Evaluation, Verification & Measurement Report
Home Energy Reports Program
Washington

Prepared for:

Pacific Power

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ADM
ENERGY RESEARCH
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Table of Contents

List of Figures

List of Tables

1 Executive Summary

This report is a summary of the evaluation, measurement, and verification (EM&V) effort of the 2020 and 2021 program years Home Energy Reports (HERs) program for Pacific Power in Washington. The evaluation was completed by ADM Associates, Inc.

ADM collected data for the evaluation through review of program materials, acquisition of program tracking data, collection of historical billing data, and a survey of participants and control group members. ADM estimated the energy impacts of the HERs program through a billing analysis with linear regression and statistically valid control groups. Table 1-1: summarizes the number of residential customers the HERs were deployed to in the Pacific Power service area during the evaluation period.

Table 1-1: Summary of HERs Program

Wave	Treatment Customers[1]	Control Customers
Remix Email	25,000	10,000
Remix Paper	21,000	10,000
Expansion 2021	14,183	8,951
Total	60,183	28,951

ADM found positive and statistically significant savings estimates for all cohorts evaluated, with the exception of the Expansion 2021 wave for program year 2021, which had positive but not statistically significant savings likely due to having had treatment for less than half a year. During 2020, the average annual household savings was 147 kWh with a total program savings of 5,748,805 kWh. During 2021, the average annual household savings was 111 kWh with a total program savings of 5,101,997 kWh.

Table 1-2: and Table 1-3: summarize HERs total program savings for 2020 and 2021.

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[1] With variable intervention dates, defining the number of treatment customers at the start is problematic since new customers are added throughout the program year. ADM estimated the number of original treatment customers as the number of customers treated during the evaluation period (e.g. 2020-2021 for Remix waves and 2021 for the Expansion wave). These participant numbers are drawn from the evaluated program tracking dataset; they do not match the participant numbers reported in *2020 Washington Annual Report on Conservation Acquisition.*

Table 1-2: Summary of HERs Program Savings During 2020

Wave	Weighted Customers*	Average Annual Household Savings (kWh)	Total Program Savings (kWh)**
Remix Email	21,375	199.69	4,268,408
Remix Paper	17,665	83.81	1,480,397
Total	39,039	147.26	5,748,805

*ADM used the weighted number of active treatment customers to produce ex-post measure savings. The total number of weighted customers may not sum to the number of weighted customers due to rounding. Weighted customers is the sum of all billing days in the post-period for all participants for the given program year/wave divided by 365.25

**Total Program Savings (kWh) may not sum to the Total due to rounding.

Table 1-3: Summary of HERs Program Savings During 2021

Wave	Weighted Customers*	Average Annual Household Savings (kWh)	Total Program Savings (kWh)**
Remix Email	20,957	142.28	2,981,698
Remix Paper	18,684	113.48	2,120,300
Expansion 2021	6,338	0.00	0
Total	45,979	110.96	5,101,997

*ADM used the weighted number of active treatment customers to produce ex-post measure savings. The total number of weighted customers may not sum to the number of weighted customers due to rounding. Weighted customers is the sum of all billing days in the post-period for all participants for the given program year/wave divided by 365.25

**Total Program Savings (kWh) may not sum to the Total due to rounding.

The HERs program resulted in a realization rate of 158 percent during the evaluation period (see Table 1-4).

Table 1-4: Program Energy Savings (kWh) and Realization Rate

Year	Claimed Savings (kWH)	Evaluated Savings (kWh)	Realization Rate
2020	3,542,270	5,748,805	162%
2021	3,333,142	5,101,997	153%
Total	**6,875,412**	**10,850,802**	**158%**

1.1 Conclusions and Recommendations

ADM offers the following conclusions and recommendations for consideration in planning future program cycles.

1.1.1 Conclusions

- Pacific Power's HERs program in Washington resulted in verified program savings of 5,748,805 kWh in 2020 and 5,101,997 kWh in 2021. ADM estimated HERs program savings using a billing analysis of randomized control trial (RCT) cohorts and matched control groups. ADM found annual savings that are positive and statistically significant savings for both Remix waves in both program years (i.e., 2020 and 2021). The Expansion 2021 wave had positive savings that are not statistically significant in 2021; however, that cohort, established in mid-2021, had operated for less than half a year.

- **All evaluated waves had valid control groups** for each program year suggesting that the implementer created the original RCT waves in accordance with industry standards.

- **Evaluated savings.** All evaluated waves displayed average annual electricity savings between 0.5 percent and 1.3 percent of annual billed use in 2020 and between 0.4 percent and 0.9 percent of annual billed use in 2021. Typical behavioral programs display average annual electricity savings between one and three percent. Therefore, savings verified in both program years are lower than those typically displayed in behavioral programs. ADM hypothesizes this is due to the inclusion of formerly treated customers in the control groups for the first two waves. The third wave established in mid-2021, however, displays savings in the typical range for a new wave, which normally have savings that are less than 1% of annual usage. Furthermore, ADM found that the email for some control customers is shared with another premise belonging to a treatment customer (approximately two percent of customers affected across all waves). The same problem occurred for the primary mailing address and affected 12 percent of customers across waves. Control customers receiving HERs could result in tainting of the control group and lower savings estimates for the program.

- **Increased savings generated through other programs.** ADM estimated that savings of -164,408 kWh in 2020 and -156,890 kWh in 2021 found in the HERs billing analysis was attributable to savings generated by other Pacific Power Home Energy Savings programs. Each estimated amount was parsed by month and removed from the estimated savings from the regression results. This ensures there is no double counting of savings of observable, billed energy usage in the Pacific Power Washington portfolio. The double counted savings represent three percent of savings

before double counting, therefore, the impact on final program savings is relatively small.

- **The control group saved more energy through other Home Energy Savings programs than the treatment group.** This often occurs for the first few years of a new wave and may be more likely to occur for the 2020 waves because some control customers in those waves were once part of a treatment group from prior waves. In addition, customers in the control group reported that they undertook more energy savings behaviors than customers in the treatment group; however, this result may be due to survey bias (i.e., control customers who respond to the survey may be more likely to exhibit energy saving behaviors than control customers who do not respond).

- **Attrition.** The total attrition for the program since inception is 16 percent for the treatment group and 15 percent for the control group. In addition, the annual attrition rate is approximately nine percent across waves for the both the treatment and control groups.

- **Customer count provided by the implementation contractor Bidgely does not match customer count reported in Pacific Power's 2020 Washington annual report.** The program tracking data ADM received from Bidgely included 25,000 customers in the Remix Email group and 21,000 customers in the Remix Paper group. The 2020 annual report indicates that 24,000 customers were included in the email group and 23,000 customers were included in the paper group. ADM reports the numbers of customers that were included in the analyzed data from Bidgely.

- **Pacific Power's reported claimed savings does not match annual savings provided by implementation contractor Bidgely.** Claimed savings reported to ADM by Pacific Power did not match the annual savings reported to ADM by Bidgely. Pacific Power reported 2020 savings of 3,542,270 kWh and 2021 savings of 3,333,142 kWh. These claimed savings are included in this evaluation report. Bidgely reported 2020 savings of 1,986 MWh and 2021 savings of 3,423 MWh.

- **HERs participants report being satisfied with the program, indicating successful program design and implementation.** The majority of HERs participants were satisfied with the reports and found the various components useful. Further, participants said receiving the reports had improved their opinion of Pacific Power.

- **The program is not achieving expected savings.** Staff indicated that remixing the treatment and control groups in 2020 was the primary reason for not achieving expected savings. They anticipate increased savings in the participants groups after longer treatment.

- **The influence of the program is unclear.** ADM did not find a statistically significant difference between the number of energy-saving actions taken by participants and

non-participants. There was a statistically significant difference between the number of energy-efficient products participants and non-participants reported installing in 2020 and 2021; non-participants indicated installing more energy efficient products than participants did. Energy efficiency attitudes and beliefs were similar across survey respondent groups.

- **There is potential to expand use of the online portal**. About half of HERs participants who responded to the survey indicated that they had logged into the online portal. Those who had visited the portal found the information useful and easy to navigate. This compares to over two-thirds of all survey respondents who indicated they had created an online account at Pacific Power's main website (pacificpower.net), suggesting a larger portion of customers are engaging with Pacific Power's standard web site rather than the HERs portal.

- **Survey responses indicate low awareness of Pacific Power's rebate programs.** Though over half of all survey respondents indicated having purchased an energy-efficient product in 2020 or 2021, less than five percent indicated receiving a Pacific Power rebate for their purchase.

1.1.2 Recommendations

Based on its evaluation, ADM recommends that Pacific Power consider the following actions.

- **When new waves are created, initiate treatment on the same date for all customers in the wave.** Multiple intervention dates for a given wave creates poorly defined pre- and post-periods. This could create a problem when defining the cohort for a wave since some customers may not have sufficient post-period billing data to be included in the cohort, which could result in an invalid cohort and the need for matching and the creation of a new control group for a wave.

- **Save and store historical billing data for all customers in each wave** to ensure future analyses will have one year of billing data prior to the intervention dates for each customer, as well as complete billing data after the intervention.

- **Reconcile program data.** Program tracking data provided by the implementation contractor for program evaluation should reconcile with reported program data included in published annual reports.

- **Investigate if control customers are receiving treatment** by sharing the same email or primary mailing address as a treated customer. Stop treatment for any control and treatment customers with different physical premises that share an email or primary mailing address to avoid tainting of the control group.

- **Emphasize the benefits of the online portal.** Participants who have visited the portal find it useful, easy to navigate, and visually appealing. Greater engagement with the online portal could increase participants' interest in energy efficiency.

2 Home Energy Reports Program Description

Pacific Power began implementation of the Home Energy Reports (HERs) program in 2012. The purpose of the program is to provide residential customers with information that encourages them to reduce their home energy use. Each household receives a periodic report which contains personalized information about their own kWh use and compares it to similar neighboring households. The reports also include information about Pacific Power's Home Energy Savings programs to encourage additional home improvements that will further reduce energy usage. The original cohorts were retired in 2019. New cohorts were initiated in 2020.

ADM has conducted an impact and process evaluation of the HERs Program for each the 2020 and 2021 program years. The program launched two waves in 2020 and launched an additional wave in 2021. Pacific Power contracted with a third-party, Bidgely, to implement the program during the evaluation period. Table 2-1 summarizes the cohorts implemented in the HERs program in the Pacific Power service area.

Table 2-1: HERs Cohorts Summary

Cohort	Treatment Start Date	Treatment Group Size		Control Group Size	
		Original Treatment Customers[2]	Number at EOY 2021	Original Control Customers	Number at EOY 2021
Remix Email	Variable. Most in January 2020 or prior	25,000	19,995	10,000	8,010
Remix Paper	Variable. Most in February 2020 or prior	21,000	18,080	10,000	8,618
Expansion 2021	Variable. Most between May 2021 and August 2021	14,183	12,584	8,951	7,893
Total		194,096	60,183	50,659	28,951

ADM estimated HERs program savings using a matched control group of non-participating residences in Pacific Power's service territory. ADM analyzed each of the

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[2] With variable intervention dates, defining the number of treatment customers at the start is problematic since new customers are added throughout the program year. ADM estimated the number of original treatment customers as the number of customers treated during the evaluation period with billing data at the start of the first year of treatment.

cohorts treated during the 2020 and 2021 program years. The results from both program years are summarized on a calendar year basis (i.e., January through December). Table 2-2 describes the evaluation period for each wave and reporting period.

Table 2-2: Summary of Cohort Organization

Cohort	Intervention Date	Pre-Period	Post-Period (Calendar Year)
Remix Email	Variable. 68% treated in January 2020	1/1/2019 – 12/31/2019	2020: 1/1/2020 to 12/31/2020 2021: 1/1/2021 to 12/31/2021
Remix Paper	Variable. 58% treated in February 2020		
Expansion 2021	Variable. Most treated between May 2021 and August 2021	5/1/2020- 4/30/2021	2021: 8/1/2021 to 12/31/2021

2.1 Program Background

Since 2012, the HERs program has been sending Home Energy Reports to Pacific Power residential customers. From 2012 through 2017, Oracle Utilities Opower served as the implementation contractor and delivered the HERs to customers. In 2018, the HERs program transitioned to a new implementation contractor, Bidgely. For the 2018-2019 program, Bidgely maintained the treatment and control group assignments that Oracle Utilities Opower had established. All treatment and control group customers belonged to one of three cohorts (*waves*) of customers:

- *Legacy wave* received first report in 2012
- *Expansion wave* received first report in 2014
- *Refill wave* received first report in 2015

In 2020, two new randomized cohorts were created that included treatment and control customers from the original waves (*Remix Email* and *Remix Paper*). In 2021, an additional cohort was created (*Expansion 2021*) from customers not included in the original pre-2020 cohorts established by Opower.

2.2 Data Provided

Pacific Power provided ADM with the following data to support the analysis:

- Pre- and post-treatment monthly electric billing data for participants and non-participants. The data started on November 2018 and ended March 2022.
- Participant and nonparticipant account move-in and account move-out dates.

- Program tracking data for participants, including date of installation and verified kWh savings for each measure installed.

2.3 Evaluation Objectives

ADM identified the following research objectives for the 2020 and 2021 HERs program evaluation:

- Evaluate program savings impacts to gain insight on program performance

- Calculate lift from other Pacific Power energy efficiency program participation

- Assess customers satisfaction with the HERs program and awareness of their individual energy consumption and other energy efficiency programs

3 Impact Evaluation Approach

This section describes the gross impact evaluation of the HERs program. ADM analyzed each cohort treated during the 2020 and 2021 program years using participant and control group billing data. ADM used pre-period (before the household starts receiving home energy reports) and post-period (after household starts receiving home energy reports) data to estimate program impact for each wave, in accordance with the Uniform Methods Project (UMP) behavioral chapter by the National Renewable Energy Laboratory[3]. In addition, ADM estimated joint savings from other downstream and upstream energy efficiency programs offered to Pacific Power's residential customers.

The work effort was divided into six distinct steps:

1. Data preparation and cleaning, including true-up and calendarization

2. Validity testing of remaining treatment and control groups during the baseline period

3. Create matched ad-hoc control group via propensity score matching for waves where validity was compromised (if needed)

4. Estimate monthly and annual billed consumption differences between treatment and control groups via regression modeling

5. Estimate and remove joint savings from other programs

6. Estimate program attrition

ADM explored several linear regression models for the impact evaluation of the HERs program. Each approach involved panel linear regression models to estimate energy savings for the treatment group. The explored methods required monthly billing data for the program participants and a comparable counterfactual (control) group.

The following types of Linear Fixed Effects Regression (LFER) models were explored during the evaluation of this program: Difference in Difference (D-in-D) with monthly controls, D-in-D with weather controls, and Post-Program Regression (PPR) models. The PPR model with weather controls provided the best fit for the data (highest adjusted R-squared). The PPR model is a panel regression model that calculates the differences between treatment and control consumption in the post-program period. It includes controls on lagged energy use for the same calendar month of the pre-program period to

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[3] https://www.nrel.gov/docs/fy18osti/70472.pdf

include in the model any small systematic differences in pre-treatment usage trends between the participant and control group.

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

3.1 Glossary of Terminology

The following terms are used throughout this report.

- **Ex-ante savings** – Calculated savings used for program and portfolio planning purposes.

- **Ex-post savings** – Savings estimates reported by an evaluator after the energy impact evaluation has been completed.

- **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.

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

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

- **Treatment** – Customers that were treated by the HERs program and provided materials with the goal of altering their energy usage.

- **Control** – Customers that were not treated by the HERs program but that are similar in their usage to treatment customers.

3.2 Step 1: Data Preparation and Cleaning

This section describes the data cleaning steps ADM performed to prepare for the billing analysis.

Customers' monthly billing periods are not all the same. For example, one customer's June bill may run from May 16th to June 17th, while another customer's bill may run from May 20th to July 5th. To make the monthly billing data consistent between participants and to represent each month accurately, ADM calendarized the data into monthly bills. 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 a given 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 usage 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	=	*The month of interest.*
$Monthly\ usage$	=	*The calendarized monthly usage for a given month.*
$Month\ days$	=	*The number of days belonging to the month of interest in a billing period.*
$Billing\ days$	=	*The 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.

- Customer months in which average daily usage exceeded 200 kWh were excluded from analysis.

- Pre-treatment data was limited to the 12 months prior to the treatment start date for each experimental cohort.

- Customers without at least 9 of the 12 months of pre-period data, as well as at least 4 of the 12 months of post-period data were removed prior to the regression.

ADM identified high outliers at the threshold of average kWh usage over 200 kWh per day. 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 HERs participants and non-participants used in the calculation of the methodologies below.

Table 3-1: Treatment and Control Customers by Program Year

Wave	Original Treatment Customers	Original Control Customers	Weighted Treatment Customers		Weighted Control Customers	
			2020	2021	2020	2021
Remix Email	25,000	10,000	21,375	20,957	9,345	8,421
Remix Paper	21,000	10,000	17,665	18,684*	9,569	8,913
Expansion 2021	14,183	8,951	N/A	6,338	N/A	8,509
Total	60,183	28,951	39,039	45,979*	18,914	25,843*

*Number of customers increased over time for these cohorts due to variation in intervention date for a portion of the customers

Weighted average customer is the sum of all billing days in the post-period for the given program year/wave divided by 365.25.

After data preparation and cleaning, ADM performed validity testing for all evaluated waves. The details of this step are provided in the next section.

3.3   Step 2: Validity Testing

The method for evaluation requires that the control group remains statistically valid for each treatment group. Validity is tested by examining billing data in the pre-treatment period for customers in the treatment and control groups. Each calendarized monthly is tested for statistically significant differences using a simple two-tailed T-test. ADM performed equivalency for each month between the provided treatment group and control group.

ADM tested the validity of each Randomized Control Trial (RCT) by completing t-tests for the average daily usage of each of the pre-period months between the remaining treatment and control groups, then tested pre-period usage for differences at the 90 percent confidence interval for each of the 12 pre-period months.

If any waves did not pass equivalency testing, ADM would perform propensity score matching (PSM) to create a post-hoc control group comprised of participants that have not received home energy reports. However, none of the waves showed differences in pre-period usage and therefore each of the waves were considered valid. As such, no PSM was performed for any of the waves and the original RCT cohorts were left intact.

3.4 Step 3: Propensity Score Matching

ADM did not perform Propensity Score Matching (PSM) and create new control groups for any waves because all of the waves passed validity testing.

3.5 Step 4: Linear Regression Modeling

ADM ran the following regression model to determine the impact of the HERs program on customer kWh use. The comparison control group was created during the RCT design and verified with validity testing. The following sections summarize the model specification ADM used to estimate impact savings for the program.

3.5.1 Post Period Regression w/ Weather Model Specification

ADM used the post-program regression with weather (PPR) model to calculate savings for the HERs program. 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 the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the participant and control customers.

In addition, 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 pre-period seasonal usage.

The PPR model is specified in Equation 3-2 below:

Equation 3-2: PPR Model

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

Where:

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

β_{myp}	=	The 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
β_1, β_2	=	The coefficients on Heating Degree Days and Cooling Degree Days
$AvgPre_{ip}$	=	Average daily usage for customer I in the pre-treatment period p, where p represents the post-period month m minus 12 months
$treatment_{imy}$	=	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_{imy}	=	Heating Degree Days for customer I in month m
CDD_{imy}	=	Cooling Degree Days for customer I in month m
τ_{my}	=	The estimated treatment effect in Usage per day per customer independent of weather.
β_3, β_4	=	The coefficients on Heating Degree Days and Cooling Degree Days 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).
ε_{imy}	=	The error term.

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 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.

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.

Monthly savings were calculated using the following equation:

Equation 3-3 Monthly kWh Savings for PPR Model

$$Monthly\ kWh\ Savings \\ = Treatment\ (\tau_{my}) * Days\ in\ Month + Treatment{:}HDD\ (B3) * HDD\ in\ Month \\ + Treatment{:}CDD\ (B4) * CDD\ in\ Month$$

3.5.2 Additional Regression Models Tested

The following section summarizes the additional model specification ADM explored to estimate impact savings for the program.

3.5.2.1 Fixed-Effects Difference-in-Difference (D-in-D)

The fixed-effects linear regression model specification contains customer-specific dummy variables to account for exogenous heterogeneity that cannot be explicitly controlled for and is not relevant to the estimation of program savings. The specification of customer specific effects allows the model to capture much of the baseline differences across customers while obtaining reliable estimates of the impact of the home energy reports.

ADM fit a monthly fixed effects panel regression model to estimate daily consumption differences between treatment and control households in each month. The model specifications used in this analysis is described below.

Equation 3-4: Fixed-Effects Difference-in-Difference (D-in-D)
Panel Regression Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(Post \times Month)_{it} + \beta_3(Treatment \times Post)_{it} \\ + \beta_4(Treatment \times Post \times Month)_{it} + \varepsilon_{it}$$

Where,

ADC_{it}	=	Estimated average daily consumption (dependent variable) in home I during period t
$Post_{it}$	=	Dummy variable indicating whether period t was in pre- or post-retrofit
$Treatment_I$	=	Dummy variable indicating whether household I was in treatment group or control group
$Month_{it}$	=	Dummy variable indicating month during period t
ε_{it}	=	Customer-level random error

α_0 =   The model intercept for home i

β_{1-4} =   Coefficients determined via regression

The coefficients β_3 and β_4 represent the average change in consumption between the treatment group and the control group in the post-period. Monthly kWh savings are then taken by using the following equation:

Equation 3-5: Monthly kWh Savings

$$monthly_{savings_t} = -1 * \beta_{4t} * days_t * participants_t$$

Where:

t =   a given month in the program year,

β_{1t} =   the regression coefficient for the treatment effect of month t in the post-period

$days_t$ =   the number of days in the given month

$participants_t$ =   the number of active participants in month t

Because the regression equation predicts average daily usage as a function of the treatment effect, and the treatment indicator has been coded as "1", the regression coefficient for the treatment effect of a given month should be negative if savings occurs. Therefore, multiplying the savings calculation by -1 will correct the sign of the results.

3.5.3 COVID Impacts

ADM ran the PPR and D-in-D 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 Washington State occurred on March 17, 2020 and were significantly lightened on March 22, 2021; this period was used to define the COVID dummy variable. Both the PPR model and D-in-D model rely on monthly fixed effects and the inclusion of a COVID dummy variable overlaps with the inclusion of monthly dummies. ADM estimated both models without monthly dummy variables but determined that the inclusion of the monthly dummy variables is desirable due to the low fit observed for models without monthly effects and the high correlation between the COVID dummy and underlying monthly effects.

ADM determined that estimating a COVID-specific effect is not feasible with monthly data and the suggested model specifications outlined in the UMP which specify the use of monthly dummy variable effects. The inclusion of a COVID dummy had little to no impact on estimated savings and led to a reduction in the Adjusted R-squared in some cases. ADM posits that the Randomized Control Trial (RCT) approach already accounts for

COVID impacts on customer usage with the control group, and the estimated savings without a COVID dummy variable included in the model are unbiased. Therefore, no COVID dummy was included in the model that estimates program savings.

3.6   Step 5: Double Count Savings Approach

Customers in both the treatment and control groups participated in other Pacific Power Home Energy Savings programs. The Pacific Power HERs program reports may increase customers' likelihood to participate those programs. This additional participation is known as uplift. The HERs sent to customers includes information about other Pacific Power 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 HERs 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 between the treatment and control groups, the UMP recommends removing uplift from each group at the household level.

The double counted savings, whether positive or negative, are subtracted from the wave's savings estimates from the regression analysis to get total verified savings. The approach for removal of 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.

3.6.1   Downstream

ADM corrected for cross-program participation in downstream programs. ADM estimated and subtracted savings from program uplift from the total program portfolio savings for each program year. The double count savings were calculated on a per-household level for each treatment group in each cohort as follows:

Equation 3-6: Double Count Specification

$$Double\ Counting = \left(\frac{OP\ kWh}{Household_{Treatment}} - \frac{OP\ kWh}{Household_{Control}} \right) \times \#\ Accounts_{Treatment}$$

Where,

$\dfrac{OP\ kWh}{Household_{Treatment}}$ $= Other\ program\ kWh\ per\ household\ in\ the\ treatment\ group$

$\dfrac{OP\ kWh}{Household_{Control}}$ $= Other\ program\ kWh\ per\ household\ in\ the\ control\ group$

$\# Accounts_{Treatment} = Total\ accounts\ in\ the\ treatment\ group$

To estimate double counted program savings from downstream program uplift, ADM completed the follow steps:

1. Matched the HERs program treatment and control group customers to the utility energy efficiency program tracking data by customer ID;
2. Calculated the savings per treatment group subject from efficiency uplift as the difference between treatment and control groups in average efficiency program savings per subject
3. Multiplied that difference by the number of subjects who are in the treatment group

ADM summarized and removed program uplift for each wave and treatment status for each of the other downstream residential program offerings.

3.6.2 Upstream

ADM estimated savings from upstream LEDs due to uplift by surveying treatment and control customers. The survey asked whether a customer had made a purchase of an LED in the past year and the number of LEDs that had been purchased in the past year. ADM used the following equation to estimate savings due to upstream LED uplift:

Equation 3-7: Light Savings Uplift

$$
\begin{aligned}
Light\ &Savings\ Uplift \\
&= HER\ Impact\ per\ Participant\ \left(\frac{Bulbs}{year}\right) * \%\ Bulbs\ Incentivized \\
&* Savings\ per\ Bulb\ \left(\frac{kWh}{year}\right) * (Percent\ Installed - Average\ Percent\ Failed)
\end{aligned}
$$

Where:

$HER\ Impact\ per\ Participant\ (\frac{bulbs}{year}) =$	Treatment effect of HERs program on the quantity of LED bulbs purchased in an upstream program. This value represents the difference in the average number of LED bulbs installed per year between the treatment and the control group, obtained via customer surveys.
$\%\ Bulbs\ Incentivized$ =	Percentage of LED bulbs sold to residential customers that were part of an upstream program. ADM used an average of the percentage reported by Cadmus in 2020 for this

		program for the evaluation of 2018 and 2019 programs
$Savings\ per\ Bulb\ (\frac{kWh}{year})$	=	Annual expected savings per LED bulb from the upstream program tracking data
$Percent\ Installed$	=	Average percent of time that bulbs were installed in the program year
$Average\ Percent\ Failed$	=	The annual failure rate, estimated as one over the average measure life

3.7   Step 6: Attrition Analysis Approach

The tracking of treatment and control households can be affected by either move-outs or opt-outs (known collectively as 'attrition'). If a household's final bill was the end of the evaluated post-period, it is considered a move out and bills occurring after move-out were removed from the analysis. Opt-outs, 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 both treatment and control move-outs over the program life by month, wave, and treatment/control status for each program year was summarized. This information can be useful for Pacific Power and the implementer Bidgely for the potential need for future wave expansions for the HERs program.

4 Impact Evaluation Results

This section provides the results of each portion of the impact evaluation. ADM calculated the percent savings per home which it found by dividing the average annual energy savings estimated in the treatment group by the average annual energy consumption from the control group for each program year. That value was then adjusted for uplift from downstream and upstream measures. The program-level savings were calculated by multiplying the average annual household impact estimate by the weighted number of active program participants in the treatment group, then removing double counted savings.

4.1 Data Preparation and Cleaning

ADM prepared and cleaned billing data provided by Pacific Power prior to running regressions. The following table represents the unique number of customers per wave and treatment group throughout the billing cleaning stages.

Table 4-1: Treatment and Control Customers After Restrictions

Wave	Restriction Detail	Treatment Customers	Control Customers
Remix Email	Start	25,000	10,000
	After removing bills that occur after inactive date	25,000	10,000
	After removing bills that occur before active date	25,000	10,000
	Remove outliers (anything over 200kWh/day)	25,000	10,000
	Remove bills with less than 10 or more than 90 days duration	25,000	10,000
	Remove treatment customers missing intervention dates	25,000	10,000
	Only keep pre-period and post-period in program year	24,994	9,995
	Only keep customers with at least 9 months pre and 4 months post	16,155	6,541
Remix Paper	Start	21,000	10,000
	After removing bills that occur after inactive date	21,000	10,000
	After removing bills that occur before active date	21,000	10,000
	Remove outliers (anything over 200kWh/day)	21,000	10,000
	Remove bills with less than 10 or more than 90 days duration	21,000	10,000
	Remove treatment customers missing intervention dates	21,000	10,000
	Only keep pre-period and post-period in program years	20,991	9,995
	Only keep customers with at least 9 months pre and 4 months post	11,745	5,647
Expansion 2021	Start	14,183	8,951
	After removing bills that occur after inactive date	14,183	8,951
	After removing bills that occur before active date	14,183	8,951
	Remove outliers (anything over 200kWh/day)	14,183	8,951
	Remove bills with less than 10 or more than 90 days duration	14,183	8,950
	Remove treatment customers missing intervention dates	13,832	8,950
	Only keep pre-period and post-period in program years	13,832	8,950
	Only keep customers with at least 9 months pre and 4 months post	12,594	7,951

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

After data preparation and cleaning, ADM performed validity testing for all evaluated waves. The details of this step are provided in the next section.

4.2   Validity Testing Results

After data preparation and cleaning, ADM tested the remaining customers for statistically significant differences in usage between the treatment and control groups for each of the 12 pre-period months in each wave. As shown in the tables below, all waves had valid control groups. Table 4-2: through Table 4-4: include differences and statistical significance between each wave's treatment and control groups for each of the 12 months in the pre-period.

Table 4-2: Remix Email Wave T-Test Results

Pre-Period Month	Treatment Group Average Daily Usage (kWh/day)	Control Group Average Daily Usage (kWh/day)	Average Daily Usage Difference (kWh/day)	P-value	Statistically Significant Difference*
Jan	56.45	56.99	-0.53	0.270	-
Feb	63.94	64.63	-0.69	0.224	-
Mar	49.85	50.27	-0.42	0.316	-
Apr	31.44	31.81	-0.36	0.115	-
May	29.10	29.53	-0.43	0.050	*
Jun	32.97	33.36	-0.39	0.126	-
Jul	37.12	37.46	-0.33	0.238	-
Aug	38.43	38.82	-0.40	0.167	-
Sep	32.17	32.45	-0.28	0.223	-
Oct	36.59	36.86	-0.27	0.332	-
Nov	49.37	49.63	-0.26	0.514	-
Dec	55.59	55.86	-0.27	0.563	-

*statistically significant if $p<0.05$

One month of 12 pre-period months showed a statistically significant difference for this wave. According to the binomial distribution, this may occur due to chance 46 percent of the time. ADM provides the allowance of up to three months of the 12 pre-period months to be rejected and still pass validity testing. Therefore, the control group is valid for this wave.

Table 4-3: Remix Paper Wave T-Test Results

Pre-Period Month	Treatment Group Average Daily Usage (kWh/day)	Control Group Average Daily Usage (kWh/day)	Average Daily Usage Difference (kWh/day)	P-value	Statistically Significant Difference*
Jan	68.37	67.83	0.54	0.240	-
Feb	77.86	77.36	0.50	0.361	-
Mar	60.21	59.80	0.41	0.300	-
Apr	36.70	36.48	0.22	0.322	-
May	32.14	31.95	0.19	0.378	-
Jun	35.11	34.85	0.26	0.329	-
Jul	38.69	38.49	0.20	0.497	-
Aug	39.73	39.51	0.22	0.467	-
Sep	34.95	34.69	0.26	0.274	-
Oct	43.37	43.05	0.32	0.231	-
Nov	59.91	59.38	0.52	0.178	-
Dec	67.00	66.54	0.46	0.304	-

*statistically significant if p<0.05

The p-values for the Remix Paper wave indicates that no statistically significant differences were found in daily usage between the treatment and control group for any of the 12 pre-period months. Therefore, the control group is valid for this wave.

Table 4-4: Expansion 2021 Wave T-Test Results

Pre-Period Month	Treatment Group Average Daily Usage (kWh/day)	Control Group Average Daily Usage (kWh/day)	Average Daily Usage Difference (kWh/day)	P-value	Statistically Significant Difference*
Jan	45.24	45.18	0.06	0.902	-
Feb	44.73	44.71	0.02	0.962	-
Mar	34.88	34.88	0.00	0.994	-
Apr	27.04	27.02	0.02	0.940	-
May	23.43	23.52	-0.09	0.710	-
Jun	26.25	26.28	-0.03	0.921	-
Jul	32.50	32.44	0.06	0.846	-
Aug	33.13	33.03	0.10	0.747	-
Sep	26.43	26.33	0.09	0.704	-
Oct	28.33	28.31	0.02	0.926	-
Nov	40.67	40.66	0.01	0.990	-
Dec	46.36	46.47	-0.11	0.809	-

*statistically significant if p<0.05

The p-values for the Expansion 2021 wave also indicates the control group is valid for this wave. ADM continued to double counting analysis for each of the three valid cohorts, further detailed in the section below.

4.3 Linear Regression Modeling Results

This section details the regression results of each of the evaluated waves. All waves were evaluated using their original RCT control groups.

As discussed in the evaluation approach section, savings are directly determined through model parameters, the coefficients, τ_{my}, β_3 and β_4 which are defined again in Table 4-5:.

Table 4-5: Regression Parameters

Variable	Parameter	Interpretation
Treatment	τ_{my}	Average daily usage in the post-period
Treatment * HDD	B3	Average daily usage in the post-period per HDD
Treatment * CDD	B4	Average daily usage in the post-period per CDD

Per-home results and percent savings by month and by program year are presented for each of the analyzed waves. Joint savings attributable to Pacific Power upstream and downstream programs were calculated and removed to avoid double counting.

ADM found each of the two waves for PY2020 had positive savings that are statistically significant. In addition, the first two waves for PY2021 had positive savings that are statistically significant. The exception is the most recent wave, Expansion 2021, which displayed positive but not statistically significant savings for the 2021 program year. However, this is a new wave that was created in mid-2021 and savings are expected to increase over time.

4.3.1 Remix Email Wave Results

Table 4-6: displays the annual kWh savings per treatment customer for the Remix Email wave by program year, prior to any double counting adjustments. The savings are positive and statistically significant at the 95 percent level.

Table 4-7: and Table 4-8: display the regression coefficients for each program year.

Table 4-6: Remix Email Wave Annual Savings by Program Year

Wave	Year	Estimate	5%	95%
Remix Email	2020	197.19	141.36	253.02
Remix Email	2021	138.04	48.68	171.01

Table 4-7: Remix Email Wave 2020 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	5.88	0.41	0.00	5.19	6.56
Treatment	0.19	0.17	0.26	-0.09	0.46
Feb	3.55	0.30	0.00	3.06	4.05
Mar	1.99	0.30	0.00	1.50	2.49
Apr	-1.40	0.33	0.00	-1.94	-0.86
May	-2.55	0.35	0.00	-3.13	-1.98
Jun	-2.45	0.36	0.00	-3.04	-1.86
Jul	-2.28	0.37	0.00	-2.90	-1.67
Aug	-2.71	0.37	0.00	-3.33	-2.10
Sep	-3.65	0.36	0.00	-4.23	-3.06
Oct	0.62	0.33	0.05	0.09	1.16
Nov	0.36	0.30	0.23	-0.14	0.86
Dec	0.93	0.30	0.00	0.44	1.43
Pre-period Usage	0.84	0.00	0.00	0.83	0.85
HDD	0.00	0.01	0.89	-0.01	0.02
CDD	0.42	0.05	0.00	0.34	0.51
Feb: Pre-period Usage	-0.27	0.00	0.00	-0.28	-0.26
Mar: Pre-period Usage	-0.15	0.00	0.00	-0.16	-0.14
Apr: Pre-period Usage	0.08	0.01	0.00	0.07	0.09
May: Pre-period Usage	0.06	0.01	0.00	0.05	0.07
Jun: Pre-period Usage	0.05	0.01	0.00	0.04	0.06
Jul: Pre-period Usage	0.12	0.01	0.00	0.11	0.13
Aug: Pre-period Usage	0.13	0.01	0.00	0.12	0.14
Sep: Pre-period Usage	0.10	0.01	0.00	0.09	0.11
Oct: Pre-period Usage	-0.07	0.01	0.00	-0.08	-0.06
Nov: Pre-period Usage	0.03	0.00	0.00	0.02	0.03
Dec: Pre-period Usage	0.05	0.00	0.00	0.04	0.06
Treatment: HDD	-0.03	0.01	0.00	-0.04	-0.02
Treatment: CDD	-0.08	0.04	0.08	-0.15	0.00

Table 4-8: Remix Email Wave 2021 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	9.56	0.46	0.00	8.81	10.31
Treatment	-0.28	0.20	0.16	-0.60	0.05
Feb	1.52	0.25	0.00	1.12	1.93
Mar	-0.25	0.27	0.37	-0.69	0.20
Apr	-3.95	0.31	0.00	-4.47	-3.43
May	-4.63	0.35	0.00	-5.21	-4.05
Jun	-1.97	0.38	0.00	-2.60	-1.33
Jul	-0.18	0.42	0.67	-0.87	0.51
Aug	-3.34	0.39	0.00	-3.99	-2.70
Sep	-5.69	0.37	0.00	-6.30	-5.09
Oct	-2.86	0.31	0.00	-3.37	-2.35
Nov	-1.15	0.27	0.00	-1.60	-0.71
Dec	-1.48	0.26	0.00	-1.91	-1.05
Pre-period Usage	0.81	0.00	0.00	0.81	0.82
HDD	-0.02	0.01	0.07	-0.04	0.00
CDD	0.18	0.05	0.00	0.10	0.26
Feb: Pre-period Usage	-0.13	0.00	0.00	-0.13	-0.12
Mar: Pre-period Usage	-0.14	0.00	0.00	-0.15	-0.13
Apr: Pre-period Usage	0.07	0.01	0.00	0.06	0.08
May: Pre-period Usage	0.09	0.01	0.00	0.08	0.10
Jun: Pre-period Usage	0.18	0.01	0.00	0.17	0.18
Jul: Pre-period Usage	0.22	0.01	0.00	0.21	0.23
Aug: Pre-period Usage	0.07	0.01	0.00	0.07	0.08
Sep: Pre-period Usage	0.04	0.01	0.00	0.03	0.05
Oct: Pre-period Usage	-0.08	0.01	0.00	-0.09	-0.07
Nov: Pre-period Usage	-0.09	0.00	0.00	-0.10	-0.09
Dec: Pre-period Usage	0.09	0.00	0.00	0.08	0.10
Treatment: HDD	-0.01	0.01	0.43	-0.02	0.01
Treatment: CDD	0.00	0.04	0.94	-0.06	0.06

Each of the models were a good fit for the data, as seen by the Adjusted R-square in Table 4-9:.

Table 4-9: Remix Email Wave Model Fit

Evaluation Period	Adjusted R2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
2020	0.803	35,089	240,927	21,375
2021	0.755	25,563	232,228	20,957

Table 4-10 and Table 4-11 present savings for the Remix Email wave by month. Monthly savings were calculated using the following equation:

$$Monthly\ kWh\ Savings = Treatment\ (\tau_{my}) * Days\ in\ Month + Treatment{:}HDD\ (B3) * HDD\ in\ Month + Treatment{:}CDD\ (B4) * CDD\ in\ Month$$

The tables also present the double counted savings for the wave, as well as the final monthly savings after removing double counted savings for each month.

Table 4-10: Remix Email Wave 2020 Monthly Savings Summary

Month	Average Treatment Impact per Customer Before Double Count (kWh/month)	Average Incremental Double Counted Savings (kWh/month)	Average Treatment Impact per Customer After Double Count (kWh/month)	Control Group Usage per Customer (kWh/month)	Percent Savings
January	23.11	0.213	23.32	1,667.84	1.40%
February	19.09	0.194	19.28	1,383.96	1.39%
March	17.06	0.213	17.27	1,314.49	1.31%
April	9.80	0.206	10.01	1,011.45	0.99%
May	7.60	0.213	7.81	931.26	0.84%
June	10.16	0.206	10.37	1,019.34	1.02%
July	20.24	0.213	20.46	1,299.59	1.57%
August	19.32	0.213	19.53	1,336.76	1.46%
September	11.96	0.206	12.17	1,006.91	1.21%
October	13.01	0.213	13.23	1,094.79	1.21%
November	20.12	0.206	20.33	1,488.52	1.37%
December	25.71	0.213	25.92	1,761.70	1.47%
Total	197.19	2.504	199.69	15,316.63	1.30%

Table 4-11: Remix Email Wave 2021 Monthly Savings Summary

Month	Average Treatment Impact per Customer Before Double Count (kWh/month)	Average Incremental Double Counted Savings (kWh/month)	Average Treatment Impact per Customer After Double Count (kWh/month)	Control Group Usage per Customer (kWh/month)	Percent Savings
January	13.79	0.360	14.15	1,724.09	0.82%
February	12.79	0.328	13.12	1,546.31	0.85%
March	12.29	0.360	12.65	1,338.56	0.95%
April	10.90	0.349	11.25	1,017.55	1.11%
May	10.37	0.360	10.73	993.72	1.08%
June	9.79	0.349	10.13	1,264.12	0.80%
July	10.10	0.360	10.47	1,566.67	0.67%
August	9.96	0.360	10.32	1,305.51	0.79%
September	9.92	0.349	10.27	959.54	1.07%
October	11.41	0.360	11.77	1,046.89	1.12%
November	12.38	0.349	12.72	1,328.71	0.96%
December	14.34	0.360	14.70	1,829.76	0.80%
Total	138.04	4.244	142.28	15,921.43	0.89%

The ex-post gross kWh savings of the Remix Email wave is summarized below by program year. The number of customers used to calculate total ex-post kWh savings is the number of weighted treatment customers in the post-period.

Table 4-12: Remix Email Wave Ex-Post Annual kWh Savings by Program Year

Evaluation Period	Annual Unadjusted Savings Per Home (kWh/year)	5% CI Annual Unadjusted Savings Per Home (kWh/year)	95% CI Annual Unadjusted Savings Per Home (kWh/year)	Annual Double Counted Savings Per Home (kWh/year)	Annual Adjusted Savings Per Home (kWh/year)	Annual Control Group Usage Per Home (kWh/year)	Annual Percent Savings Per Home
2020	197.19	141.36	253.02	2.504	199.69	15,316.63	1.30%
2021	138.04	48.68	171.01	4.244	142.28	15,921.43	0.89%

Table 4-13: Remix Email Wave Total Program Year Savings by Evaluation Period

Evaluation Period	Annual Adjusted Savings Per Home (kWh)	Weighted Treatment Customers	Program Year Savings (kWh)	Program Year Savings (kWh) 5% CI	Program Year Savings (kWh) 95% CI
2020	199.69	21,375	4,268,407.78	2,906,648.92	5,630,166.65
2021	142.28	20,957	2,981,697.66	1,820,526.41	4,142,868.91

The Remix Email wave displayed 1.30 percent and 0.89 percent annual household savings for 2020 and 2021, respectively. Average annual household savings for treated customers in the Remix Email wave was 200 and 142 kWh for 2020 and 2021, respectively. Household savings estimates were extrapolated using the number of weighted treatment customers active in the post-period. The Remix Email wave saved 4,268,408 kWh in 2020 and 2,981,698 kWh in 2021. In addition, the 95 percent confidence intervals are summarized for each program year.

4.3.2 Remix Paper Wave Results

Table 4-14: displays the annual kWh savings per treatment customer for the Remix Paper wave by program year, prior to any double counting adjustments. The savings are positive and statistically significant at the 95 percent level.

Table 4-15: and Table 4-16: display the regression coefficients for each program year.

Table 4-14: Remix Paper Wave Annual Savings by Program Year

Wave	Year	Estimate	5%	95%
Remix Paper	2020	77.53	13.82	141.24
Remix Paper	2021	109.85	48.68	171.01

Table 4-15: Remix Paper Wave 2020 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	6.74	0.54	0.00	5.84	7.63
Treatment	-0.16	0.19	0.39	-0.47	0.15
Feb	3.78	0.50	0.00	2.96	4.61
Mar	2.22	0.44	0.00	1.50	2.95
Apr	-1.76	0.47	0.00	-2.52	-0.99
May	-3.45	0.48	0.00	-4.24	-2.66
Jun	-3.66	0.49	0.00	-4.46	-2.86
Jul	-4.95	0.51	0.00	-5.78	-4.12
Aug	-5.25	0.50	0.00	-6.08	-4.42
Sep	-6.72	0.49	0.00	-7.52	-5.92
Oct	-0.44	0.46	0.34	-1.19	0.31
Nov	-1.06	0.43	0.01	-1.77	-0.36
Dec	-1.00	0.43	0.02	-1.70	-0.30
Pre-period Usage	0.80	0.00	0.00	0.80	0.81
HDD	0.07	0.01	0.00	0.05	0.09
CDD	0.50	0.06	0.00	0.40	0.61
Feb: Pre-period Usage	-0.24	0.01	0.00	-0.26	-0.23
Mar: Pre-period Usage	-0.19	0.01	0.00	-0.20	-0.18
Apr: Pre-period Usage	0.06	0.01	0.00	0.05	0.07
May: Pre-period Usage	0.06	0.01	0.00	0.05	0.07
Jun: Pre-period Usage	0.06	0.01	0.00	0.05	0.07
Jul: Pre-period Usage	0.16	0.01	0.00	0.15	0.17
Aug: Pre-period Usage	0.17	0.01	0.00	0.15	0.18
Sep: Pre-period Usage	0.14	0.01	0.00	0.12	0.15
Oct: Pre-period Usage	-0.09	0.01	0.00	-0.10	-0.07
Nov: Pre-period Usage	0.03	0.01	0.00	0.02	0.04
Dec: Pre-period Usage	0.06	0.01	0.00	0.05	0.07
Treatment: HDD	-0.02	0.01	0.03	-0.03	0.00
Treatment: CDD	0.06	0.05	0.18	-0.01	0.14

Table 4-16: Remix Paper Wave 2021 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	12.11	0.57	0.00	11.18	13.04
Treatment	0.08	0.22	0.71	-0.28	0.44
Feb	1.68	0.36	0.00	1.08	2.27
Mar	-0.21	0.39	0.59	-0.86	0.43
Apr	-5.08	0.44	0.00	-5.81	-4.35
May	-7.09	0.47	0.00	-7.87	-6.31
Jun	-5.50	0.50	0.00	-6.32	-4.67
Jul	-4.27	0.55	0.00	-5.17	-3.36
Aug	-6.28	0.50	0.00	-7.10	-5.45
Sep	-8.38	0.49	0.00	-9.18	-7.58
Oct	-4.09	0.44	0.00	-4.80	-3.37
Nov	-1.66	0.39	0.00	-2.30	-1.02
Dec	-1.52	0.38	0.00	-2.15	-0.90
Pre-period Usage	0.78	0.00	0.00	0.78	0.79
HDD	-0.03	0.01	0.05	-0.05	0.00
CDD	0.19	0.06	0.00	0.09	0.29
Feb: Pre-period Usage	-0.13	0.00	0.00	-0.13	-0.12
Mar: Pre-period Usage	-0.15	0.01	0.00	-0.16	-0.14
Apr: Pre-period Usage	0.05	0.01	0.00	0.04	0.06
May: Pre-period Usage	0.09	0.01	0.00	0.08	0.11
Jun: Pre-period Usage	0.19	0.01	0.00	0.17	0.20
Jul: Pre-period Usage	0.24	0.01	0.00	0.23	0.25
Aug: Pre-period Usage	0.08	0.01	0.00	0.07	0.10
Sep: Pre-period Usage	0.04	0.01	0.00	0.02	0.05
Oct: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.09
Nov: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.09
Dec: Pre-period Usage	0.10	0.01	0.00	0.09	0.10
Treatment: HDD	-0.02	0.01	0.04	-0.03	0.00
Treatment: CDD	-0.04	0.04	0.33	-0.10	0.03

Each of the models were a good fit for the data, as seen by the Adjusted R-square in Table 4-17:.

Table 4-17: Remix Paper Wave Model Fit

Evaluation Period	Adjusted R2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
2020	0.782	22,827	178,032	17,665
2021	0.728	18,033	189,078	18,684

Table 4-18 and Table 4-19 present the savings for the Remix Paper wave by month. Monthly savings were calculated using the following equation:

$$Monthly\ kWh\ Savings$$
$$= Treatment\ (\tau_{my}) * Days\ in\ Month + Treatment:HDD\ (B3)$$
$$* HDD\ in\ Month + Treatment:CDD\ (B4) * CDD\ in\ Month$$

The tables also present the double counted savings for the wave, as well as the final monthly savings after removing double counted savings for each month.

Table 4-18: Remix Paper Wave 2020 Monthly Savings Summary

Month	Average Treatment Impact per Customer Before Double Count (kWh/month)	Average Incremental Double Counted Savings (kWh/month)	Average Treatment Impact per Customer After Double Count (kWh/month)	Control Group Usage per Customer (kWh/month)	Percent Savings
January	18.99	0.533	19.52	1,976.37	0.99%
February	16.23	0.486	16.71	1,628.18	1.03%
March	15.88	0.533	16.42	1,525.65	1.08%
April	9.35	0.516	9.87	1,125.12	0.88%
May	3.91	0.533	4.44	987.80	0.45%
June	-3.35	0.516	-2.83	1,038.27	-0.27%
July	-14.48	0.533	-13.94	1,288.10	-1.08%
August	-13.90	0.533	-13.37	1,314.27	-1.02%
September	-2.13	0.516	-1.61	1,021.14	-0.16%
October	9.56	0.533	10.09	1,199.66	0.84%
November	17.17	0.516	17.68	1,722.29	1.03%
December	20.30	0.533	20.84	2,045.73	1.02%
Total	77.53	6.277	83.81	16,872.59	0.50%

Table 4-19: Remix Paper Wave 2021 Monthly Savings Summary

Month	Average Treatment Impact per Customer Before Double Count (kWh/month)	Average Incremental Double Counted Savings (kWh/month)	Average Treatment Impact per Customer After Double Count (kWh/month)	Control Group Usage per Customer (kWh/month)	Percent Savings
January	11.72	0.309	12.03	1,995.57	0.60%
February	11.17	0.281	11.45	1,789.94	0.64%
March	7.60	0.309	7.91	1,519.13	0.52%
April	5.36	0.299	5.66	1,112.20	0.51%
May	4.68	0.309	4.98	1,020.15	0.49%
June	11.37	0.299	11.67	1,246.86	0.94%
July	15.65	0.309	15.96	1,522.98	1.05%
August	10.22	0.309	10.52	1,275.30	0.83%
September	4.93	0.299	5.23	968.54	0.54%
October	5.26	0.309	5.57	1,149.99	0.48%
November	8.65	0.299	8.95	1,518.77	0.59%
December	13.24	0.309	13.54	2,122.32	0.64%
Total	109.85	3.637	113.48	17,241.75	0.66%

The ex-post gross kWh savings for the Remix Paper wave is summarized below by program year. The number of customers used to calculate total ex-post kWh savings is the number of weighted treatment customers in the post-period.

Table 4-20: Remix Paper Wave Ex-Post Annual kWh Savings by Program Year

Evaluation Period	Annual Unadjusted Savings Per Home (kWh/year)	5% CI Annual Unadjusted Savings Per Home (kWh/year)	95% CI Annual Unadjusted Savings Per Home (kWh/year)	Annual Double Counted Savings Per Home (kWh/year)	Annual Adjusted Savings Per Home (kWh/year)	Annual Control Group Usage Per Home (kWh/year)	Annual Percent Savings Per Home
2020	77.53	13.82	141.24	6.277	83.81	16,872.59	0.50%
2021	109.85	48.68	171.01	3.637	113.48	17,241.75	0.66%

Table 4-21: Remix Paper Wave *Total Program Year Savings by Evaluation Period*

Evaluation Period	Annual Adjusted Savings Per Home (kWh)	Weighted Treatment Customers	Program Year Savings (kWh)	Program Year Savings (kWh) 5% CI	Program Year Savings (kWh) 95% CI
2020	83.81	17,665	1,480,397.35	354,997.31	2,605,797.39
2021	113.48	18,684	2,120,299.57	977,560.58	3,263,038.57

The Remix Paper wave displayed 0.50 percent and 0.66 percent annual household savings for 2020 and 2021, respectively. Average annual household savings for treated customers in the Remix Paper wave was 84 and 113 kWh for 2020 and 2021, respectively. Household savings estimates were extrapolated using the number of weighted treatment customers active in the post-period. The Remix Paper wave saved 1,480,397 kWh in 2020 and 2,120,300 kWh in 2021. In addition, the 95 percent confidence intervals are summarized for each program year.

4.3.3 Expansion 2021 Wave Results

Table 4-22: displays the annual kWh savings per treatment customer for the Expansion 2021 wave by program year, prior to any double counting adjustments. The savings are positive but not statistically significant at the 95 percent level. Due to the lack of statistically significant savings, ADM assigned 0 annual kWh savings per treatment customer for the Expansion 2021 wave. Table 4-23: displays the regression coefficients for 2021.

Table 4-22: Expansion 2021 Wave Annual Savings by Program Year

Wave	Year	Estimate	5%	95%
Expansion 2021	2021	49.98	-60.64	160.60

Table 4-23: Expansion 2021 Wave 2021 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	-0.60	0.38	0.11	-1.23	0.02
Treatment	-0.92	0.24	0.00	-1.31	-0.53
Sep	2.03	0.25	0.00	1.61	2.44
Oct	2.37	0.30	0.00	1.87	2.87
Nov	3.56	0.35	0.00	2.98	4.13
Dec	2.24	0.44	0.00	1.52	2.95
Pre-period Usage	0.86	0.00	0.00	0.86	0.87
HDD	0.03	0.02	0.07	0.00	0.05
CDD	1.13	0.08	0.00	1.00	1.26
Sep: Pre-period Usage	0.00	0.01	0.52	-0.01	0.01
Oct: Pre-period Usage	0.02	0.01	0.00	0.01	0.03
Nov: Pre-period Usage	-0.07	0.00	0.00	-0.08	-0.06
Dec: Pre-period Usage	0.11	0.00	0.00	0.11	0.12
Treatment: HDD	0.03	0.01	0.00	0.01	0.04
Treatment: CDD	0.11	0.07	0.10	0.00	0.22

Each of the models were a good fit for the data, as seen by the Adjusted R-square in Table 4-24:.

Table 4-24: Expansion 2021 Wave Model Fit

Evaluation Period	Adjusted R2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
2021	0.837	36,982	100,780	6,338

The ex-post gross kWh savings for the Expansion 2021 wave is summarized below by program year. Due to the lack of statistically significant in the annual savings estimate, ADM assigned 0 annual savings per customer in PY2021 for the Expansion 2021 wave.

Table 4-25: Expansion 2021 Wave Ex-Post Annual kWh Savings by Program Year

Evaluation Period	Annual Unadjusted Savings Per Home (kWh/year)	5% CI Annual Unadjusted Savings Per Home (kWh/year)	95% CI Annual Unadjusted Savings Per Home (kWh/year)	Annual Double Counted Savings Per Home (kWh/year)	Annual Adjusted Savings Per Home (kWh/year)	Annual Control Group Usage Per Home (kWh/year)	Annual Percent Savings Per Home
2021	0.00	0.00	0.00	0.000	0.00	12,419.54	0.00%

Table 4-26: Expansion 2021 Wave Total Program Year Savings by Evaluation Period

Evaluation Period	Annual Adjusted Savings Per Home (kWh)	Weighted Treatment Customers	Program Year Savings (kWh)	Program Year Savings (kWh) 5% CI	Program Year Savings (kWh) 95% CI
2021	0.00	6,338	0.00	0.00	0.00

The Expansion 2021 wave displayed 0.00 percent annual household savings for 2021 because annual savings were not statistically significant. Average annual household savings for treated customers in the Expansion 2021 wave was 0 kWh for 2021. The Expansion 2021 wave saved 0 kWh in 2021.

4.3.4 Aggregated Waves Results

ADM found positive, statistically significant savings for the majority of waves evaluated and adjusted regression results for double counted savings that resulted from other downstream and upstream programs to determine the final program savings estimate. The following tables summarize each wave's annual household energy savings impact with 95 percent confidence intervals.

Table 4-27: 2020 Program Savings Summary

Wave	Weighted Customers	Annual Household Savings (kWh)	Annual Household 5% CI (kWh)	Annual Household 95% CI (kWh)	Program Savings (kWh)	Program Savings 5% CI (kWh)	Program Savings 95% CI (kWh)
Remix Email	21,375	199.69	135.99	263.40	4,268,408	2,906,649	5,630,167
Remix Paper	17,665	83.81	20.10	147.51	1,480,397	354,997	2,605,797
Total	39,039	147.26	83.55	210.97	5,748,805	3,261,646	8,235,964

Table 4-28: 2021 Program Savings Summary

Wave	Weighted Customers	Annual Household Savings (kWh)	Annual Household 5% CI (kWh)	Annual Household 95% CI (kWh)	Program Savings (kWh)	Program Savings 5% CI (kWh)	Program Savings 95% CI (kWh)
Remix Email	20,957	142.28	86.87	197.69	2,981,698	1,820,526	4,142,869
Remix Paper	18,684	113.48	52.32	174.64	2,120,300	977,561	3,263,039
Expansion 2021	6,338	0.00	0.00	0.00	0	0	0
Total	45,979	110.96	60.86	161.07	5,101,997	2,798,087	7,405,907

4.4 Double Counting Analysis Results

Participants in both the treatment and control groups participated in other Pacific Power energy efficiency programs. The double counted savings, defined in the methodology, whether positive or negative, were subtracted from the wave's gross savings estimates from the regression analysis to get total verified savings. This section summarizes the results of the double counting analysis for downstream and upstream programs.

4.4.1 Downstream Programs

ADM identified and summarized the average treatment customer, average control customer, and average incremental savings attributed to downstream residential programs for each wave. Table 4-29: and Table 4-30: display the downstream double counting savings to subtracted from each group's annual program savings for each program year.

Due to the lack of statistically significant savings for the Expansion 2021 wave in PY2021, there is no downstream double counting adjustment for the Expansion 2021 wave.

Table 4-29: 2020 Downstream Double Counting Results

Wave	Average Treatment Household Daily Savings (kWh/day)	Average Control Household Daily Savings (kWh/day)	Average Incremental Household Daily Savings (kWh/day)	Average Annual Household Savings (kWh/year)	Weighted Treatment Customers	Downstream Program Double Count Savings
Remix Email	0.034	0.037	-0.002	-0.802	21,375	-17,134
Remix Paper	0.025	0.037	-0.013	-4.575	17,665	-80,816
Total	0.030	0.037	-0.007	-2.509	39,039	-97,950

Table 4-30: 2021 Downstream Double Counting Results

Wave	Average Treatment Household Daily Savings (kWh/day)	Average Control Household Daily Savings (kWh/day)	Average Incremental Household Daily Savings (kWh/day)	Average Annual Household Savings (kWh/year)	Weighted Treatment Customers	Downstream Program Double Count Savings
Remix Email	0.022	0.020	0.002	0.594	20,957	12,447
Remix Paper	0.022	0.019	0.003	1.201	18,684	22,446
Expansion 2021	N/A	N/A	N/A	N/A	6,338	N/A
Total	0.022	0.020	0.002	0.880	45,979	34,893

ADM identified -97,950 kWh in double counted downstream savings for 2020 and 34,893 kWh in double counted downstream savings in 2021. The downstream double counting values were parsed by month and subtracted from the regression model results for each program year.

4.4.2 Upstream

Table 4-31: displays the upstream double counting savings ADM subtracted from each group's annual program savings for each program year.

Table 4-31: Upstream Double Counting Results

Program Year	Year of Bulb Purchase	HER Impact per Participant (Bulbs/year)	% Bulbs Incentivized	Savings per Bulb (kWh/year)	Average Measure Life (years)	Average Time Installed (% of year)	Average Percent Failed	Upstream Lighting Uplift per Customer (kWh/year)
2020 Total		-2.00	0.215	7.91	12.66	50%		-1.70
2021	2020	-2.00	0.215	7.91	12.66	100%	7.90%	-3.14
2021	2021	-2.00	0.215	7.91	12.66	50%	0.00%	-1.70
2021 Total		-4.00	0.215	7.91	12.66	75%	3.95%	-4.84

The following tables summarize the upstream double counted savings for each wave and program year. As the table shows, the control group had higher rates of LED installation than the treatment group since the joint savings per home (kWh/year) was negative. This outcome may occur in the first several years of a newly established wave; ADM adjusted upstream double count caused by uplift in accordance with the UMP which advises to make the adjustment regardless of whether the uplift is positive or negative.

Table 4-32: 2020 Upstream Double Counted Savings

Wave	Approximate Years of Deployment	Joint Savings per Home (kWh/year)	Weighted Treatment Participants	Double Count (kWh)
Remix Email	1	-1.70	21,375	-36,387
Remix Paper	1	-1.70	17,665	-30,071
Total		-1.70	39,039	-66,458

Table 4-33: 2021 Upstream Double Counted Savings

Wave	Approximate Years of Deployment	Joint Savings per Home (kWh/year)	Weighted Treatment Participants	Double Count (kWh)
Remix Email	2	-4.84	20,957	-101,389
Remix Paper	2	-4.84	18,684	-90,394
Expansion 2021	0.5	N/A	6,338	N/A
Total		-4.84	45,979	-191,783

The HERs 2020 upstream program double counted savings totaled -66,458 kWh. The HERs 2021 upstream program double counted savings totaled -191,783 kWh. The above values are used for each wave to adjust both the annual and monthly regression savings estimates.

4.5 Attrition Analysis Results

ADM estimated the cumulative attrition rates of both treatment and control group customers who moved out of the service area by month, wave, and treatment/control status for each program year. The following table displays the total move-out rate aggregating all waves. Attrition since inception of each wave, in aggregation, equals approximately 15 percent. However, attrition for the program years 2020 and 2021 is approximately nine percent.

Table 4-34: Program Move-out Rates by Program Year

Period	Treatment Customers	Control Customers	Treatment Move-out Percent	Control Move-out Percent
2020	46,000	20,000	9.17%	8.83%
2021	55,638	27,047	8.95%	9.34%
Since Inception	60,183	28,951	15.83%	15.30%

Table 4-35: summarizes the move-out rates for each wave in 2020. The move-out rates for each wave range between seven percent and 11 percent. Table 4-36: summarizes the move-out rates for each wave in 2021. The move-out rates for each wave range between seven percent and 12 percent.

Table 4-35: 2020 Move-out Rates by Wave

Wave	Treatment Customers Start	Control Customers Start	Treatment Customers End	Control Customers End	Treatment Move-outs	Control Move-outs	Treatment Move-out Percent	Control Move-out Percent
Remix Email	25,000	10,000	22,253	8,919	2,747	1,081	10.99%	10.81%
Remix Paper	21,000	10,000	19,529	9,316	1,471	684	7.00%	6.84%

Table 4-36: 2021 Move-out Rates by Wave

Wave	Treatment Customers Start	Control Customers Start	Treatment Customers End	Control Customers End	Treatment Move-outs	Control Move-outs	Treatment Move-out Percent	Control Move-out Percent
Remix Email	22,063	8,848	19,995	8,010	2,068	838	9.37%	9.47%
Remix Paper	19,392	9,248	18,080	8,618	1,312	630	6.77%	6.81%
Expansion 2021	14,183	8,951	12,584	7,893	1,599	1,058	11.27%	11.82%

4.6 Realization Rates

The HERs program resulted in a realization rate of 158 percent during the evaluation period (see Table 4-37).

Table 4-37: Program Energy Savings (kWh) and Realization Rate

Year	Claimed Savings (kWH)	Evaluated Savings (kWh)	Realization Rate
2020	3,542,270	5,748,805	162%
2021	3,333,142	5,101,997	153%
Total	**6,875,412**	**10,850,802**	**158%**

The primary driver for the program realization rate is the difference in annual kWh savings per customer. ADM found annual kWh savings were 95 percent higher in 2020 and 55 percent higher in 2021 compared to claimed annual kWh savings per customer. The difference between the claimed and evaluated annual kWh savings per customer is likely the result of the following factors:

- ADM utilized a PPR regression model that includes weather effects, while ex-ante estimates are based on a regression model without weather effects. The inclusion of weather effects is import when modeling energy usage and resulted in increased model fit.

- ADM required at least 4 months of post-period billing months for customers to ensure a sufficient post-period was available for each customer for the PPR regression model. The ex-ante regression had no minimum post-period requirement.

- ADM estimated upstream and downstream uplift. ADM determined that, compared to the customers in the treatment group, the customers in the control group saved three percent more energy from Pacific Power's other energy efficiency programs. Thus, ADM adjusted our regression results for the treatment group to account for the additional three percent which is appropriate to attribute to the treatment group.

5 Process evaluation

5.1 Program Operations Perspective

This section summarizes the findings of interviews conducted with Pacific Power and Bidgely implementation staff for the purposes of learning about the program's design and implementation in 2020 and 2021. The interview also focused on program's progress toward energy savings goals, strengths and challenges, and planned changes for the future.

The following summarizes key findings from the interviews.

- **Implementation staff confirmed report delivery frequency and content**. Participants receive either bi-weekly (email) or quarterly (paper) reports. Participants who receive emailed HERs, receive a total of 24 reports per year. These customers receive one report a month with the customers' total energy use and a breakdown of energy use by appliance type, and another report each month that compares the customer's energy use with similar homes and provides energy saving tips. The reports also promote other Pacific Power programs. Quarterly paper HERs contain similar content. The implementer meets with utility staff on a quarterly basis to determine marketing efforts and report content.

- **Implementation staff indicated the HERs program had several upgrades in Fall 2020**. The upgrades included improved email aesthetics, mobile compatibility, and additional portal web pages with interactive graphs, and revised energy efficiency recommendations. Additionally, the upgrade included easier access to the online portal with a "lazy log on" feature. Beginning in October 2020, customers could click a link in their HERs email and go directly to the website without needing to provide login information. Before this, customers could only get to the online portal through the Pacific Power website. Implementation staff observed that this change had increased traffic to the online portal.

- **Program communication is sufficient**. Implementation staff provides utility program staff with monthly reports and access to interactive online tools with program metrics. Further, implementation staff said they were "always working closely" with Pacific Power staff and neither implementation nor utility staff expressed concerns regarding the frequency or quality of program communication.

- **The program is not achieving expected savings**. Implementation staff noted that the program had remixed the treatment and control groups in 2020 and this was the primary driver of lower savings. In addition to customers needing time to begin taking energy saving actions, the implementation staff noted that some of the customers that were placed into the control group had previously received reports and that the

influence of the reports likely persisted amongst these customers. Staff also noted an expansion wave was launched in April 2021 with both email and physical report recipients and a shared control group. This expansion wave allowed additional customers to receive reports and was launched in part due to program attrition.

- **Customer engagement metrics exceeded expectations.** Click rates increased for email HERs recipients from 2019 to 2020. Bidgely estimated that the percentage of customers who followed a link in the email to visit the Pacific Power website and the Bidgely Home Energy dashboard customer portal (the click rate) increased from around one percent to 15 percent from 2019 to 2020. They noted that the click rates were currently around five percent in March 2022. Qualitative feedback from the utility's program staff as well as the call center also indicated high customer satisfaction in 2020 and 2021.

- **Implementation staff identified several program strengths.** Staff highlighted the recent upgrade that allows HERs recipients to directly access the online portal through their HERs email. They also noted the customer-specific nature of the program and how reports provide home-specific information and recommendations for each customer and educate customers about their energy by disaggregating home energy use. Additionally, implementation staff indicated they have aligned the HERs marketing content with Pacific Power's marketing and each month the HERs feature a Pacific Power program.

- **Staff identified smart meter data as an opportunity to improve HERs**. Using smart meter data would allow the program to improve appliance disaggregation and provide richer insights to customers about their energy use and ways they could save energy.

5.2 Participant and Control Group Survey Results

ADM surveyed Pacific Power customers who received HERs in 2020 and 2021 and a sample of customers designated as controls. Those customers who received home energy reports are referred to as *email participants* or *paper participants*, while those designated as part of the control group are referred to as *non-participants*. The survey was administered in March 2022. ADM collected a total of 247 survey responses, however 11 percent of respondents indicated that they received a HERs format (email/paper) that did not align with program tracking records and were removed from analysis. Table 5-1 displays response rate information.

Table 5-1: Summary of Email Survey Response

Metric	Control	Email	Paper	Total
Initial Invite	1479	1489	1502	4470
Total emails sent (including reminders)	1568	2799	2827	7194
Complete	77	73	72	222
Response Rate	5%	5%	5%	5%

The survey collected information about the program participants' experiences with the HERs and satisfaction with Pacific Power. The survey also inquired about the participants' and non-participants' use of Pacific Power's online energy portal and about energy-saving actions customer have taken (e.g., behavioral changes, or installing energy efficient appliances and equipment).

ADM compared responses from customers who received paper HERs, email HERs, and non-participants Statistically significant differences are noted.[4]

5.2.1 Reading Home Energy Reports

Most respondents (84 percent) reported that they read most or all the HERs they received in 2021 (Table 5-2).

Table 5-2: How often did you read the Home Energy Reports in 2021?

Portion Read	All Responses (n = 145)	Paper HERs (n = 72)	Email HERs (n = 73)
All the Reports	58%	61%	55%
Most of the Reports	30%	25%	34%
About half of the Reports	6%	7%	4%
Only a couple of the Reports	5%	6%	4%
None of the Reports	1%	1%	1%
Don't know	1%	0%	1%

Twenty-one percent of survey respondents reported that someone else in their household had read the HERs. However, of those who said someone else was reading reports as well, 90 percent said they themselves had read all or most of the reports. Thus,

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[4] ADM compared results with two proportion z-tests. Reported differences are statistically significant at $p < 0.05$ using a two-tailed test.

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 (one percent) or only read a couple of the reports (five percent) were asked why they chose not to read the HERs. Of the 9 respondents who reported reading half or fewer of the reports, the plurality (44 percent) reported that the primary reason for not reading the reports was that they did not have the time. Other reasons included: lacking interest or not seeing value in reports, not understanding them, or not being aware they received the reports.

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 to be, and their satisfaction with the report. Most survey respondents (84 percent) found the HERs information on their home's energy use easy to understand. Responses were similar for both email and paper HERs recipients (see Table 5-3).

The rated ease of understanding was positively related to reading more of the HERs. 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 a few reports.

Table 5-3: Rated Ease of Understanding HERs Information

Answer	All Responses (n = 145)	Paper HERs (n = 72)	Email HERs (n = 73)
1 – Very difficult	3%	0%	3%
2	1%	1%	1%
3	12%	7%	12%
4	16%	22%	16%
5 – Very easy	67%	69%	67%
I don't know	0%	0%	0%

5.2.3 Perceived Value of Information on Home Energy Use

Most respondents perceived the various components of the HERs to be valuable, with over 70 percent scoring each of the five HERs components as valuable (Figure 5-1).[5]

Figure 5-1: Rated Value of HERs Information
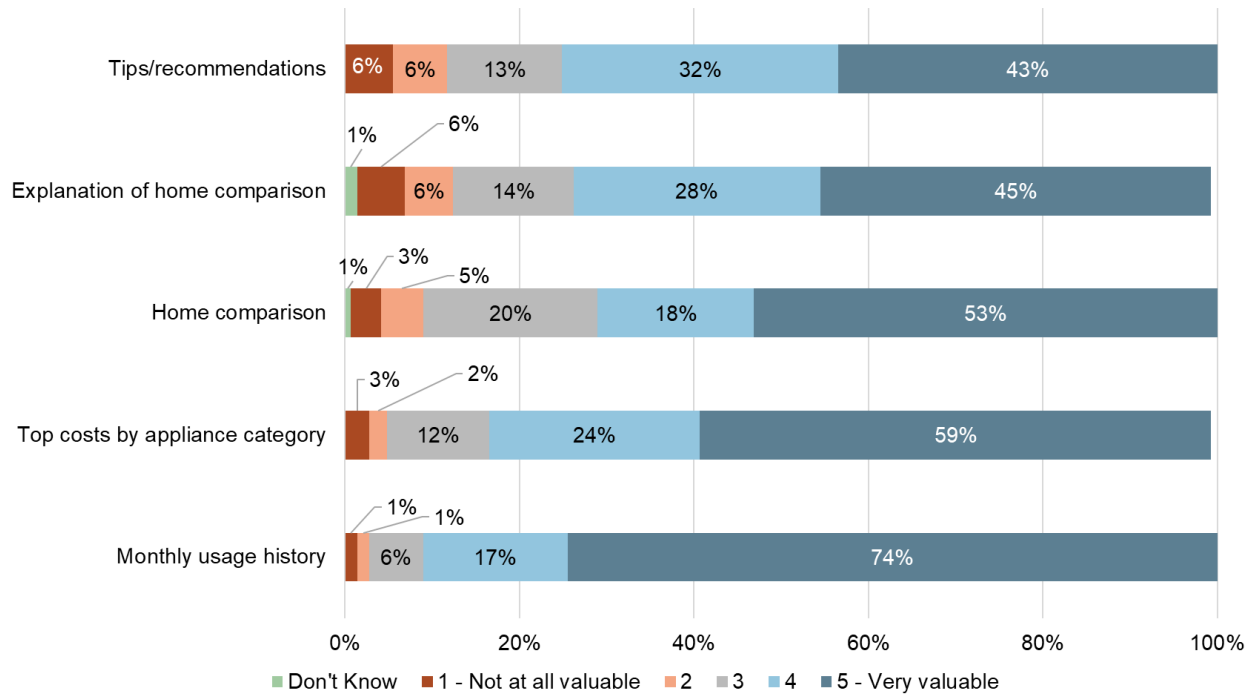
5.2.4 Perceived Accuracy of Information on Home Energy Use

Survey respondents reported that the information on their home's energy use was accurate (see Table 5-4).

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[5] n=72. Rated the value a 4 or 5 on a scale from 1 (not at all valuable) to 5 (very valuable).

Table 5-4: Rated Accuracy of HERs Information

Answer	All Responses	Paper HERs	Email HERs
	(n = 145)	(n = 72)	(n = 73)
1 – Not at all accurate	0%	0%	4%
2	4%	4%	3%
3	18%	18%	12%
4	33%	33%	30%
5 – Very accurate	36%	36%	45%
I don't know	8%	8%	5%

The respondents who said the HERs information was inaccurate (rated as a 1 or 2 on a 5-point scale) provided some explanation for their rating. These respondents shared various feedback regarding their report accuracy. Two respondents indicated their homes are heated with gas rather than electricity, and two respondents stated that they had purchased electric vehicles and felt reports did not incorporate car charging accurately. Other comments included not trusting the method for comparing their home to others in the area. These respondents suggested that reports did not account for multiple meters, house size, and occupancy.

5.2.5 Satisfaction with HERs

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). Further, 32 percent of respondents said that receiving the home energy reports had changed their opinion of Pacific Power, with 96 percent indicating that receiving the reports had improved their opinion.[6]

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[6] n=47. Rated their change in opinion a 4 (43 percent) or 5 (53 percent) on a scale from 1 (greatly worsened) to 5 (greatly improved).

Figure 5-2: Satisfaction with HERs
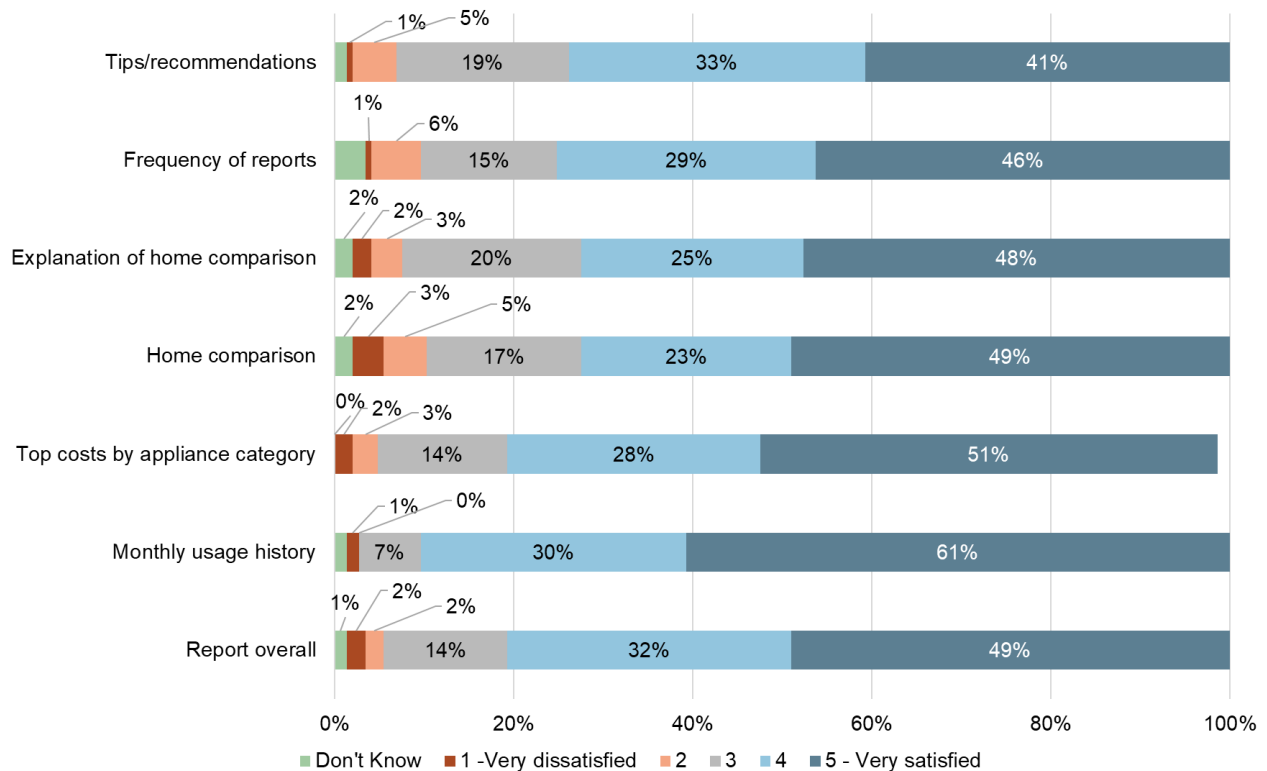
The survey offered respondents an opportunity to provide recommendations on how to improve the information on the HERs and to comment on reasons for dissatisfaction with their reports. Below are the suggestions provided by survey respondents:

- *Frequency:* Five survey respondents commented on the frequency of the HERs. Three requested they stop receiving the reports, and one preferred to receive the report quarterly instead of monthly. The other respondent indicated they would like to receive reports more frequently.

- *Accuracy or level of detail:* Four respondents suggested that the reports should be more accurate or include additional information, with three specifically citing opportunities to improve the home comparison's accuracy by using correct or more detailed information about their home.

- *Other:* Three respondents provided other comments. One respondent suggested enlarging the font size, one requested explanation of the annual usage chart, and one suggested the report's design "start over with a clean slate and rethink this top to bottom."

5.2.6 Experience with Online Portal

Forty-nine percent of participants recalled logging onto Pacific Power's online portal. A larger portion of email HERs recipients reported logging on (63 percent) compared to

paper HERs recipients (35 percent). Most of the customers that indicated logging onto the online portal indicated they were satisfied with the information provided and agreed the website was easy to navigate and provided interesting, helpful, easy to understand information (see Figure 5-3).

Figure 5-3: HERs Participant Online Portal Experience
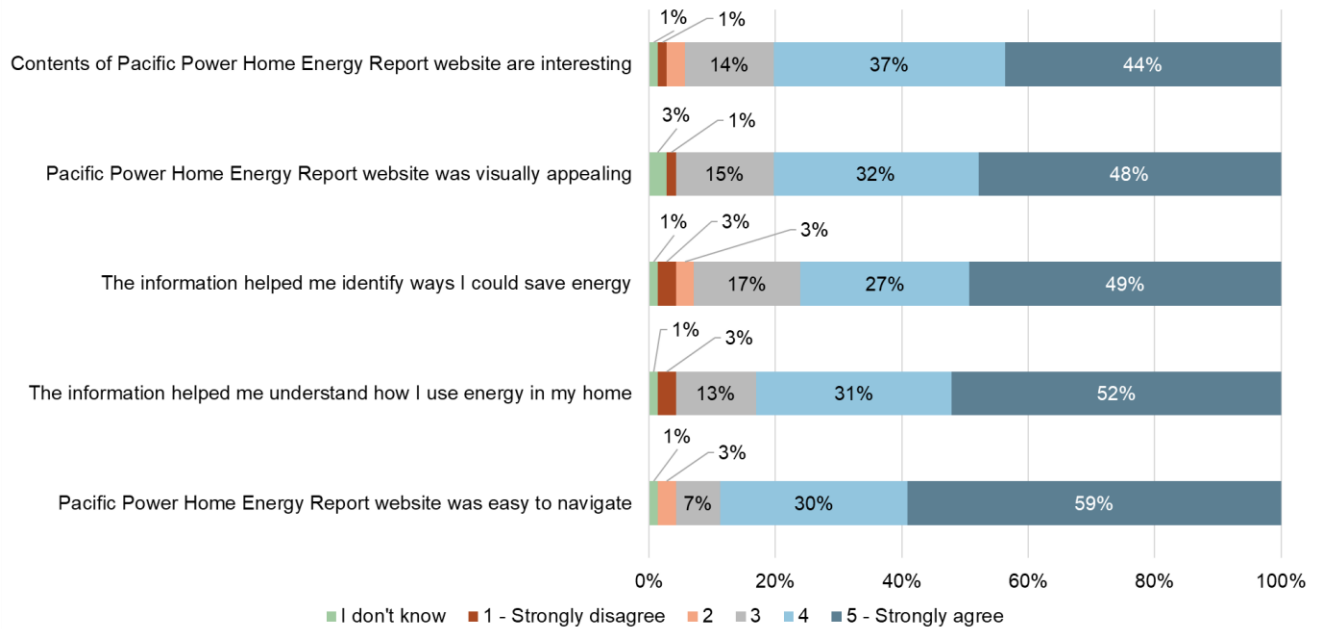
Most respondents who said they had not logged on to the online portal indicated they were not aware of the portal. Table 5-5 displays reasons customers noted for not having logged onto the portal.

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

Reason	Percentage of Respondents (n = 74)
Was not aware of the portal	57%
Did not have the time to use the portal	18%
Did not know how to access the portal	15%
Did not think the portal would provide useful information	5%
Not interested in my energy use	3%
Experienced technical difficulties trying to access the portal	3%
Prefer the paper report. Get enough emails	1%
Don't know	4%

5.2.6.1 Energy Saving Awareness and Behavior

Fifty-three percent of HERs recipients reported they had made changes or took actions to save energy based on the information they had learned from the HERs they received in 2020 or 2021. Of those, eighty-six percent of respondents said that the information provided in the HERs was important in their decision to make those changes.[8]

Similarly, 55 percent said they had installed one or more energy-efficient product 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).

5.2.6.2 Opinion Toward Pacific Power

Respondents provided feedback on whether and how receiving the HERs had affected their opinion of Pacific Power. Thirty-two percent indicated that receiving the report had changed their opinion of Pacific Power. Of those who indicated receiving the report had changed their opinion, nearly all (96 percent) indicated it had improved their opinion (see Table 5-6).

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[7] Other reasons customers cited included preferring receiving information in paper form and not

[8] n=77. Rated the importance of the HERs a 4 (34 percent) or 5 (52 percent) on a scale from 1 (not at all important) to 5 (very improved).

Table 5-6: Rated Change in Satisfaction with Pacific Power

Rating	Percentage of All Respondents (n = 47)
5 – Greatly improved	53%
4	43%
3	2%
2	2%
1 – Greatly worsened	0%
Don't know	0%

5.2.6.3 Comparison Between Participant and Non-Participant Survey

ADM examined the demographics of the participants and non-participants to determine if there were any statistically significant differences between the two groups. In addition, ADM evaluated the impact of the COVID-19 pandemic on participants and non-participants, including any ways in which the pandemic may have affected their ability to participate in other Pacific Power programs.

5.2.6.4 Demographics

Participants and non-participants were asked about their home characteristics, including home ownership, home type, and year of construction. Most of the respondents owned a single-family home. Nearly half lived in homes built between 1960 and 1979. ADM found no statistically significant differences between the home characteristics for participants and non-participants (Table 5-7).

Table 5-7: Respondent Home Characteristics

Response	All Respondents (n = 222)	Participants (n = 145)	Non-participants (n = 77)
Home Ownership			
Own	68%	65%	73%
Rent	30%	33%	25%
Prefer not to answer	2%	2%	3%
Home Type			
Single-family home	71%	68%	77%
Manufactured or mobile home	11%	10%	12%
Duplex or triplex	7%	8%	5%
Apartment in an apartment building or complex	10%	12%	5%
Condominium or townhome	1%	1%	1%
Don't know	0%	1%	0%
Year Home Was Built			
Before 1960	28%	28%	29%
1960 to 1979	20%	21%	18%
1980 to 1999	20%	17%	26%
2000 to 2009	10%	9%	12%
2010 or later	10%	12%	6%
Don't know	12%	13%	9%

Home heating and water heating was similar for both participants and non-participants, with most indicating they had electric home and water heating, with tank water heaters (Table 5-8).

Table 5-8: Respondent Home Characteristics

Response	All Respondents (n = 222)	Participants (n = 145)	Non-participants (n = 77)
Home Heating Type			
Electricity	61%	63%	57%
Natural Gas	32%	31%	35%
Propane, heating oil, wood, other	5%	5%	6%
Don't know	1%	1%	1%
Propane	1%	1%	0%
Water Heating System			
Natural gas storage tank water heater	23%	21%	27%
Electric storage tank water heater	57%	59%	53%
Heat pump water heater	7%	8%	6%
Natural gas tankless water heater	3%	3%	3%
Electric tankless water heater	5%	6%	5%
Other	1%	1%	0%
Don't know	1%	1%	1%
Prefer not to answer	3%	3%	4%

ADM also asked respondents about their household characteristics. Most identified as white or Caucasian and indicated they had some post-high school education. Eighty-nine percent said English was the primary language spoken at home. The other respondents indicated either Spanish (11 percent) or Chinese was the primary language spoken at home (less than one percent).

On average, about three people lived at each respondent's residence and 72 percent of respondents said that three or fewer lived at their home.

The typical respondent's average monthly electric bill was $150 or less. Thirty-four percent of respondents indicated their household income was less than 200 percent of the federal poverty line.

Table 5-9: Respondent Background Characteristics

Response	All Respondents (n = 221)	Participants (n = 144)	Non-participants (n = 77)
Average Monthly Electricity Bill			
$0 - $50	15%	17%	10%
$51 - $100	32%	31%	34%
$101 - $150	18%	21%	13%
$151 - $200	20%	19%	22%
$201 - $250	7%	6%	10%
$251 - $300	4%	3%	4%
$301 - $350	1%	1%	0%
$351 - $400	0%	0%	1%
Don't know	3%	1%	5%
Prefer not to say	0%	1%	0%
Community Characterization			
Urban*	32%	38%	21%
Rural	33%	28%	40%
Suburban	31%	29%	35%
Don't know	5%	6%	4%
Age			
18-24 years old	2%	3%	1%
25-34 years old	16%	15%	17%
35-44 years old	19%	17%	23%
45-54 years old	14%	12%	18%
55-64 years old*	15%	20%	6%
65-74 years old	23%	27%	16%
75-85 years old	7%	5%	12%
86 years old or older	0%	1%	0%
Prefer not to answer*	3%	1%	6%
Education			
Less than high school	4%	3%	6%
High school graduate/GED	24%	25%	23%
Associates degree, vocation/school, or some college	32%	32%	31%
Four-year college degree	16%	15%	18%
Graduate or professional degree	19%	23%	13%
Don't know	0%	1%	0%
Prefer not to answer	5%	3%	8%
Race or Ethnicity			
Asian	3%	2%	5%
Black/African American	2%	1%	3%
Caucasian/White	62%	60%	66%
Hispanic or Latino	27%	30%	21%
Native American or Alaska Native	3%	1%	5%
Pacific Islander or Native Hawaiian	0%	1%	0%
Other	2%	3%	0%
Prefer not to answer	8%	6%	10%

5.2.6.5 Impact of the Coronavirus Pandemic

The 2021 participant survey included questions to assess the effect of the coronavirus pandemic on time spent at home, electricity use, efforts to control use, and ability to participate in Pacific Power energy efficiency programs.

Sixty percent of respondents observed that the pandemic had not changed the number of people in their household that worked or went to school remotely.[9]

Twenty-five percent said that more members of their household were attending school or working remotely since the COVID-19 pandemic began and 15 percent indicated that fewer members of their household were now working or attending school remotely compared to before the COVID-19 pandemic.

Sixty-eight percent of respondents said that the amount of time they spend at home has increased since the COVID-19 pandemic began.[10] Thirty-five percent of respondents indicated that their utility bill had increased. Figure 5-4 displays the change in time spent at home and cost of electricity bills since the COVID-19 pandemic began.

Figure 5-4: Change in amount of time spent at home and electricity bill since COVID-19 pandemic began

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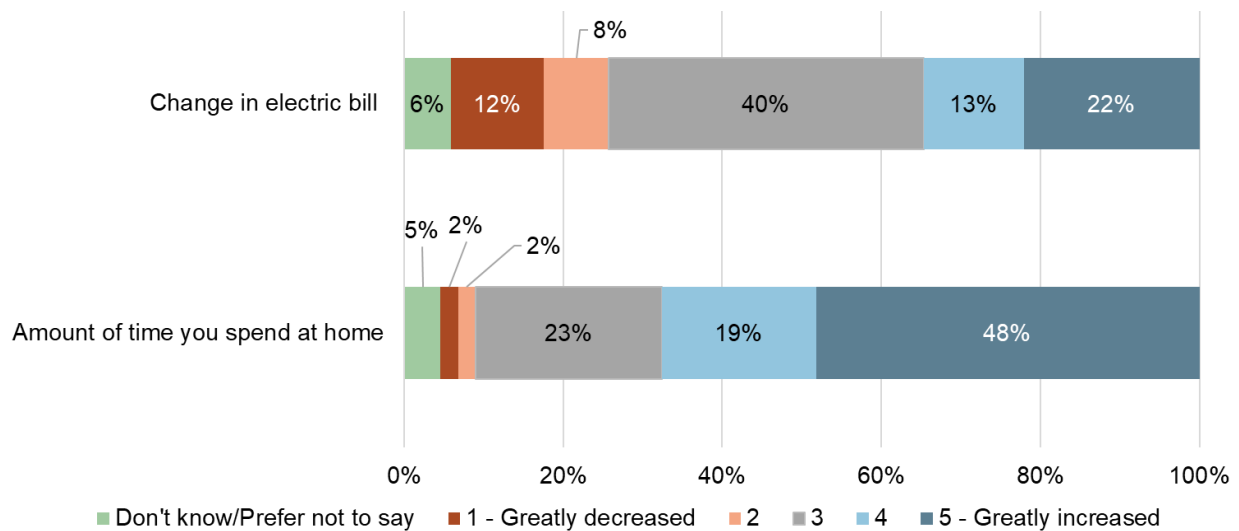
[9] n=222

[10] Rated the change in amount of time a 4 or 5 on a scale from 1 (greatly decreased) to 5 (greatly increased).

5.2.6.6 Beliefs and Attitudes Relating to Energy Efficiency

Survey respondents generally endorsed positive beliefs and attitudes about energy efficiency. Non-participant respondents generally agreed to various statements about energy efficiency in levels comparable to those of participants. In most cases, participants agreed at marginally higher levels than non-participants except for the statement "Energy efficiency saves money." See Figure 5-5 for more details. ADM did not find statistically significant differences between the control and experimental groups.

Figure 5-5: Pro-Energy Efficiency Beliefs and Attitudes*
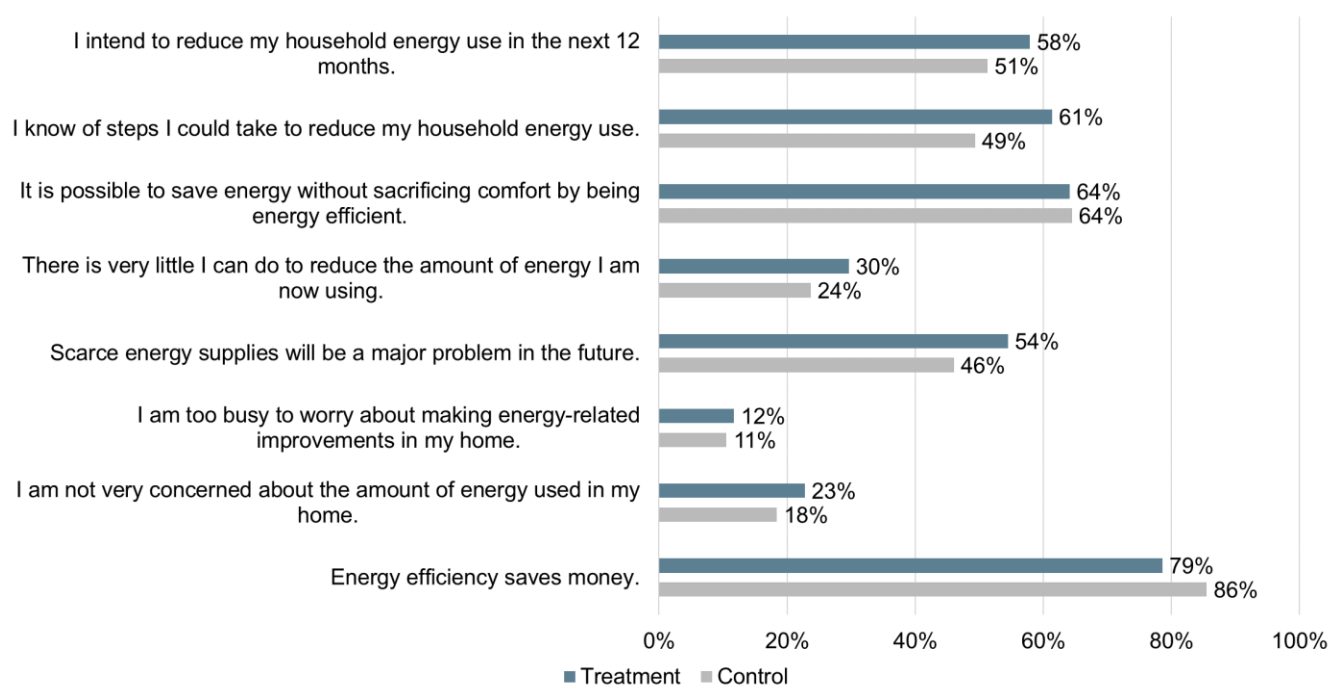
*Agreement = rating of 7 or higher on scale from 0 (strongly disagree) to 10 (strongly agree).

5.2.6.7 Energy Saving Behavior

ADM compared participants and non-participants on several self-reported energy-saving actions taken that were included in HERs. ADM did not find a statistically significant difference between the number of actions reported for participants and non-participants (Table 5-10).[11]

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[11] ADM compared the proportions with two proportion z-tests. Reported differences are significant with an alpha of 0.05 using a two-tailed p value.

Fifty-three percent of HERs recipients reported they had made changes or took actions to save energy based on the information they had learned from the HERs they had received in 2020 or 2021. Eighty-six percent of respondents of these respondents said that the information provided in the HERs was important in their decision to take energy-saving actions.[12]

Table 5-10: Comparison of Participants and Non-participants on Energy-Saving Actions

	Participants (n = 145)	Non-participants (n = 74)
Made changes/took actions to reduce energy use	53%	66%
Number of Actions Taken to Reduce Energy Use – All Respondents		
None	47%	34%
1 to 5	10%	7%
6 to 10	25%	38%
11 to 15	12%	19%
More than 15	6%	3%

ADM did not find any statistically significant difference between the number of actions participants and non-participants took to save energy. Table 5-11Table 5-11 summarizes all energy saving actions recommended on HERs that participants and non-participants reported taking.

Table 5-11: Actions Taken among Participants and Non-participants

Action	Participants (n = 145)	Non-participants (n = 77)
Allowed sun to heat home (opened curtains on south/west facing windows in winter)	42%	55%
Ran ceiling fans in reverse in winter	20%	23%
Let dishes air dry	42%	44%
Dried clothes at lower temperature	32%	44%
Unplugged second refrigerator when not in use	11%	10%
Adjusted freezer temperature settings	32%	29%
Washed clothes using cold water versus hot water	40%	52%
Replaced old cookware with flat-bottomed cookware	23%	34%

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[12] n=77. Rated the importance of the HERs a 4 (34 percent) or 5 (52 percent) on a scale from 1 (not at all important) to 5 (very improved).

Kept refrigerator full to better maintain cold temperatures	34%	45%
Shut flue damper on fireplace or wood stove after usage	10%	19%
Made sure refrigerator had minimum clearance to allow operating at maximum efficiency	32%	45%
Wrapped hot water heater in an insulating blanket	16%	19%
Installed a dimmer switch for to control lighting levels	17%	29%
Turned off game consoles when not in use instead of leaving in stand-by mode	28%	27%
Unplugged stereo when not in use	26%	19%
Optimized display on television	31%	32%
Used an electric kettle instead of a pot on the stove	21%	19%
Checked seal on refrigerator to ensure appropriate tightness	35%	45%

ADM also asked customers if they had enrolled in Pacific Power's time-of-use residential billing plan that rewards off-peak electricity consumption with lower rates. Five percent all survey respondents indicated that they had enrolled in a time-of-use plan in 2021. Notably, email HERs recipients indicated enrolling at a higher rate (ten percent) than paper HERs recipients (one percent).

5.2.7 Energy Saving Purchases

Fifty-five percent of HERs 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). Seventy-three percent of control group respondents said they installed an energy efficient item in 2020 or 2021. Of these respondents, 55 percent indicated information they received from Pacific Power by means other than HERs had been important in their decision to purchase energy efficient equipment. A larger portion of HERs participants noted receiving an incentive for their purchase, though the difference was not statistically significant.[13]

There was a statistically significant difference between the number of energy efficient items participants and non-participants reported installing in 2020 and 2021; non-participants reported installing more energy efficient products than participants did.

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[13] Six percent of HERs participants noted receiving an incentive for their purchase, compared to 1 percent of non-participants.

Table 5-12: Comparison of Participants and Non-participants on Energy-Saving Purchases and Installations

	Participants (n = 145)	Non-participants (n = 74)
Installed energy efficient items	55%	73%
Number of Energy Efficiency Items Installed		
	145	74
None	45%	27%
One	12%	12%
Two	11%	14%
Three	9%	18%
Four or more	23%	30%

The most common items respondents purchased and installed were ENERGY STAR®️ lightbulbs, refrigerators, and televisions (see Table 5-13). There was a statistically significant difference between the percentage of non-participants and participants who reported purchasing an ENERGY STAR®️ freezer.

Among those participants who purchased LED bulbs, 16 percent bought 3 or fewer, 35 percent bought 4 to 7 bulbs, and 49 percent purchased 8 or more bulbs. There were no statistically significant differences between the number of LED bulbs purchased by participants and non-participants.

Table 5-13: Energy Efficient Items Purchased or Installed

Equipment or Appliance	Percent of All Respondents (n = 222)	Percent of Participants (n = 145)	Percent of Non-Participants (n = 77)
Smart thermostat (e.g., Nest, Lyric, Ecobee, Sensi)	13%	11%	16%
Energy efficient windows or doors	12%	11%	14%
Attic, floor or wall insulation	9%	7%	13%
Advanced power strips	12%	10%	16%
Low flow faucet aerators or showerheads	17%	15%	19%
ENERGY STAR® Appliances	**(n = 222)**	**(n = 145)**	**(n = 77)**
ENERGY STAR® LED light bulbs	42%	38%	51%
ENERGY STAR® LED fixtures	13%	10%	17%
ENEGY STAR® central air conditioner	9%	8%	12%
ENERY STAR® room air conditioner	5%	3%	8%
ENERGY STAR® clothes dryer	15%	15%	16%
ENERGY STAR® clothes washer	18%	16%	22%

ENERGY STAR® refrigerator	19%	17%	23%
ENERGY STAR® stand-alone freezer*	10%	7%	16%
ENERGY STAR® heat pump water heater	7%	5%	10%
ENERGY STAR® dehumidifier	2%	1%	3%
ENERGY STAR® computer or computer monitor	5%	5%	5%
ENERGY STAR® scanner or printer	5%	4%	8%
ENERGY STAR® television	18%	15%	25%

Sixty percent of participants said that the information provided in the HERs was important (rating of 4 or 5) in their decision to purchase or install the energy efficient equipment or appliances. Similarly, 55 percent of control group respondents indicated information they received about energy efficiency from Pacific Power had been important in their decision to purchase energy efficient products.

5.2.7.1 Energy Savings Actions Before 2020

ADM also asked if respondents had taken any energy saving actions before 2020. Overall, 59 percent of respondents said they had taken some action to reduce energy use in their home before 2020. There was minimal variation between the participants and non-participants. Half of the respondents who noted taking action to reduce energy use before 2020 noted some kind of behavior change (e.g., unplugging appliances, turning off lights). One-third noted installing a major measure such as windows, attic insulation, furnace, or hot water heater, while 26 percent indicated they had made other less expensive energy efficient improvements such as installing LEDs or weatherstripping.

5.2.7.2 Pacific Power Online Customer Experience

ADM also asked several questions about customers' experience with the Pacific Power website.

Seventy-two percent of survey respondents said they had created an account at the Pacific Power website, with email HERs and control group respondents indicated creating accounts at a higher rate compared to paper HERs recipients.[14]

The most commonly cited reason for not creating an online account was not knowing about the opportunity. See Table 5-14 for reasons customers reported for not creating an

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[14] Eighty-one percent of email HERs recipients, 78 percent of control group, and 56 percent of paper HERs respondents stated they had created an account.

online account. Most respondents who indicated "other" did clearly communicate why they had not made an account.

Table 5-14: Reasons Customers Have Not Created Account

Reason	All Respondents (n= 64)	Participants (n = 47)	Non-participants (n = 17)
I didn't know about it	40%	43%	29%
I don't know how to	13%	15%	6%
I have concerns about internet privacy/paying online	19%	17%	24%
I don't think it would provide valuable or interesting information	13%	17%	0%
Technical difficulties	5%	7%	0%
Other	22%	15%	41%

Of the respondents who said they had created an online account, 61 percent said they had only logged in one time, 22 percent said they had logged in multiple times and the remaining 17 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 5-6).

Figure 5-6: Perceived Value of Pacific Power Website's Tips and Information
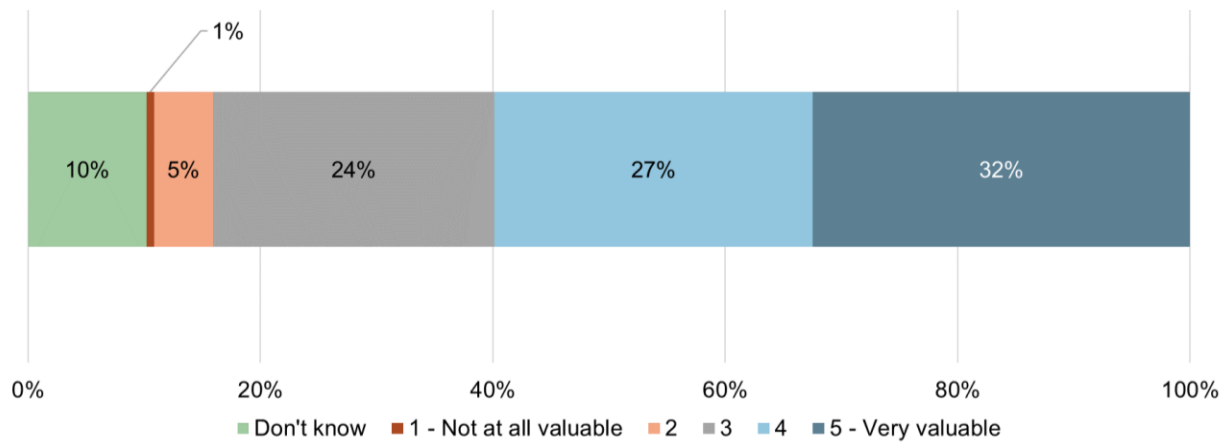
Overall, 43 percent of respondents said they had visited the Pacific Power website to view energy saving tips and usage information. Similar to creating an account, ADM found that

email HERs recipients and non-participants reported visiting the website to view usage information and energy saving tips more often than paper HERs recipients.[15]

All customers that had created an account were asked how the Pacific Power website could be improved. Six percent (n=9) shared feedback to improve the website including these comments:

Three percent mentioned adding additional or more focused detail on the website. These respondents suggested additional detail for usage over time (ability to compare longer time periods and actual usage opposed to estimates) and the ability to provide personalized tips and information based on a more detailed questionnaire that would capture their water heating and home heating type and whether they are homeowners or renters.

Two percent suggested improving the user interface by adding more photos, improving usability, or general aesthetics.

One percent requested additional utility contact with one suggesting seasonally relevant energy-saving tips be sent via email and one indicating technical issues with logging into the website and interest in attic insulation rebates.

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[15] Fifty-one percent of email HERs and 52 percent of non-participants reported visiting the website to view tips and usage information compared to 25 percent of paper HERs recipients.

6 Conclusions and Recommendations

ADM offers the following conclusions and recommendations for consideration in planning future program cycles.

6.1.1 Conclusions

- Pacific Power's HERs program in Washington resulted in verified program savings of 5,748,805 kWh in 2020 and 5,101,997 kWh in 2021. ADM estimated HERs program savings using a billing analysis of randomized control trial (RCT) cohorts and matched control groups. ADM found annual savings that are positive and statistically significant savings for both Remix waves in both program years (i.e., 2020 and 2021). The Expansion 2021 wave had positive savings that are not statistically significant in 2021; however, that cohort, established in mid-2021, had operated for less than half a year.

- **All evaluated waves had valid control groups** for each program year suggesting that the implementer created the original RCT waves in accordance with industry standards.

- **Evaluated savings.** All evaluated waves displayed average annual electricity savings between 0.5 percent and 1.3 percent of annual billed use in 2020 and between 0.4 percent and 0.9 percent of annual billed use in 2021. Typical behavioral programs display average annual electricity savings between one and three percent. Therefore, savings verified in both program years are lower than those typically displayed in behavioral programs. ADM hypothesizes this is due to the inclusion of formerly treated customers in the control groups for the first two waves. The third wave established in mid-2021, however, displays savings in the typical range for a new wave, which normally have savings that are less than 1% of annual usage. Furthermore, ADM found that the email for some control customers is shared with another premise belonging to a treatment customer (approximately two percent of customers affected across all waves). The same problem occurred for the primary mailing address and affected 12 percent of customers across waves. Control customers receiving HERs could result in tainting of the control group and lower savings estimates for the program.

- **Increased savings generated through other programs.** ADM estimated that savings of -164,408 kWh in 2020 and -156,890 kWh in 2021 found in the HERs billing analysis was attributable to savings generated by other Pacific Power Home Energy Savings programs. Each estimated amount was parsed by month and removed from the estimated savings from the regression results. This ensures there is no double counting of savings of observable, billed energy usage in the Pacific Power Washington portfolio. The double counted savings represent three percent of savings

before double counting, therefore, the impact on final program savings is relatively small.

- **The control group saved more energy through other Home Energy Savings programs than the treatment group.** This often occurs for the first few years of a new wave and may be more likely to occur for the 2020 waves because some control customers in those waves were once part of a treatment group from prior waves. In addition, customers in the control group reported that they undertook more energy savings behaviors than customers in the treatment group; however, this result may be due to survey bias (i.e., control customers who respond to the survey may be more likely to exhibit energy saving behaviors than control customers who do not respond).

- **Attrition.** The total attrition for the program since inception is 16 percent for the treatment group and 15 percent for the control group. In addition, the annual attrition rate is approximately nine percent across waves for the both the treatment and control groups.

- **Customer count provided by the implementation contractor Bidgely does not match customer count reported in Pacific Power's 2020 Washington annual report.** The program tracking data ADM received from Bidgely included 25,000 customers in the Remix Email group and 21,000 customers in the Remix Paper group. The 2020 annual report indicates that 24,000 customers were included in the email group and 23,000 customers were included in the paper group. ADM reports the numbers of customers that were included in the analyzed data from Bidgely.

- **Pacific Power's reported claimed savings does not match annual savings provided by implementation contractor Bidgely.** Claimed savings reported to ADM by Pacific Power did not match the annual savings reported to ADM by Bidgely. Pacific Power reported 2020 savings of 3,542,270 kWh and 2021 savings of 3,333,142 kWh. These claimed savings are included in this evaluation report. Bidgely reported 2020 savings of 1,986 MWh and 2021 savings of 3,423 MWh.

- **HERs participants report being satisfied with the program, indicating successful program design and implementation.** The majority of HERs participants were satisfied with the reports and found the various components useful. Further, participants said receiving the reports had improved their opinion of Pacific Power.

- **The program is not achieving expected savings.** Staff indicated that remixing the treatment and control groups in 2020 was the primary reason for not achieving expected savings. They anticipate increased savings in the participants groups after longer treatment.

- **The influence of the program is unclear.** ADM did not find a statistically significant difference between the number of energy-saving actions taken by participants and

non-participants. There was a statistically significant difference between the number of energy-efficient products participants and non-participants reported installing in 2020 and 2021; non-participants indicated installing more energy efficient products than participants did. Energy efficiency attitudes and beliefs were similar across survey respondent groups.

- **There is potential to expand use of the online portal**. About half of HERs participants who responded to the survey indicated that they had logged into the online portal. Those who had visited the portal found the information useful and easy to navigate. This compares to over two-thirds of all survey respondents who indicated they had created an online account at Pacific Power's main website (pacificpower.net), suggesting a larger portion of customers are engaging with Pacific Power's standard web site rather than the HERs portal.

- **Survey responses indicate low awareness of Pacific Power's rebate programs.** Though over half of all survey respondents indicated having purchased an energy-efficient product in 2020 or 2021, less than five percent indicated receiving a Pacific Power rebate for their purchase.

6.1.2 Recommendations

Based on its evaluation, ADM recommends that Pacific Power consider the following actions.

- **When new waves are created, initiate treatment on the same date for all customers in the wave.** Multiple intervention dates for a given wave creates poorly defined pre- and post-periods. This could create a problem when defining the cohort for a wave since some customers may not have sufficient post-period billing data to be included in the cohort, which could result in an invalid cohort and the need for matching and the creation of a new control group for a wave.

- **Save and store historical billing data for all customers in each wave** to ensure future analyses will have one year of billing data prior to the intervention dates for each customer, as well as complete billing data after the intervention.

- **Reconcile program data.** Program tracking data provided by the implementation contractor for program evaluation should reconcile with reported program data included in published annual reports.

- **Investigate if control customers are receiving treatment** by sharing the same email or primary mailing address as a treated customer. Stop treatment for any control and treatment customers with different physical premises that share an email or primary mailing address to avoid tainting of the control group.

Appendix: Participant and Control Group Survey

HOME ENERGY REPORTS

[DISPLAY BLOCK IF GROUP = 1]

1. Do you recall receiving Home Energy Reports like the one below from Pacific 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?

    [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]

11. 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]

12. How could we improve the Home Energy Reports?

    [OPEN-ENDED]

13. Have the Home Energy Reports changed your opinion of Pacific Power?

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

[DISPLAY Q14 IF Q13 = 1]

14. How have the Home Energy Reports changed your opinion of Pacific Power?

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

15. Pacific 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]

16. 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]

17. 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 Pacific 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 Pacific Power Home Energy Reports website are interesting
    5. The Pacific Power Home Energy Reports website was visually appealing

ENERGY EFFICIENCY BEHAVIORS- PARTICIPANTS

18. 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

19. 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

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

    [OPEN-ENDED]

21. 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]

22. 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]

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

> [OPEN-ENDED]

[DISPLAY Q24 IF Q23>0]

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

> [OPEN-ENDED]

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

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

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

ENERGY EFFICIENCY BEHAVIORS- CONTROL GROUP

[DISPLAY BLOCK IF GROUP = 0]

26. 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]

27. 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]

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

    [OPEN-ENDED]

29. 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]

30. Did you apply for the [ANSWER Q29] Pacific Power rebate?

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

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

31. How important was any information provided by Pacific 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.

ENERGY ATTITUDES & BEHAVIORS - BOTH GROUPS

32. 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]

33. What did you do save energy before 2020?

[OPEN ENDED]

34. In 2021 did your household enroll in a Time of Use energy plan with Pacific Power?

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

35. Pacific 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

36. Have you created an online account at the Pacific Power website?

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

[DISPLAY Q37 IF Q36=2 OR 98]

37. Why haven't you created an online account at the Pacific 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]

38. What kind of technical difficulties did you have?

    [OPEN ENDED]

[DISPLAY Q39-Q41 IF Q36=1]

39. How often you log in to Pacific 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

40. 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]

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

42. 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

EFFECTS OF THE PANDEMIC

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

44. 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]

45. 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]

46. 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]

47. 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]

48. 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]

DEMOGRAPHICS

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

49. Do you rent or own your home?

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

50. 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

51. 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

52. 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

53. 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

54. 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

55. 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

56. 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

57. 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

58. Part of our goal in this survey is to help Pacific Power ensure it is serving everyone in its territory. To help us better understand who Pacific 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

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

60. 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