.93 | -6% | 0.743 |
| 2020 | 2020 | Simple | -1054.45 | 1039.15 | 1069.76 | -11% | 0.004 |
| 2020 | 2020 | Simple Fixed | -1325.84 | 1317.36 | 1334.32 | -14% | 0.697 |
| 2020 | 2020 | Month Weather Fixed | -735.27 | -725.39 | -745.15 | -8% | 0.777 |
| 2012 | 2021 | Simple | 2184.41 | 2158.74 | 2210.08 | 13% | 0.022 |
| 2012 | 2021 | Simple Fixed | 2156.23 | 2136.16 | 2176.31 | 13% | 0.413 |
| 2012 | 2021 | Month Weather Fixed | 2699.70 | 2680.01 | 2719.39 | 16% | 0.563 |
| 2014 | 2021 | Simple | 107.53 | 95.53 | 119.52 | 1% | 0.000 |
| 2014 | 2021 | Simple Fixed | 116.79 | 107.36 | 126.23 | 1% | 0.394 |
| 2014 | 2021 | Month Weather Fixed | 91.90 | 84.04 | 99.77 | 1% | 0.611 |
| 2016 | 2021 | Simple | -348.30 | -305.17 | -391.42 | -3% | 0.001 |
| 2016 | 2021 | Simple Fixed | -328.24 | -297.20 | -359.29 | -3% | 0.498 |
| 2016 | 2021 | Month Weather Fixed | -316.57 | -287.90 | -345.24 | -3% | 0.629 |
| 2018 | 2021 | Simple | -958.49 | -943.10 | -973.89 | -12% | 0.008 |
| 2018 | 2021 | Simple Fixed | -810.73 | -800.51 | -820.96 | -11% | 0.587 |
| 2018 | 2021 | Month Weather Fixed | -573.19 | -564.44 | -581.95 | -7% | 0.735 |
| 2020 | 2021 | Simple | -767.10 | -754.90 | -779.29 | -8% | 0.003 |
| 2020 | 2021 | Simple Fixed | -636.68 | -629.72 | -643.64 | -7% | 0.682 |
| 2020 | 2021 | Month Weather Fixed | -472.44 | -466.05 | -478.83 | -5% | 0.765 |

# Appendix C: Memo Establishing Deemed Savings

## Memorandum

To: Rocky Mountain Power [Staff names redacted.]

From: Cadmus [Staff names redacted.]

Subject: Deemed Savings for Rocky Mountain Power Utah HER Program

Date: June 3, 2020

### *Introduction*

Rocky Mountain Power (RMP) operates home energy reports (HER) programs in Idaho, Utah, and Wyoming. These programs have consistently delivered energy savings and high customer satisfaction ratings. In Utah in 2019, RMP delivers energy reports to 311,051 customers belonging to four waves, and the program saved between 0.3% and 1.8% of electricity consumption, depending on the wave.[1] While RMP has recently expanded its Utah HER program, many of its residential customers still do not receive energy reports.[2]

RMP is considering expanding its HER program to serve all residential customers in Utah.[3] This would require changing the program evaluation approach. Currently, RMP 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.

RMP asked Cadmus to investigate whether its HER program in Utah could reliably be evaluated with a deemed savings approach given that the program has a long record of consistently delivering energy savings.[4] With a deemed savings approach, PacifiCorp 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 RMP Utah HER program participants.

[2] There were 758,000 RMP residential customers in Utah. The RMP Utah HER program comprises four waves: Legacy (first reports delivered in 2012), Expansion (2014), Refill (2016), and Refill 2 (2018).

[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 ADM Associates (2018) for the most recent evaluation of RMP's Utah HER program.

## Research Objectives

For a deemed savings approach to evaluating RMP'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 RMP wishes to apply deemed savings to residential customers who have never received HERs, the deemed savings values must be applicable to RMP's residential customers who do not currently receive energy reports.

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 RMP Utah HER program. The focus of this research is on assessing the second and third conditions, because, as discussed below, the accuracy of the evaluated annual savings are not at issue. To assess the second and third questions, Cadmus analyzed the evaluated annual savings from RMP HER programs and the HER program of other utilities as well as billing data for RMP Utah 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' assessment finds that the RMP Utah savings estimates from RCTs are accurate indicators of past program performance and that these savings estimates could be used to develop deemed savings values. Also, the savings from the RMP Utah HER programs follow a predictable time trend. Specifically, savings reach a steady state after three years of treatment and savings maintain while customers receive energy reports. This suggests that deemed savings based on past savings estimates can be used to measure future program savings. The assessment also determined that customers participating in the HER experiment tend to have higher consumption than customers currently not participating and that HER savings depend on household consumption levels. This means that the evaluated savings from the RCT experiments cannot be directly applied to the non-participant population. This memo concludes with recommendations for HER deemed savings values based on regression analysis of RMP UMP customer billing consumption data.

# *Deemed Savings Approach Assessment*

## Accuracy of Evaluated Savings

The first condition regarding the accuracy of the RMP's 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 RMP HER program evaluations were conducted as large RCTs involving

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

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

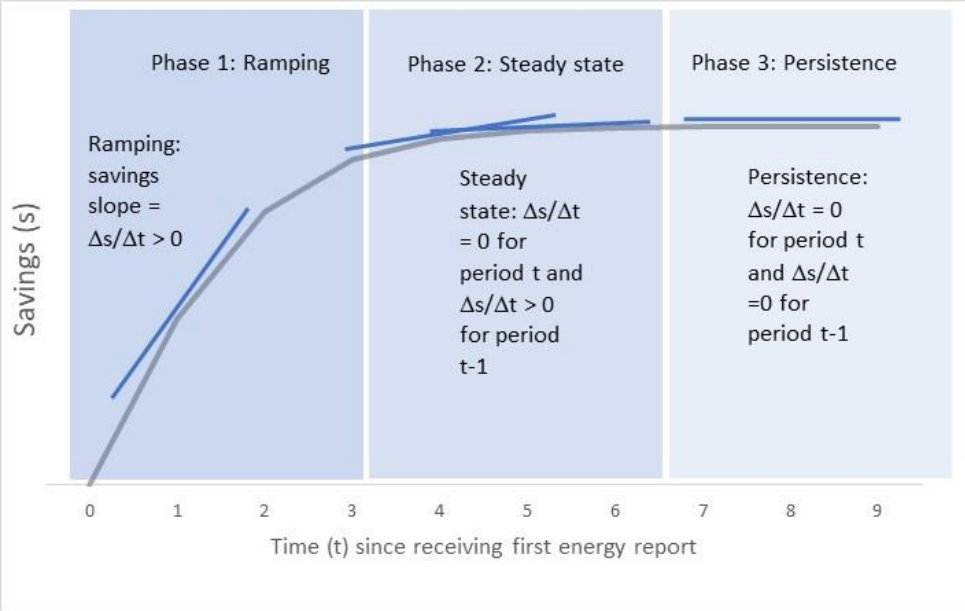
Most RCT impact evaluations from long-running utility HER programs suggest that savings reach a steady state after customers receive energy reports for two or three years (Khawaja and Stewart 2014).

[6] For its evaluation of RMP's Utah 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.

Figure **1** illustrates the hypothesized savings trend for a typical HER program since the time of first treatment. The x axis shows time (in years) since the first reports were delivered and the y 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]

[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**




### *RMP Utah HER Savings Trends*

Cadmus analyzed savings trends for the RMP Utah 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 RMP's Utah HER programs and the HER programs of other utilities to estimate how HER savings evolve over time. We show that RMP's Utah HER program follows the savings trends in

Figure **1**.

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 average percentage savings in each year of treatment. The utility-wave fixed effects control for differences in program population and program implementation 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.

In a second regression, we test whether the savings trend for RMP's Utah HER program differs from the savings trend for the other utilities in the analysis sample. We did this by re-running the first regression with a set of year-of-treatment indicators interacted with a dummy variable for whether the savings estimate was from RMP Utah. We conducted statistical tests of the hypothesis that the coefficients on the interaction variables for program years 3 and higher are equal to zero, which would indicate that RMP Utah's steady-state savings is not statistically different from other utilities. There were not enough annual savings estimates from RMP Utah HER program to develop a separate model for Utah.

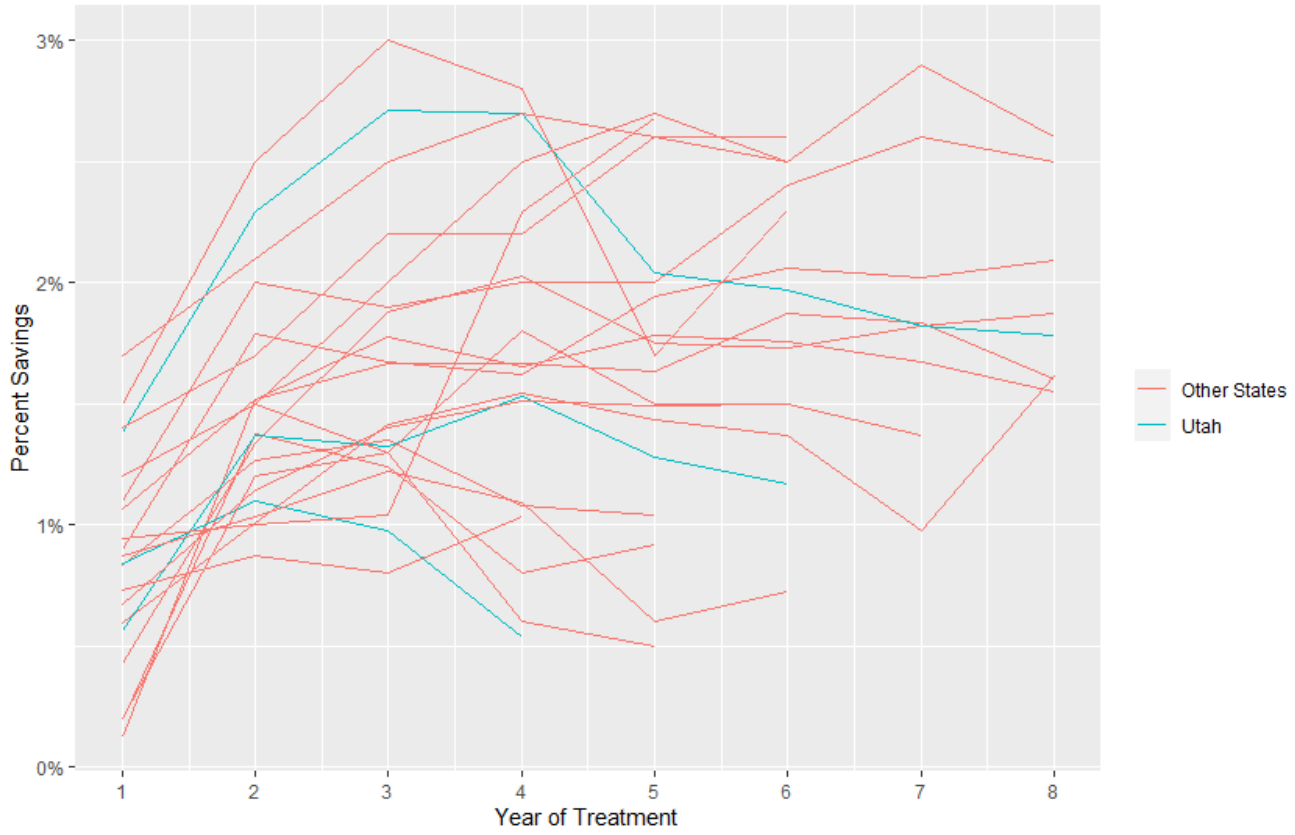
The analysis sample includes data for six utilities and 21 utility-waves and a total of 135 observations of annual percentage HER savings. Specifically, we analyzed annual HER savings from the long running HER programs of RMP (Utah), Pacific Power (Washington), Vectren (Indiana), PPL Electric (Pennsylvania), Commonwealth Edison (Illinois), and Indianapolis Power & Light (Indiana).[9] Like RMP's Utah 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 RMP Utah'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 RMP Utah waves are presented in blue. RMP Utah suspended delivery of energy reports most of 2018, which may help to explain the decline in savings for the two waves with the lowest savings.

[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.

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

**Figure 2. HER Program Savings Trends for Utility Waves**



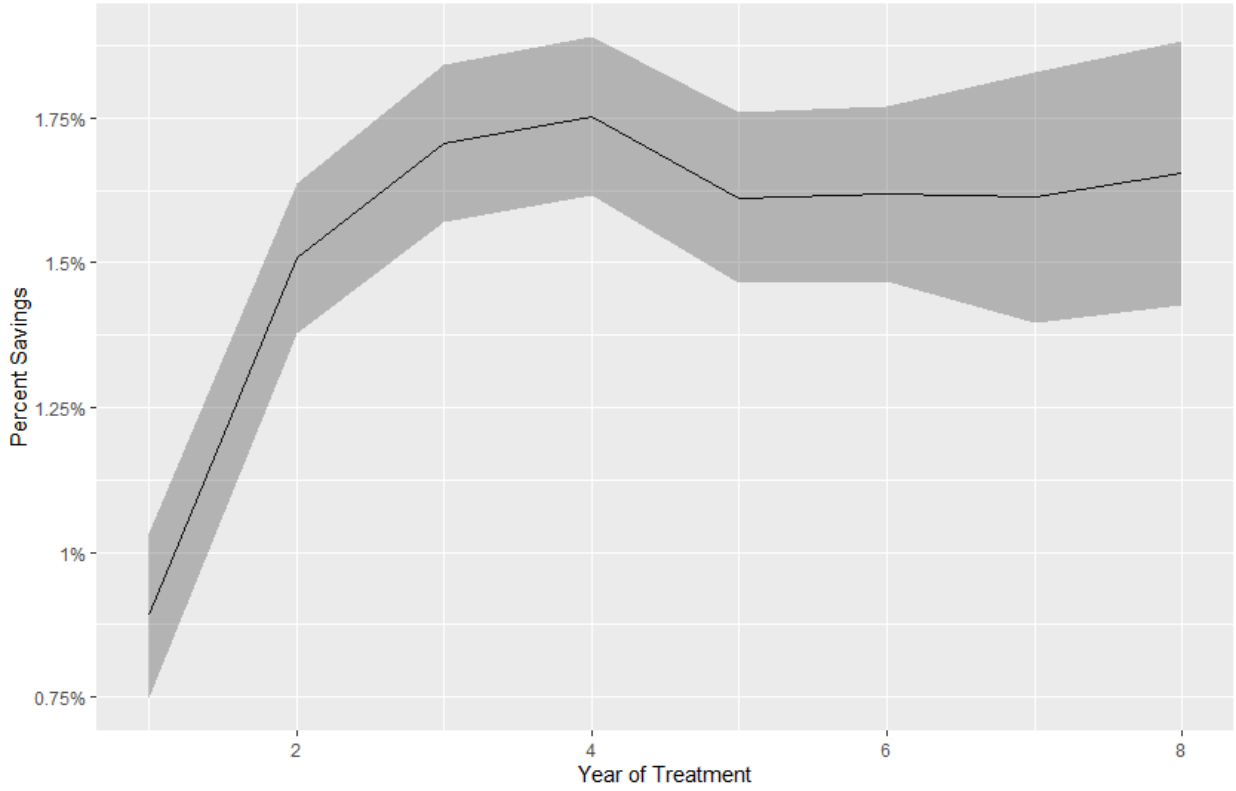

***Results***

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 (.816) shows that the wave-year fixed effects and the year-of-treatment indicators can explain 81.6% of the variation in annual percentage savings.

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.[10]

**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 2 show that we cannot reject this hypothesis. The F statistic equals 0.84 and the p-value equals 0.53, 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 one, 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

[10] 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.

insignificant (t stat = .355, p value = .723), again suggesting that savings did not trend up or down after reaching a steady state.

**Table 2. Test for a Savings Steady State**

| F Statistic | Degrees of Freedom (num, den) | p value |
|---|---|---|
| 0.84 | 5, 20 | 0.534 |

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 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 RMP Utah's HER program exhibit the same properties? We formally test for differences in savings between RMP's Utah HER and the HER programs of the other utilities in the analysis sample by running the second regression with the interaction variables between the year of treatment and an indicator variable for RMP Utah. The regression is estimated with annual savings data for Utah HER programs (n=16 annual observations) and the other utility waves in our sample (n=102 annual observations) with a minimum of four years of estimated savings. All observations with treatment year greater than six years were dropped from the analysis sample because there was only one utility-wave in RMP Utah's program with more than six treatment years. Table 3 shows the results of an F test of the hypothesis that there was no statistically significant difference between the steady state savings for years 3 through year 6 of the RMP Utah program and the other programs.[11] This results suggests that the HER program savings of RMP Utah and the other utilities follow the same predictable trends.

**Table 3. Test of Difference in Savings between RMP Utah and Other Utilities**

| F Statistic | Degrees of Freedom (num, den) | p value |
|---|---|---|
| 1.69 | 4, 20 | 0.192 |

Notes: Table shows results of F test of hypothesis that the coefficients (savings) on the interaction variables between year of treatment and indicator variable for UMP Utah program equal zero. Dependent variable in the regression is HER annual percentage energy savings. Model was estimated by OLS with standard errors clustered on utility-wave.

This analysis of HER savings trends shows that HER program savings follow a predictable trend: after ramping for one or two years, savings reach a steady state. The analysis also suggests that the savings of RMP's Utah HER programs follow the same trend. Moreover, most of the variance in percentage annual savings can be explained by the utility fixed effects and the program year of treatment.

## External Validity of the HER Savings Estimates

Cadmus assessed the extent to which RMP Utah HER savings estimates would be applicable to RMP 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 Utah where the highest expected savers were selected for the program. We assessed the external validity of RMP's HER savings estimates by comparing the energy consumption, demographic, and home characteristics of residential customers participating and not participating in the RCT evaluations.

[11] Also, none of the coefficients on the interaction variables between treatment year and the indicator variable for Utah for program years 3 through 6 were statistically significant at the 10% level.

Expanding the HER program would involve sending energy reports to three groups of customers, two of which have not previously received reports:[12]

- **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 RMP Utah program may not apply to this group.

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

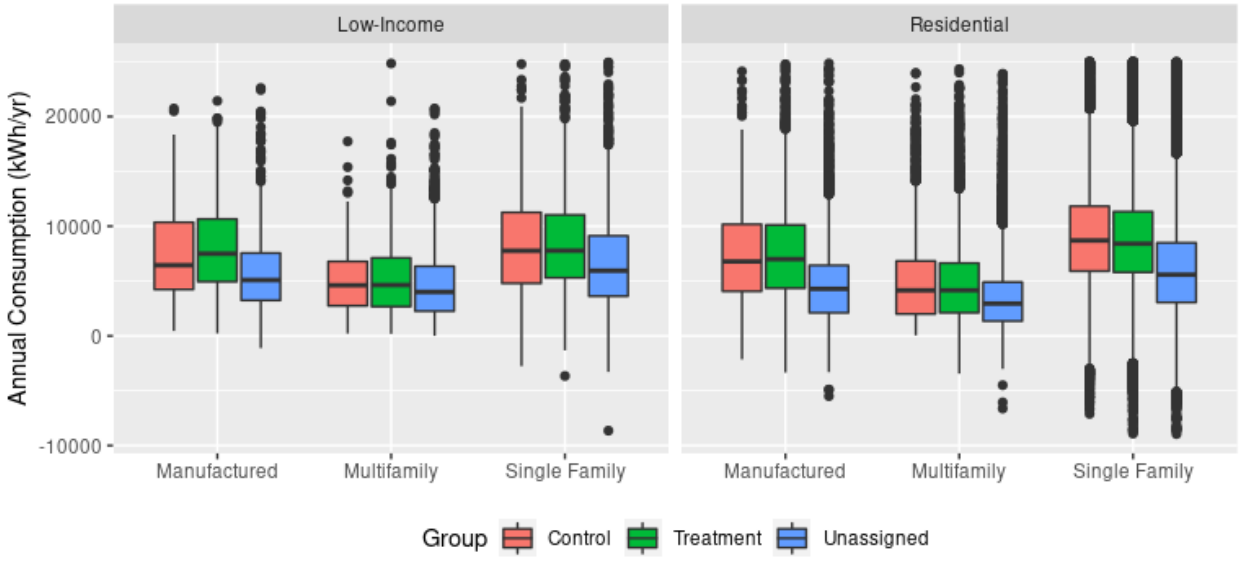
- Annual electricity consumption
- Climate (normal weather annual HDDs and CDDs)
- Type of household
- Low-income status (determined by whether a customer was on a low-income rate)

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 RMP Utah HER experiments (customers assigned to the treatment or control group of any wave) and customers who were not included (Unassigned). The results are presented by low income status and by home type (manufactured, multifamily, and single-family).

[12] Rocky Mountain Power launched email-only HER waves in Idaho, Utah, and Wyoming in late 2018 and early 2019. The savings of these customers may still be ramping up, and it remains to be seen how their savings compare to customers who received paper reports.

**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 (shown by the heavy line in each box) and annual consumption distributions (shown by the bottom (25th percentile) and top (75th percentile of the box). This balance is attributable to the random assignment of customers to treatment or control in the experimental population. However, the figure also shows that the HER experiments tended to include customers with higher consumption and exclude customers with lower consumption, though the distributions of the experimental and Unassigned populations significantly overlap. This overlap is important because Cadmus analyzes the monthly billing data from the HER experiments to obtain deemed savings values for RMP Utah's residential customer population.

Cadmus formally tested if mean annual electricity consumption differed significantly for customers assigned to an existing HER program experiment group and those who remained unassigned. Table 4 shows the results of the two-sample t-test. Consistent with the boxplot shown in Figure 4, Cadmus found that customers in RMP Utah territory consumed significantly less than customers assigned to either a treatment or control group in one of its ongoing HER programs.

**Table 4. Test for Difference in Average Pre-Treatment Consumption**

| Mean Annual Consumption (kWh/yr) | | | T Statistic | Degrees of Freedom | p value |
|---|---|---|---|---|---|
| Assigned | Unassigned | Difference | | | |
| 8,596 kWh/yr | 5,679 kWh/yr | 2,917 kWh/yr | -140.06 | 253,223 | < 0.0001 |

The differences between the experimental population and the unassigned population mean that RMP Utah should not directly apply the evaluated percentage savings from the RCT experiments without first checking if the HER savings in the experiment depend on annual consumption.

## Deemed Savings Values

Using monthly billing consumption data for the customers in the Utah 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, which are conditional mean savings estimates across all treatment group customers, 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 1 and 2) and the other for the steady state phase (program year 3 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. Both regressions estimated savings as a function of a customer's annual pre-treatment consumption. Each customer in the HER experiments was assigned to a consumption quartile based on their annual pre-treatment consumption.

We used data for each RMP Utah wave's first two program years to estimate the ramping phase regression. Data for program years three or higher from 2016, 2017, and 2019 were used to estimate the steady state phase regression. The regressions pooled data from all waves (Utah Legacy, Utah Expansion, Utah Refill, and Utah Refill 2) to estimate the average saving by consumption quartile.

Table **5** and Table 6 show the regression-based estimates of the average treatment effects in kWh per customer per day (=-1*savings) and the standard errors by consumption quartile for the ramping phase and steady state phases. All estimates were statistically significant at the 5% significance level.

Table **5** shows that savings increased from the first year of treatment to the second year of treatment consistently across all consumption quartiles. For example, the average daily savings per treated customer was approximately -0.0226 kWh. As expected, customers with higher pre-treatment consumption, such as those in the third and fourth quartiles, reduced their energy consumption more than customers with lower pre-treatment consumption. Cadmus found the largest differences in estimated savings between second and third consumption quartiles.

**Table 5. Ramping Phase Savings Estimates by Consumption Quartile**

| Pre-Treatment Annual Consumption Range (kWh/yr) | Year of Treatment | Estimated Treatment Effect (kWh per customer per day) | Standard Error | p-value |
|---|---|---|---|---|
| < 4,047 | 1 | -0.0056 | 0.0018 | 0.0023 |
| | 2 | -0.0104 | 0.0021 | < 0.0001 |
| > 4,047 to < 7,027 | 1 | -0.0068 | 0.0011 | < 0.0001 |
| | 2 | -0.0133 | 0.0012 | < 0.0001 |
| > 7,027 to < 10,356 | 1 | -0.0119 | 0.0019 | < 0.0001 |
| | 2 | -0.0247 | 0.0019 | < 0.0001 |
| > 10,356 | 1 | -0.0143 | 0.0040 | < 0.0001 |
| | 2 | -0.0226 | 0.0038 | < 0.0001 |

Notes: Dependent variable was the natural logarithm of monthly average daily consumption. The fixed-effects differences-in-differences regression model included separate month-year of sample fixed effects for each consumption quartile and customer fixed effects. The model was estimated by OLS with data for 367,187 customers and 7,270,385 observations of monthly adc. Standard errors were clustered on customers.

Table 6 shows the estimated steady-state treatment effects for each consumption quartile. Consistent with the ramp-up savings trends by consumption quartile, the steady state savings also increased with annual pre-treatment consumption. Cadmus found that customers who consumed more than 7,027 kWh/yr in their pre-treatment period saved between approximately 2.4% and 2.5% at their savings steady state, while customers who annually consumed less than 7,027 kWh/yr in their pre-treatment period saved between 1.0% and 1.5% at their steady state.

**Table 6. Steady State Phase Savings Estimates by Consumption Quartile**

| Pre-Treatment Annual Consumption Range (kWh/yr) | Estimated Treatment Effect (kWh per customer per day) | Standard Error | p-value |
|---|---|---|---|
| < 4,047 | -0.0100 | 0.0026 | 0.0001 |
| > 4,047 to < 7,027 | -0.0147 | 0.0017 | < 0.0001 |
| > 7,027 to < 10,356 | -0.0243 | 0.0027 | < 0.0001 |
| > 10,356 | -0.0254 | 0.0052 | < 0.0001 |

Notes: Dependent variable was the natural logarithm of monthly average daily consumption. The model included separate month-year fixed effects and pre-period consumption variables for each consumption quartile. The model was estimated by OLS with data for 254,233 customers and 11,339,319 observations of monthly adc. Standard errors were clustered on customers.

The results in

Table **5** and Table 6 show that percentage savings increased with customer annual consumption and confirm that the evaluated savings from the RMP Utah experiments cannot be directly applied to unassigned customers because of the large differences in annual consumption between customers included and excluded from the HER experiments.

### *Recommended Deemed Savings Values*

Cadmus recommends that RMP Utah use the deemed savings values provided in Table 7 to calculate HER savings if a control group cannot be reasonably established. The deemed savings values were obtained from the regression-based savings estimates in

Table **5** and Table 6 and vary by a customer's pre-treatment consumption and the customer's length of treatment.

**Table 7. Recommended Deemed Percentage Savings Values**

| Pre-Treatment Annual Consumption Range (kWh/yr) | Program Year 1 | Program Year 2 | Program Year 3+ |
|---|---|---|---|
| < 4,047 | 0.6% | 1.0% | 1.0% |
| > 4,047 to < 7,027 | 0.7% | 1.3% | 1.5% |
| > 7,027 to < 10,356 | 1.2% | 2.4% | 2.4% |
| > 10,356 | 1.4% | 2.2% | 2.5% |

Note: Deemed savings values for program years 1 and 2 and consumption range were calculated from the regression coefficients in

Table **5** as deemed savings = -1*[exp(est. reg. coefficient) -1], where exp is the exponential function.

It should be stressed that these deemed savings values assume that RMP Utah 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.

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