Appendix 6

2022-2023
Home Energy Reports Evaluation

Pacific Power

May 31, 2024

Evaluation, Verification & Measurement Report
Home Energy Reports Program
Washington

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ENERGY RESEARCH
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Table of Contents

List of Figures

List of Tables

Glossary of Terms

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 HER program and provided materials with the goal of altering their energy usage.

Control – Customers that were not treated by the HER program but that are similar in their usage to treated customers.

1 Executive Summary

This report is a summary of the evaluation, measurement, and verification (EM&V) effort for the 2022 and 2023 Home Energy Report (HER) program for Pacific Power in Washington. The evaluation was completed by ADM Associates, Inc.

ADM collected data for the evaluation using 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 HER program through a billing analysis with linear regression and statistically valid control groups. Table 1-1 summarizes the number of residential customers HERs were sent to in the Pacific Power service area during the evaluation period.

Table 1-1: Summary of HER program

Wave	Treatment Customers[1]	Control Customers
Remix Email	25,000	10,000
Remix Paper	21,000	10,000
Expansion 2021	14,184	8,951
Expansion 2023	10,776	10,776
Total	**70,960**	**28,951**[2]

ADM found positive and statistically significant savings for the Remix Email and the Expansion 2021 waves. ADM found statistically significant savings for two subsets of Remix Paper customers. ADM found no significant savings for the Expansion 2023 wave.

During 2022, the average annual household savings was 87.29 kWh with a total program savings of 4,766,090 kWh. During 2023, the average annual household savings was 98.56 kWh with a total program savings of 4,515,926 kWh. Table 1-2 and Table 1-3 summarize HERs total program savings for 2022 and 2023.

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[1] ADM estimated the number of treatment customers as the total number of customers ever treated in each wave. These participant numbers are drawn from the evaluated program tracking dataset.

[2] The total number of control customers does not equal the sum of treated customers because the implementer created the Expansion 2023 control group from members of previous waves' control groups to maximize treatment group size.

Table 1-2: Summary of HER program Evaluated Savings During 2022

Wave	Weighted Customers[a]	Average Annual Household Savings (kWh)	Total Program Savings (kWh)
Remix Email	21,703	93.47	2,017,077
Remix Paper	19,907	66.33	1,320,373
Expansion 2021	12,990	110.75	1,428,640
Total	**54,600**	**87.29**	**4,766,090**

[a]ADM used the weighted number of active treatment customers to produce ex-post measure savings. Weighted customers are the sum of all billing days in the post-period for all participants for the given program year/wave divided by 365.25

Table 1-3: Summary of HER program Evaluated Savings During 2023

Wave	Weighted Customers[a]	Average Annual Household Savings (kWh)	Total Program Savings (kWh)
Remix Email	17,494	72.22	1,197,814
Remix Paper	16,141	156.25	2,522,029
Expansion 2021	9,990	80.76	796,083
Expansion 2023	2,196	0.00	0.00
Total	**45,821**	**98.56**	**4,515,926**

[a]ADM used the weighted number of active treatment customers to produce ex-post measure savings. 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

The HER program resulted in a realization rate of 106 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
2022	4,289,670	4,766,090	111%
2023	4,466,880	4,515,926	101%
Total	**8,756,550**	**9,282,016**	**106%**

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 HER program in Washington resulted in evaluated program savings of 4,766,090 kWh in 2022 and 4,515,926 kWh in 2023. ADM estimated HER program savings using a billing analysis of randomized control trial (RCT) cohorts and matched control groups.

ADM found statistically significant annual savings for Remix Email and Expansion 2021 waves in both program years (i.e., 2022 and 2023).

Within the Remix Paper wave, customers who received five HERs in 2022 and those who received fewer than four reports in 2023 had statistically significant savings. No savings were detectible for the remaining subsets of this wave during 2022 or 2023.

The Expansion 2023 wave did not result in savings in 2023. Treatment for this group began in November 2023 resulting in a very short treatment period. ADM did not detect any savings in the billing analysis of customers in this treatment wave. These results are consistent with the previous program evaluation that did not find savings during the first year of treatment for the Expansion 2021 wave.

All evaluated waves had valid control groups for each program year which indicates that the implementer created the original RCT waves in accordance with industry standards. ADM created a post-hoc control group for the subsets of Remix Paper wave for which savings were identified.

ADM found (and deducted from ex-post kWh savings) limited savings that were attributable to other Pacific Power Home Energy Savings programs. ADM estimated that 21,600 kWh of 2022 savings and -16,538 kWh of 2023 savings observed through the HER program billing analysis were due to cross-participation in other Pacific Power Home Energy Savings programs. The estimated savings attributable to cross-participation were removed from the regression results to ensure no double counting of savings. Savings attributable to cross-participation represent ± 0.6 percent of the initial regression analysis results, therefore, the impact on final program savings was relatively small.

Program attrition was within a normal range. By the end of 2023, total attrition for the program since inception was 26 percent for the treatment groups and 5.6 percent for the control groups. The annual attrition rate is approximately five to seven percent across waves for both the treatment and control groups.

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

Survey results did not show a difference between treatment and control group behaviors to create online accounts or take energy savings actions. Treatment and control group survey respondents indicated creating online customer accounts at similar rates. ADM did not find a statistically significant difference between the number of self-reported energy saving actions taken by participants and non-participants.

Overall report engagement decreased from 2020 to 2023. Though per participant (unique email) engagement increased from 2020 to 2021, generally it decreased from 2021-2023.

ADM received multiple versions of the customer dataset from the implementation contractor, referred to as the "original" and "revised" datasets in this report. Evaluation results reflect values included in the revised dataset. Results based on revised dataset identified statistically significant savings; however, the results are inconsistent with the reported program delivery. ADM did not identify an increase in energy savings correlated with more reported HERs delivered in the revised dataset.

1.1.2 Recommendations

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

Implement data management and quality control processes with the implementation contractor. The program implementer, Bidgely, should improve data management processes to ensure that data is accurate. Data extracts should result in consistent reports of HER delivery and program performance. Repeatable data extractions will increase confidence in the accuracy of datasets.

Verify that paper HERs are mailed. Implementer should regularly and systematically verify that paper HERs are delivered as expected by implementer's subcontractor.

Request that the program implementor reports HER delivery dates for each customer. The datasets provided by implementer included annual total quantities of reports delivered for each customer; however, different versions of the dataset reported different totals. Increased granularity of HER delivery data will enable the evaluators to check datasets for duplicate records and confirm program design compliance.

Review the number of paper HERs mailed to each customer annually to ensure consistency with program design. Program datasets reported paper HER delivery quantities that were inconsistent with the program design that each customer is to receive

four HERs annually. Consistent program implementation may result in more consistent program performance.

Include weather effects in ex-ante savings estimates. Program savings are related to regional temperature; the control group is not necessarily a perfect "baseline" for the treatment group if the groups experience different weather. Developing a regression model that includes weather variables can correct this effect. The inclusion of weather effects is important when modeling energy usage; its inclusion will likely improve model fit.

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 conducted an impact and process evaluation of the HER program for each of the 2020 and 2021 program years in 2022. The program launched two waves in 2020, one wave in 2021, and an additional wave in 2023. In this evaluation, ADM evaluated results for the 2022 and 2023 program years. Pacific Power contracted with a third-party implementer to manage the program during the evaluated period. Table 2-1 summarizes the participant cohorts included in the HER program in the Pacific Power Washington service area.

Table 2-1: HERs Cohorts Summary

Cohort	Treatment Start Date	Treatment Group Size		Control Group Size	
		Original Treatment Customers[3]	Number at EOY 2023	Original Control Customers	Number at EOY 2023
Remix Email	Variable. Most in January 2020 or prior	25,000	17,063	10,000	6,848
Remix Paper	Variable. Most in February 2020 or prior	21,000	15,758	10,000	7,470
Expansion 2021	Variable. Most between May 2021 and August 2021	14,183	9,571	8,951	6,006
Expansion 2023	November 2023	10,776	10,776	10,776	10,389
Total		**70,960**	**53,168**	**28,951**	**20,304**

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[3] 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.

ADM estimated HER program savings using a matched control group of non-participating residences in Pacific Power's service territory. ADM analyzed each of the cohorts treated during the 2022 and 2023 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	2022: 1/1/2022 to 12/31/2022 2023: 1/1/2023 to 12/31/2023
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	2022: 1/1/2022 to 12/31/2022 2023: 1/1/2023 to 12/31/2023
Expansion 2023	November 2023	11/1/2022- 10/31/2023	2023: 12/1/2023- 12/31/2023

2.1 Program Background

Since 2012, the HER 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 HER 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 identified as *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. In 2023, another cohort was created (*Expansion 2023*) from customers not included in the previous three waves. The control group customers for Expansion 2023 were drawn from previous control group customers.

The four waves that are included in this evaluation for which there were claimed savings include:

- *Remix Email* (email only reports)
- *Remix Paper* (paper only reports)
- *Expansion 2021* (email and paper reports)
- *Expansion 2023* (email only report during this evaluation period)

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 2024.
- Participant and nonparticipant account move-in and account move-out dates.
- Program tracking data for participants, including date of installation and evaluated kWh savings for each measure installed.

The program implementer provided the following data for the analysis:

- A customer dataset that identified the wave, the treatment or control group assignment, and the quantity of reports each customer received annually.
- After ADM completed its analysis, the implementer provided ADM with a revised customer dataset with revised quantities of reports each customer received annually.

2.3 Evaluation Objectives

ADM identified the following research objectives for the 2022 and 2023 HER 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 HER program and awareness of their individual energy consumption and other energy efficiency programs.

3 Impact Evaluation Approach

ADM analyzed each cohort treated during the 2022 and 2023 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[4]. In addition, ADM estimated savings generated by participants from other energy efficiency programs offered to Pacific Power's residential customers. The work effort was divided into five 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. Estimate monthly and annual billed consumption differences between treatment and control groups via regression modeling

4. Estimate and remove joint savings from other programs

5. Estimate program attrition

ADM explored seven linear regression models as part of the impact evaluation of the HER 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 multiple Post-Program Regression (PPR) models. A 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 include in the model any small systematic differences in pre-treatment usage trends between the participant and control groups.

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

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

3.1 Step 1: Data Preparation and Cleaning

This section describes the data cleaning steps that 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 each calendar month are then summed to generate a calendarized usage value and the number of billed days for that month. The following equation provides the method for calculating the monthly 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 10 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. For the Expansion 2023 wave, only one month of post-period data was required given the recent start date.

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 HER 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[5]		Weighted Control Customers	
			2022	2023	2022	2023
Remix Email	25,000	10,000	21,703	17,494	8,710	7,021
Remix Paper	21,000	10,000	19,907	16,141	9,466	7,659
Expansion 2021	14,183	8,951	12,991	9,990	8,167	6,509
Expansion 2023	10,776	10,776	N/A	2,196	N/A	10,607
Total	**70,960**	**28,951**[6]	**54,601**	**45,821**	**26,343**	**21,189**[6]

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

3.2 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 month of data is tested

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

[6] The total number of control customers is not the same as the sum of all waves because the Expansion 2023 control group was drawn from other control groups.

for statistically significant differences between the treatment and control groups using a simple two-tailed T-test.

ADM tested the control group validity of each treatment wave by completing T-tests for the average daily usage in each of the pre-period months between the 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. ADM considered control groups to pass the validity test 9 or more of the months do not show a significant difference between the energy use of treatment and control groups.

If any waves had not passed equivalency testing, ADM would have performed 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.

3.2.1 Validity testing for subgroup of Remix Paper wave

Initially, ADM found no statically significant savings for the Remix Paper wave. Therefore, ADM explored the possibility of segmenting the wave into subsets defined by the reported quantities of HERs delivered to the treatment group customers. To verify if such a modeling approach would be reasonable, ADM conducted additional validity testing comparing the subset treatment groups to the control group for the wave.

ADM tested the validity of each subset by completing t-tests for the average daily usage in each of the pre-period months between the subset of treatment groups and the control group, then tested pre-period usage for differences at the 90 percent confidence interval for each of the 12 pre-period months. Similar to the criteria for the aggregated treatment group, ADM considered a subgroup with 9 or more months without significant difference from the control group to pass the validity test.

The subsets did not pass equivalency testing. Therefore, ADM performed propensity score matching (PSM) to create post-hoc control groups comprised of treatment participants that did not receive home energy reports. These post-hoc control groups were used to analyze savings for the subsets of the Remix Paper wave. ADM built a unique post-hoc control group for each subset of Remix Paper wave evaluated.

3.3 Step 3: Linear Regression Modeling

ADM ran seven regression models and determined which model resulted in the best fit to the billing data. ADM compared the R-squared value for all models and found model seven (the Post Period Regression with Weather Model) had the highest quality fit (see Table 3-2) for all but the newest wave, which didn't have enough post-period data for

model 7. Model 4 had the highest adjusted R-squared value for the Expansion 2023 wave and was therefore used to calculate savings for that wave.

Table 3-2: Adjusted R-squared Values for regression models

Wave	Year	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Remix Email	2022	0.002	0.513	0.142	0.670	0.680	0.737	**0.737**
	2023	0.000	0.515	0.110	0.641	0.664	0.669	**0.669**
Remix Paper	2022	0.002	0.360	0.271	0.653	0.659	0.718	**0.718**
	2023	0.002	0.362	0.232	0.614	0.641	0.654	**0.654**
Revised Remix Paper 5[7]	2022	0.000	0.296	0.371	0.696	0.695	0.746	**0.746**
Revised Remix Paper 0-3 [8,9]	2023	0.001	0.346	0.278	0.641	0.655	0.644	**0.644**
Expansion 2021	2022	0.005	0.641	0.089	0.736	0.745	0.826	**0.826**
	2023	0.001	0.651	0.068	0.729	0.744	0.763	**0.764**
Expansion 2023[10]	2022	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2023	0.008	0.649	0.083	**0.733**	N/A	N/A	N/A

ADM ran the Post Period Regression with Weather Model to calculate the impact of the HER 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.

3.3.1   Post Period Regression with Weather Model Specification

ADM used the post-program regression with weather (PPR) model to calculate savings for the HER 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.

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[7] Revised Remix Paper 5 is the subset of customers who were identified in the revised dataset that ADM received from the implementer as having received 5 HERs in 2022.

[8] Revised Remix Paper 0-3 is the subset of customers who were identified in the revised dataset that ADM received from the implementer as having received 0-3 HERs in 2023.

[9] Other subsets of the Remix Paper wave are not included in the table because no savings were identified for them.

[10] Not enough post-period data was available to run models 5 through 7 for this wave.

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 dummy variables or each customer's average pre-period seasonal usage.

The PPR model is specified in Equation 3-2 below (Model 7):

Equation 3-2: PPR Model (Model 7)

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

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. This model estimates the monthly fixed effect and its interaction with the pre-program energy use. 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 determined by customer zip code. 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 CDDs are calculated as temperature values over the cooling setpoint (65°F). The setpoint values for HDDs and CDDs were determined by running regressions with multiple setpoints from 65°F through 75°F. ADM chose the setpoint combination with the highest adjusted R-squared value, demonstrating the best fit for the data.

Monthly savings were calculated using the following equation:

Equation 3-3 Monthly kWh Savings for PPR Model

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

3.3.2 Additional Regression Models Tested

The following section summarizes the additional regression models that ADM explored to estimate impact savings for the program. These models had lower adjusted R-squared values than the model ADM used for the analysis.

3.3.2.1 Fixed-Effects Difference-in-Difference (D-in-D) Models

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 are described below.

*Equation 3-4: Fixed-Effects Difference-in-Difference (D-in-D)
Panel Regression Model Specification (Model 5)*

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

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.

The additional four D-in-D model variations have different combination of variables and interaction effects among variables:

Equation 3-6: Simple Difference-in-Difference (D-in-D)
Panel Regression Model Specification (Model 1)

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

Equation 3-7: Simple Fixed Difference-in-Difference (D-in-D)
Panel Regression Model Specification (Model 2)

$$ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(Treatment * Post)_{it} + \varepsilon_{it}$$

Equation 3-8: Simple Difference-in-Difference (D-in-D) with Weather
Panel Regression Model Specification (Model 3)

$$\begin{aligned} ADC_{it} = \alpha_0 &+ \beta_1(Post)_{it} + \beta_2(Treatment)_{it} + \beta_3(HDD)_{it} + \beta_4(CDD)_{it} + \beta_5(Treatment * Post)_{it} \\ &+ \beta_6(Post * HDD)_{it} + \beta_7(Post * CDD)_{it} + \beta_8(Treatment * Post * HDD)_{it} \\ &+ \beta_8(Treatment * Post * CDD)_{it} + \varepsilon_{it} \end{aligned}$$

Equation 3-9: Fixed Difference-in-Difference (D-in-D) with Weather
Panel Regression Model Specification (Model 4)

$$\begin{aligned} ADC_{it} = \alpha_0 &+ \beta_1(Post)_{it} + \beta_2(HDD)_{it} + \beta_3(CDD)_{it} + \beta_3(Treatment * Post)_{it} + \beta_4(Post * HDD)_{it} \\ &+ \beta_5(Post * CDD)_{it} + \beta_6(Treatment * Post * HDD)_{it} \\ &+ \beta_7(Treatment * Post * CDD)_{it} + \varepsilon_{it} \end{aligned}$$

Equation 3-10: Fixed Difference-in-Difference (D-in-D) with Month
Panel Regression Model Specification (Model 5)

$$\begin{aligned} ADC_{it} = \alpha_0 &+ \beta_1(Post)_{it} + \beta_2(Month)_{it} + \beta_3(Treatment * Post)_{it} \\ &+ \beta_4(Treatment * Post * Month)_{it} + \varepsilon_{it} \end{aligned}$$

3.3.2.2 Additional Post-Program Regression Model Version

ADM evaluated the following additional PPR model:

Equation 3-11: PPR Model (Model 6)

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

3.4 Step 4: Double Count Savings Approach

Customers in both the treatment and control groups participated in other Pacific Power Home Energy Savings programs. The Pacific Power HER program reports may increase customers' likelihood to participate in those programs. This additional participation is known as uplift. The HERs sent to customers include 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 HER program savings using observed customer billing data and again in the estimate of savings for the other energy efficiency program. Although uplift rarely displays a statistically significant difference 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 evaluated savings. ADM corrected for cross-program participation in other energy efficiency 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 3-12: Double Count Specification

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

Where,

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

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

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

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

1. Matched the HER 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 residential program offerings.

3.5 Step 5: 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 at 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.

ADM summarized 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. This information can be useful for Pacific Power and the implementer for the potential need for future wave expansions for the HER 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 other energy efficiency program savings. 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	24,969	9,993
	After removing bills that occur after inactive date	24,937	9,993
	After removing bills that occur before active date	24,933	9,990
	Remove outliers (anything over 200kWh/day)	24,933	9,990
	Remove bills with less than 10 or more than 90 days duration	24,930	9,990
	Remove treatment customers missing intervention dates	24,930	9,990
	Only keep pre-period and post-period in program year	24,872	9,989
	Only keep customers with at least 10 months pre and 4 months post	19,066	7,668
Remix Paper	Start	20,982	9,991
	After removing bills that occur after inactive date	20,905	9,991
	After removing bills that occur before active date	20,905	9,990
	Remove outliers (anything over 200kWh/day)	20,905	9,990
	Remove bills with less than 10 or more than 90 days duration	20,905	9,989
	Remove treatment customers missing intervention dates	20,905	9,989
	Only keep pre-period and post-period in program years	20,889	9,985
	Only keep customers with at least 10 months pre and 4 months post	17,465	8,297
Expansion 2021	Start	14,154	8,938
	After removing bills that occur after inactive date	13,810	8,938
	After removing bills that occur before active date	13,807	8,938
	Remove outliers (anything over 200kWh/day)	13,807	8,938
	Remove bills with less than 10 or more than 90 days duration	13,807	8,934
	Remove treatment customers missing intervention dates	13,807	8,934
	Only keep pre-period and post-period in program years	13,806	8,930
	Only keep customers with at least 10 months pre and 4 months post	11,522	7,222
Expansion 2023	Start	10,683	10,773
	After removing bills that occur after inactive date	10,166	10,773
	After removing bills that occur before active date	10,165	10,773
	Remove outliers (anything over 200kWh/day)	10,165	10,773
	Remove bills with less than 10 or more than 90 days duration	10,165	10,771
	Remove treatment customers missing intervention dates	10,165	10,771
	Only keep pre-period and post-period in program years	10,150	10,747
	Only keep customers with at least 10 months pre and 1 month post	3,403	10,290

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 4-3 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[11]
Jan	57.40	57.62	-0.22	0.624	-
Feb	64.93	65.30	-0.37	0.478	-
Mar	50.86	51.13	-0.27	0.475	-
Apr	32.47	32.58	-0.11	0.584	-
May	30.28	30.43	-0.15	0.455	-
Jun	34.36	34.49	-0.13	0.563	-
Jul	38.70	38.83	-0.13	0.622	-
Aug	39.97	40.14	-0.17	0.533	-
Sep	33.29	33.42	-0.13	0.527	-
Oct	37.52	37.62	-0.09	0.711	-
Nov	50.29	50.35	-0.06	0.877	-
Dec	54.71	54.85	-0.14	0.664	-

The p-values for the Remix Paper wave indicate 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.

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[11] statistically significant if $p < 0.05$

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[12]
Jan	66.31	66.12	0.19	0.609	-
Feb	75.44	75.39	0.05	0.904	-
Mar	58.60	58.47	0.13	0.688	-
Apr	36.13	36.06	0.07	0.685	-
May	31.88	31.85	0.03	0.873	-
Jun	34.96	34.95	0.01	0.966	-
Jul	38.62	38.71	-0.08	0.732	-
Aug	39.65	39.72	-0.06	0.792	-
Sep	34.56	34.58	-0.01	0.942	-
Oct	42.29	42.32	-0.03	0.885	-
Nov	58.08	58.11	-0.02	0.938	-
Dec	63.88	63.21	0.67	0.017	*

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.

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[12] statistically significant if $p<0.05$

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[13]
Jan	44.95	44.81	0.14	0.692	-
Feb	44.36	44.28	0.08	0.823	-
Mar	34.57	34.57	0.00	0.986	-
Apr	26.90	26.90	-0.01	0.979	-
May	23.45	23.48	-0.03	0.845	-
Jun	26.39	26.36	0.03	0.894	-
Jul	32.73	32.59	0.14	0.545	-
Aug	33.25	33.08	0.17	0.459	-
Sep	26.44	26.32	0.12	0.505	-
Oct	28.36	28.36	0.01	0.973	-
Nov	40.37	40.34	0.03	0.920	-
Dec	46.14	46.17	-0.03	0.923	-

The p-values for the Expansion 2021 wave also indicates the control group is valid for this wave.

Table 4-5: Expansion 2023 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	55.76	54.24	1.52	0.045	*
Feb	49.86	49.61	0.25	0.715	-
Mar	42.78	41.89	0.89	0.117	-
Apr	32.18	32.22	-0.04	0.918	-
May	29.24	28.82	0.42	0.247	-
Jun	32.76	32.12	0.64	0.126	-
Jul	36.70	37.90	-1.20	0.010	*
Aug	35.00	35.30	-0.30	0.490	-
Sep	28.39	27.73	0.67	0.062	-
Oct	30.37	29.70	0.68	0.067	-
Nov	48.77	49.20	-0.43	0.519	-
Dec	59.16	60.45	-1.29	0.114	-

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[13] statistically significant if p<0.05

Two months of 12 pre-period months showed a statistically significant difference for this wave. 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.

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 4-6

Table 4-6: Regression Parameters

Variable	Parameter	Interpretation
Treatment	τ_{my}	Average daily usage in the post-period
Treatment * HDD	β_3	Average daily usage in the post-period per HDD
Treatment * CDD	β_4	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 programs were calculated and removed to avoid double counting.

ADM found the Remix Email and Expansion 2021 waves for PY2022 and PY2023 had positive savings that are statistically significant. The Remix Paper wave displayed positive but not statistically significant savings for the 2022 and 2023 program years.

4.3.1   Remix Email Wave Results

Table 4-7 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 4-8 and Table 4-9 display the regression coefficients for each program year.

Table 4-7: Regression Estimates for Remix Email Wave
Annual Savings by Program Year

Wave	Year	Annual Estimated Savings (kWh)	5%	95%
Remix Email	2022	93.47	32.21	154.74
Remix Email	2023	72.22	14.57	157.10

Table 4-8: Remix Email Wave 2022 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	13.32	0.40	0.00	12.67	13.98
Treatment	-0.24	0.15	0.12	-0.48	0.01
Feb	2.50	0.20	0.00	2.18	2.82
Mar	-0.84	0.28	0.00	-1.30	-0.38
Apr	-4.42	0.29	0.00	-4.91	-3.94
May	-4.27	0.35	0.00	-4.84	-3.70
Jun	-6.09	0.39	0.00	-6.73	-5.46
Jul	-4.30	0.43	0.00	-5.01	-3.59
Aug	-4.50	0.43	0.00	-5.22	-3.79
Sep	-7.70	0.39	0.00	-8.34	-7.06
Oct	-2.90	0.34	0.00	-3.46	-2.34
Nov	-2.15	0.25	0.00	-2.56	-1.75
Dec	-1.29	0.24	0.00	-1.69	-0.89
Pre-period Usage	0.99	0.00	0.00	0.99	0.99
HDD	-0.15	0.01	0.00	-0.17	-0.14
CDD	0.08	0.05	0.10	0.00	0.16
Feb: Pre-period Usage	-0.31	0.00	0.00	-0.32	-0.31
Mar: Pre-period Usage	-0.35	0.00	0.00	-0.36	-0.35
Apr: Pre-period Usage	-0.01	0.01	0.02	-0.03	0.00
May: Pre-period Usage	-0.20	0.01	0.00	-0.21	-0.19
Jun: Pre-period Usage	-0.22	0.01	0.00	-0.23	-0.21
Jul: Pre-period Usage	-0.08	0.01	0.00	-0.08	-0.07
Aug: Pre-period Usage	-0.06	0.01	0.00	-0.07	-0.05
Sep: Pre-period Usage	-0.11	0.01	0.00	-0.12	-0.10
Oct: Pre-period Usage	-0.32	0.01	0.00	-0.33	-0.32
Nov: Pre-period Usage	-0.02	0.00	0.00	-0.03	-0.02
Dec: Pre-period Usage	0.14	0.00	0.00	0.13	0.14
Treatment: HDD	-0.01	0.01	0.16	-0.02	0.00
Treatment: CDD	0.04	0.04	0.27	-0.02	0.10

Table 4-9: Remix Email Wave 2023 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	12.92	0.38	0.00	12.29	13.54
Treatment	0.04	0.19	0.84	-0.28	0.36
Feb	2.41	0.27	0.00	1.97	2.86
Mar	-0.75	0.28	0.01	-1.21	-0.28
Apr	-3.67	0.32	0.00	-4.20	-3.14
May	-4.90	0.37	0.00	-5.51	-4.29
Jun	-5.05	0.38	0.00	-5.67	-4.43
Jul	-2.87	0.41	0.00	-3.55	-2.20
Aug	-4.65	0.40	0.00	-5.30	-3.99
Sep	-6.61	0.37	0.00	-7.22	-6.00
Oct	-2.87	0.33	0.00	-3.42	-2.33
Nov	-0.73	0.29	0.01	-1.21	-0.26
Dec	0.49	0.29	0.09	0.02	0.96
Pre-period Usage	0.91	0.00	0.00	0.91	0.92
HDD	-0.13	0.01	0.00	-0.15	-0.11
CDD	-0.03	0.06	0.58	-0.13	0.07
Feb: Pre-period Usage	-0.23	0.00	0.00	-0.24	-0.23
Mar: Pre-period Usage	-0.16	0.00	0.00	-0.17	-0.15
Apr: Pre-period Usage	0.00	0.01	0.93	-0.01	0.01
May: Pre-period Usage	-0.05	0.01	0.00	-0.07	-0.04
Jun: Pre-period Usage	-0.04	0.01	0.00	-0.05	-0.03
Jul: Pre-period Usage	-0.03	0.01	0.00	-0.04	-0.02
Aug: Pre-period Usage	-0.09	0.01	0.00	-0.10	-0.08
Sep: Pre-period Usage	-0.12	0.01	0.00	-0.13	-0.10
Oct: Pre-period Usage	-0.23	0.01	0.00	-0.24	-0.22
Nov: Pre-period Usage	-0.13	0.00	0.00	-0.14	-0.13
Dec: Pre-period Usage	-0.10	0.00	0.00	-0.11	-0.09
Treatment: HDD	-0.02	0.01	0.01	-0.03	-0.01
Treatment: CDD	0.03	0.05	0.51	-0.05	0.12

Each of the models were a good fit for the data, as seen by the Adjusted R-square in Table 4-10.

Table 4-10: Remix Email Wave Model Fit

Evaluation Period	Adjusted R^2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
2022	0.737	36,337	362,801	21,703
2023	0.669	21,110	291,946	17,494

Table 4-11 and Table 4-12 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 4-11: Remix Email Wave 2022 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	16.10	0.02	16.11	1991.25	0.81%
February	13.43	0.00	13.43	1551.79	0.87%
March	11.98	-0.01	11.96	1300.64	0.92%
April	11.91	-0.04	11.87	1119.44	1.06%
May	9.42	-0.08	9.34	966.18	0.97%
June	3.27	-0.10	3.18	983.86	0.32%
July	-7.14	-0.08	-7.22	1387.69	-0.52%
August	-7.41	-0.16	-7.57	1441.17	-0.53%
September	2.45	-0.11	2.34	1028.95	0.23%
October	7.90	-0.02	7.88	1038.77	0.76%
November	14.59	-0.02	14.57	1644.01	0.89%
December	16.98	0.08	17.05	2119.14	0.80%
Total	**93.47**	**-0.53**	**92.94**	**16572.88**	**0.56%**

Table 4-12: Remix Email Wave 2023 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	20.16	-0.08	20.09	1901.71	1.06%
February	17.57	-0.05	17.52	1557.11	1.12%
March	15.64	-0.20	15.44	1462.71	1.06%
April	9.65	-0.21	9.43	1099.93	0.86%
May	-2.59	-0.40	-2.99	1039.06	-0.29%
June	-5.48	-0.42	-5.90	1128.19	-0.52%
July	-12.50	-0.63	-13.13	1372.06	-0.96%
August	-10.35	-0.49	-10.84	1273.20	-0.85%
September	-0.40	-0.31	-0.71	966.25	-0.07%
October	7.86	-0.31	7.55	1044.15	0.72%
November	15.86	-0.32	15.54	1437.91	1.08%
December	16.80	-0.31	16.48	1724.48	0.96%
Total	**72.22**	**-3.74**	**68.47**	**16006.76**	**0.43%**

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 4-13: 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
2022	93.47	32.21	154.74	-0.53	92.94	16,572.88	0.56%
2023	72.22	14.57	157.10	-3.74	68.47	16,006.76	0.43%

Table 4-14: 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
2022	92.94	21,703	2,017,077	699,054	3,358,322
2023	68.47	17,494	1,197,814	254,888	2,748,307

The Remix Email wave displayed 0.56 percent and 0.43 percent annual household savings for 2022 and 2023, respectively. Average annual household savings for treated customers in the Remix Email wave was 93 and 68 kWh for 2022 and 2023, respectively. Household savings estimates were extrapolated using the number of weighted treatment customers active in the post-period. The Remix Email wave saved 2,017,077 kWh in 2022 and 1,197,814 kWh in 2023. In addition, the 95 percent confidence intervals are summarized for each program year.

4.3.2 Remix Paper Wave Results

ADM reviewed the Remix Paper Wave using two different datasets provided by program implementer. Appendix B provides a discussion of the complete analysis for the Remix Paper Wave and as well as observations that resulted from the analysis.

ADM found savings that were statistically significant for two subsets of the Remix Paper wave.

Table 4-15 includes the regression-estimated annual savings (kWh) per treated customer for the subset of customers who had a reported 5 HERs delivered in 2022, and the savings for the subset of customers who had a reported 0 through 3 delivered HERs in 2023. For these subsets, ADM found positive, statistically significant savings at the 95 percent level. Table 4-16 and Table 4-17 provide the regression coefficients from the subset analyses.

Table 4-15: Regression Estimates for Remix Paper Wave
Annual Savings by Program Year

Wave	Year	Annual Estimated Savings (kWh)	5%	95%
Remix Paper (5 reports)	2022	274.28	181.57	366.99
Remix Paper (0-3 reports)	2023	341.35	218.12	464.59

Table 4-16: Remix Paper Wave 2022 Regression Results
Subset of Customers Who Received Five Reports

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	14.62	0.80	0.00	13.30	15.93
Treatment	-1.05	0.22	0.00	-1.41	-0.69
Feb	2.03	0.58	0.00	1.08	2.98
Mar	-1.61	0.66	0.01	-2.69	-0.53
Apr	-2.67	0.67	0.00	-3.77	-1.56
May	-2.45	0.74	0.00	-3.67	-1.24
Jun	-7.01	0.79	0.00	-8.32	-5.71
Jul	-7.42	0.86	0.00	-8.84	-6.00
Aug	-7.53	0.86	0.00	-8.96	-6.11
Sep	-10.76	0.80	0.00	-12.08	-9.45
Oct	-3.91	0.74	0.00	-5.13	-2.70
Nov	-1.27	0.59	0.03	-2.25	-0.30
Dec	1.09	0.59	0.06	0.13	2.06
Pre-period Usage	0.97	0.01	0.00	0.96	0.98
HDD	-0.10	0.02	0.00	-0.14	-0.07
CDD	0.11	0.08	0.15	-0.02	0.24
Feb: Pre-period Usage	-0.35	0.01	0.00	-0.36	-0.33
Mar: Pre-period Usage	-0.37	0.01	0.00	-0.39	-0.36
Apr: Pre-period Usage	-0.06	0.01	0.00	-0.08	-0.04
May: Pre-period Usage	-0.26	0.01	0.00	-0.28	-0.23
Jun: Pre-period Usage	-0.25	0.01	0.00	-0.27	-0.23
Jul: Pre-period Usage	-0.05	0.01	0.00	-0.07	-0.03
Aug: Pre-period Usage	-0.04	0.01	0.00	-0.06	-0.03
Sep: Pre-period Usage	-0.13	0.01	0.00	-0.15	-0.11
Oct: Pre-period Usage	-0.40	0.01	0.00	-0.41	-0.38
Nov: Pre-period Usage	-0.07	0.01	0.00	-0.08	-0.05
Dec: Pre-period Usage	0.05	0.01	0.00	0.04	0.06
Treatment: HDD	0.04	0.01	0.00	0.03	0.05
Treatment: CDD	-0.13	0.05	0.01	-0.21	-0.05

Table 4-17: Remix Paper Wave 2023 Regression Results
Subset of Customers Who Received Zero to Three Reports

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	14.94	0.69	0.00	13.80	16.08
Treatment	-0.94	0.27	0.00	-1.39	-0.49
Feb	1.10	0.51	0.03	0.25	1.94
Mar	-2.28	0.54	0.00	-3.17	-1.39
Apr	-3.29	0.61	0.00	-4.30	-2.28
May	-7.50	0.70	0.00	-8.65	-6.34
Jun	-8.35	0.71	0.00	-9.53	-7.18
Jul	-7.02	0.83	0.00	-8.39	-5.65
Aug	-8.00	0.78	0.00	-9.28	-6.71
Sep	-10.04	0.70	0.00	-11.18	-8.89
Oct	-4.72	0.64	0.00	-5.77	-3.68
Nov	-2.90	0.55	0.00	-3.80	-2.00
Dec	-0.76	0.54	0.16	-1.65	0.13
Pre-period Usage	0.86	0.01	0.00	0.85	0.87
HDD	-0.04	0.02	0.02	-0.07	-0.01
CDD	0.19	0.11	0.07	0.02	0.36
Feb: Pre-period Usage	-0.21	0.01	0.00	-0.22	-0.20
Mar: Pre-period Usage	-0.15	0.01	0.00	-0.16	-0.14
Apr: Pre-period Usage	-0.01	0.01	0.28	-0.03	0.01
May: Pre-period Usage	-0.05	0.01	0.00	-0.07	-0.03
Jun: Pre-period Usage	-0.04	0.01	0.00	-0.05	-0.02
Jul: Pre-period Usage	0.04	0.01	0.00	0.02	0.05
Aug: Pre-period Usage	-0.06	0.01	0.00	-0.07	-0.04
Sep: Pre-period Usage	-0.07	0.01	0.00	-0.09	-0.05
Oct: Pre-period Usage	-0.23	0.01	0.00	-0.25	-0.21
Nov: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.08
Dec: Pre-period Usage	-0.13	0.01	0.00	-0.14	-0.11
Treatment: HDD	-0.01	0.01	0.35	-0.03	0.01
Treatment: CDD	0.05	0.07	0.48	-0.07	0.17

Each of the models using wave subsets were a good fit for the data, as seen by the Adjusted R-square in Table 4-18.

Table 4-18: Remix Paper Wave Model Fit

Evaluation Period	Adjusted R^2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
Remix Paper (5 reports)	0.746	11,731	111,780	4,818
Remix Paper (0-3 reports)	0.644	8,877	137,474	7,266

The ex-post gross electric savings for the Remix Paper wave are summarized below by program year. For the subset of the wave that received five HERs in 2022, the average annual savings were 274.05 kWh. For the subset that received with 0-3 HERs in 2023, the average annual savings were 347.10 kWh.

Table 4-19: 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
Remix Paper (5 reports)	274.28	181.57	366.99	-0.23	274.05	17,804.54	1.54%
Remix Paper (0-3 reports)	341.35	218.12	464.59	5.75	347.10	17,591.83	1.97%

Table 4-20: 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
Remix Paper (5 reports)	274.05	4,818	1,320,373	874,804	1,768,158
Remix Paper (0-3 reports)	347.10	7,266	2,522,029	1,584,860	3,375,711

This wave displayed a 1.54% saving when only evaluating customers who receiving 5 reports in 2022, and 1.97% for customers with 0-3 reports in 2023. Average annual household savings for treated customers in the Remix Paper wave was 66.33 kWh and 156.25 kWh for 2022 and 2023, respectively. The Remix Paper wave saved 1,320,373 kWh and 2,522,029 kWh in 2022 and 2023, respectively.

4.3.3 Expansion 2021 Wave Results

Table 4-21 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 4-22 and Table 4-23 display the regression coefficients for each program year.

Table 4-21 Regression Estimates for Expansion 2021 Wave
Annual Savings by Program Year

Wave	Year	Annual Estimated Savings (kWh)	5%	95%
Expansion 2021	2022	110.75	55.07	166.44
Expansion 2021	2023	80.76	-5.23	166.13

Table 4-22: Expansion 2021 Wave 2022 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	7.42	0.38	0.00	6.80	8.04
Treatment	-0.16	0.14	0.25	-0.38	0.07
Feb	0.22	0.17	0.20	-0.06	0.49
Mar	-1.32	0.25	0.00	-1.73	-0.92
Apr	-1.44	0.25	0.00	-1.85	-1.04
May	-0.65	0.30	0.03	-1.15	-0.15
Jun	-2.52	0.35	0.00	-3.09	-1.94
Jul	-1.55	0.40	0.00	-2.20	-0.90
Aug	-1.44	0.40	0.00	-2.10	-0.79
Sep	-2.80	0.34	0.00	-3.37	-2.24
Oct	-1.97	0.30	0.00	-2.46	-1.47
Nov	0.68	0.20	0.00	0.34	1.01
Dec	1.59	0.20	0.00	1.26	1.93
Pre-period Usage	1.12	0.00	0.00	1.12	1.13
HDD	-0.14	0.01	0.00	-0.16	-0.12
CDD	0.00	0.05	0.92	-0.07	0.08
Feb: Pre-period Usage	-0.18	0.00	0.00	-0.18	-0.17
Mar: Pre-period Usage	-0.23	0.00	0.00	-0.23	-0.22
Apr: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.10
May: Pre-period Usage	-0.27	0.01	0.00	-0.28	-0.26
Jun: Pre-period Usage	-0.29	0.01	0.00	-0.30	-0.28
Jul: Pre-period Usage	-0.21	0.00	0.00	-0.22	-0.20
Aug: Pre-period Usage	-0.19	0.00	0.00	-0.20	-0.18
Sep: Pre-period Usage	-0.23	0.01	0.00	-0.24	-0.23
Oct: Pre-period Usage	-0.30	0.01	0.00	-0.30	-0.29
Nov: Pre-period Usage	-0.09	0.00	0.00	-0.10	-0.09
Dec: Pre-period Usage	0.02	0.00	0.00	0.01	0.02
Treatment: HDD	-0.01	0.00	0.07	-0.02	0.00
Treatment: CDD	0.01	0.03	0.84	-0.05	0.06

Table 4-23: Expansion 2021 Wave 2023 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	8.32	0.38	0.00	7.70	8.95
Treatment	-0.19	0.19	0.32	-0.51	0.12
Feb	0.62	0.25	0.01	0.22	1.03
Mar	-0.75	0.26	0.00	-1.17	-0.32
Apr	-1.38	0.29	0.00	-1.85	-0.91
May	-1.26	0.35	0.00	-1.83	-0.69
Jun	-1.97	0.36	0.00	-2.56	-1.38
Jul	-1.26	0.40	0.00	-1.92	-0.61
Aug	-2.29	0.38	0.00	-2.92	-1.66
Sep	-2.73	0.35	0.00	-3.30	-2.16
Oct	-1.86	0.31	0.00	-2.36	-1.35
Nov	1.11	0.26	0.00	0.69	1.54
Dec	1.39	0.26	0.00	0.97	1.82
Pre-period Usage	1.04	0.00	0.00	1.04	1.05
HDD	-0.15	0.01	0.00	-0.16	-0.13
CDD	-0.11	0.06	0.07	-0.21	-0.01
Feb: Pre-period Usage	-0.11	0.00	0.00	-0.12	-0.10
Mar: Pre-period Usage	-0.03	0.01	0.00	-0.04	-0.02
Apr: Pre-period Usage	-0.09	0.01	0.00	-0.10	-0.08
May: Pre-period Usage	-0.16	0.01	0.00	-0.17	-0.14
Jun: Pre-period Usage	-0.12	0.01	0.00	-0.13	-0.11
Jul: Pre-period Usage	-0.16	0.01	0.00	-0.17	-0.15
Aug: Pre-period Usage	-0.22	0.01	0.00	-0.23	-0.21
Sep: Pre-period Usage	-0.24	0.01	0.00	-0.25	-0.23
Oct: Pre-period Usage	-0.22	0.01	0.00	-0.23	-0.21
Nov: Pre-period Usage	-0.20	0.00	0.00	-0.21	-0.19
Dec: Pre-period Usage	-0.18	0.00	0.00	-0.19	-0.17
Treatment: HDD	-0.01	0.01	0.35	-0.02	0.01
Treatment: CDD	0.03	0.05	0.56	-0.06	0.11

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: Remix Email Wave Model Fit

Evaluation Period	Adjusted R2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
2022	0.826	42,876	252,057	12,990
2023	0.764	22,402	194,018	9,991

Table 4-25 and Table 4-26 present savings for the Expansion 2021 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 4-25: Expansion 2021 Wave 2022 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	15.13	0.04	15.18	1606.58	0.94%
February	12.35	-0.10	12.25	1271.14	0.96%
March	10.45	-0.09	10.35	1062.75	0.97%
April	10.43	-0.07	10.36	909.09	1.14%
May	8.16	-0.11	8.05	779.92	1.03%
June	5.28	-0.12	5.16	785.34	0.66%
July	2.99	-0.12	2.87	1101.62	0.26%
August	2.94	-0.01	2.92	1139.54	0.26%
September	5.33	0.03	5.36	819.15	0.65%
October	8.06	-0.06	8.00	840.33	0.95%
November	13.49	-0.14	13.35	1357.13	0.98%
December	16.15	-0.02	16.12	1711.61	0.94%
Total	**110.75**	**-0.78**	**109.98**	**13384.20**	**0.82%**

Table 4-26: Expansion 2021 Wave 2023 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	13.56	-0.03	13.54	1562.61	0.87%
February	12.07	-0.05	12.02	1282.52	0.94%
March	11.97	-0.08	11.89	1209.74	0.98%
April	9.29	0.01	9.30	902.31	1.03%
May	2.91	0.01	2.92	839.85	0.35%
June	0.80	-0.05	0.75	904.84	0.08%
July	-4.37	-0.11	-4.48	1100.59	-0.41%
August	-2.62	-0.14	-2.75	1027.10	-0.27%
September	4.25	-0.19	4.06	780.63	0.52%
October	8.71	-0.10	8.61	861.19	1.00%
November	11.82	-0.12	11.71	1197.19	0.98%
December	12.36	-0.24	12.12	1431.29	0.85%
Total	**80.76**	**-1.08**	**79.68**	**13099.86**	**0.61%**

The ex-post gross kWh savings of the Expansion 2021 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 4-27: 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
2022	110.75	55.07	166.44	-0.78	109.98	13384.20	0.82%
2023	80.76	-5.23	166.13	-1.08	79.68	13099.86	0.61%

Table 4-28: 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
2022	109.98	12,990	1,428,640	715,359	2,162,056
2023	79.68	9,991	796,083	-52,253	1,659,805

The Expansion 2021 wave displayed 0.82 percent and 0.61 percent annual household savings for 2022 and 2023, respectively. Average annual household savings for treated customers in the Expansion 2021 wave was 110 and 80 kWh for 2022 and 2023, respectively. Household savings estimates were extrapolated using the number of weighted treatment customers active in the post-period. The Expansion 2021 wave saved 1,428,640 kWh in 2022 and 796,083 kWh in 2023. In addition, the 95 percent confidence intervals are summarized for each program year.

4.3.4 Expansion 2023 Wave Results

Table 4-29 displays the annual kWh savings per treatment customer for the Expansion 2023 wave by program year, prior to any double counting adjustments. The savings are negative and statistically significant at the 95 percent level. Due to the lack of data, ADM assigned 0 annual kWh savings per treatment customer for the Expansion 2023 wave. Table 4-30 displays the regression coefficients for 2023.

Table 4-29: Regression Estimates for Expansion 2023 Wave
Annual Savings by Program Year

Wave	Year	Annual Estimated Savings (kWh)	5%	95%
Expansion 2023	2023	-918.44	-1191.62	-645.25

Table 4-30: Expansion 2023 Wave 2023 Regression Results*

Coefficient	Estimate	Std Error	P Value	5%	95%
Treatment Post	2.51	0.38	0.00	1.89	3.14
Post	9.66	0.19	0.00	9.35	9.98

*Model 2 was used as it had the higher R-square values among models (model 1-4). Some of the models (model 5-7) couldn't be run as there was not enough post-period data.

The model was a good fit for the data, as seen by the Adjusted R-square in Table 4-31.

Table 4-31: Expansion 2023 Wave Model Fit

Evaluation Period	Adjusted R2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
2023	0.620	22	177,835	2,196

The ex-post gross kWh savings for the Expansion 2023 wave is summarized below by program year. Due to the negative saving, ADM assigned 0 annual savings per customer in PY2023 for the Expansion 2023 wave.

Table 4-32: Expansion 2023 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
2023	0.00	0.00	0.00	0.000	0.00	14,564.03	0.00%

Table 4-33: Expansion 2023 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
2023	0.00	2,196	0.00	0.00	0.00

The Expansion 2023 wave displayed 0.00 percent annual household savings for 2023 because of negative annual savings. Average annual household savings for treated customers in the Expansion 2023 wave was 0 kWh for 2023.

4.3.5 Aggregated Waves Results

The following tables summarize each wave's annual household energy savings impact with 95 percent confidence intervals.

Table 4-34: 2022 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	21,703	93.47	32.21	154.74	2,017,077	699,054	3,358,322
Remix Paper	19,907	66.33	43.95	88.82	1,320,373	874,804	1,768,158
Expansion 2021	12,990	110.75	55.07	166.44	1,428,640	715,359	2,162,056
Total	**54,600**	**87.29**	**41.93**	**133.49**	**4,766,090**	**2,289,217**	**7,288,536**

Table 4-35: 2023 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	17,494	72.22	14.57	157.10	1,197,814	254,888	2,748,307
Remix Paper	16,141	156.25	98.19	209.14	2,522,029	1,584,860	3,375,711
Expansion 2021	9,990	80.76	-5.23	166.13	796,083	-52,253	1,659,805
Expansion 2023	2,196	0.00	0.00	0.00	0.00	0.00	0.00
Total	**45,821**	**98.56**	**39.01**	**169.87**	**4,515,926**	**1,787,495**	**7,783,823**

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 evaluated savings. This section summarizes the results of the double counting analysis for other programs.

ADM identified and summarized the average treatment customer, average control customer, and average incremental savings attributed to residential programs for each wave. Table 4-36 and Table 4-37 display the 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 Remix Paper and Expansion 2023 waves, there are no double counting adjustments for these waves.

Table 4-36: 2022 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	Program Double Count Savings
Remix Email	0.027	0.026	0.001	0.529	21,703	11,481
Expansion 2021	0.018	0.016	0.002	0.779	12,990	10,119
Total	**0.045**	**0.042**	**0.003**	**1.308**	**34,693**	**21,600**

Table 4-37: 2023 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	Program Double Count Savings
Remix Email	0.061	0.050	0.010	3.745	17,494	65,515
Remix Paper	0.058	0.074	-0.015	-5.752	16,141	-92,843
Expansion 2021	0.033	0.030	0.003	1.080	9,991	10,790
Total	**0.053**	**0.054**	**-0.001**	**-0.379**	**43,626**	**-16,538**

ADM identified 21,600 kWh in double counted savings for 2022 and -16,538 kWh in double counted savings in 2023. The double counting values were parsed by month and subtracted from the regression model results for each program year.

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 20 percent. However, attrition for the program years 2022 and 2023 is approximately five to seven percent.

Table 4-38: Program Move-out Rates by Program Year

Period	Treatment Customers	Control Customers	Treatment Move-out Percent	Control Move-out Percent
2022	4,532	2,308	6.49%	7.98%
2023	3,744	1,797	5.36%	6.21%
Since Inception	18,133	1,620	25.97%	5.60%

Table 4-39 summarizes the move-out rates for each wave in 2022. The move-out rates for each wave range between six percent and 12 percent. Table 4-40 summarizes the move-out rates for each wave in 2023. The move-out rates for each wave range between two percent and 10 percent.

Table 4-39: 2022 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	24,638	9,855	19,800	7,913	1,658	660	6.73%	6.70%
Remix Paper	20,692	9,888	17,924	8,546	1,245	605	6.02%	6.12%
Expansion 2021	13,476	8,721	12,148	7,651	1,629	1,043	12.09%	11.96%

Table 4-40: 2023 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	19,800	7,913	18,554	7,410	1,246	503	6.29%	6.36%
Remix Paper	17,924	8,546	16,870	8,014	1,054	532	5.88%	6.23%
Expansion 2021	12,148	7,651	10,947	6,889	1,201	762	9.89%	9.96%
Expansion 2023	10,166	10,773	9,923	10,346	243	427	2.39%	3.96%

4.6 Discussion of Realization Rates

The HER program resulted in a realization rate of 106 percent during the evaluation period (see Table 4-41).

Table 4-41: Program Energy Savings (kWh) and Realization Rate

Year	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
2022	4,289,670	4,766,090	111%
2023	4,466,880	4,515,926	101%
Total	**8,756,550**	**9,282,016**	**106%**

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 did not include weather effects. The inclusion of weather effects is important when modeling energy usage and results in increased model fit.

Insufficient duration of treatment for Expansion 2023 wave to generate savings. ADM found no detectible savings for customers whose first report was delivered in November of 2023. These results are consistent with industry standards and the results from the previous evaluation which found no statistically significant savings for customers with less than a year of treatment. Expansion wave customers accounted for 5 percent of treated customers in 2023.

ADM estimated uplift. ADM determined that, compared to the customers in the treatment group, the customers in the control group saved slightly less energy from Pacific Power's other energy efficiency programs. Thus, ADM adjusted our regression results for the treatment group to account for the excess savings that is appropriate to attribute to the treatment group.

5 Process evaluation

ADM's process evaluation of the 2022 and 2023 HER program was based on customers survey results and customer engagement data provided by the implementer.

5.1 HER Participant and Control Group Survey Results

ADM surveyed Pacific Power customers who received HERs in 2022 and 2023 and a sample of customers designated as controls. Customers who received Home Energy Reports are referred to as *participants*, while those designated as part of the control group are referred to as *non-participants*. The survey was conducted in March 2024. ADM collected a total of 146 survey responses, Table 5-1 displays response rates.

Table 5-1: Summary of Email Survey Response

Metric	Control	Treatment	Total
Email Invite	1,522	1,478	3,000
Bounce	95	84	179
Complete	73	73	146
Response rate	5%	5%	5%

Treatment customers received reports in email, paper or both formats. Eighty-one percent of respondents confirmed receiving a form of report (email/paper) that was consistent with the program's tracking data. The other 19 percent confirmed receiving at least one report, however the form of report they confirmed receiving did not align with the program's tracking data.

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 customers have taken (e.g., behavioral changes, or installing energy efficient appliances and equipment). ADM compared responses from participants and non-participants. Statistically significant differences are noted.[14]

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[14] ADM compared results with two proportion z, Fisher Exact, and Mann-Whitney U tests depending on variable characteristics. Reported differences are statistically significant at $p < 0.05$.

5.1.1 Participants Perceptions of Home Energy Reports

5.1.1.1 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 2023?

Portion Read	Percent (n = 73)
All the Reports	47%
Most of the Reports	37%
About half of the Reports	5%
Only a couple of the Reports	11%

Eighteen 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, 92 percent said they themselves had read all or most of the reports. Thus, 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 only read a couple of the reports (11 percent) were asked why they chose not to read the HERs. Reasons included not having the time, not finding the information valuable or applicable to their homes, and/or the reports being sent more frequently than needed.

5.1.1.2 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 (95 percent) found the HER information on their home's energy use easy to understand (see Table 5-3).

Table 5-3: Rated Ease of Understanding HER Information

Answer	Percent (n = 73)
1 - Very difficult	1%
2	1%
3	3%
4	27%
5 - Very easy	67%
Don't know	1%

5.1.1.3 Perceived Value of Information on Home Energy Use

Most respondents perceived the various components of the HERs to be valuable, with over 60 percent scoring each of the five HER components as valuable (see Table 5-4).[15]
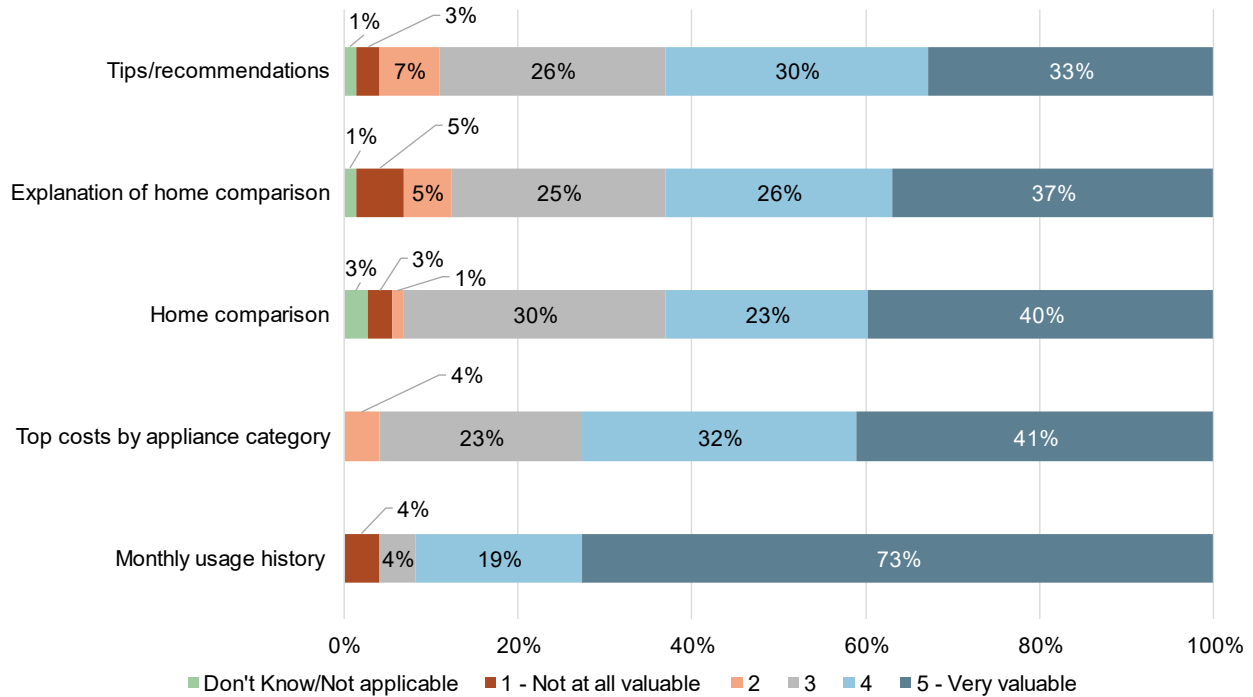
Table 5-4: Rated Value of HER Information

5.1.1.4 Perceived Accuracy of Information on Home Energy Use

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

Table 5-5: Rated Accuracy of HER Information

Answer	Percent (n = 73)
1 - Not at all accurate	3%
2	3%
3	23%
4	37%
5 - Very accurate	27%
Don't know	7%

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[15] n=73. Rated the value a 4 or 5 on a scale from 1 (not at all valuable) to 5 (very valuable).

The respondents who said the HER information was inaccurate (rated as a 1 or 2 on a 5-point scale) provided some explanation for their rating. These respondents shared feedback suggesting they perceived the reports to be misaligned with their actual usage.

5.1.1.5 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 Table 5-6). Further, twenty-one percent of respondents said that receiving the home energy reports had changed their opinion of Pacific Power, with 93 percent saying receiving the reports had improved their opinion.[16]
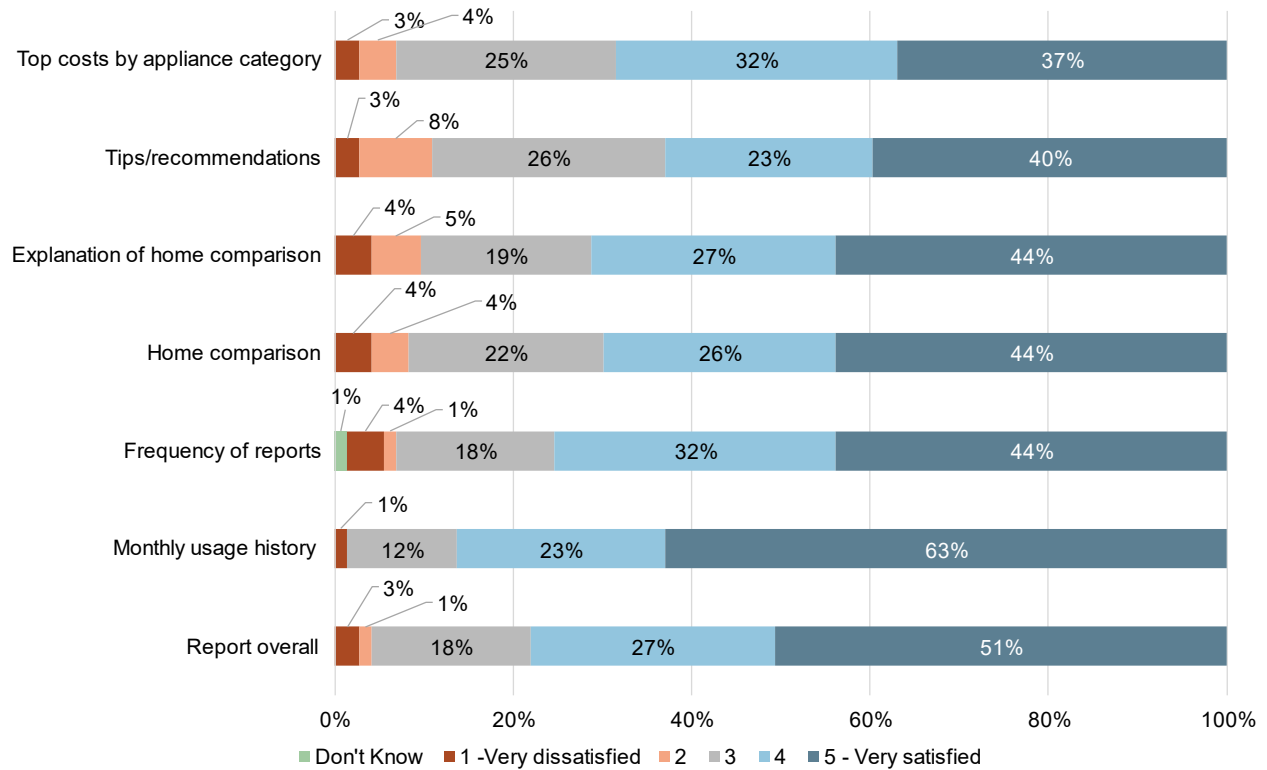
Table 5-6: Satisfaction with HERs

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:

- **Relevance and accuracy:** Sixteen percent of respondents suggested that the reports should be more accurate or include information that was more relevant to their home. These comments ranged from general comments suggesting the reports did not

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[16] n=15. Rated their change in opinion a 4 (73%) or 5 (20%) on a scale from 1 (greatly worsened) to 5 (greatly improved).

provide relevant or helpful information, to more specific requests for tips and recommendations for renters, low-income households, and older homes as well as certain appliance types. One customer suggested the tip section of the report be removed.

- **Content:** Seven percent of survey respondents commented on the content of the HERs and made suggestions to add or update information included in the reports. These recommendations include adding more explanation for the home comparison's methodology, improving the readability of the energy use assessment, and providing a direct link to access the report information.

- **Other support from utility:** Ten percent of respondents requested additional related support from Pacific Power with suggestions such as improving website usability, energy efficient equipment giveaways, additional rebate offerings, and including energy saving tips with monthly bills or in separate emails.

- **Modify frequency of reports:** Four percent of respondents commented on the availability of reports. Three percent suggested Pacific Power stop sending reports and 1% suggested the reports be made available to all customers.

Forty-four percent of participants recalled logging onto Pacific Power's online portal. 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 Table 5-7).
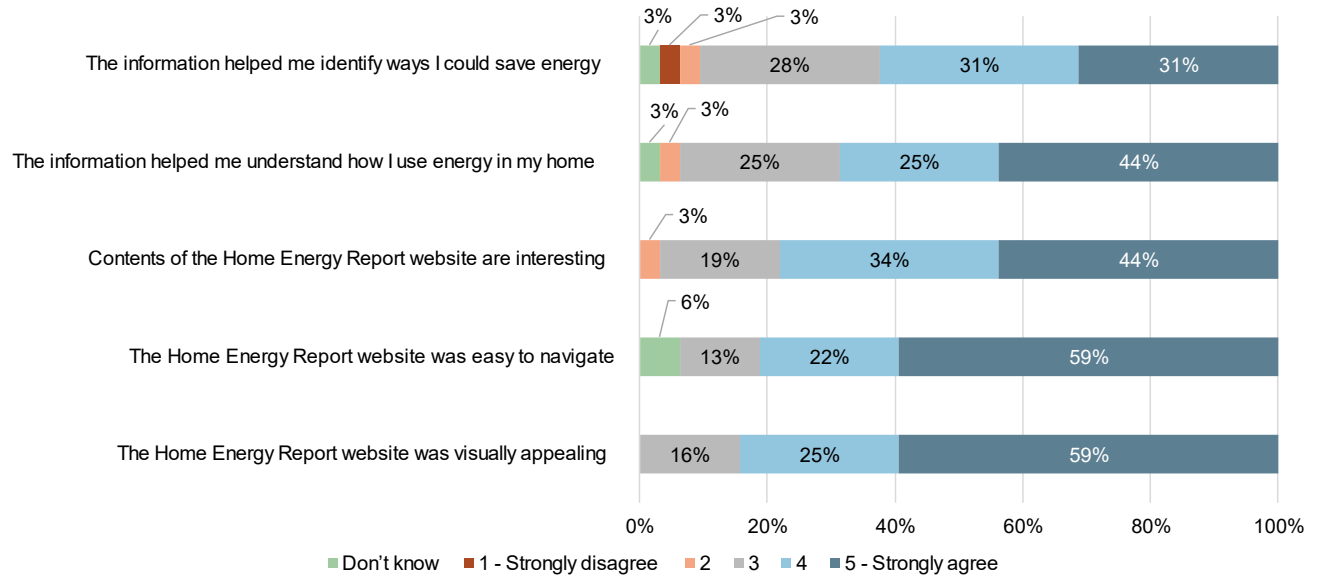
Table 5-7: HER Participant Online Portal Experience (n=32)

Most respondents who said they had not logged on to the online portal indicated they were not aware of the portal. Table 5-8 displays reasons customers noted for not having logged onto the portal.

Table 5-8: Primary Reason why Customers had not *logged onto Portal*

Reason	Percentage of Respondents (n = 41)
Was not aware of the portal	54%
Did not have the time to use the portal	24%
Did not think the portal would provide useful information	7%
Not interested in my energy use	5%
Experienced technical difficulties trying to access the portal	5%
Did not know how to access the portal	2%
Don't know	2%

5.1.1.6 Opinion Toward Pacific Power

Respondents provided feedback on whether and how receiving the HER had affected their opinion of Pacific Power. Twenty-one 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 indicated it had improved their opinion (see Table 5-9).

Table 5-9: Rated Change in Satisfaction with Pacific Power

Rating	Percentage (n = 15)
5 - Greatly improved	20%
4	73%
3	0%
2	7%
1 - Greatly worsened	0%
Don't know	0%

5.1.1.7 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. Over half lived in homes built between 1960 and 1979. ADM did not find statistically significant differences between the home characteristics for participants and non-participants (see Table 5-10).

Table 5-10: Respondent Home Characteristics

Response	All Respondents (n = 146)	Participants (n = 73)	Non-participants (n = 73)
Home Ownership			
Own	85%	90%	79%
Rent	15%	10%	21%
Home Type			
Single-family home	75%	84%	67%
Manufactured or mobile home	11%	10%	12%
Duplex or triplex	6%	1%	11%
Apartment in an apartment building or complex	5%	4%	5%
Condominium or townhome	3%	1%	4%
Year Home Was Built			
Before 1960	32%	34%	29%
1960 to 1979	26%	30%	22%
1980 to 1999	18%	19%	17%
2000 to 2009	10%	5%	14%
2010 or later	9%	8%	10%
Don't know	6%	3%	8%

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 5-11).

Table 5-11: Respondent Home Characteristics

Response	All Respondents (n = 146)	Participants (n = 73)	Non-participants (n = 73)
Home Heating Type			
Electricity	59%	58%	61%
Natural Gas	34%	34%	33%
Wood	5%	5%	4%
Propane	1%	1%	1%
Oil	1%	1%	0%
Water Heating System			
Natural gas storage tank water heater	26%	23%	28%
Electric storage tank water heater	59%	63%	54%
Heat pump water heater	8%	7%	10%
Natural gas tankless water heater	3%	4%	1%
Electric tankless water heater	1%	1%	0%
Other	1%	0%	1%
Don't know	3%	1%	6%

ADM also asked respondents about their household characteristics. Most identified as white or Caucasian and indicated they had some post-high school education. Ninety-one percent said English was the primary language spoken at home. The other respondents indicated either Spanish (7 percent), Vietnamese (1 percent), or Korean (1 percent) were the primary languages spoken at home.

On average, about three people lived at each respondent's residence and 76 percent of respondents said that three or fewer lived at their home.

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

Table 5-12: Respondent Background Characteristics

Response	All Respondents (n = 145)	Participants (n = 73)	Non-participants (n = 72)
Average Monthly Electricity Bill			
$0 - $50	6%	4%	7%
$51 - $100	30%	32%	29%
$101 - $150	31%	30%	32%
$151 - $200	13%	14%	13%
$201 - $250	4%	4%	4%
$251 - $300	6%	8%	3%
$301 or more	6%	5%	6%
Don't know	1%	1%	0%
Prefer not to say	2%	0%	4%
Community Characterization			
Urban	25%	25%	25%
Rural	34%	32%	36%
Suburban	38%	42%	33%
Don't know	3%	1%	6%
Primary Language			
English	91%	92%	90%
Spanish	7%	4%	10%
Vietnamese	1%	1%	0%
Korean	1%	1%	0%
Prefer not to say	1%	1%	0%
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 years old or older	38%	40%	36%
Prefer not to answer	3%	1%	6%
Education			
Less than high school	1%	0%	1%
High school graduate/GED	19%	19%	19%
Associates degree, vocation/school, or some college	34%	33%	35%
Four-year college degree	25%	26%	24%
Graduate or professional degree	16%	16%	15%
Don't know	0%	0%	0%
Prefer not to answer	6%	5%	6%

Response	All Respondents (n = 145)	Participants (n = 73)	Non-participants (n = 72)
Race or Ethnicity			
Asian	1%	1%	1%
Black/African American	1%	1%	0%
Caucasian/White	73%	75%	71%
Hispanic or Latino	17%	12%	22%
Native American or Alaska Native	1%	0%	3%
Middle Eastern or North African	1%	3%	0%
Other	1%	0%	1%
Prefer not to answer	6%	7%	6%

5.1.1.8 Beliefs and Attitudes Relating to Energy Efficiency

Survey respondents generally endorsed positive beliefs and attitudes about energy efficiency. Non-participant respondents agreed to various statements about energy efficiency in levels comparable to those of participants. See Table 5-13 for more details. There was a statistically significant difference between groups for one of the eight questions (denoted by an asterisk in the figure).
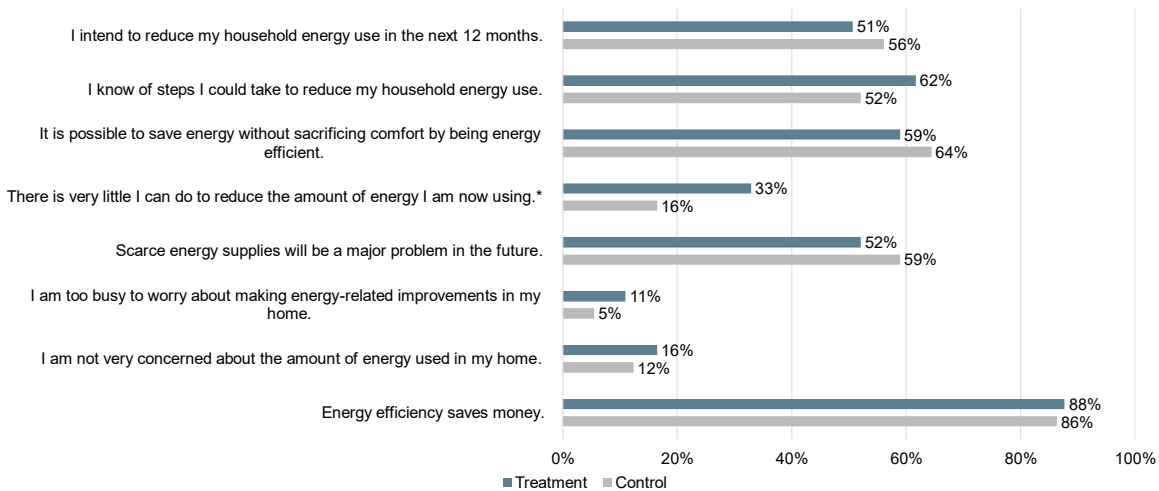
Table 5-13: Pro-Energy Efficiency Beliefs and Attitudes[17]

5.1.1.9 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 5-14). Fifty-five 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

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[17] Agreement = rating of 7 or higher on scale from 0 (strongly disagree) to 10 (strongly agree).

they had received in 2022 or 2023. Seventy-eight percent of these respondents said that the information provided in the HERs was important in their decision to take energy-saving actions.[18] Table 5-15 summarizes all energy saving actions recommended on HERs that participants and non-participants reported taking; ADM found one statistically significant difference between the groups.

Table 5-14: Comparison of Participants and Non-participants on Energy-Saving Actions

Energy Saving Behavior	Participants (n = 73)	Non-participants (n = 73)
Made changes/took actions to reduce energy use	55%	67%
Number of Actions Taken to Reduce Energy Use – All Respondents		
None	45%	33%
1 to 5	10%	5%
6 to 10	27%	42%
11 to 15	11%	19%
More than 15	7%	0%

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[18] n=40. Rated the importance of the HERs a 4 (43%) or 5 (35%) on a scale from 1 (not at all important) to 5 (very improved).

Table 5-15: Actions Taken among Participants and Non-participants

Action Taken	Participants (n = 73)	Non-participants (n = 73)
Allowed sun to heat home (opened curtains on south/west facing windows in winter)	40%	60%
Ran ceiling fans in reverse in winter	27%	26%
Let dishes air dry	40%	51%
Dried clothes at lower temperature	37%	42%
Unplugged second refrigerator when not in use	10%	4%
Adjusted freezer temperature settings	23%	32%
Washed clothes using cold water versus hot water	45%	60%
Replaced old cookware with flat-bottomed cookware	26%	38%
Kept refrigerator full to better maintain cold temperatures	32%	51%
Shut flue damper on fireplace or wood stove after usage	14%	4%
Made sure refrigerator had minimum clearance to allow operating at maximum efficiency	38%	44%
Wrapped hot water heater in an insulating blanket	11%	12%
Installed a dimmer switch for to control lighting levels	29%	26%
Turned off game consoles when not in use instead of leaving in stand-by mode	26%	34%
Unplugged stereo when not in use	15%	26%
Optimized display on television	26%	42%
Used an electric kettle instead of a pot on the stove	19%	23%
Checked seal on refrigerator to ensure appropriate tightness	38%	49%

ADM 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. Three percent of all survey respondents indicated that they had enrolled in a time-of-use plan in 2022 or 2023.

5.1.1.10 Energy Saving Purchases

Seventy-four percent of HER participants said they had installed one or more energy efficient items in 2022 or 2023 and 57 percent of these respondents 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 2022 or 2023 and of these respondents, 42 percent indicated information that had been provided to them by Pacific Power by means other than HERs had been important in their decision to purchase energy efficient equipment. A larger portion of HER participants noted receiving an incentive for their purchase, though the difference was not

statistically significant.[19]

Table 5-16: Comparison of Participants and Non-participants
on Energy-Saving Purchases and Installations

Action Taken	Participants (n = 73)	Non-participants (n = 73)
Installed energy efficient items	74%	73%
Number of Energy Efficiency Items Installed		
None	26%	27%
One	18%	12%
Two	19%	19%
Three	7%	8%
Four or more	30%	33%

The most common items respondents purchased and installed were ENERGY STAR®
lightbulbs, televisions, aerators, and showerheads (see Table 5-17). Among those who
purchased LED bulbs, 19 percent bought 3 or fewer, 35 percent bought 4 to 7 bulbs, and
47 percent purchased 8 or more bulbs. There were no statistically significant differences
between the number of LED bulbs purchased by participants and non-participants.

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[19] Ten percent of HERs participants noted receiving an incentive for their purchase, compared to 4% of non-participants.

Table 5-17: Energy Efficient Items Purchased or Installed

Equipment	Percent of All Respondents (n = 146)	Percent of Participants (n = 73)	Percent of non-participants (n = 73)
Low flow faucet aerators or showerheads	22%	19%	25%
Smart thermostat (e.g., Nest, Lyric, Ecobee, Sensi)	17%	22%	12%
Energy efficient windows or doors	14%	8%	19%
Advanced power strips	14%	15%	14%
Attic, floor, or wall insulation	10%	8%	11%
ENERGY STAR LED light bulbs	55%	52%	59%
ENERGY STAR television	24%	21%	27%
ENERGY STAR clothes washer	21%	23%	18%
ENERGY STAR clothes dryer	18%	19%	16%
ENERGY STAR LED fixtures	16%	21%	12%
ENERGY STAR refrigerator	14%	14%	15%
ENERGY STAR stand-alone freezer	11%	8%	14%
ENERGY STAR computer or computer monitor	10%	7%	14%
ENERGY STAR scanner or printer	9%	10%	8%
ENERGY STAR heat pump	8%	7%	8%
ENERY STAR room air conditioner	8%	10%	5%
ENEGY STAR central air conditioner	6%	7%	5%
ENERGY STAR heat pump water heater	4%	4%	4%
ENERGY STAR dehumidifier	1%	0%	1%
Solar Panels (Write In)	1%	0%	3%
Door seal (Write In)	1%	0%	1%

5.1.1.11 Energy Savings Actions Before 2022

ADM also asked if respondents had taken any energy saving actions before 2022. Overall, 61 percent of respondents said they had taken some action to reduce energy use in their home before 2022. There was minimal variation between the participants and non-participants. Fifty-five percent of the respondents who noted taking action to reduce energy use before 2022 noted some kind of behavior change (e.g., unplugging appliances, turning off lights). One-third indicated they had made other less expensive energy efficient improvements such as installing LEDs, a smart thermostat, or weatherstripping and 30% noted installing a major measure such as windows, attic insulation, furnace, or hot water heater.

5.1.1.12 Pacific Power Online Customer Experience

ADM also asked several questions about customers' experience with the Pacific Power website. Seventy-seven percent of survey respondents said they had created an account

at the Pacific Power website, with participant and control group respondents indicating creating accounts at similar rates.

The most commonly cited reason for not creating an online account was not knowing about the opportunity. See Table 5-18 for reasons customers reported for not creating an online account. Respondents who indicated "other" reasons noted having limited internet access, preferring to pay bills on their phone or preferring no to engage with utility further, or having difficulty recalling details needed to create an account or login.

Table 5-18: Reasons Customers Have Not Created Account

Reason	All Respondents (n= 28)	Participants (n = 14)	Non-participants (n = 14)
Prompted Responses – Selected All That Apply			
I didn't know about it	43%	43%	43%
I don't know how to	11%	7%	14%
I have concerns about internet privacy/paying online	14%	14%	14%
I don't think it would provide valuable or interesting information	25%	29%	21%
Technical difficulties	11%	14%	7%
Unprompted Responses – Open-end or "Other" Reasons			
Access to internet	11%	0%	21%
Preference	7%	14%	0%
Difficulty remembering account details to log in	11%	7%	14%

Of the respondents who said they had created an online account, most indicated that the energy-saving tips and information available on the website were valuable (see Table 5-19).
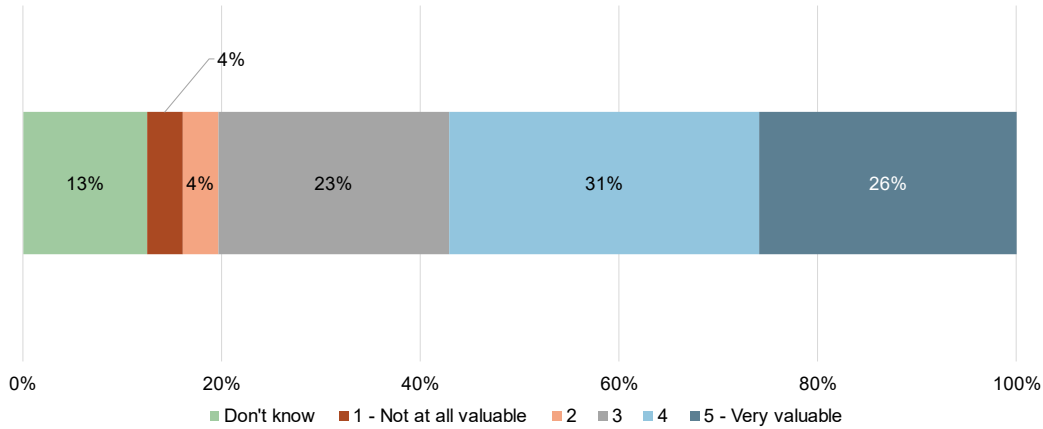
Table 5-19: Perceived Value of Pacific Power Website's Tips and Information

Overall, 45 percent of respondents said they had visited the Pacific Power website. ADM found that non-participants reported having visited the website more often than HER recipients.[20]

5.1.2 Participant Engagement Metrics

ADM investigated email report engagement. The program's tracking data included information on the number of reports sent, clicked, marked thumbs up, and marked thumbs down. Table 5-20 shows email report engagement. The *Per Participant* columns display the portion of unique email addresses that were sent one or more email that clicked a report link or marked thumbs up or thumbs down from 2020-2023 and in total over the four years. The *Overall* columns display raw engagement statistics, with the portion of emails with clicks, thumbs down, and thumbs up divided by the total sent for each year and the total over the four years.

Of the unique email addresses that were sent one or more report from 2020-2023, about one-third clicked a report, 7% gave at least one thumbs up, and 1% gave at least one thumbs down.

Overall engagement decreased from 2020 to 2023. Though per participant (unique email) engagement increased from 2020 to 2021, generally it decreased from 2021-2023.

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[20] Thirty-six percent of participants and 53% of non-participants reported visiting the website.

Table 5-20: Email HER Engagement Metrics

Year	Per Participant			Overall		
	Clicked	**Thumbs Down**	**Thumbs Up**	**Clicked**	**Thumbs Down**	**Thumbs Up**
2020	1.99%	0.07%	0.34%	1.92%	0.07%	0.33%
2021	19.64%	0.69%	3.81%	1.73%	0.05%	0.31%
2022	18.31%	0.64%	3.44%	1.47%	0.05%	0.27%
2023	16.88%	0.62%	2.83%	1.33%	0.04%	0.19%

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 HER program in Washington resulted in evaluated program savings of 4,766,090 kWh in 2022 and 4,515,926 kWh in 2023. ADM estimated HER program savings using a billing analysis of randomized control trial (RCT) cohorts and matched control groups.

ADM found statistically significant annual savings for Remix Email and Expansion 2021 waves in both program years (i.e., 2022 and 2023).

Within the Remix Paper wave, customers who received five HERs in 2022 and those who received fewer than four reports in 2023 had statistically significant savings. No savings were detectible for the remaining subsets of this wave during 2022 or 2023.

The Expansion 2023 wave did not result in savings in 2023. Treatment for this group began in November 2023 resulting in a very short treatment period. ADM did not detect any savings in the billing analysis of customers in this treatment wave. These results are consistent with the previous program evaluation that did not find savings during the first year of treatment for the Expansion 2021 wave.

All evaluated waves had valid control groups for each program year which indicates that the implementer created the original RCT waves in accordance with industry standards. ADM created a post-hoc control group for the subsets of Remix Paper wave for which savings were identified.

ADM found (and deducted from ex-post kWh savings) limited savings that were attributable to other Pacific Power Home Energy Savings programs. ADM estimated that 21,600 kWh of 2022 savings and -16,538 kWh of 2023 savings observed through the HER program billing analysis were due to cross-participation in other Pacific Power Home Energy Savings programs. The estimated savings attributable to cross-participation were removed from the regression results to ensure no double counting of savings. Savings attributable to cross-participation represent $\pm$0.6 percent of the initial regression analysis results, therefore, the impact on final program savings was relatively small.

Program attrition was within a normal range. By the end of 2023, total attrition for the program since inception was 26 percent for the treatment groups and 5.6 percent for the control groups. The annual attrition rate is approximately five to seven percent across waves for both the treatment and control groups.

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

Survey results did not show a difference between treatment and control group behaviors to create online accounts or take energy savings actions. Treatment and control group survey respondents indicated creating online customer accounts at similar rates. ADM did not find a statistically significant difference between the number of self-reported energy saving actions taken by participants and non-participants.

Overall report engagement decreased from 2020 to 2023. Though per participant (unique email) engagement increased from 2020 to 2021, generally it decreased from 2021-2023.

ADM received multiple versions of the customer dataset from the implementation contractor, referred to as the "original" and "revised" datasets in this report. Evaluation results reflect values included in the revised dataset. Results based on revised dataset identified statistically significant savings; however, the results are inconsistent with the reported program delivery. ADM did not identify an increase in energy savings correlated with more reported HERs delivered in the revised dataset.

6.1.2 Recommendations

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

Implement data management and quality control processes with the implementation contractor. The program implementer, Bidgely, should improve data management processes to ensure that data is accurate. Data extracts should result in consistent reports of HER delivery and program performance. Repeatable data extractions will increase confidence in the accuracy of datasets.

Verify that paper HERs are mailed. Implementer should regularly and systematically verify that paper HERs are delivered as expected by implementer's subcontractor.

Request that the program implementor reports HER delivery dates for each customer. The datasets provided by implementer included annual total quantities of reports delivered for each customer; however, different versions of the dataset reported different totals. Increased granularity of HER delivery data will enable the evaluators to check datasets for duplicate records and confirm program design compliance.

Review the number of paper HERs mailed to each customer annually to ensure consistency with program design. Program datasets reported paper HER delivery quantities that were inconsistent with the program design that each customer is to receive

four HERs annually. Consistent program implementation may result in more consistent program performance.

Include weather effects in ex-ante savings estimates. Program savings are related to regional temperature; the control group is not necessarily a perfect "baseline" for the treatment group if the groups experience different weather. Developing a regression model that includes weather variables can correct this effect. The inclusion of weather effects is important when modeling energy usage; its inclusion will likely improve model fit.

Appendix A: 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

[DISPLAY BLOCK IF GROUP = 1]

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

[DISPLAY Q19 IF Q18 = 1]

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

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

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. ENERGY STAR central air conditioner
9. ENERGY 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 to 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

DEMOGRAPHICS

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

43. Do you rent or own your home?

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

44. 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

45. 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

46. 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

47. 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

48. 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

49. 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

50. 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

51. 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

52. 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

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

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

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

        1. Over
        2. Under
        3. I don't know
        99. Prefer not to answer

Appendix B: Remix Paper Wave Analysis Additional Information

This appendix describes the evaluation of the Remix Paper wave, which involved the review of two separate datasets referred to as "original" and "revised" datasets. The results in Section 4.3.2 are based on the revised dataset. ADM completed the following steps to calculate the savings.

1. ADM calculated the average quantities of HERs delivered per customer in 2022 (3.0) and in 2023 (1.4) for the Remix Paper wave using the original dataset. The program is designed to deliver four HERs to each customer per year.
2. ADM completed a regression analysis of all customers included in the wave and found no statistically significant savings. ADM concluded that this was likely the result of the low average quantity of reported HERs delivered.
3. ADM identified a subset of customers who generated statistically significant savings in 2023: customers who received two or more HERs in 2023. Customers who received fewer than two reports did not generate statistically significant savings. These results were consistent with the expectation that increased treatment would result in increased savings. No savings were identified for any subset of customers in 2022.
4. After ADM completed its analysis, the implementer informed ADM that it had provided incorrect quantities of paper HERs delivered per customer in 2023. The implementer indicated that the subcontractor responsible for mailing paper reports was deficient in its 2023 reporting to the implementer. The implementer provided ADM with a revised dataset with revised HER quantities for the Remix Paper wave for both 2022 and 2023. The revised dataset also included revised reported quantities for the Remix Email wave for program years 2020 through 2023.
5. ADM completed a regression analysis of the Remix Paper wave using the revised HER quantities and identified subsets of customers who generated statistically significant savings (customers who received five reports in 2022 and those received three or less in 2023). These results were inconsistent with expectations that increased treatment would result in increased savings.

B.1 Analysis Steps

The steps that ADM took to evaluate savings generated by the Remix Paper wave are described in detail below.

1. **ADM calculated the average quantities of HERs delivered per customer in 2022 (3.0) and in 2023 (1.4) for the Remix Paper wave using the original dataset.** The program is designed to deliver four HERs to each customer per year.

The implementer provided ADM with HER customer data which included the following information for each treatment and control group customer:

- Customer identification information (e.g. billing account number, address, etc.)

- Wave assignment

- Treatment or control group assignment

- Quantity of HERs delivered for each program year 2020 through 2023

According to the original dataset, the average quantities of HERs delivered per customer was 3.0 in 2022 and 1.4 in 2023. See Figure B-1 and Figure B-2.
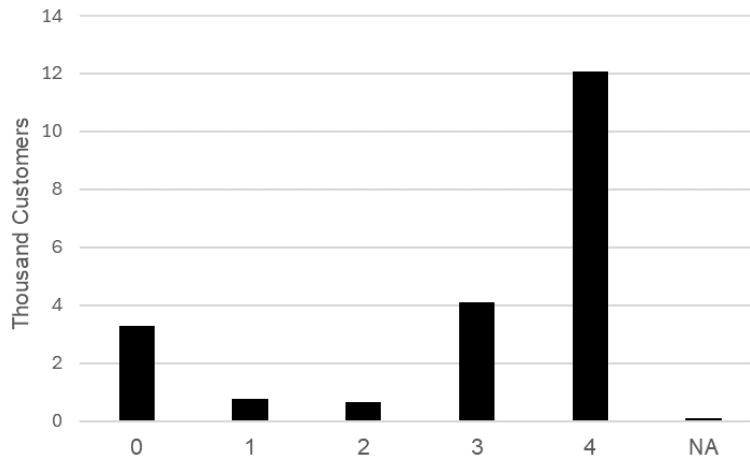
Figure B-1: 2022 Quantities of HERs Reported Delivered - Original Dataset
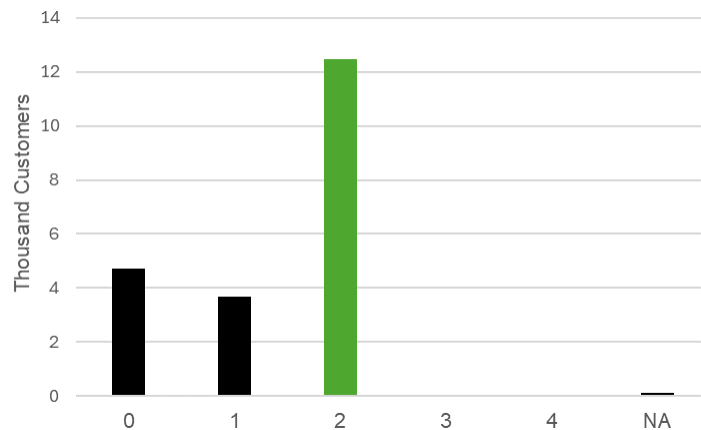
Figure B-2: 2023 Quantities of HERs Reported Delivered - Original Dataset

2. **ADM completed a regression analysis of all customers included in the wave and found no statistically significant savings.** Table B-1 displays the regression-estimated annual electric savings (kWh) per treated customer for the aggregate Remix

Paper wave by program year, prior to any double counting adjustments. The savings are positive but not statistically significant at the 95 percent level.

Table B-1: Regression Estimates for Remix Paper Wave
Annual Savings by Program Year

Wave	Year	Annual Estimated Savings (kWh)	5%	95%
Remix Paper	2022	29.64	-31.22	90.49
Remix Paper	2023	18.29	-66.08	102.05

Table B-2 and Table B-3 display the regression coefficients from the aggregate analyses of the Remix Paper wave.

Table B-2: Aggregate Remix Paper Wave 2022 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	14.64	0.45	0.00	13.90	15.38
Treatment	0.28	0.15	0.06	0.03	0.52
Feb	3.13	0.25	0.00	2.71	3.54
Mar	-0.96	0.36	0.01	-1.55	-0.38
Apr	-3.37	0.37	0.00	-3.99	-2.76
May	-2.77	0.41	0.00	-3.45	-2.09
Jun	-7.17	0.45	0.00	-7.90	-6.43
Jul	-7.31	0.50	0.00	-8.13	-6.49
Aug	-7.53	0.50	0.00	-8.36	-6.71
Sep	-11.10	0.45	0.00	-11.85	-10.35
Oct	-3.58	0.42	0.00	-4.27	-2.90
Nov	-2.46	0.32	0.00	-2.98	-1.94
Dec	-0.56	0.32	0.07	-1.08	-0.05
Pre-period Usage	0.96	0.00	0.00	0.96	0.97
HDD	-0.14	0.01	0.00	-0.16	-0.12
CDD	0.17	0.05	0.00	0.08	0.26
Feb: Pre-period Usage	-0.32	0.00	0.00	-0.32	-0.31
Mar: Pre-period Usage	-0.36	0.00	0.00	-0.37	-0.35
Apr: Pre-period Usage	-0.06	0.01	0.00	-0.07	-0.05
May: Pre-period Usage	-0.26	0.01	0.00	-0.27	-0.25
Jun: Pre-period Usage	-0.24	0.01	0.00	-0.25	-0.23
Jul: Pre-period Usage	-0.06	0.01	0.00	-0.07	-0.05
Aug: Pre-period Usage	-0.05	0.01	0.00	-0.06	-0.04
Sep: Pre-period Usage	-0.09	0.01	0.00	-0.10	-0.08
Oct: Pre-period Usage	-0.36	0.01	0.00	-0.37	-0.35
Nov: Pre-period Usage	-0.03	0.00	0.00	-0.04	-0.02
Dec: Pre-period Usage	0.12	0.00	0.00	0.12	0.13
Treatment: HDD	-0.01	0.01	0.02	-0.02	0.00
Treatment: CDD	-0.04	0.03	0.25	-0.10	0.02

Table B-3: Aggregate Remix Paper Wave 2023 Regression Results

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	14.94	0.39	0.00	14.29	15.58
Treatment	0.10	0.19	0.58	-0.21	0.41
Feb	2.73	0.34	0.00	2.17	3.29
Mar	-0.96	0.36	0.01	-1.55	-0.37
Apr	-2.95	0.39	0.00	-3.60	-2.30
May	-7.29	0.42	0.00	-7.97	-6.60
Jun	-8.09	0.41	0.00	-8.77	-7.41
Jul	-6.09	0.46	0.00	-6.85	-5.34
Aug	-7.27	0.44	0.00	-7.99	-6.54
Sep	-9.66	0.42	0.00	-10.34	-8.97
Oct	-3.80	0.40	0.00	-4.45	-3.14
Nov	-1.28	0.36	0.00	-1.88	-0.68
Dec	0.43	0.36	0.24	-0.16	1.02
Pre-period Usage	0.89	0.00	0.00	0.88	0.89
HDD	-0.13	0.01	0.00	-0.15	-0.12
CDD	0.01	0.06	0.92	-0.09	0.10
Feb: Pre-period Usage	-0.23	0.00	0.00	-0.24	-0.23
Mar: Pre-period Usage	-0.17	0.01	0.00	-0.17	-0.16
Apr: Pre-period Usage	-0.06	0.01	0.00	-0.07	-0.04
May: Pre-period Usage	-0.07	0.01	0.00	-0.08	-0.05
Jun: Pre-period Usage	-0.03	0.01	0.00	-0.05	-0.02
Jul: Pre-period Usage	-0.02	0.01	0.00	-0.03	-0.01
Aug: Pre-period Usage	-0.09	0.01	0.00	-0.10	-0.08
Sep: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.09
Oct: Pre-period Usage	-0.26	0.01	0.00	-0.27	-0.24
Nov: Pre-period Usage	-0.14	0.01	0.00	-0.15	-0.13
Dec: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.10
Treatment: HDD	0.00	0.01	0.54	-0.02	0.01
Treatment: CDD	-0.02	0.05	0.64	-0.10	0.06

3. **ADM identified a subset of customers who generated statistically significant savings in 2023.** Using the original dataset, ADM segmented the Remix Paper wave into subsets defined by the reported quantity of HERs delivered. ADM found that customers who had 2 or more reported HERs delivered during 2023 saved an average of 67.88 kWh during 2023. See green bar in Figure B-2. These results were consistent with the expectation that increased treatment would result in increased savings. No

savings were identified for any subsets of customers in 2022. See Tables B-4 and B-5.

Table B-4: Regression Estimates for Remix Paper Wave
Annual Savings by Program Year

Wave	Year	Annual Estimated Savings (kWh)	5%	95%
Remix Paper (2+ reports)	2023	67.88	9.09	96.23

Table B-5: Remix Paper Wave 2023 Regression Results
Subset of Customers Who Received Two or More Reports

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	14.37	0.40	0.00	13.71	15.03
Treatment	0.09	0.19	0.62	-0.22	0.40
Feb	2.67	0.36	0.00	2.08	3.26
Mar	-1.03	0.37	0.01	-1.64	-0.41
Apr	-2.94	0.41	0.00	-3.61	-2.26
May	-6.96	0.43	0.00	-7.67	-6.25
Jun	-7.82	0.43	0.00	-8.53	-7.11
Jul	-6.09	0.48	0.00	-6.87	-5.30
Aug	-7.23	0.46	0.00	-7.98	-6.48
Sep	-9.30	0.43	0.00	-10.02	-8.59
Oct	-3.42	0.41	0.00	-4.10	-2.74
Nov	-0.99	0.38	0.01	-1.61	-0.37
Dec	0.44	0.37	0.24	-0.18	1.05
Pre-period Usage	0.90	0.00	0.00	0.89	0.90
HDD	-0.13	0.01	0.00	-0.15	-0.11
CDD	0.03	0.06	0.66	-0.07	0.12
Feb: Pre-period Usage	-0.23	0.00	0.00	-0.24	-0.23
Mar: Pre-period Usage	-0.16	0.01	0.00	-0.17	-0.15
Apr: Pre-period Usage	-0.05	0.01	0.00	-0.07	-0.04
May: Pre-period Usage	-0.06	0.01	0.00	-0.08	-0.05
Jun: Pre-period Usage	-0.03	0.01	0.00	-0.04	-0.02
Jul: Pre-period Usage	-0.02	0.01	0.01	-0.03	-0.01
Aug: Pre-period Usage	-0.09	0.01	0.00	-0.10	-0.07
Sep: Pre-period Usage	-0.11	0.01	0.00	-0.12	-0.09

Coefficient	Estimate	Std Error	P Value	5%	95%
Oct: Pre-period Usage	-0.26	0.01	0.00	-0.27	-0.25
Nov: Pre-period Usage	-0.15	0.01	0.00	-0.16	-0.14
Dec: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.09
Treatment: HDD	-0.01	0.01	0.14	-0.02	0.00
Treatment: CDD	-0.03	0.05	0.57	-0.11	0.05

4. **After ADM completed its analysis, the implementer informed ADM that it had provided the incorrect quantities of paper HERs delivered per customer in 2023.** The implementer indicated that their subcontractor who mails paper HERs provided them with incomplete data for 2023. The implementer provided ADM with a revised dataset that included revised report quantities for the Remix Paper wave for both 2022 and 2023. The revised dataset also included revised quantities for the Remix Email wave. Table B-6 compares the average quantity of HERs reported delivered in the original and the revised datasets. The implementer did not provide an explanation for the changes in quantities of HERs sent for other waves and years other than the 2023 paper wave for which they had explained the data error.

Table B-6: Average Quantity of HERs Reported Delivered
by Program Year and Wave: Original vs. Revised Datasets

Waves/Format		2020	2021	2022	2023
Original Dataset					
Remix Email		0.0	17.4	21.0	18.8
Remix Paper		5.6	3.5	3.0	1.4
Expansion 2021	Paper		2.8	3.2	1.4
	Email		14.0	18.2	15.0
Expansion 2023					2.6
Revised Dataset					
Remix Email		0.78	21.9	20.4	17.6
Remix Paper		NP	NP	5.6	3.1
Expansion 2021	Paper		NP	5.5	3.1
	Email		14.0	18.2	14.4
Expansion 2023					NP

NP: Not provided in the revised dataset.

See Figures B-3 and B-4 for a distribution of revised quantities of Remix Paper HERs reported.
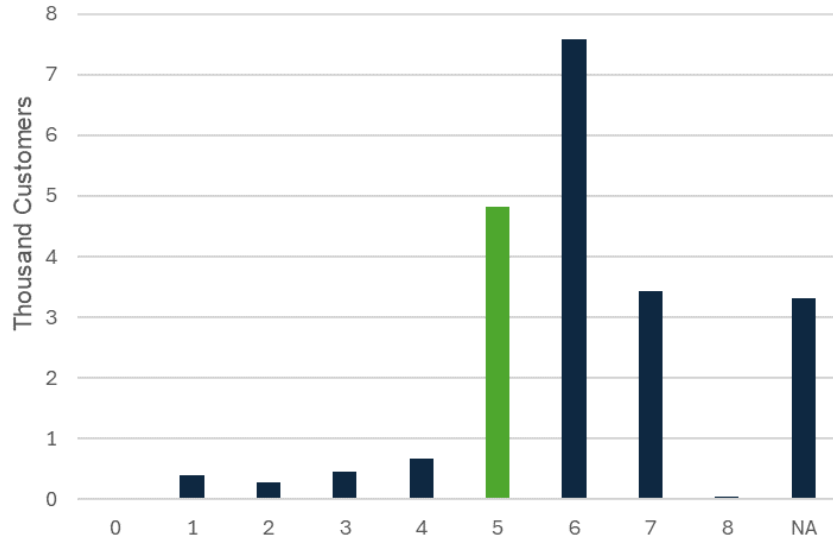
Figure B-3: 2022 Quantity HERs Reported Delivered - Revised Dataset
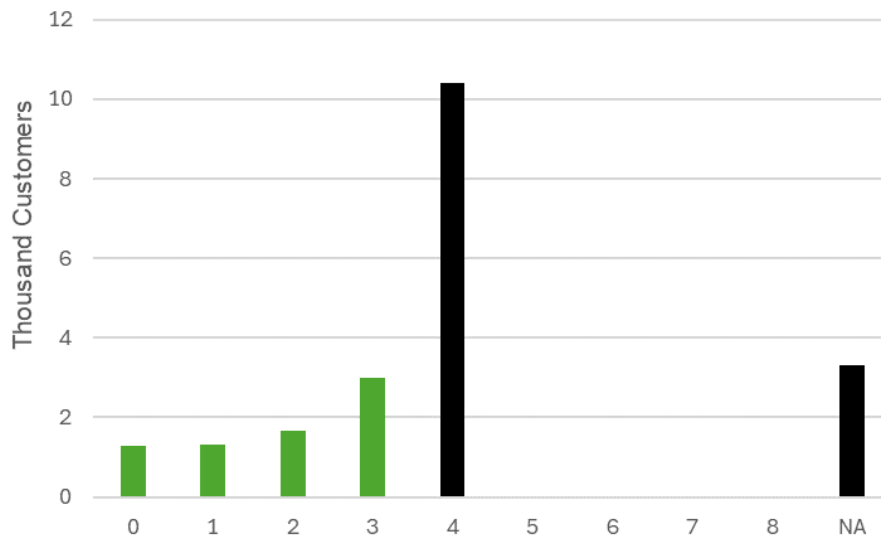
Figure B-4: 2023 Quantity HERs Reported Delivered - Revised Dataset

5. **ADM completed a regression analysis of the Remix Paper wave using the revised HER quantities and identified subsets of customers who generated statistically significant savings.** ADM analyzed the revised data to determine if savings were generated by any subsets of the Remix Paper wave during 2022 or 2023 using the revised reported quantities of delivered HERs. ADM identified two subsets that generated savings. ADM performed control group validity testing on those subsets. The control group did not pass the validity test. Therefore, ADM performed propensity score matching (PSM) to create post-hoc control groups for each subgroup comprised of treatment participants that did not receive home energy reports. The

subset passed equivalency testing for all the months with the post-hoc control groups. These post-hoc control groups were used to analyze savings for the subsets of the Remix Paper wave.

Table B-7: Remix Paper Wave 2022 T-Test Results Subset of Customers Who Received Five Reports as Reported in Revised Dataset

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[21]
Jan	69.78	69.22	0.56	0.334	-
Feb	81.33	81.12	0.21	0.764	-
Mar	62.24	62.01	0.23	0.642	-
Apr	36.40	36.27	0.13	0.636	-
May	29.95	29.89	0.06	0.810	-
Jun	31.76	31.79	-0.03	0.913	-
Jul	34.41	34.44	-0.03	0.939	-
Aug	35.65	35.66	-0.02	0.958	-
Sep	31.93	31.98	-0.05	0.853	-
Oct	43.18	43.15	0.03	0.924	-
Nov	61.53	61.47	0.06	0.909	-
Dec	70.48	70.40	0.08	0.891	-

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[21] statistically significant if $p < 0.05$

Table B-8: Remix Paper Wave 2023 T-Test Results Subset of Customers Who Received Zero to Three Reports as Reported in Revised Dataset

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[22]
Jan	66.39	66.48	-0.08	0.867	-
Feb	77.09	77.41	-0.31	0.605	-
Mar	59.95	59.80	0.15	0.736	-
Apr	35.34	34.98	0.36	0.121	-
May	30.96	30.67	0.29	0.211	-
Jun	34.55	34.32	0.23	0.425	-
Jul	36.94	36.73	0.21	0.510	-
Aug	38.54	38.24	0.30	0.353	-
Sep	33.53	33.21	0.32	0.191	-
Oct	41.90	41.52	0.39	0.171	-
Nov	58.35	58.15	0.20	0.643	-
Dec	68.79	68.63	0.16	0.765	-

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[22] statistically significant if p<0.05

Table B-9: Remix Paper Wave 2022 Regression Results
Subset of Customers Who Received Five Reports
as Reported in Revised Dataset

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	14.62	0.80	0.00	13.30	15.93
Treatment	-1.05	0.22	0.00	-1.41	-0.69
Feb	2.03	0.58	0.00	1.08	2.98
Mar	-1.61	0.66	0.01	-2.69	-0.53
Apr	-2.67	0.67	0.00	-3.77	-1.56
May	-2.45	0.74	0.00	-3.67	-1.24
Jun	-7.01	0.79	0.00	-8.32	-5.71
Jul	-7.42	0.86	0.00	-8.84	-6.00
Aug	-7.53	0.86	0.00	-8.96	-6.11
Sep	-10.76	0.80	0.00	-12.08	-9.45
Oct	-3.91	0.74	0.00	-5.13	-2.70
Nov	-1.27	0.59	0.03	-2.25	-0.30
Dec	1.09	0.59	0.06	0.13	2.06
Pre-period Usage	0.97	0.01	0.00	0.96	0.98
HDD	-0.10	0.02	0.00	-0.14	-0.07
CDD	0.11	0.08	0.15	-0.02	0.24
Feb: Pre-period Usage	-0.35	0.01	0.00	-0.36	-0.33
Mar: Pre-period Usage	-0.37	0.01	0.00	-0.39	-0.36
Apr: Pre-period Usage	-0.06	0.01	0.00	-0.08	-0.04
May: Pre-period Usage	-0.26	0.01	0.00	-0.28	-0.23
Jun: Pre-period Usage	-0.25	0.01	0.00	-0.27	-0.23
Jul: Pre-period Usage	-0.05	0.01	0.00	-0.07	-0.03
Aug: Pre-period Usage	-0.04	0.01	0.00	-0.06	-0.03
Sep: Pre-period Usage	-0.13	0.01	0.00	-0.15	-0.11
Oct: Pre-period Usage	-0.40	0.01	0.00	-0.41	-0.38
Nov: Pre-period Usage	-0.07	0.01	0.00	-0.08	-0.05
Dec: Pre-period Usage	0.05	0.01	0.00	0.04	0.06
Treatment: HDD	0.04	0.01	0.00	0.03	0.05
Treatment: CDD	-0.13	0.05	0.01	-0.21	-0.05

Table B-10: Remix Paper Wave 2023 Regression Results
Subset of Customers Who Received Zero to Three Reports
as Reported in Revised Dataset

Coefficient	Estimate	Std Error	P Value	5%	95%
(Intercept)	14.94	0.69	0.00	13.80	16.08
Treatment	-0.94	0.27	0.00	-1.39	-0.49
Feb	1.10	0.51	0.03	0.25	1.94
Mar	-2.28	0.54	0.00	-3.17	-1.39
Apr	-3.29	0.61	0.00	-4.30	-2.28
May	-7.50	0.70	0.00	-8.65	-6.34
Jun	-8.35	0.71	0.00	-9.53	-7.18
Jul	-7.02	0.83	0.00	-8.39	-5.65
Aug	-8.00	0.78	0.00	-9.28	-6.71
Sep	-10.04	0.70	0.00	-11.18	-8.89
Oct	-4.72	0.64	0.00	-5.77	-3.68
Nov	-2.90	0.55	0.00	-3.80	-2.00
Dec	-0.76	0.54	0.16	-1.65	0.13
Pre-period Usage	0.86	0.01	0.00	0.85	0.87
HDD	-0.04	0.02	0.02	-0.07	-0.01
CDD	0.19	0.11	0.07	0.02	0.36
Feb: Pre-period Usage	-0.21	0.01	0.00	-0.22	-0.20
Mar: Pre-period Usage	-0.15	0.01	0.00	-0.16	-0.14
Apr: Pre-period Usage	-0.01	0.01	0.28	-0.03	0.01
May: Pre-period Usage	-0.05	0.01	0.00	-0.07	-0.03
Jun: Pre-period Usage	-0.04	0.01	0.00	-0.05	-0.02
Jul: Pre-period Usage	0.04	0.01	0.00	0.02	0.05
Aug: Pre-period Usage	-0.06	0.01	0.00	-0.07	-0.04
Sep: Pre-period Usage	-0.07	0.01	0.00	-0.09	-0.05
Oct: Pre-period Usage	-0.23	0.01	0.00	-0.25	-0.21
Nov: Pre-period Usage	-0.10	0.01	0.00	-0.11	-0.08
Dec: Pre-period Usage	-0.13	0.01	0.00	-0.14	-0.11
Treatment: HDD	-0.01	0.01	0.35	-0.03	0.01
Treatment: CDD	0.05	0.07	0.48	-0.07	0.17

Table B-11 reports the savings generated by these two subsets of customers. Customers with 5 reported HERs delivered in 2022 generated an average of 274 kWh during the year. Customers with 0-3 reported HERs delivered in 2023 generated an average of 341 kWh during the year.

Table B-11: Remix Paper Wave Annual Savings by Program Year

Wave	Year	Annual Estimated Savings (kWh)	5%	95%
Remix Paper (5 reports)	2022	274.28	181.57	366.99
Remix Paper (0-3 reports)	2023	341.35	218.12	464.59

Table B-12: Remix Paper Wave Model Fit

Wave	Year	Adjusted R^2	F Statistic	Number of Observations	Number of Weighted Treatment Customers
Remix Paper (5 reports)	2022	0.746	11,731	111,780	4,818
Remix Paper (0-3 reports)	2023	0.644	8,877	137,474	7,266

B.2 Remix Paper Wave Final Results

The final savings results for this wave are reported in Table B-13 and Table B-14.

Table B-13: Remix Paper Wave Ex-Post Annual kWh Electric 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
Remix Paper (5 reports)	274.28	181.57	366.99	-0.23	274.05	17,804.54	1.54%
Remix Paper (0-3 reports)	341.35	218.12	464.59	5.75	347.10	17,591.83	1.97%

Table B-14: 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
Remix Paper (5 reports)	274.05	4,818	1,320,373	874,804	1,768,158
Remix Paper (0-3 reports)	347.10	7,266	2,522,029	1,584,860	3,375,711

B.3 Observations

ADM made the following observations about the original and revised datasets provided by the implementer:

- The HER program design for paper HERs designates that each customer in a paper wave will receive four paper reports per year. Based on the revised dataset, in 2022, 75 percent of treated customers received five or more paper reports.

- The implementer indicated that the data error in the original dataset was limited to the quantities of paper reports sent in 2023. The revised dataset included revised quantities of paper HERs delivered in 2022 and 2023 as well as revised quantities of emailed HERs delivered in 2020-2023.

- The results of ADM's 2023 analysis using the original dataset were consistent with expectations that savings increase with increased treatment.

- The results of ADM's 2022 and 2023 analyses using the revised dataset are inconsistent with expectations that savings increase with increased treatment.