HOME ENERGY REPORTS

2022 Impact Evaluation and 2022-2023 Process Evaluation Report

Puget Sound Energy

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1 EXECUTIVE SUMMARY

1.1 Program Overview

Puget Sound Energy (PSE) launched the Home Energy Reports (HER) program in 2008. The HER program delivers customized information on energy consumption to participating households and compares the households' energy consumption to that of similar neighboring homes. In addition, the report provides personalized tips on how to save energy based on the energy usage and housing profile of recipients. The HER program was designed to motivate households to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.[1]

1.2 Impact Evaluation Approach

Each new cohort of the program is structured as a randomized controlled trial (RCT) where the eligible population is randomly assigned to treatment and control groups. The RCT design results in precise and unbiased estimates of savings per household since the only systematic difference between randomly assigned treatment and control households is the HER.

Since the launch of the program, the number of households and the composition of PSE HER cohorts have changed over time (Table 1-1). The legacy cohort initially started with 40,000 treatment and 44,000 control households. Three years later, PSE discontinued sending the reports to 10,000 treatment households, thus creating the "current" (those who still receive the reports) and "suspended" (those who do not receive the reports anymore) treatment cohorts that share the same control group. In 2014, PSE added a pilot study (expansion) that consisted of three cohorts and has been adding new cohorts in subsequent years. The "remaining counts" columns reflect the number of remaining customers at the start of 2022 for all the cohorts except the low-to-moderate income and gas-only refill cohorts which began in June 2022.

Table 1-1. PSE HER cohorts

Time	Cohort Description	Starting Treatment Household Count	Starting Control Household Count	Remaining Treatment Households	Remaining Control Households
2008	Legacy	40,000	44,000	-	-
2008	Unmatched group	5,000	-	2,138	-
2011	Legacy current	30,000	44,000	9,826	18,469
2011	Legacy suspended	10,000		4,886	
March 2014	Relative high users	31,500	10,500	12,732	4,307
March 2014	Dual-fuel non-urban	42,000	14,000	19,513	6,595
March 2014	Electric only	31,500	10,500	14,744	4,889
May 2015	Dual-fuel refill	25,000	10,500	13,260	5,596
May 2019	Electric-only refill	65,000	25,000	46,705	18,000
May 2019	Electric-only manufactured homes	37,977	9,494	28,307	7,007
January 2020	Dual-fuel refill ("refill 2020")	90,000	30,000	70,638	23,622
March 2021	Electric-only manufactured home refill	7,148	1,787	6,038	1,533
September 2021	Gas-only refill ("gas only 2021")	100,000	30,000	91,756	27,459
January 2022	Electric-only multifamily homes	104,637	34,879	101,844	33,961

[1] Puget Sound Energy. Home Energy Report Program: Program Guide.

Time	Cohort Description	Starting Treatment Household Count	Starting Control Household Count	Remaining Treatment Households	Remaining Control Households
June 2022	Electric-only low-to-moderate income (LMI)	39,999	10,000	38,805	9,660
June 2022	Gas-only refill ("gas only 2022")	60,000	15,000	58,528	14,644

1.3 Impact Evaluation Results

Table 1-2 and Table 1-3 provide the cohort-level and overall electric and gas savings estimates, respectively. The overall electric savings were estimated at 90/25 precision and the gas savings were estimated at 90/23 precision. The electric-only refill cohort generated the most electric savings among all the treatment groups. Overall, PSE HER electric customers saved 42,405 MWh in 2022 which is about 9% lower than the electric savings from 2021. Two recently added cohorts, the manufactured homes 2021 refill and 2022 LMI cohorts, did not produce any savings, and the 2022 multifamily homes cohort produced positive but statistically insignificant savings.

Table 1-2. Total credited electric savings for 2022 HER programs (kWh)

HER Treatment Group	Per Household				Total		
	Measured Savings	Joint Savings	Claimed Savings	No. in Group	Total Savings	Lower Limit 90% CI	Upper Limit 90% CI
Legacy – Current	129	7	122	9,826	1,201,185	349,385	2,052,985
Legacy – Suspended	121	0	121	4,886	591,435	53,751	1,129,119
Legacy – Unmatched^			120	2,138	256,407	71,068	441,747
Expansion – Electric Only	220	12	207	14,744	3,058,179	751,542	5,364,816
Expansion – High Relative User	277	16	261	12,732	3,321,131	1,490,428	5,151,834
Expansion – Non-urban	145	27	118	19,513	2,310,481	259,341	4,361,621
Expansion – Refill	234	21	213	13,260	2,827,372	1,003,763	4,650,980
Expansion – Refill Electric Only	331	17	314	46,705	14,661,584	7,819,419	21,503,750
Expansion – Manufactured Homes	242	17	226	28,307	6,385,281	878,045	11,892,517
Expansion – Refill 2020	99	13	86	70,638	6,068,792	2,964,995	9,172,589
Expansion – Manufactured Homes Refill	-66	11	-77	6,038	0	0	0
Expansion – Multifamily Homes 2022	17	0	17	101,844	1,723,297	(61,670)	3,508,263
LMI 2022	-2	0	-2	38,805	0	0	0
Total			115	369,436	42,405,144	32,050,516	52,759,772

* Note that we calculated the unmatched per household savings by multiplying the legacy current per household savings as a percentage of consumption (1.8%) by the average household consumption of the unmatched group (9,421 kWh).

On the gas side, all but the expansion high-user, non-urban, and expansion gas-only 2022 refill cohorts generated statistically significant savings. Overall, PSE HER customers saved 1,219,536 therms in 2022, which is about 0.2% lower than the gas savings from 2021.

Table 1-3. Total credited gas savings for 2022 HER programs (therms)

HER Treatment Group	Per Household				Total		
	Measured Savings	Joint Savings	Claimed Savings	No. in group	Total savings	Lower limit 90% CI	Upper limit 90% CI
Legacy – Current	11	2	9	9,826	85,215	31,382	139,047
Legacy – Suspended	10	0	10	4,886	47,488	13,400	81,576
Legacy – Unmatched ^			9	2,138	20,292	8,579	32,005
Expansion – High Relative User	7	2	5	12,732	65,135	(31,677)	161,947
Expansion – Non-urban	3	0.2	3	19,513	53,924	(47,294)	155,141
Expansion – Refill	8	0.4	8	13,260	102,600	16,798	188,402
Expansion – Refill 2020	4	0.1	4	70,638	311,240	162,109	460,370
Expansion – Gas Only 2021	6	0.02	6	91,756	514,818	360,024	669,612
Expansion – Gas Only 2022	0.3	0.01	0.3	58,528	18,825	(60,653)	98,303
Total			4	283,277	1,219,536	930,235	1,508,836

* Note that we calculated the unmatched per household savings by multiplying the legacy current per household savings as a percentage of consumption (1.0%) by the average household consumption of the unmatched group (872 therms).

1.4 Process Evaluation Approach

The process evaluation is designed to provide information on how the HER program creates savings and how it might increase those savings. This year's evaluation included two components:

1. An interview of PSE HER program staff
2. A large-scale survey of HER recipients to understand their behaviors and attitudes

The program staff interview was designed to understand challenges and opportunities from the perspective of PSE's program manager. The primary goals of the program staff interview were to understand any recent and planned program changes, barriers preventing HER recipients from saving more energy, and opportunities for increasing savings through the HER program.

The online survey was sent to a large sample of HER recipients and customers from the control group from different survey waves to better understand customer behaviors that affect energy use, their attitudes toward the HERs, and how these might vary between different types of customers. Specifically, we focused on questions related to occupancy behaviors, thermostat use, purchases of energy efficient technologies, and other changes to household characteristics to determine differences between HER recipients and non-recipients.

1.5 Process Evaluation Results

As mentioned in the previous section, DNV launched an online survey to gauge level of awareness, engagement, and satisfaction with HERs, among other research objectives. Program participants who responded to the online survey were asked if they remembered receiving a HER from PSE in the past three months. A large majority (88%) of respondents stated that they did remember receiving the HER.

All respondents who said they did remember receiving the reports were asked, in general, what they have done with them. Most of the participants either read some of the content (47%) or read the reports thoroughly (34%). Only 2% of the respondents said they did not look at them at all. This suggests that a vast majority of respondents have at least a moderate level of engagement with the HERs they receive.

Program participants were also asked to think about the HERs and then decide if they agree or disagree with various statements about these reports. A large majority of respondents agreed that they liked the HERs (85%) and the energy efficiency tips within the report were useful (78%). Fewer respondents, though still a majority, agreed that the comparisons to similar homes were fair (65%) or that the reports helped them make better energy-related decisions (63%).

1.5.1 Mechanisms for Savings

As with the 2021 survey results, the reported differences between HER recipients and non-recipients in their energy savings behaviors are small, reflecting the small per-home impacts of the reports. Given these small differences, very few are statistically significant. However, in this survey we did find some significant differences, with recipients more likely to have warmer thermostat setpoints in summer and cooler setpoints in winter. Recipients were also significantly more likely to report prioritizing saving energy to the extent that they are [still] somewhat comfortable.

1.5.2 Other Online Survey Results

Occupancy

Overall, we found that customers reported spending a little more time at home in 2022 and 2023 (135 hours per week) compared to previous years (131 hours per week in 2019).[2] Survey results suggest that rather than occupancy, setpoints could be a bigger driving force in saving energy. Behavior related to set points discussed above in Section 1.5.1 showing differences between HER recipients and non-recipients appears to be a bigger driver of savings than occupancy.

Equity

Surveys continue to show that low income HER recipients report more engagement with the reports and that they find the reports more useful than other recipients. Low-income survey respondents (a combination of HER recipients and non-recipients) also are more likely to report having very little or very high awareness of PSE's energy efficiency programs, indicating that PSE is successfully reaching one segment of low-income customers but missing another low-income segment.

[2] The 2019-2020 program (PY) evaluation found that customers spent less time at home (131 hrs per week in 2019 and 143 hrs per week in 2020).

1.6 Findings and Recommendations

1.6.1 Impact Evaluation Findings

We note the following key findings from the impact evaluation.

FINDINGS

Total PSE HER 2022 credited electric savings were 42,405,144 kWh and credited gas savings were 1,219,536 therms. The total electric and gas savings are lower than what was achieved in 2021 despite adding new cohorts.

Per household electric and gas savings have been trending downward since 2017. Possible explanations include customers who previously received the report becoming a member of the control group after moving, previous control customers moving into houses with energy-efficient upgrades done by previous customers who received the report, and the fact that the HER program is also starting to reach customers with less potential for energy savings than cohorts created earlier in the program's history, such as high electric and gas users.

The legacy current cohort's measured electric and gas savings has been trending downwards for the past several years.

The legacy suspended cohort's measured electric savings had been statistically insignificant for the past several years before turning significant again in 2022.

The earlier expansion cohorts (electric only, non-urban, high user, refill) continue to save electricity and gas, but they have been exhibiting declines since reaching their peaks.

The two expansion cohorts from 2019, the electric-only refill and the manufactured homes, continue to save electricity. The electric-only refill cohort generated less savings than in 2021 while the manufactured homes cohort generated more.

The refill 2020 and manufactured homes refill cohorts have performed considerably worse than their original counterparts (refill 2015 and manufacture homes, respectively).

- The refill 2020 cohort's electric per household savings is about a third of what the refill 2015 cohort achieved in their third year, and if it follows a similar trajectory then we should expect refill 2020 to generate fewer and fewer savings moving forward.
- The manufactured homes refill's electric savings continued to stay statistically insignificant and even became negative in 2022. This is in complete contrast to the original manufactured homes cohort that continued to exhibit growing electric savings.

The new cohorts introduced in 2022 generated smaller than expected savings.

1.6.2 Impact Evaluation Recommendations

We note the following recommendations based on key findings from the impact evaluation.

RECOMMENDATIONS	**Additional Review of HER Results:** DNV recommends that efforts should be made to understand why DNV and Oracle (the program implementer) have different unadjusted savings estimates. We recommend that these efforts include investigating the treatment and control counts used by DNV and Oracle among other potential sources of differences.
	2024 HER Mid-Year Unadjusted Analysis: DNV recommends a mid-year analysis in the summer of 2024 as a status check on how the HER program is performing in 2024 to help PSE improve its forecasts of expected program savings.
	Underperforming Cohorts: DNV recommends formulating a strategy regarding underperforming cohorts. Currently, cohorts that generate negative savings are excluded from the total program savings if we believe them to be one-off occurrences. However, if we start seeing a trend over the next year with negative savings, then we believe the cohorts should either count against the total program savings or be removed from the program

1.6.3 Process Evaluation Findings

Below are key findings from the process evaluation.

FINDINGS	The majority of the HER treatment customers (88%) were aware of seeing the report in the past three months, and 81% are at least moderately engaged with the reports.
	Per survey results, 95% of respondents primarily speak English at home. According to the US Census Bureau's 2022 American Community Survey (ACS), 21% of King County residents speak a language other than English at home. Survey results revealed a higher percentage of people who primarily speak English at home than the general population (95%).[3]
	PSE's customers spend more time working at home or otherwise being at home during the workweek than they did in 2019 but are spending more time away from the home than in 2020.
	Surveys show that low income HER recipients are more engaged with the reports and find the reports more useful than other recipients. They also are more likely to report having very little or very high awareness of PSE's energy efficiency programs.

[3] US Census Bureau. 2022 American Community Survey. https://www.census.gov/programs-surveys/acs/data.html

1.6.4 Process Evaluation Recommendations

We note the following recommendations based on key findings from the process evaluation.

RECOMMENDATIONS

Decarbonization: HERs are both an effective way to save energy and are broadly popular. Simple messages are remembered best. If PSE's goals evolve to focus on decarbonization instead of energy efficiency, a similar report recommending simple actions to achieve decarbonization is likely to be effective and well received.

Demand Response: Furthermore, as more customers electrify their homes, demand response programs will increase in importance. As PSE's demand response programs expand, HERs could include messages aimed at reducing electric consumption during peak hours and could also include information on how customers can enroll in demand response programs.

Spanish Language HERs: PSE should consider adding Spanish language HERs if they believe these may deliver additional cost-effective savings from the program. According to the ACS, 9% of King County residents primarily speak Spanish at home.

Low Income Customers: Given that low income customers have a higher level of engagement with HERs than non-low income recipients, PSE should consider increasing communications about programs that are geared toward low income customers in the HERs sent to the low and moderate income, manufactured homes, and multifamily cohorts.

2 INTRODUCTION

2.1 Program Overview

The Home Energy Report (HER) program delivers customized information on energy consumption to participating households and compares the households' energy consumption to that of similar neighboring homes. In addition, the report provides personalized tips on how to save energy based on the energy usage and housing profile of recipients. The HER program was designed to motivate households to reduce energy consumption through behavioral changes and participation in other Puget Sound Energy (PSE) energy efficiency programs.

PSE first implemented the HER program in 2008. The program was structured as a randomized controlled trial (RCT) where the eligible population was randomly assigned to treatment and control groups. The RCT design results in precise and unbiased estimates of savings per household, since the only systematic difference between randomly assigned treatment and control households is the effect of HER program.

2.2 Research Objectives

2.2.1 Impact Evaluation

The main goal of the impact evaluation is to estimate HER legacy and expansion program savings for 2022. Specifically, the impact evaluation research objectives are:

1. Measure the reduction in electric and natural gas consumption for the HER treatment groups relative to the control groups.
2. Quantify joint savings from HER-related increased uptake of other PSE energy efficiency programs.
3. Provide an estimate of 2022 HER credited savings for legacy and expansion programs adjusted for joint savings resulting from participation in PSE programs.
4. Provide an estimate of electric and natural gas savings for an additional legacy treatment group that had been previously excluded from savings estimates due to lack of a randomly assigned control group (the unmatched treatment group).

This evaluation used historical consumption data to measure the difference in consumption between the treatment and control groups.[4] We measured savings estimates for the different treatment sub-groups, namely, the current and suspended cohorts for the HER legacy program and the numerous cohorts for the HER expansion program. To quantify joint savings, DNV used the PSE program tracking data for downstream programs and the 2022 survey for upstream lighting purchases.

After DNV saw differences between the results generated by the pooled fixed-effects (FE) model and Oracle's results, DNV explored switching to using a lagged-dependent variable (LDV) model (7.1.2). Comparing our FE results to the LDV results, we saw no discernible reason that would explain the differences with Oracle's results.

[4] DNV used daily consumption data obtained from Oracle (the program implementer) to conduct the 2022 analysis.

2.2.2 Process Evaluation

The goal of the process evaluation is to understand the customer experience with the program, drivers of savings, and opportunities for increased savings in the future. The primary objectives of this HER process evaluation were as follows:

1. Understand how energy savings behaviors and technologies are different between customers who receive HERs and those who do not.
2. Quantify the level of awareness and satisfaction among recipients of HERs.

We assessed these primary objectives through an online survey with HER recipients and non-recipients.

2.3 Impact Evaluation Overview

2.3.1 Measured Savings

Our evaluation used daily household energy consumption data to calculate the reduction in energy consumption of the treatment group relative to the control group. Consumption reduction is the full measure of savings caused by receipt of home energy reports and is referred to here as measured savings. We used a pooled FE model to estimate savings.

The FE methodology is a flexible characterization of the effect of the treatment on household consumption. It allows us to estimate the effect of the treatment over time while controlling for household and time-specific characteristics, which results in more precise estimates. Further, it allows us to estimate savings from partial-year treatment participants.

The FE model specification estimates program savings by comparing consumption of the treatment and control groups before and after program implementation. The change that occurs in the treatment group is adjusted to reflect any change that occurred in the control group to isolate changes attributable to the program.

2.3.2 Joint Savings

The HER program has a secondary objective of promoting other PSE energy efficiency programs. When the HER program is successful in achieving this objective, the measured consumption reduction includes the savings from any increased uptake of these other energy efficiency programs. We refer to this as joint program savings since savings could be attributable in part by HER messaging. Joint savings can occur when HER recipients:

- Install rebate program measures in greater numbers
- Install rebate program measures generating greater savings
- Install any rebate program measures earlier than control households, regardless of the level of savings

Since the rebate programs claim the savings, we deducted joint savings from the HER measured savings to avoid double counting. The measured savings with joint savings removed are referred to as “credited savings” in this report. The following two sections go into further detail about how we calculated the downstream rebate and upstream lighting joint savings.

2.3.2.1 Downstream Rebate

We used PSE tracking and end-use load shape data to quantify energy savings for HER participants through PSE rebate programs. HERs generate a flow of savings throughout a program year that increases or decreases as the consumption of the treatment group changes compared to the control group. On the other hand, rebate savings are generally reported on an annual basis and do not account for when measures were installed, how long they last, or when during the year savings from such measures happen.

To account for rebate program savings in a way that is consistent with the measured HER program savings, we took into consideration:

- When savings started (installation dates for downstream, rebate year for upstream)
- When during the year savings occurred (load shape of yearly savings)
- How long the savings will last (persistence of savings or measure life)

We calculated the stream of savings from PSE rebate programs for HER treatment and control group households by summing the savings achieved in 2022, including measures installed in prior years that are expected to be still in use. The rebate portion of joint savings is the difference between the treatment and control groups' savings. We removed this difference from the HER measured savings.

2.3.2.2 Upstream Lighting

DNV administered an online survey to collect information from program participants about the purchase and installation of LED bulbs, fixtures, linear tube lamps, and outdoor string lights during the 2022 program year. We used survey results to calculate the number of purchased LEDs incentivized by PSE's upstream lighting program for the HER treatment and control groups. These results were used to estimate joint savings associated with PSE's upstream LED lighting programs.

In particular, the difference in the average number of LEDs purchased by treatment and control households of each wave provided the uplift in efficient lighting due to the HER program. We multiplied savings per LED by the estimated uplift to generate upstream joint savings in 2022. Since efficient lighting products (compact fluorescents and LEDs) have measure lives of 5 years or more, total program year 2022 upstream savings were based on cumulative LED savings of the past 5 years. We used upstream joint savings calculated in this manner to generate credited savings per household.

2.3.3 Legacy Unmatched Savings Estimates

The legacy treatment group includes a small subset of households, concentrated in the 98006 zip code, which have received HER reports since the start of the program. These households were randomly selected to receive the reports but were not assigned a random control group. Savings from this group were not included in program totals until the 2016 program year.

For 2016 and 2017 program years, we explored the possibility of capturing savings from this customer group by creating a matched comparison group to arrive at measured savings. We could not create a satisfactory comparison group because most PSE customers in this geographic region were receiving the HER treatment. In this analysis, we use percent savings per household of the legacy current group to estimate the savings of the unmatched group. We found this approach provides a reasonable estimate of credited savings for the 2,138 customers that remained in the unmatched group in 2022.

2.4 Process Evaluation Overview

The process evaluation is designed to provide information on how the HER program creates savings and how it might increase those savings. This year's evaluation included two components:

- An interview of PSE HER program staff
- A large-scale survey of HER recipients to understand their behaviors and attitudes

The program staff interview was designed to understand challenges and opportunities from the perspective of PSE's program manager. The primary goals of the program staff interview were to understand any recent and planned program changes, barriers preventing HER recipients from saving more energy, and opportunities for increasing savings through the HER program.

The online survey was sent to a large sample of HER recipients and customers from the control group from different survey waves to better understand customer behaviors that affect energy use, their attitudes toward the home energy reports, and how these might vary between different types of customers. We focused, specifically, on questions related to occupancy behaviors, thermostat use, purchases of energy efficient technologies, and other changes to household characteristics to determine differences between HER recipients and non-recipients.

2.5 Report Overview

We have organized the remainder of this report as follows:

- **Section 3 Data Sources** describes the evaluation's data sources.
- **Section 4 Impact Evaluation Results** details the results of the impact evaluation.
- **Section 5 Process Evaluation Results** provides the results of the process evaluation.
- **Section 6 Findings and Recommendations** includes the evaluation's key findings and recommendations.
- **Appendix A: Impact Evaluation Methods** provides additional details on the impact evaluation methods.
- **Appendix B: Online Survey Sample Design** details the sample design used for the participant online surveys.
- **Appendix C: Demographics of Online Survey Respondents** includes additional tables of demographic results from the participant online survey.
- **Appendix D: Data Collection Instrument** provides the data collection instrument used for the participant online surveys.

3 DATA SOURCES

3.1 Program Participants

PSE provided premise numbers, customer account numbers, and treatment assignment of HER program participants. These data served as the original roster of program participants for the HER evaluation and were used in conjunction with the program tracking data and daily consumption data.

3.2 Program Tracking Data

PSE provided the 2022 rebate program tracking data, which we used to calculate rebate program joint savings. The tracking data included participant information, account numbers, program name, measures installed, installation dates, and claimed savings. PSE also provided us with end-use load shapes when we first began evaluating the HER program, which we used to determine when savings occurred during the year for each measure installed.

3.3 Daily Consumption Data

DNV received daily consumption data from January 2022 to December 2022 from Oracle to facilitate the impact analysis. This dataset included premise numbers, customer account numbers, meter numbers, daily consumption reads, read dates, and the type of reading (actual or estimated).

3.4 Program Staff Interview

The program staff interview took place in October of 2023 with the PSE HER program manager. The primary goals of the program staff interview were to understand any recent and planned program changes, barriers preventing HER recipients from saving more energy, and opportunities for increasing savings through the HER program.

3.5 Online Consumer Survey Data

As part of the process evaluation, DNV sent surveys via email to 85,993 customers enrolled in the HER program ("treatment" customers) and 36,025 customers who are not enrolled ("control" customers) as shown in Table 3-1. Of the customers who received a survey, 7% of control group and 7% of treatment customers responded, for a total of 2,645 responses from control and 6,034 responses from treatment customers. Overall, DNV sent out 122,018 surveys, of which 8,679 were completed, representing a 7% response rate.

Table 3-1. Online survey responses and response rates

Recipient Type	Surveys Sent*	Surveys Completed	Response Rate
Treatment	85,993	6,034	7%
Control	36,025	2,645	7%
Total	**122,018**	**8,679**	**7%**

* When preparing the online survey sample, DNV removed participants from the HER survey population who either: a.) opted out of receiving emails or b.) did not have valid email addresses.

Data collected from the survey included questions intended to determine changes in household occupancy, which could change total energy use. The survey also included questions on different energy saving technology purchases/ownership, with in-depth questions on heating and cooling behavior, as this represents a large fraction of energy use. HER recipients saw questions on their awareness of, attitudes toward, and satisfaction with the reports, and whether they found them useful. Finally, all survey participants answered questions on demographics, including questions on income and education.

To motivate respondents to participate in the online survey, we held a lottery that offered two e-gift cards incentives of $300 and $200. Respondents who completed the survey were eligible to win one of the prizes if they consented to participate in the gift card lottery. All respondents were provided the option to opt-out of the survey and opt-out of the gift card lottery.

4 IMPACT EVALUATION RESULTS

4.1 Overview

Below we present the measured, joint, and credited impact evaluation savings results for the 2022 HER program.

4.2 Results

Table 4-1 presents a summary of credited savings per household and joint savings results for the legacy cohorts. The legacy current treatment group produced statistically significant credited electric savings of 122 kWh (1.3%) and gas savings of 8.7 therms (1.1%). Unlike the previous year (PY 2021), the suspended treatment group produced statistically significant electric savings of 121 kWh (1.3%) and gas savings of 9.7 therms (1.2%). Consistent ongoing gas savings from the suspended group may be due to installation of more efficient hardware, while electric savings may depend more on behavioral changes, such as turning off lights and unplugging discretionary load. Efficient gas hardware would remain after the program, while discretionary behaviors may attenuate.

Table 4-1. Summary of credited savings per household for PSE HER legacy, 2022

Treatment Groups	Consumption	HER Measured Savings	Downstream Joint Savings	Upstream Joint Savings	Credited Savings	Percent Credited Savings
Electric (kWh)						
Current	9,603	129.2*	7.0	0.0	122.2*	1.3%
		(43.1, 215.4)	(-2.7, 16.6)	(0.0, 0.0)	(35.6, 208.9)	
Suspended		121.0*	0.0	0.0	121.0*	1.3%
		(11.0, 231.1)	(0.0, 0.0)	(0.0, 0.0)	(11.0, 231.1)	
Gas (Therms)						
Current	796	10.6*	1.9*		8.7*	1.1%
		(5.2, 15.9)	(0.6, 3.2)		(3.2, 14.2)	
Suspended		9.7*	0.0		9.7*	1.2%
		(2.7, 16.7)	(0.0, 0.0)		(2.7, 16.7)	

* Indicates statistically significant at 90% confidence level. Values in parentheses show upper and lower bounds at 90% confidence level.

Table 4-2 provides the same summary of savings for the expansion cohorts. For electric savings, the cohorts that date from 2020 and earlier generated statistically significant savings. The most recent cohorts, which include the manufactured home refill, multifamily, and low-to-moderate income (LMI), have low or negative savings that are not statistically significant. On the gas side, the two earliest cohorts (high-user, non-urban) and the most recent gas-only 2022 cohort did not produce statistically significant savings. Statistically significant savings is produced by a combination of non-zero per household savings and a sufficient number of customers in the cohort to produce confidence intervals smaller than the savings magnitude. The recent cohorts have small or negative savings. Even in the case of the most recent multifamily cohort, which had a control group of almost 35,000 customers,[5] the confidence intervals are greater than the modest savings. The early gas cohorts have cohort-level control groups that have dropped to relatively small numbers so, despite the high user cohort having reasonable magnitude savings, the result is still not significant. In combination, across all cohorts, these savings combine to produce statistically significant savings.

[5] The smaller group count drives the precision estimates and control groups are sized to limit the number of customers excluded while maintain reasonable precision.

Table 4-2. Summary of credited savings per household for PSE HER expansion, 2022

Treatment Groups	Consumption	HER Measured Savings	Downstream Joint Savings	Upstream Joint Savings	Credited Savings	Percent Credited Savings
Electric (kWh)						
Electric Only	14,545	219.6*	12.1	0.0	207.4*	1.4%
		(65.8, 373.3)	(-16.6, 40.8)	(0.0, 0.0)	(51.0, 363.9)	
High User	11,313	276.9*	16.1*	0.0	260.8*	2.3%
		(133.6, 420.2)	(4.2, 28.0)	(0.0, 0.0)	(117.1, 404.6)	
Non-urban	10,167	145.0*	10.7*	15.9	118.4*	1.2%
		(43.6, 246.4)	(1.3, 20.1)	(-10.2, 42.0)	(13.3, 223.5)	
Refill	12,330	234.0*	18.4*	2.4	213.2*	1.7%
		(100.5, 367.5)	(8.9, 27.9)	(-29.3, 34.0)	(75.7, 350.8)	
Refill Electric Only	21,864	330.7*	16.8*	0.0	313.9*	1.4%
		(184.7, 476.8)	(5.2, 28.4)	(0.0, 0.0)	(167.4, 460.4)	
Manufactured Homes	15,009	242.3*	13.2	3.6	225.6*	1.5%
		(51.8, 432.8)	(-4.9, 31.3)	(-31.7, 38.8)	(31.0, 420.1)	
Refill 2020	10,557	99.0*	0.4	12.7	85.9*	0.8%
		(59.5, 138.5)	(-2.6, 3.4)	(-6.3, 31.7)	(42.0, 129.9)	
Manufactured Homes Refill	14,947	-65.7	11.3	0.0	-77.1	-0.5%
		(-273.1, 141.7)	(-13.1, 35.7)	(0.0, 0.0)	(-285.9, 131.8)	
Multifamily Homes 2022	8,486	17.0	0.1	0.0	16.9	0.2%
		(-0.5, 34.5)	(-0.9, 1.1)	(0.0, 0.0)	(-0.6, 34.4)	
LMI	4,895	-2.2	1.7*	0.0	-2.2	-0.0%
		(-30.3, 25.9)	(0.2, 3.2)	(0.0, 0.0)	(-30.3, 25.9)	
Gas (therms)						
High User	787	7.3	2.2*		5.1	0.7%
		(-0.2, 14.8)	(0.9, 3.5)		(-2.5, 12.7)	
Non-urban	717	3.0	0.2		2.8	0.4%
		(-2.2, 8.1)	(-0.7, 1.1)		(-2.4, 8.0)	
Refill	839	8.1*	0.4		7.7*	0.9%
		(1.7, 14.5)	(-0.5, 1.3)		(1.3, 14.2)	
Refill 2020	717	4.5*	0.1		4.4*	0.6%
		(2.4, 6.6)	(-0.2, 0.3)		(2.3, 6.5)	
Gas Only 2021	630	5.6*	0.0		5.6*	0.9%
		(3.9, 7.3)	(-0.1, 0.1)		(3.9, 7.3)	
Gas Only 2022	293	0.3	0.0*		0.3	0.1%
		(-1.0, 1.7)	(0.0, 0.1)		(-1.0, 1.7)	

* Indicates statistically significant at 90% confidence level. Values in parentheses show upper and lower bounds at 90% confidence level.

Among the expansion cohorts, the electric-only refill cohort generated the largest credited electric savings per household while the refill cohort generated the largest credited gas savings per household. The non-urban cohort generated the largest joint electric savings, primarily due to upstream joint savings. Savings are cumulative for the 5-year effective useful life of the rebated lighting products and thus leave a sizeable amount of upstream savings for this cohort. Prior year upstream savings that remain will continue to be deducted until the remaining useful life of rebated bulbs and fixtures expire.

Table 4-3 presents baseline electric and gas consumption and the average savings per household as a percent of consumption for the unmatched households. For each fuel, we selected the legacy current cohort's percentage savings per household and multiplied these by the unmatched group's baseline consumption to generate the credited savings per household for the group.

Table 4-3. Summary of credited savings for the unmatched group

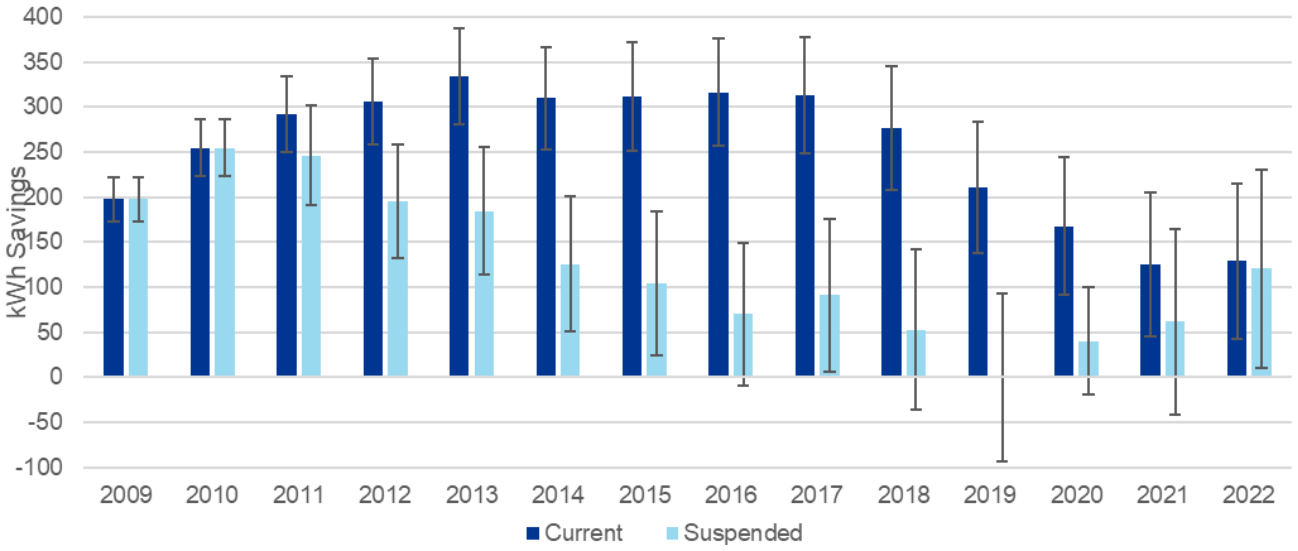
Electric (kWh)			Gas (Therms)		
Consumption	Savings	Percent	Consumption	Savings	Percent
9,421	119.9 (33.2, 206.6)	1.3%	872	9.5 (4.0, 15.0)	1.1%

* Indicates statistically significant at 90% confidence level. Values in parentheses show upper and lower bounds at 90% confidence level.

To put the 2022 findings in context, we provide measured electric and gas savings over time. Figure 4-1 provides measured electric savings and Figure 4-2 shows measured gas savings for the legacy program from 2009 to 2022. The current legacy cohort has continually registered electricity savings since the start of the HER program. While the savings for this cohort have persisted over the entire period, their upward trend has stalled since 2013 (the fifth year of the program) and decreased from 2017 to 2021 before increasing again in 2022. The electric savings of the suspended cohort have generally been in decline since the group stopped receiving HERs in 2011, generating insignificant savings from 2018 through 2021. In 2022, the cohort's electric savings became significant again for the first time since 2017.

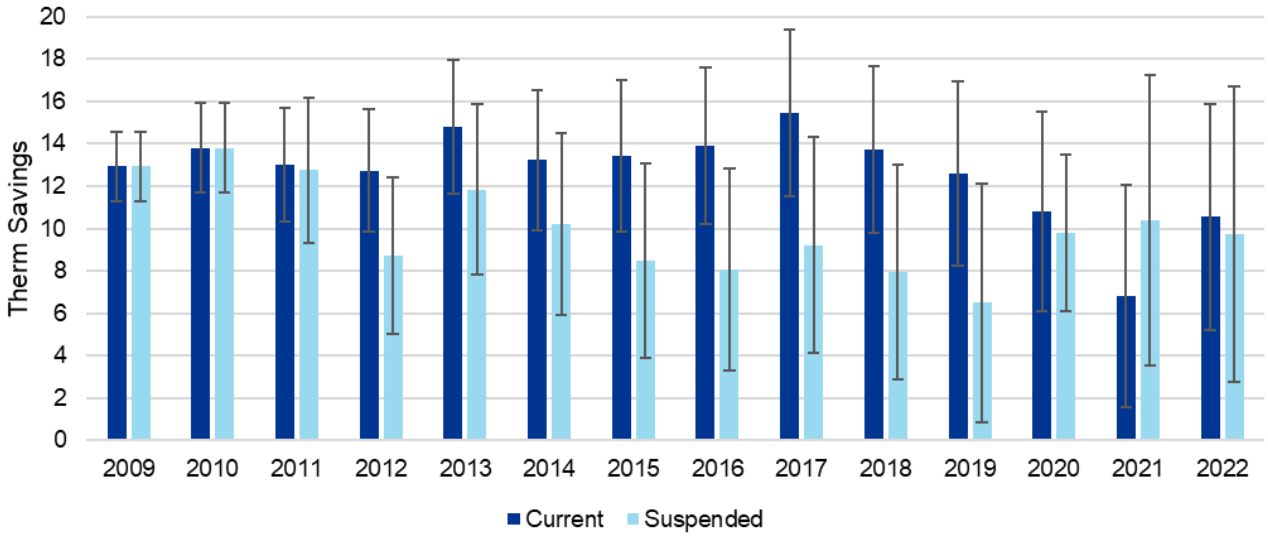
Gas savings also persist both for the current and suspended legacy cohorts. Gas savings do not have a marked trend and are not statistically different over the years. Legacy suspended gas savings have generally decreased since PSE discontinued HER messaging.

Figure 4-1. Measured HER electric savings per household for legacy, 2009-2022



Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

Figure 4-2. Measured HER gas savings per household for legacy, 2009-2022

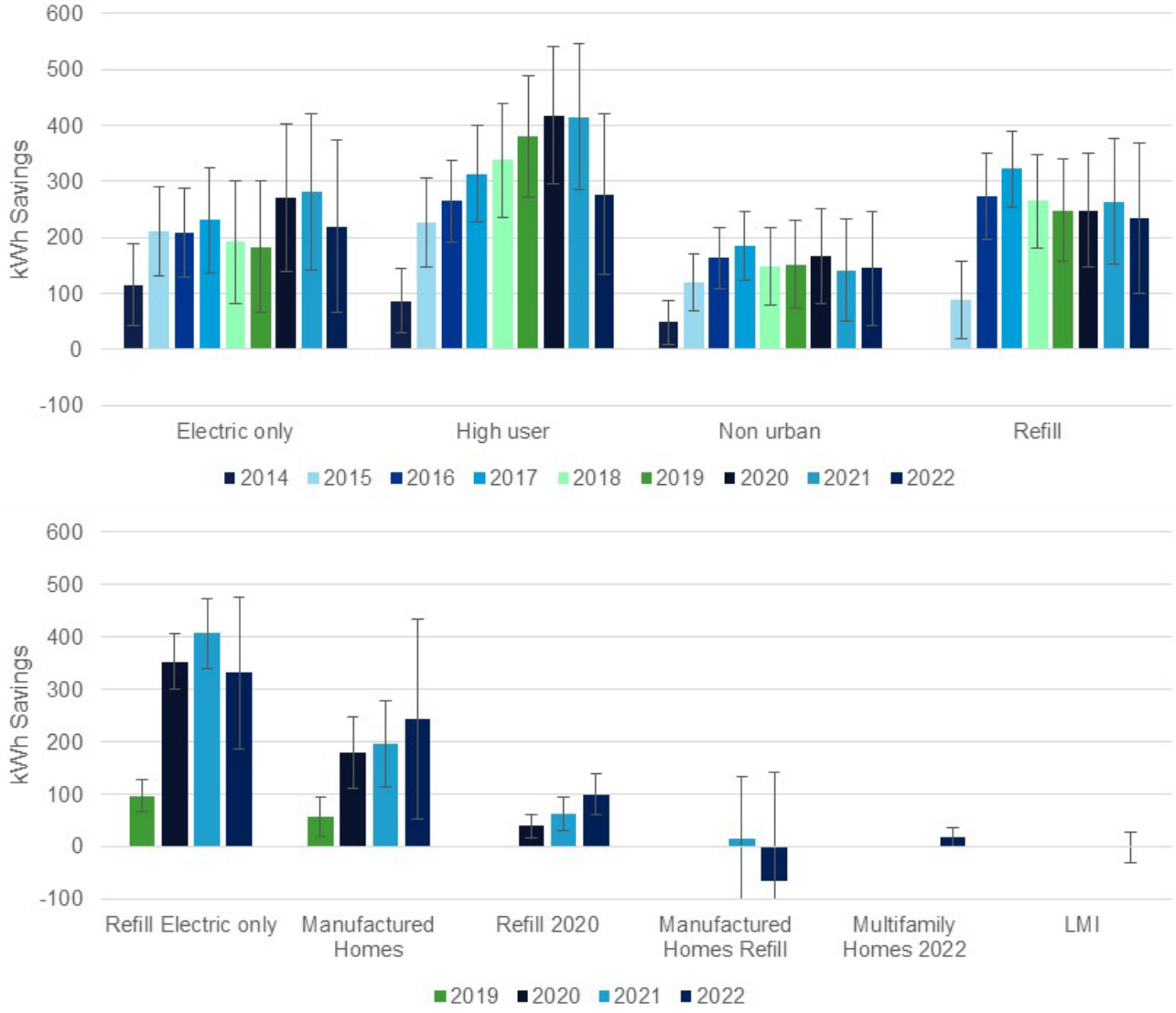


Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

We provide electricity measured savings over time for the expansion cohorts in Figure 4-3 and gas measured savings over time in Figure 4-4. The savings for 2014 reflect partial year HER messaging as the program began in March 2014 for high users, electric-only and non-urban households, all of which were in their eighth full year of the program in 2022. The refill group is in its seventh full year since the program for this group began in May 2015. Both the manufactured homes refill and gas-only refill began in March and September 2021, respectively, so they were in their first full year of the program in 2022. The multifamily home savings reflect a full year of being in the program while the LMI and gas-only 2022 cohorts' savings reflect approximately half a year of being in the program. Measured electric savings are lower than they were in 2021 for the earlier cohorts while some of the more recent cohorts are still exhibiting signs of ramp-up. The increasing trend in savings for both electricity and gas follow patterns exhibited by other HER cohorts in their early years. However, the refill 2020 cohort showed a very small increase in electric savings in 2022 compared to 2021, which is much smaller than what previous cohorts exhibited. The manufactured homes refill and LMI cohorts generated insignificant negative savings while the multifamily homes cohort generated a small amount of significant savings. The gas-only 2022 refill cohort generated positive but insignificant savings as well.

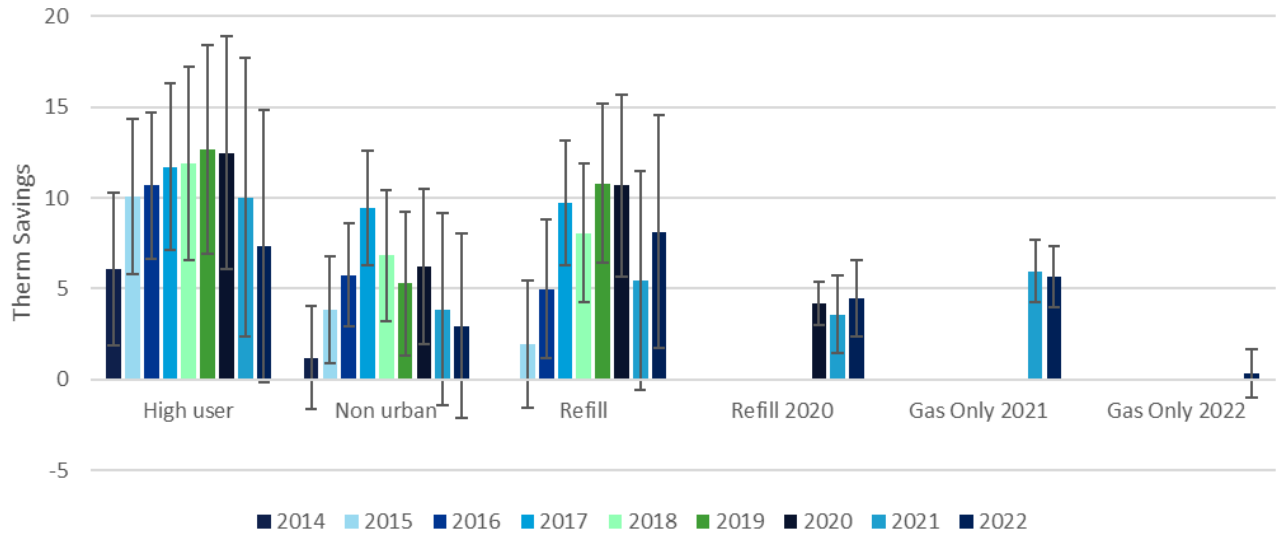
Overall, the early cohorts that started in 2014 and 2015 may have already reached their peaks and may continue to decline moving forward. The 2020 refill and manufactured homes refill groups have been underperforming compared to their original cohort counterparts. PSE should consider how to move forward with underperforming cohorts.

Figure 4-3. Measured HER electric savings per household for expansion cohorts from 2014 to 2022



Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

Figure 4-4. Measured HER gas savings per household for expansion cohorts from 2014 to 2022



Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

Figure 4-5 and Figure 4-6 show the total measured program savings across all cohorts from 2015 through 2022. We see that the total program savings generally increased over time as new cohorts were added. However, looking at the per household level (Figure 4-7 and Figure 4-8), savings have been trending downward since 2017. It is possible that messaging from the HER program has become less impactful as awareness of how to reduce energy consumption has increased across the population over time. Furthermore, as the program has expanded and attrition has occurred in older cohorts, some households that were previously in treatment groups may have moved and are now in a control group. These households' energy saving habits may have persisted even though they are no longer receiving HERs. Alternately, some control households may have moved into a home that was previously in a HER treatment group.

Figure 4-5. Total electric program savings from 2015 to 2022

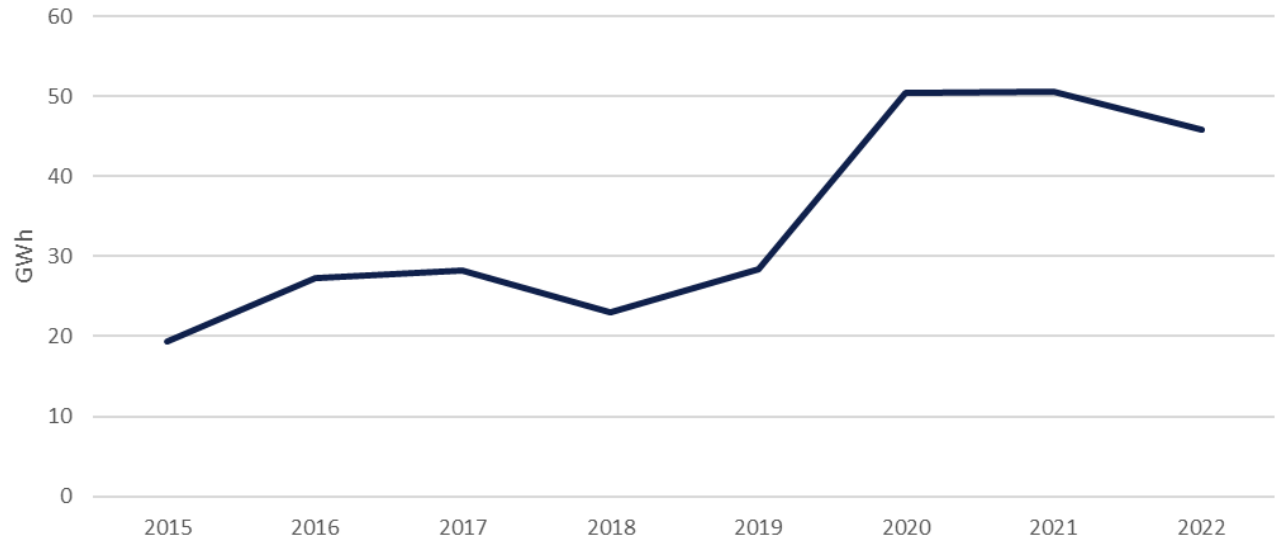


Figure 4-6. Total gas program savings from 2015 to 2022

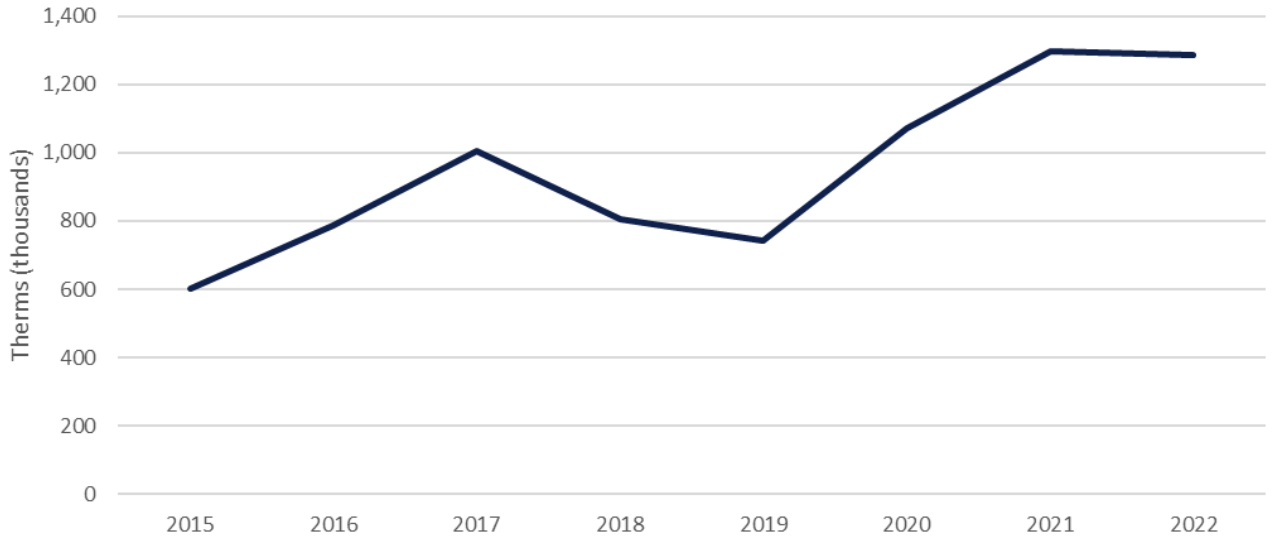


Figure 4-7. Per household electric savings from 2015 to 2022

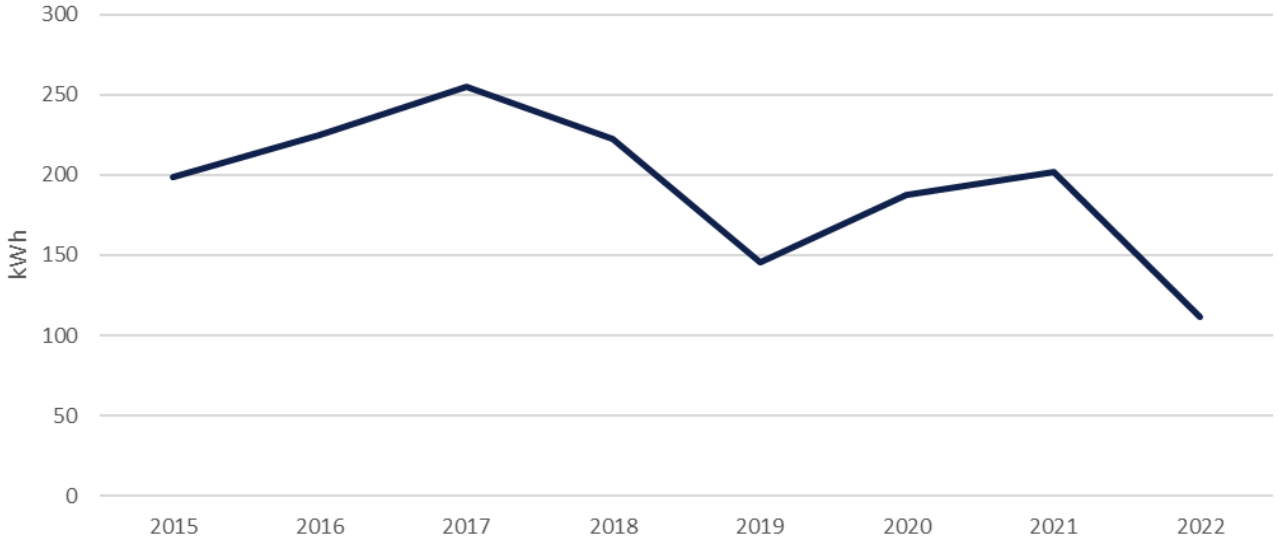
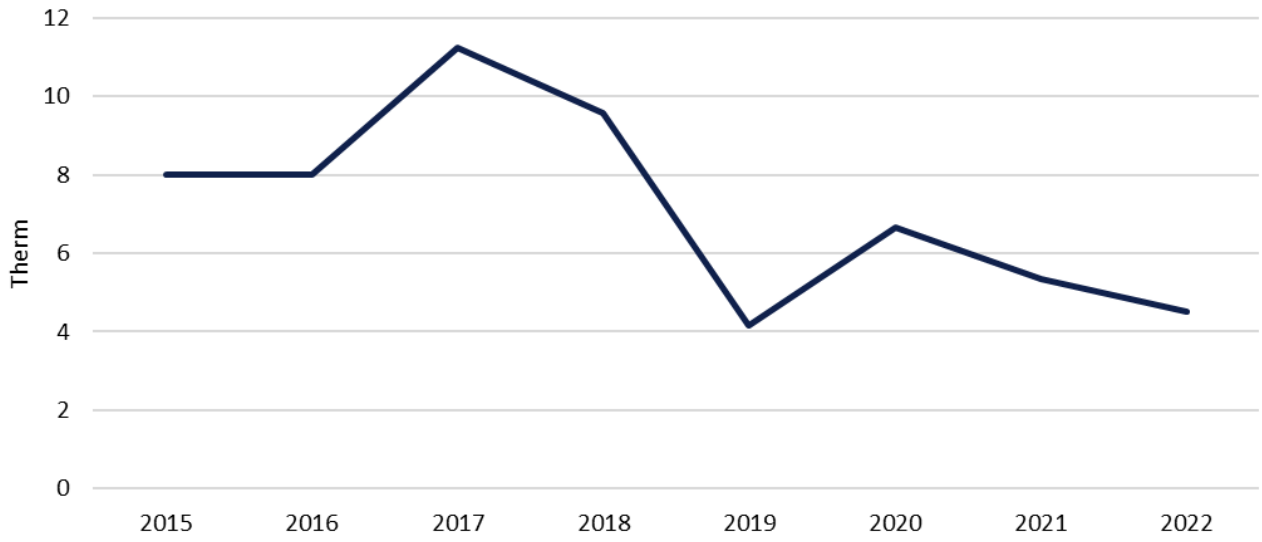


Figure 4-8. Per household gas savings from 2015 to 2022



5 PROCESS EVALUATION RESULTS

5.1 Recent and Planned Program Changes

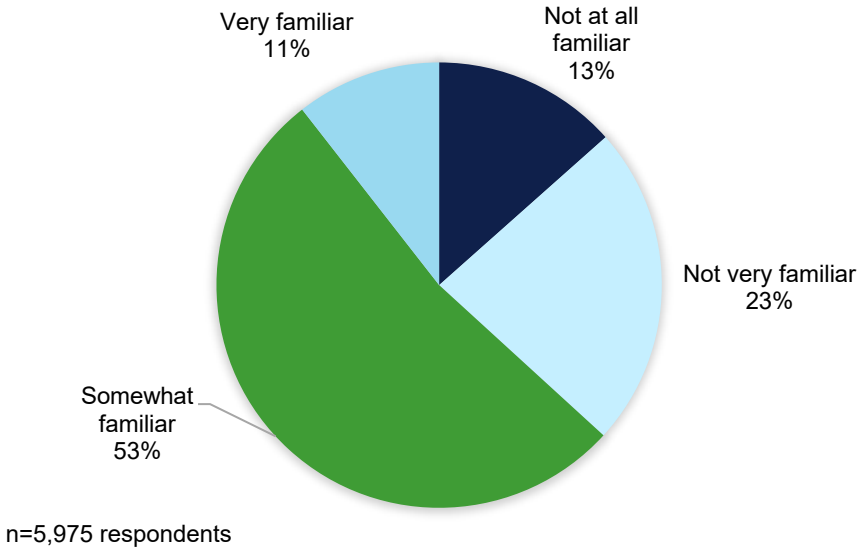
DNV spoke with PSE's HER program manager in October of 2023 about recent and planned program changes. In 2022, PSE added an electric-only multifamily homes cohort in January of that year (104,637 treatment households and 34,879 control households). In June of 2022, PSE also added an electric-only LMI cohort (39,999 treatment and 10,000 control households) as well as a gas-only refill cohort (60,000 treatment and 15,000 control households). For 2023, PSE did not add any new cohorts, but did add approximately 85,000 households as refill households split between the 2020 dual fuel cohort and the 2022 electric-only LMI cohort. PSE is not planning to add any new cohorts in 2024.

Other changes to the program include a reduction in the number of print reports that PSE is mailing to households in favor of email reports. The frequency of reports can vary between quarterly, every other month, and monthly. Before the end of 2023, PSE also expects to send out HERs with estimates on electric usage related to electric vehicle (EV) charging among households identified as having level 2 EV charging[6]. Evaluators asked whether PSE offers HERs in languages other than English, such as Spanish. PSE currently does not offer Spanish language HERs, but the program implementer is able to provide this service if PSE chooses to add Spanish language HERs in the future.

5.2 Awareness

DNV assessed awareness of PSE's conservation programs and HERs through an online survey. We evaluated HER recipient awareness by first asking respondents how familiar they are with PSE's energy efficiency or conservation programs that are designed to help identify ways to use less energy or lower their bill. Figure 5-1 shows that over half (53%) of the 5,975 respondents reported being "somewhat familiar" with energy efficiency or conservation programs, with only a relatively small percent (11%) of respondents being "very familiar".

Figure 5-1. Familiarity with PSE's energy efficiency and conservation programs: HER recipients

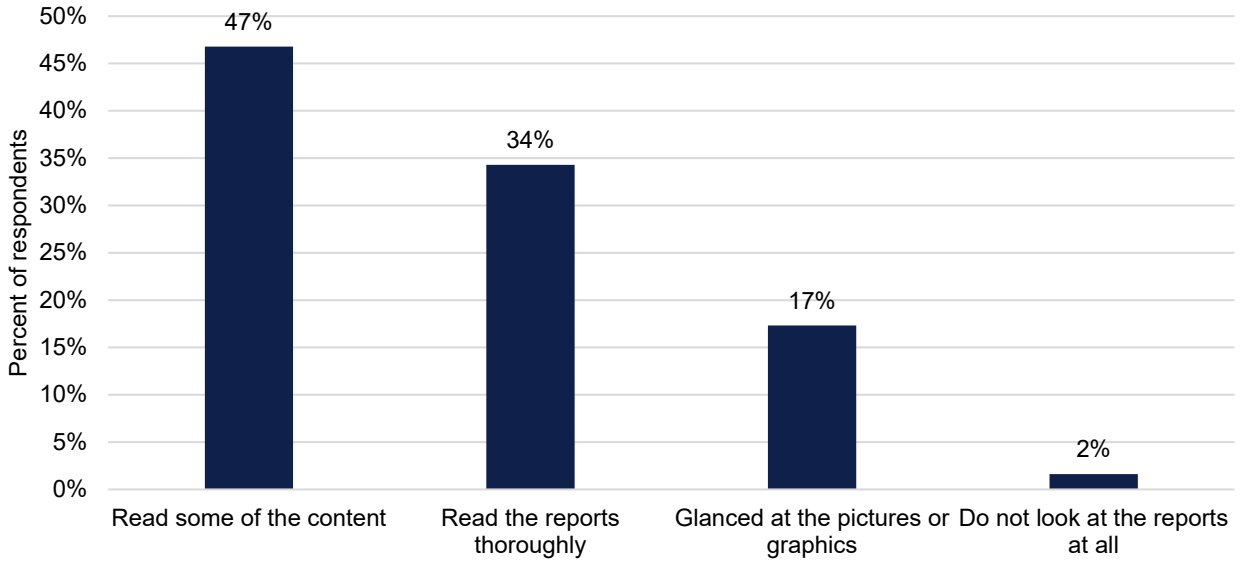


[6] A Level 1 EV charger delivers around 1.2 kW to an EV, while a Level 2 charger ranges from 6.2 to 19.2 kW. A Level 2 EV charger requires a 240v outlet.

HER recipients were then asked if they remembered receiving a HER from PSE in the past 3 months. A large majority (88%) of respondents stated they did remember receiving the HER, with the remainder reporting they either did not (7%) or were not sure (5%).[7]

Next, all respondents who said they remembered receiving the HER were asked, in general, what they do with them. As depicted in Figure 5-2, most of the participants either read some of the content (47%) or read the reports thoroughly (34%). Only 2% of the respondents said they did not look at them at all. This suggests that a vast majority of respondents have at least a moderate level of engagement with the HER reports they receive.

Figure 5-2. Level of attention given to HER



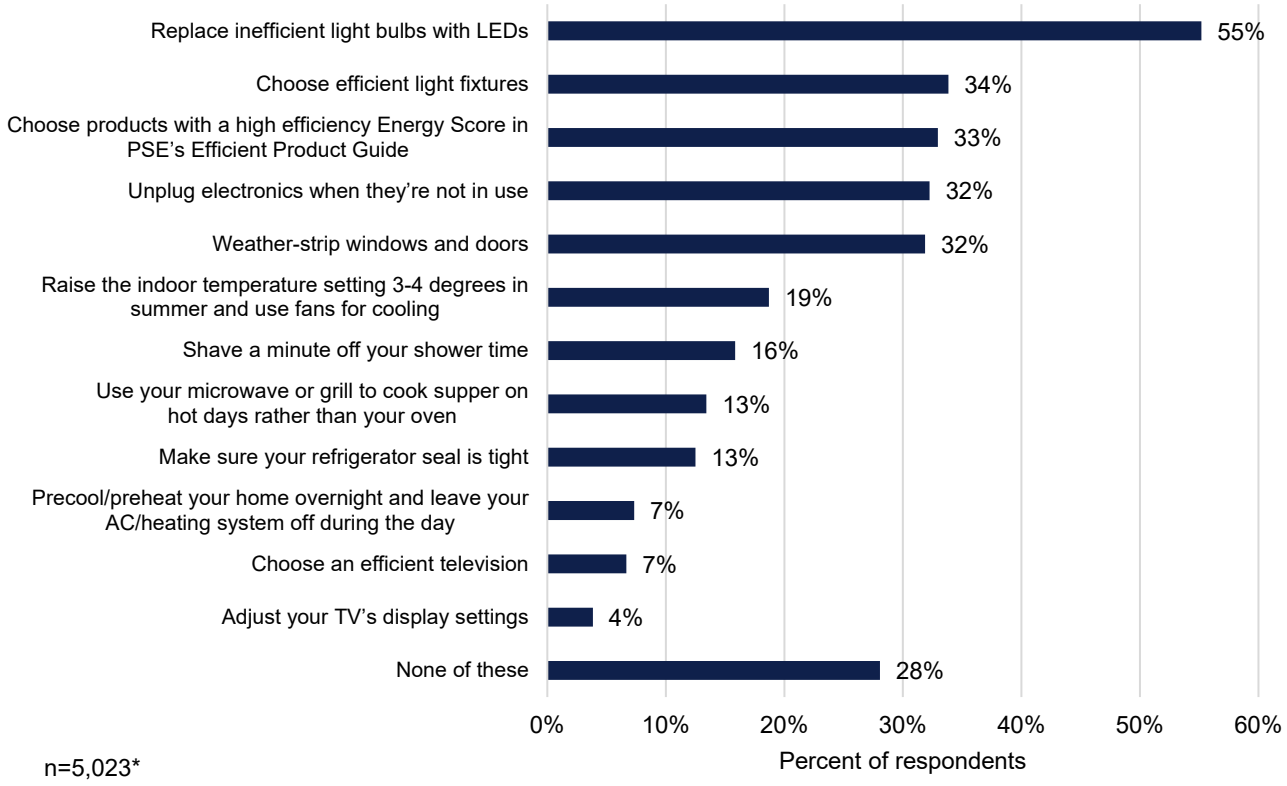
n=5,227

Respondents who remembered receiving the HER were then presented with a list of advertisements and messages and asked which they recalled seeing in the HER. Figure 5-3 shows over half (55%) of the participants who responded to this question recalled seeing the suggestion to replace inefficient light bulbs with LEDs. Roughly a third of the respondents remembered seeing the suggestion to choose efficient light fixtures (34%), choose products with high efficiency scores (33%), or unplug electronics when they are not in use (32%). About a quarter of the respondents (28%) reported they did not recall any of the messages presented to them.

Survey respondents were also presented with two messages that were not actually shown to participants on the HERs. Thirteen percent of respondents incorrectly recalled seeing the message to “use your microwave or grill to cook supper on hot days rather than your oven” and 7% incorrectly recalled seeing the message to “precool/preheat your home overnight and leave your AC/heating system off during the day.”

[77] There were 5,975 responses to this question.

Figure 5-3. Recollection of specific home energy report messages



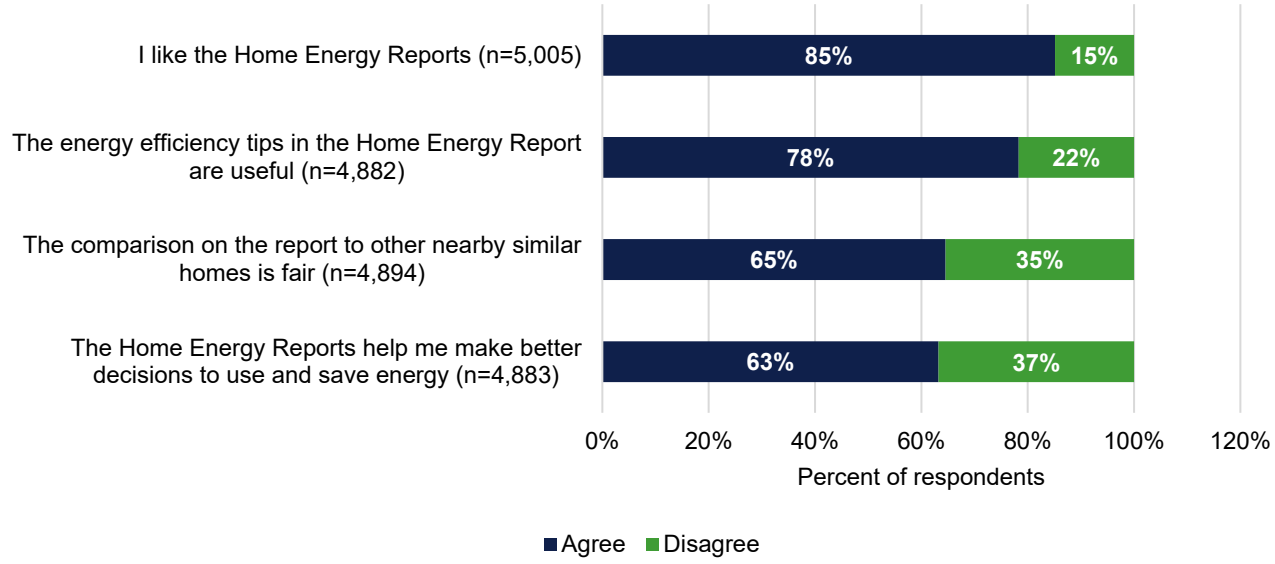
*Respondents were instructed to select all the messages they recalled, so the totals exceed 100%.

5.3 Satisfaction

Participant satisfaction was first evaluated by asking respondents if receiving the report made them more or less satisfied with PSE. About three-quarters (68%) of the survey respondents stated that their opinion of PSE did not change. Twenty-seven percent reported that they were more satisfied with PSE after receiving the HER, with the remaining respondents (5%) being less satisfied. This suggests that HERs do not change customer perception of PSE for the vast majority of customers, but they may have a net positive effect on perception for some customers.

Program participants were also asked to think about the HER and then decide if they agree or disagree with the various statements (see Figure 5-4). A large majority of respondents agreed that they liked the HER (85%) and the energy efficiency tips within the report were useful (78%). Fewer respondents, though still a majority, agreed that the comparisons to similar homes were fair (65%) or that the reports helped them make better energy-related decisions (63%).

Figure 5-4. Program experience and satisfaction



5.4 Mechanisms for Savings

In addition to asking HER recipients about their awareness and satisfaction with the reports, we compared their self-reported energy usage behaviors to the control group of survey respondents who do not receive HERs. Table 5-1 contains self-reported percentages of HER recipients and non-recipients who use certain energy-consuming technologies. The technologies included in the survey were intended to represent new technologies and those that consume large amounts of electricity. None of these technologies shows a significant difference between groups, indicating if there are any effects that influence HER savings, they are small. Interestingly, while we did not investigate the significance of trends from the similar survey in 2021, there is some suggestion of increases in adoption of technologies such as air purifiers, mini-splits, solar panels, EVs, and home battery storage.

Table 5-1. Comparison of recipient and non-recipient energy using technologies

Which of the Following Technologies Do You Currently Use?	Non-recipients (n=2,608)	Recipients (n=5,943)
Home hub or smart hub (like Amazon Alexa or Google Home)	28.8%	29.4%
Smart LED light bulbs (can be controlled by a phone app)	24.8%	22.5%
Smart appliances (appliances that can be controlled by a phone app)	13.6%	15.3%
Smart thermostat (internet connected like Nest or Ecobee)	20.1%	22.3%
Central forced air or heat pump	43.1%	43.6%
Ductless heat pump or mini-split system	7.1%	7.2%
Air purifier	27.3%	25.8%
Window air conditioning unit	22.7%	25.4%
Solar photovoltaic panels	4.1%	4.0%
Battery storage (like Enphase or Powerwall)	0.8%	1.1%
Plug-in EV	8.7%	9.1%
None of these	18.1%	17.4%

* Bold text indicates a statistically significant difference between recipients and non-recipients at 90% confidence level.

Table 5-2, similarly, shows no significant difference between HER recipients and non-recipients in energy saving actions. As such, there is no trend to help explain whether or which energy-saving actions lead to overall HER savings. We do see potential trends since the 2021 survey in fewer customers reporting cleaning air filters, having HVAC maintenance done, or setting cooling setpoints higher when the home is unoccupied.

Table 5-2. Comparison of recipient and non-recipient energy saving actions

Which of the Following Energy Saving Actions Do You Take in Your Home?	Non-recipients (n=2,604)	Recipients (n=5,935)
Keep water heater at a reduced temperature	42.3%	44.5%
Clean/replace air filters on space heating system	57.3%	58.3%
Professional maintenance performed on heating/cooling system	42.4%	41.8%
Turn down heat at night	82.4%	82.4%
Turn down heat when your home is unoccupied	79.0%	80.0%
Set cooling setpoint to higher temperature during the day	29.3%	30.7%
Set cooling setpoint to higher temperature when home is unoccupied	31.4%	31.8%
None of these	3.2%	2.5%

* Bold text indicates a statistically significant difference between recipients and non-recipients at 90% confidence level.

We also asked more detailed questions about other specific home heating and cooling behaviors around smart thermostat settings. We did find significantly more HER recipients likely to set their heating setpoints at lower temperatures and cooling setpoints at higher temperatures, though they were also significantly more likely to override setpoints in the heating season. HER recipients also report being significantly more likely to prioritize saving energy to the extent that they are somewhat uncomfortable.

Overall, these results are inconsistent with survey results from 2021, so it is challenging to attribute HER savings to one group of actions or technologies that differentiate HER recipients.

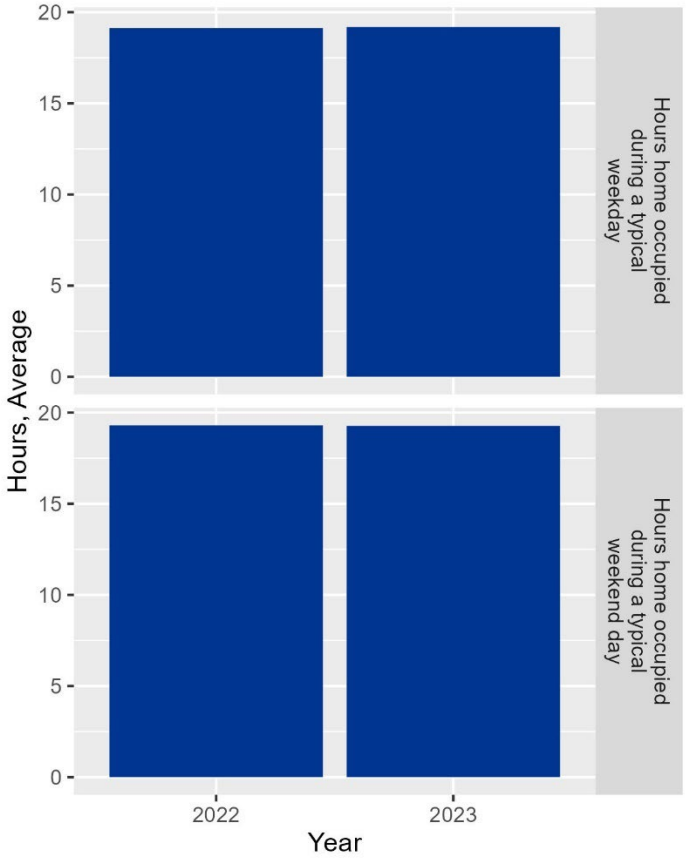
Again, it is likely that very small differences (not detectable at a statistically significant level) across many different technologies and behaviors lead to these savings. When we look for statistically significant differences across many variables, it is likely that some will appear significant simply by chance. Given that most differences, even those that are significant, are small, we would expect that the effects will shift between surveys, even given the large sample sizes. This means that even with this large survey sample size, we are unable to conclusively identify those differences.

5.5 Other Online Survey Results

5.5.1 Occupancy

Overall, we found that despite the end of the COVID-19 public health emergency and associated restrictions, homes still tend to be occupied most hours of the day. Figure 5-5 shows that customers tend to occupy their homes about 19.1 hours per weekday and 19.3 hours per weekend day in 2022 and 2023. While the survey conducted for the 2019-2020 program year (PY) evaluation asked about time at home in a different way and is therefore not exactly comparable to these results, we note that these survey results indicate slightly more hours at home than were reported for 2019 (135 hrs per week in 2022-2023 vs.131 hrs per week in 2019) and fewer hours than in 2020 (135 hrs per week in 2022-2023 vs. 143 hrs per week in 2020).

Figure 5-5. Home occupancy per day in the post-COVID emergency years



5.5.2 Equity

Like the 2021 customer survey, this effort studied how low income customers experienced HERs differently than non-low income customers. We found that many low income customers (defined here as having a self-reported income of less than $50,000) had different levels of awareness, satisfaction, and perceived usefulness of HERs, when compared to non-low income customers.

We first explored customer awareness of PSE's energy efficiency programs overall (both HER recipients and non-recipients responded to this question). Specifically, we asked "How familiar are you with PSE's energy efficiency or conservation programs that are designed to help you identify ways to use less energy and lower your bill?" The results in Table 5-3 indicate that about 5% fewer low income respondents were not very familiar with programs and that about 6% more low income respondents were very familiar with programs. Survey results indicate a statistically significant trend of more low income customers who are not at all familiar with PSE's programs, more non-low income in the middle awareness categories, and also more low income customers who are very familiar with programs.[8] These results would indicate a segment of low income customers that PSE is reaching with its programs, and another segment that could see big benefits from increased outreach.

Table 5-3. Familiarity with PSE's energy efficiency programs: low income and non-low income customers

How Familiar are You with PSE's Energy Efficiency or Conservation Programs that are Designed to Help You Identify Ways to Use Less Energy and Lower Your Bill?	Low Income (%) (n=712)	Non-low Income (%) (n=3,652)
Not at all familiar	14%	12%
Not very familiar	**18%**	**23%**
Somewhat familiar	53%	55%
Very familiar	**16%**	**10%**

* Bold text indicates a statistically significant difference between low income and not low income at 90% confidence level.

We then asked HER recipients about their level of engagement with the reports: "Thinking of all the reports you have received, in general, what have you done with them?" Table 5-4 shows that low income recipients are more likely to engage with the reports, with 50% reading the reports thoroughly, as compared to only about 33% of other recipients.

Table 5-4. Level of engagement with HERs: low income and non-low income customers

Thinking of All the Reports You Have Received, in General, What Have You Done with Them?	Low income (n=581)	Non-low Income (n=3,237)
Do not look at reports	2%	1%
Glanced at the pictures or graphics	**11%**	**18%**
Read some of the content	**38%**	**48%**
Read the reports thoroughly	**50%**	**33%**

* Bold text indicates a statistically significant difference between low income and not low income at 90% confidence level.

The last type of question where we saw differences in low income responses were those that asked about the report's usefulness. Specifically, these questions asked if recipients found the home energy reports useful for making better decisions for using and saving energy and if the tips in the reports were helpful. Table 5-5 demonstrates that low income recipients are about 5% more likely to find HERs useful as a decision-making aid and about 5% more likely to find the

[8] All response categories were found to be statistically significant in the 2019-2020 program year (PY) evaluation.

energy efficiency tips useful (when compared to non-low income recipients). Low income recipients are also about 5% more likely to report that the comparison to similar homes is fair.

Table 5-5. Comparison of recipients' reported usefulness of HERs: low income and non-low income customers

Percentage Who Agree with These Statements	Low Income	Non-low Income
The home energy reports help me make better decisions to use and save energy.	**72% (n=533)**	**67% (n=3,076)**
The energy efficiency tips in the Home Energy Report are useful.	**86% (n=541)**	**81% (n=3,068)**
The comparison on the report to other nearby similar homes is fair.	**75% (n=532)**	**70% (n=3,080)**

* Bold text indicates a statistically significant difference between low income and not low income at 90% confidence level.

Overall, these results indicate that HERs are an effective mechanism of reaching out to PSE's low income customers, reducing their energy burden, and promoting equity in energy savings.

We also examined whether low income customers tend to spend more or less time at home. While the differences were not statistically significant, low income customers reported averaging about an hour less time at home than other customers on weekdays, and about half an hour on weekends. If further research confirms this trend, PSE may want to target low income cohorts with messages about behaviors like setting thermostat schedules, which can help save energy when customers are away from home.

6 FINDINGS AND RECOMMENDATIONS

6.1 Impact Evaluation Findings

We note the following key findings from the impact evaluation.

FINDINGS	Total PSE HER 2022 credited electric savings were 42,405,144 kWh and credited gas savings were 1,219,536 therms. The total electric and gas savings are lower than what was achieved in 2021 despite adding new cohorts.
	Per household electric and gas savings have been trending downward since 2017. Possible explanations include customers who previously received the report becoming a member of the control group after moving, previous control customers moving into houses with energy-efficient upgrades done by previous customers who received the report, and the fact that the HER program is also starting to reach customers with less potential for energy savings than cohorts created earlier in the program's history, such as high electric and gas users.
	The legacy current cohort's measured electric and gas savings has been trending downwards for the past several years.
	The legacy suspended cohort's measured electric savings had been statistically insignificant for the past several years before turning significant again in 2022.
	The earlier expansion cohorts (electric only, non-urban, high user, refill) continue to save electricity and gas, but they have been exhibiting declines since reaching their peaks.
	The two expansion cohorts from 2019, the electric-only refill and the manufactured homes, continue to save electricity. The electric-only refill cohort generated less savings than in 2021 while the manufactured homes cohort generated more.
	The refill 2020 and manufactured homes refill cohorts have performed considerably worse than their original counterparts (refill 2015 and manufacture homes, respectively). • The refill 2020 cohort's electric per household savings is about a third of what the refill 2015 cohort achieved in their third year, and if it follows a similar trajectory then we should expect refill 2020 to generate fewer and fewer savings moving forward. • The manufactured homes refill's electric savings continued to stay statistically insignificant and even became negative in 2022. This is in complete contrast to the original manufactured homes cohort that continued to exhibit growing electric savings.
	The new cohorts introduced in 2022 generated smaller than expected savings.

6.2 Impact Evaluation Recommendations

We note the following recommendations based on key findings from the impact evaluation.

RECOMMENDATIONS	**Additional Review of HER Results:** DNV recommends that efforts should be made to understand why DNV and Oracle (the program implementer) have different unadjusted savings estimates. We recommend that these efforts include investigating the treatment and control counts used by DNV and Oracle among other potential sources of differences.
	2024 HER Mid-Year Unadjusted Analysis: DNV recommends a mid-year analysis in the summer of 2024 as a status check on how the HER program is performing in 2024 to help PSE improve its forecasts of expected program savings.
	Underperforming Cohorts: DNV recommends formulating a strategy regarding underperforming cohorts. Currently, cohorts that generate negative savings are excluded from the total program savings if we believe them to be one-off occurrences. However, if we start seeing a trend over the next year with negative savings, then we believe the cohorts should either count against the total program savings or be removed from the program

6.3 Process Evaluation Findings

Below are key findings from the process evaluation.

FINDINGS	The majority of the HER treatment customers (88%) were aware of seeing the report in the past three months, and 81% are at least moderately engaged with the reports.
	Per survey results, 95% of respondents primarily speak English at home. According to the US Census Bureau's 2022 American Community Survey (ACS), 21% of King County residents speak a language other than English at home. Survey results revealed a higher percentage of people who primarily speak English at home than the general population (95%).[9]
	PSE's customers spend more time working at home or otherwise being at home during the workweek than they did in 2019 but are spending more time away from the home than in 2020.
	Surveys show that low income HER recipients are more engaged with the reports and find the reports more useful than other recipients. They also are more likely to report having very little or very high awareness of PSE's energy efficiency programs.

[9] US Census Bureau. 2022 American Community Survey. https://www.census.gov/programs-surveys/acs/data.html

6.4 Process Evaluation Recommendations

We note the following recommendations based on key findings from the process evaluation.

RECOMMENDATIONS

Decarbonization: HERs are both an effective way to save energy and are broadly popular. Simple messages are remembered best. If PSE's goals evolve to focus on decarbonization instead of energy efficiency, a similar report recommending simple actions to achieve decarbonization is likely to be effective and well received.

Demand Response: Furthermore, as more customers electrify their homes, demand response programs will increase in importance. As PSE's demand response programs expand, HERs could include messages aimed at reducing electric consumption during peak hours and could also include information on how customers can enroll in demand response programs.

Spanish Language HERs: PSE should consider adding Spanish language HERs if they believe these may deliver additional cost-effective savings from the program. According to the ACS, 9% of King County residents primarily speak Spanish at home.

Low Income Customers: Given that low income customers have a higher level of engagement with HERs than non-low income recipients, PSE should consider increasing communications about programs that are geared toward low income customers in the HERs sent to the low and moderate income, manufactured homes, and multifamily cohorts.

7 APPENDICES

7.1 Appendix A: Impact Evaluation Methods

7.1.1 Fixed Effects Model

We estimated monthly savings using a fixed-effects (FE) regression model that is standard for evaluating behavioral programs like HER. The FE model estimates program savings by comparing consumption of the treatment group to the control group before and after program implementation. The change that occurs in the treatment group is adjusted to reflect any change that occurred in the control group, to isolate changes attributable to the program.

The FE equation is:

$$E_{it} = \mu_i + \lambda_t + \beta_t P_{it} + \varepsilon_{it}$$

Where:

E_{it} = Average daily energy consumption for account i during month t

P_{it} = Binary variable: one for households in the treatment group in the post period month *t*, zero otherwise

λ_t = Monthly effects

μ_i = Account level fixed effect

ε_{it} = Regression residual

This model produces estimates of average monthly savings using the following equation:

$$\bar{S}_t = \hat{\beta}_t$$

Where:

$\bar{S}_t$ = Average treatment related consumption reduction during month t

$\hat{\beta}_t$ = Estimated parameter measuring the treatment group difference in the post period month *t*

The model also includes site-specific and month/year fixed effects. The site-specific effects control for mean differences between the treatment and control groups that do not change over time. Baseline energy use is captured by estimates of λ_t in post-treatment period months. The month/year fixed effects control for change over time that is common to both treatment and control groups. The monthly post-program dummy variables pick up the average monthly effects of the treatment. During post-treatment months, the energy use of control households is estimated by $\widehat{\lambda_t}$ while those of the treatment households is estimated by $\widehat{\lambda_t}$+$\hat{\beta}_t$; the latter is a negative term that indicates reduction due to HER. This model is consistent with best practices as delineated in State and Local Energy Efficiency Action Network's (SEE Action) Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.[10]

[10] https://www.energy.gov/sites/default/files/2021-08/emv_behaviorbased_eeprograms.pdf

7.1.2 Lagged-Dependent Variable Model Results

Table 7-1 shows the credited electric savings generated by the lagged-dependent variable model.

Table 7-1. Total credited electric savings from LDV (kWh)

HER Treatment Group	Per Household				Total		
	Measured Savings	Joint Savings	Claimed Savings	No. in Group	Total savings	Lower Limit 90% CI	Upper Limit 90% CI
Legacy – Current	184	7	177	9,826	1,735,980	992,984	2,478,976
Legacy – Suspended	121	0	121	4,886	593,148	123,909	1,062,387
Legacy – Unmatched^			173	2,138	370,566	208,900	532,231
Expansion – Electric Only	219	12	207	14,744	3,054,810	1,053,991	5,055,630
Expansion – High Relative User	238	16	222	12,732	2,827,076	1,272,067	4,382,085
Expansion – Non-urban	148	27	122	19,513	2,372,776	619,944	4,125,608
Expansion – Refill	259	21	238	13,260	3,159,270	1,530,644	4,787,897
Expansion – Refill Electric Only	365	17	348	46,705	16,239,999	12,192,492	20,287,507
Expansion – Manufactured Homes	231	17	215	28,307	6,071,965	2,692,190	9,451,740
Expansion – Refill 2020	98	13	84	70,638	5,968,443	2,904,419	9,032,467
Expansion – Manufactured Homes Refill	-59	11	-70	6,038	0	0	0
Expansion – Multifamily Homes 2022	20	0	20	101,844	2,009,497	196,155	3,822,838
LMI 2022	16	0	16	38,805	617,455	(1,044,446)	2,279,357
Total			**122**	**369,436**	**45,020,986**	**37,525,113**	**52,516,858**

Table 7-2 shows the total credited gas savings generated by the lagged-dependent variable model.

Table 7-2. Total credited gas savings from LDV (therm)

HER Treatment Group	Per Household				Total		
	Measured Savings	Joint Savings	Claimed Savings	No. in Group	Total savings	Lower Limit 90% CI	Upper Limit 90% CI
Legacy – Current	10	2	8	9,826	76,772	29,608	123,936
Legacy – Suspended	8	0	8	4,886	41,326	11,911	70,740
Legacy – Unmatched^			9	2,138	18,281	8,019	28,544
Expansion – High Relative User	6	2	4	12,732	46,800	(41,972)	135,571
Expansion – Non-urban	6	0	6	19,513	119,626	26,506	212,746
Expansion – Refill	10	0	10	13,260	128,288	46,945	209,630
Expansion – Refill 2020	5	0	5	70,638	340,255	194,448	486,062
Expansion – Gas Only 2021	5	0	5	91,756	480,003	328,101	631,905
Expansion – Gas Only 2022	0.1	0	0.1	58,528	4,780	(105,071)	114,631
Total			**4**	**283,277**	**1,256,131**	**968,443**	**1,543,819**

7.2 Appendix B: Online Survey Sample Design

To create the sample frame for the HER online survey, the project team used PSE's list of residential customers who were active in 2022 and had an assigned HER cohort with treatment or control status. The project team developed the sample using a stratified random sample methodology to define separate targets for each HER cohort and treatment status. We selected a sample of 9,500 households based on results from the prior study that suggested this would be sufficient to achieve reasonably precise results for each of the cohorts and treatment statuses individually. The sample was stratified by total annual household consumption to ensure the survey covered a variety of home types and usage patterns to account for the potential of responses to vary based on these characteristics.

The sample targets and population for each HER wave are shown in Table 7-3.

Table 7-3. HER survey sample design

Wave	Treatment Status	Target Sample	Population
Dual-Fuel Non-urban	Control	136	6,596
	Treatment	392	19,521
Dual-Fuel Refill	Control	149	5,599
	Treatment	316	13,264
Dual-Fuel Refill ("Refill 2020")	Control	487	23,630
	Treatment	1,497	70,655
Electric Only	Control	49	4,912
	Treatment	144	14,802
Electric-Only LMI	Control	62	9,698
	Treatment	245	38,973
Electric-Only Manufactured Homes	Control	69	7,036
	Treatment	275	28,416
Electric-Only Manufactured Homes Refill	Control	16	1,538
	Treatment	59	6,055
Electric-Only Multifamily Homes	Control	173	33,995
	Treatment	517	101,933
Electric-Only Refill	Control	271	18,092
	Treatment	691	46,952
Gas-Only Refill ("Gas Only 2021")	Control	649	27,460
	Treatment	1,119	91,671
Gas-Only Refill ("Gas Only 2022")	Control	185	14,623
	Treatment	893	58,386
Legacy Current	Control	409	18,472
	Treatment	210	9,827
Legacy Suspended	Treatment	107	4,887
Relative High Users	Control	96	4,308
	Treatment	284	12,736
Total	**Control**	**2,751**	**175,959**
	Treatment	**6,749**	**518,078**
	All	**9,500**	**694,037**

After creating the sample, we scrubbed our sample frame of any customers that either did not have an email address in the data we received or requested to opt-out from any communication. The tables below show the target sample, completed sample, total population, and remaining population after scrubbing opt outs and bad emails for each wave and treatment status.

Table 7-4. HER survey scrubbing and completed samples

Wave	Treatment Status	Sum of Target Sample	Sum of Completed Sample	Sum of Population	Sum of Population: Opt Outs and Bad Emails Removed
Dual-Fuel Non-urban	Control	136	154	6,596	5,281
	Treatment	392	400	19,521	15,573
Dual-Fuel Refill	Control	149	142	5,598	4,304
	Treatment	316	291	13,264	10,398
Dual-Fuel Refill ("Refill 2020")	Control	487	416	23,629	19,913
	Treatment	1,497	1,248	70,655	59,200
Electric Only	Control	49	40	4,912	4,385
	Treatment	144	131	14,802	13,267
Electric-Only LMI	Control	62	40	9,698	9,036
	Treatment	245	177	38,973	36,194
Electric-Only Manufactured Homes	Control	69	66	7,036	6,352
	Treatment	275	240	28,416	25,683
Electric-Only Manufactured Homes Refill	Control	16	23	1,538	1,418
	Treatment	59	43	6,055	5,612
Electric-Only Multifamily Homes	Control	173	140	33,995	32,470
	Treatment	517	372	101,933	97,490
Electric-Only Refill	Control	271	263	18,092	15,791
	Treatment	691	579	46,952	40,895
Gas-Only Refill ("Gas Only 2021")	Control	649	713	27,460	24,738
	Treatment	1,119	1,208	91,671	86,914
Gas-Only Refill ("Gas Only 2022")	Control	185	156	14,623	12,879
	Treatment	893	776	58,384	50,019
Legacy Current	Control	409	429	18,472	14,380
	Treatment	210	231	9,827	7,661
Legacy Suspended	Treatment	107	116	4,887	3,838
Relative High Users	Control	96	63	4,308	3,400
	Treatment	284	222	12,736	9,927
Total	**Control**	**2,751**	**2,645**	**175,957**	**154,347**
	Treatment	**6,749**	**6,034**	**518,076**	**462,671**
	All	**9,500**	**8,679**	**694,033**	**617,018**

7.3 Appendix C: Demographics of Online Survey Respondents

We provide information on the demographics of the online survey respondents in the tables below.

Table 7-5. Own or rent home

Own/Rent	Percent
Own	90%
Rent	10%
Do not own or rent	0%
Total	**100%**

n=8,487 respondents

Table 7-6. Home building type

Building Type	Percent
Single family detached home (home not attached to another home)	85%
Townhouse, duplex, or row house (shares exterior walls with neighboring unit, but not roof or floor)	5%
Apartment in multi-unit structure of 2-4 units	2%
Apartment in multi-unit structure of 5 or more units	3%
Manufactured or mobile home	5%
Other	1%
Total	**100%**

n=8,587 respondents

Table 7-7. Living space square footage

Living Space	Percent
Less than 1,200 square feet	11%
1,200 to less than 1,800 square feet	27%
1,800 to less than 2.400 square feet	28%
2,400 to less than 3,000 square feet	19%
3,000 square feet or more	16%
Total	**100%**

n=8,367 respondents

Table 7-8. Year home built

Year Built	Percent
Before the 1970s	29%
1970s	15%
1980s	14%
1990s	17%
2000-2009	16%
2010-2019	9%
2020-2023	1%
Total	**100%**

n=8,330 respondents

Table 7-9. Highest education level

Education Level	Percent
Elementary (grades 1-8)	0%
Some high school (grades 9-12)	1%
High school graduate	6%
Some college/trade/vocational school	23%
College graduate	39%
Postgraduate degree	30%
Other (please specify)	1%
Total	**100%**

n=8,202 respondents

Table 7-10. Primary household language

Primary Language	Percent
Chinese (including Mandarin and Cantonese)	1%
English	95%
Korean	0%
Russian	0%
Spanish	1%
Tagalog	0%
Vietnamese	0%
Other (please specify)	2%
Total	**100%**

n=8,423 respondents

Table 7-11. 2020 total income level

Income Range	Percent
Less than $10,000	1%
$10,000 - $19,999	2%
$20,000 - $24,999	2%
$25,000 - $49,999	10%
$50,000 - $74,999	14%
$75,000 - $99,999	15%
$100,000 - $149,999	22%
$150,000 - $174,999	9%
$175,000 - $199,999	6%
$200,000 - $249,999	8%
$250,000 or more	11%
Total	**100%**

n=6,289 respondents

7.4 Appendix D: Data Collection Instrument

PSE's Home Energy Report Part & Non-Part Online Survey

SURVEY NOTIFICATION LETTER AND SURVEY INVITE

From: "PSE Residential Energy Study"<pseresidentialstudy@pse.com>

Send reply to

Subject: We'd like to hear from you -- PSE Residential Energy Survey

Attach files...

Email priority (•) Normal ( ) High

[ ] Request read receipt

Dear PSE Customer,

Puget Sound Energy is committed to providing its customers with safe, reliable, and reasonably priced energy service. As part of this effort, we are conducting a Residential Energy Survey with DNV Energy (www.dnv.com), a company specializing in energy research, to learn more about lighting and energy usage in homes. This information will be used to help us make improvements to existing energy efficiency programs. The survey should only take ten minutes, and your responses are completely anonymous.

We value your help. Your participation is very important as only a limited number of customers were selected to take this survey.

Please complete the survey online. To get started, click here: **[ST]** This survey can be completed on a on mobile device, tablet, or a desktop computer**.**

Your answers will be held in the strictest of confidence. The information you provide will be combined with information from other households that complete the survey. Individual household responses will not be published. The results are reported in summaries such as group averages, percentages, and other general statistics.

Reward for you Participation: **Reward for your Participation**: As a thank you, you will be entered into a drawing for an Amazon e-gift card of up to $300. For more information on the contest rules please visit: https://www.pse.com/pages/pse-events/rules.

If you have any questions about the survey, please contact the PSE Energy Efficiency Evaluations Group at EESEvaluations@PSE.com

Thank you for participating in PSE's survey. We appreciate your input!

Jesse Durst
Senior Market Analyst
Energy Efficiency Services
Puget Sound Energy
EESEvaluations@PSE.com

- This email was sent by DNV on behalf of Puget Sound Energy. DNV is an authorized agent of Puget Sound Energy. If you have questions about the survey or would like to be removed from future surveys, please contact the study coordinator at: survey.pse@impact.dnv.com.
- To unsubscribe from future energy efficiency promotional emails, contact eesevaluations@pse.com.
- Link to PSE's Privacy Policy: https://www.pse.com/pages/privacy
-

SURVEY

Lighting

1. Do you have an active account with PSE at {address}?

    a1. Yes
    a2. No [END]

2. LED light bulbs are the most efficient light bulbs available on the market and come in many shapes and sizes. In this section we would like to learn about your household's purchase of LEDs light bulbs. Have you heard of LED lights?

    a1. Yes
    a2. No [Skip to Q8]
    a3. Don't know [Skip to 8]

3. In year 2023 or 2022 did anyone in your household purchase and install any of the following lights: LED screw-based bulbs, hard-wired fixtures, patio-style LED string lights, or linear LED tubes? Select all that apply.

    a1. LED screw-based bulbs
    a2. LED hard-wired fixtures
    a3. LED patio-style string lights
    a4. LED linear tubes
    a5. None of these

4. [Show if Q3= a1] Approximately how many LED screw-based light bulbs your household purchased in the following years? If you purchased any multi-packs, enter the total number of bulbs included in all packages. For example, two multi-packs with three bulbs each would count as six. Your best estimate is fine.

   a1. Total purchases in 2023:
   a2. Total purchases in 2022

5. [Show if Q3= a2] Please indicate the number of LED fixtures your household purchased in the following years:

   a1. Total purchases in 2023:
   a2. Total purchases in 2022:

6. [Show if Q3= a3] Please indicate the number of LED patio-style LED string lights your household purchased in the following years:

   a1. Total purchases in 2023:
   a2. Total purchases in 2022:

7. [Show if Q3= a4] Please indicate the number of LED linear tubes lights your household purchased in the following years:

   a1. Total purchases in 2023:
   a2. Total purchases in 2022:

Daily Household Occupancy

8. In 2022 and 2023, approximately how many hours a day was/is your house occupied during a typical weekday and weekend?

Typical weekday	2022:	2023:
Typical weekend	2022:	2023:

9. Did your household purchase and install any of the following in 2022? Please select all that apply.

a1. Major household appliance, e.g., fridge, washer
a2. Heating, cooling, dehumidifier, or air purifier
a3. Water heating system
a4. Electronics, e.g., computer/monitor
a5. Insulate your home walls, floor, attic or ceiling
a6. None of these [Exclusive]

[Show if appliance selected in Q9] 10. Which of the following appliances did you purchase and install? Select all that apply.	**If the appliance is rated ENERGY STAR check this box**
a1. Freezer	[check box]
a2. Refrigerator	[check box]
a3. Clothes dryer- electric	[check box]
a4. Clothes dryer - gas	[check box]
a5. Clothes washer	[check box]
a6. Dishwasher	[check box]
[Show if heating/cooling selected in Q9] 11. Which air heating, cooling or air comfort equipment did you purchase and install? Select all that apply.	**If the appliance is rated ENERGY STAR check this box**
a1. Air purifier	[check box]
a2. Air source heat pump	[check box]
a3. Boiler	[check box]
a4. Central air conditioner	[check box]
a5. Dehumidifier	[check box]
a6. Ductless heat pump	[check box]
a7. Electric furnace	[check box]
a8. Gas-powered furnace	[check box]
a9. Geothermal heat pump	[check box]
a10. Room/portable air conditioner	[check box]
a11. Uncertain of the technology (heater)	[check box]
a12. Uncertain of the technology (air conditioner)	[check box]

[Show if water heating selected in Q9] 12. What kind of water heater did you purchase and install? Select all that apply.	**If the appliance is rated ENERGY STAR check this box**
a1. Electric water heater	[check box]
a2. Heat pump (also electric) water heater	[check box]
a3. Tankless water heater, electric	[check box]
a4. Tankless water heater, natural gas	[check box]
a5. Natural gas or propane water heater	[check box]
a6. Unsure of the technology (water heater)	[check box]
[Show if electronic selected in Q9] 13. What electronics did you purchase? Select all that apply.	**If the appliance is rated ENERGY STAR check this box**
a1. Computer	[check box]
a2. Monitor	[check box]
a3. Television	[check box]
a4. Gaming devices	[check box]

Energy Saving Technologies and Behaviors

14. Which of the following technologies do you currently use?

a1. Home hub or smart hub (like Amazon Alexa or Google Home)
a2. Smart LED light bulbs, can be controlled by a phone app
a3. Smart appliances, appliances that can be controlled by a phone app
a4. Smart thermostat, (internet connected like Nest or Ecobee)
a5. Central forced air, heat pump
a6. Ductless heat pump or mini-split system
a7. Air purifier
a8. Window air conditioning unit
a9. Solar photovoltaic panels
a10. Battery storage (like Enphase or Powerwall)
a11. Plug-in electric vehicle
a12. None of these [Exclusive]

15. [Show if selected in Q14] In which year did you install these technologies?

List options: 1. 2023 2. 2022 3. 2021 4. 2020 5. 2019 6. 2018-2015 7. Before 2015 8. Don't recall

a1. Home hub or smart hub (home automation system for devices like Alexa or Google Home)

a2. Smart LED light bulbs, can be controlled by a phone app
a3. Smart appliances, can be controlled by a phone app
a4. Smart thermostat, (internet connected like Nest or Ecobee)
a5. Central forced air, heat pump
a6. Ductless heat pump or mini split
a7. Air purifier
a8. Window air conditioning unit
a9. Solar photovoltaic panels
a10. Battery storage/backup e.g., Enphase or Powerwall
a11. Plug-in electric vehicle

16. Please describe any additional energy technologies you have in your home.

    [Record Open Ended Response]

17. Which energy saving actions do you take in your home?

    a1. Keep water heater at a lower temperature
    a2. Clean/replace air filters on space heating system
    a3. Professionally maintenance performed on heat/cooling system
    a4. Turn down heat at night
    a5. Turn down heat when your home is unoccupied
    a6. Set cooling setpoint to higher temperature during the day
    a7. Set cooling setpoint to higher temperature when home is unoccupied
    a8. None of these [Exclusive]
    a9. Other, specify:

18. In your search for a new large appliance such as a clothes dryer, home heating furnace, water heater, or central air conditioner, all else being equal, would you:

    a1. Purchase a high efficiency appliance that costs a lot more
    a2. Purchase a high efficiency appliance that costs a little more
    a3. Purchase a standard efficiency appliance that costs a little less
    a4. Purchase a standard efficiency appliance that costs a lot less
    a5. Efficiency is not factored into my purchase decision
    a6. I do not make purchase decisions

Thermostat Use for Heating and Cooling

19. What type of thermostat does your household use?

    a1. Non-programmable/manual thermostat [Skip to Q23]
    a2. Programmable thermostat that can be set to different temperatures for different times [Skip to Q23]
    a3. Smart thermostat, e.g., Nest, Lyric, Sensi or Ecobee
    a4. No thermostat [Skip to Q29]

20. A smart thermostat can learn energy consumption habits of users through automation. Please select the response choice that best describes the settings/programming of your smart thermostat:

a1. I use factory default settings
a2. Contractor/installer programmed the settings
a3. I have provided some setting preferences and minimal programming of my thermostat
a4. I programmed my thermostat settings per my schedule and comfort needs
a5. Let the smart thermostat programming/algorithm learn my household's habits and set an automatic schedule
a6. My smart thermostat is not working/not turned on
a7. Don't know
a8. Other, please specify:

21. Do you use a mobile app to access your smart thermostat?

a1. Yes
a2. No

22. Which of the following smart thermostat device or mobile app features do you use? Please select all that apply.

a1. Remotely lock thermostat use
a2. Remotely adjust home temperature
a3. Pre-cool or pre-heat the home to an exact specified time (e.g., use the "Early On" feature)
a4. Use an "Auto Away" feature, where the set point will automatically revert to the set-back temperature if the sensor senses no activity
a5. Use the "Cool to Dry" feature which runs the air conditioner to reduce humidity
a6. Use the smart thermostat to schedule the HVAC system fan
a7. None of these [exclusive]
a8. Other, specify:

23. If your main heating system is controlled by a thermostat, what is the average thermostat temperature usually set for during the heating season?

a1. Below 55
a2. 56-60
a3. 61-65
a4. 66-70
a5. 71-75
a6. Above 75
a7. Off
a8. Don't know
a9. Not applicable/no thermostat
a10. Other, please specify:

24. How often do you override the thermostat temperature setpoint during the heating season?

a1. Most days
a2. A few days per week
a3. A few days per month
a4. Almost never
a5. Never
a6. I don't control the thermostat
a7. I don't have a thermostat
a8. Don't know

25. Next, we would like to ask a few questions about cooling your home. Do you use central air conditioning to cool your home?

a1. Yes

a2. No [skip to Q29]

26. If your main cooling system is controlled by a thermostat, what is the average thermostat temperature usually set for during the cooling season?

a1. Below 70
a2. 70-71
a3. 72-73
a4. 74-75
a5. 76-77
a6. 78-79
a7. 80-81
a8. Above 82 degrees
a9. Off
a10. Don't know
a11. Other, please specify:

27. How often do you override the thermostat temperature setpoint during the cooling season?

a1. Most days
a2. A few days per week
a3. A few days per month
a4. Almost never
a5. Never
a6. I don't control the thermostat
a7. Don't know

28. When you adjust your home heating and cooling, do you:

a1. Prioritize saving energy despite being uncomfortable
a2. Prioritize saving energy to the extent that you are somewhat uncomfortable
a3. Consider saving energy, but ensure that you are often comfortable
a4. Ensure that you are always comfortable regardless of the energy use
a5. I do not make decisions about home heating and cooling

Bill Pay

29. During 2022, did you ever have to choose between paying your electric and gas bill or paying another bill?

a1. Yes
a2. No [Skip to Q31]
a3. Prefer not to say [Skip to Q31]
a4. Don't know [Skip to Q31]

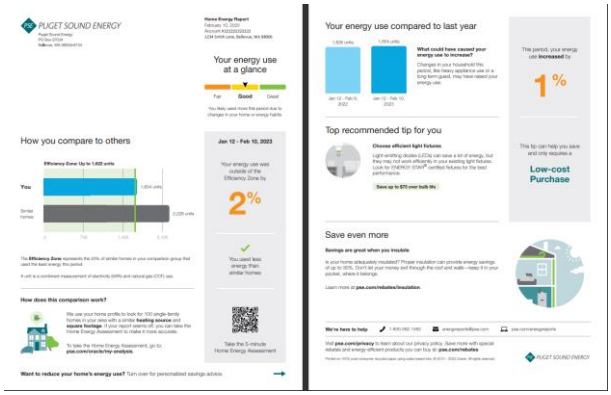
30. In 2022, how many months did you have to choose between paying your electric and gas bill and paying another bill? [Drop down 1-12]

Home Energy Reports

31. How familiar are you with PSE's energy efficiency or conservation programs that are designed to help you identify ways to use less energy and lower your bill?

a1. Not at all familiar
a2. Not very familiar
a3. Somewhat familiar
a4. Very familiar

32. In the past three months, do you remember receiving a Home Energy Report from PSE about your in-home energy use?



a1. Yes
a2. No [Skip to Q39]
a3. Don't know [Skip to Q39]

33. Thinking of all the reports you have received, in general, what have you done with them?

a1. Read the reports thoroughly
a2. Read some of the content
a3. Glanced at the pictures or graphics
a1. Do not look at the reports at all [Skip to Q36]

34. Do you recall seeing any of the following advertisements or messages in your Home Energy Report? Not all messages were shown to all Home Energy Report recipients. Check all that apply.

a1. Choose products with a high efficiency Energy Score in PSE's Efficient Product Guide
a2. Shave a minute off your shower time
a3. Choose efficient light fixtures
a4. Make sure your refrigerator seal is tight
a5. Use your microwave or grill to cook supper on hot days rather than your oven
a6. Raise the indoor temperature setting 3-4 degrees in summer and use fans for cooling
a7. Unplug electronics when they're not in use
a8. Choose an efficient television
a9. Adjust your TV's display settings
a10. Replace inefficient light bulbs with LEDs
a11. Precool/preheat your home overnight and leave your AC/heating system off during the day
a12. Weather-strip windows and doors
a13. None of these [exclusive]

35. Thinking about the Home Energy Reports you've received; how much do you agree or disagree with each of the following statements?

a1. I like the Home Energy Reports	[Agree/Disagree]
a2. The Home Energy Reports help me make better decisions to use and save energy	[Agree/Disagree
a3. The energy efficiency tips in the Home Energy Report are useful	[Agree/Disagree
a4. The comparison on the report to other nearby similar homes is fair	[Agree/Disagree

36. Has receiving the report made you more or less satisfied with PSE or has your opinion not changed?

a1. More satisfied
a2. Less satisfied
a3. Opinion unchanged

37. What aspect of the Home Energy Reports do you like the most?

[Record Open Ended Response]

38. What aspect of the Home Energy Reports should be improved?

    [Record Open Ended Response]

About Your Home & Household

39. Do you own or rent?

    a1. Own
    a2. Rent
    a3. Do not own or rent
    a4. Prefer not to say

40. Which of the following building types best describes your home?

    a1. Single-family detached home (home not attached to another home)
    a2. Townhouse, duplex, or row house (shares exterior walls with neighboring unit, but not roof or floor)
    a3. Apartment in multi-unit structure of 2–4 units
    a4. Apartment in multi-unit structure of 5 or more units
    a5. Manufactured or mobile home
    a6. Other

41. Approximately how many square feet of living space is there in your home, including bathrooms, foyers and hallways? Exclude garages, unfinished basements or unheated porches.

    a1. Less than 1,200 square feet
    a2. 1,200 to less than 1,800 square feet
    a3. 1,800 to less than 2.400 square feet
    a4. 2,400 to less than 3,000 square feet
    a5. 3,000 square feet or more
    a6. Don't know

42. Did you complete a remodel or addition to your home between 2021 and 2022?

    a1. Remodel
    a2. Addition
    a3. Both remodel and addition
    a4. None of these

43. [If Q42=a2 or a3] How many square feet did you add?

    a1. SQFT:

44. Approximately what year was this property built?

    a1. Before the 1970s
    a2. 1970s
    a3. 1980s
    a4. 1990s
    a5. 2000-2009
    a6. 2010-2019
    a7. 2020-2023
    a8. Don't know

45. For each of the following age groups, how many people, including yourself, live in this home year-round? Please select one response for each age category.

Age category

a1. 5 and under
a2. 6–18
a3. 19–34
a4. 35–54
a5. 55–64
a6. 65 and over

46. How many people lived in your household, on average, in 2021 and in 2022? If you did not live in this home during these years, please skip this question.

a1. 2021
a2. 2022

47. What is the highest degree or level of school you have completed? If you're currently enrolled in school, please indicate the highest degree you have received.

a1. Elementary (grades 1-8)
a2. Some high school (grades 9-12)
a3. High school graduate
a4. Some college/trade/vocational school
a5. College graduate
a6. Postgraduate degree
a7. Prefer not to say
a8. Other (please specify)

48. What is the primary household language?

a1. English
a2. Spanish
a3. Chinese (including Mandarin and Cantonese)
a4. Tagalog
a5. Russian
a6. Vietnamese
a7. Korean
a8. Prefer not to say
a9. Other (please specify)

49. This information is collected for internal purposes only and remains confidential. Please check the range that best describes your household's 2020 total annual income.

a1. Less than $10,000
a2. $10,000 – $19,999
a3. $20,000 – $24,999
a4. $25,000 – $49,999
a5. $50,000 – $74,999
a6. $75,000 – $99,999
a7. $100,000 – $149,999
a8. $150,000 – $174,999
a9. $175,000 – $199,999
a10. $200,000 – $249,999
a11. $250,000 or more
a12. Prefer not to say

50. This concludes our survey. As a thank you for your participation your response will be entered into a drawing for up to a $300 Amazon e-gift card. If selected as the winning respondent, you will be notified by email. Would you like to be included in the incentive drawing?

a1. Yes, include my response in the drawing
a2. No, exclude my response in the drawing

51. [Show if Q50 = a1] Please confirm your email address for communication regarding the Amazon e-gift card drawing

Email address: [TEXT BOX]

About DNV

DNV is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas, power and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter and greener.

Evaluation Report Response

Program: Home Energy Reports

Program Manager: Chris Stapleton

Study Report Name: Home Energy Reports 2022 Impact Evaluation and 2022-2023 Process Evaluation Final Report

Draft Report Date: December 11, 2023

Evaluation Analyst: Jesse Durst

Date of Final Report Provided to Program Manager: February 2, 2024

Date of Program Manager Response: February 28, 2024

Overview

Puget Sound Energy (PSE) launched the Home Energy Reports (HER) program in 2008. The HER program delivers customized information on energy consumption to participating households and compares the households' energy consumption to that of similar neighboring homes. In addition, the report provides personalized tips on how to save energy based on the energy usage and housing profile of recipients. The HER program was designed to motivate households to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.

Each new cohort of the program is structured as a randomized controlled trial (RCT) where the eligible population is randomly assigned to treatment and control groups. The RCT design results in precise and unbiased estimates of savings per household since the only systematic difference between randomly assigned treatment and control households is the HER.

Since the launch of the program, the number of households and the composition of PSE HER cohorts have changed over time. The legacy cohort initially started with 40,000 treatment and 44,000 control households. Three years later, PSE discontinued sending the reports to 10,000 treatment households, thus creating the "current" (those who still receive the reports) and "suspended" (those who do not receive the reports anymore) treatment cohorts that share the same control group. In 2014, PSE added a pilot study (expansion) that consisted of three cohorts and has been adding new cohorts in subsequent years.

Evaluation

The primary evaluation research objectives included both impact and process elements. The impact evaluation in the attached report covers the 2022 program year. The 2023 program year impact evaluation is currently underway and a memo will be submitted with PSE's Biennial Conservation Report in June, 2024.

The impact evaluation used historical consumption data to measure the difference in consumption between the treatment and control groups. This is accomplished by measuring the reduction in electric and natural gas consumption for the treatment groups, quantifying joint savings from HER-related increased uptake by other PSE energy efficiency programs, adjusting the savings credited to treatment groups by the joints savings resulting from participation in PSE programs, and estimating the savings of the unmatched treatment group.

The process evaluation in the attached report covers both the 2022 and 2023 program years. The process evaluation's objectives are to understand the customer experience with the program, uncover potential drivers of energy savings, and identify program opportunities. The process evaluation consisted of an interview with PSE program staff and a survey of HER recipients. The online survey was sent to a large sample of HER recipients and non-recipients from different survey waves.

Key Findings

The key findings from the 2022 HER program impact evaluation are as follows:

- Total PSE HER 2022 credited electric savings were 42,405,144 kWh and credited gas savings were 1,219,536 therms. The total electric and gas savings are lower than what was achieved in 2021 despite adding new cohorts.
- Per household electric and gas savings have been trending downward since 2017. Possible explanations include customers who previously received the report becoming a member of the control group after moving, previous control customers moving into houses with energy-efficient upgrades done by previous customers who received the report, and the fact that the HER program is also starting to reach customers with less potential for energy savings than cohorts created earlier in the program's history, such as high electric and gas users.
- The legacy current cohort's measured electric and gas savings has been trending downwards for the past several years.
- The legacy suspended cohort's measured electric savings had been statistically insignificant for the past several years before turning significant again in 2022.
- The earlier expansion cohorts (electric only, non-urban, high user, refill) continue to save electricity and gas, but they have been exhibiting declines since reaching their peaks.
- The two expansion cohorts from 2019, the electric-only refill and the manufactured homes, continue to save electricity. The electric-only refill cohort generated less savings than in 2021 while the manufactured homes cohort generated more.
- The refill 2020 and manufactured homes refill cohorts have performed considerably worse than their original counterparts (refill 2015 and manufacture homes, respectively).
    - The refill 2020 cohort's electric per household savings is about a third of what the refill 2015 cohort achieved in their third year, and if it follows a similar trajectory then we should expect refill 2020 to generate fewer and fewer savings moving forward.

    - The manufactured homes refill's electric savings continued to stay statistically insignificant and even became negative in 2022. This is in complete contrast to the original manufactured homes cohort that continued to exhibit growing electric savings.

- The new cohorts introduced in 2022 generated smaller than expected savings.

The key findings from the 2022-23 HER program process evaluation are as follows:

- The majority of the HER treatment customers (88%) were aware of seeing the report in the past three months, and 81% are at least moderately engaged with the reports.
- Per survey results, 95% of respondents primarily speak English at home. According to the US Census Bureau's 2022 American Community Survey (ACS), 21% of King County residents speak a language other than English at home. Survey results revealed a higher percentage of people who primarily speak English at home than the general population (95%).
- PSE's customers spend more time working at home or otherwise being at home during the workweek than they did in 2019 but are spending more time away from the home than in 2020.
- Surveys show that low income HER recipients are more engaged with the reports and find the reports more useful than other recipients. They also are more likely to report having very little or very high awareness of PSE's energy efficiency programs.

Recommendations

Recommendation

Additional Review of HER Results: DNV recommends that efforts should be made to understand why DNV and Oracle (the program implementer) have different unadjusted savings estimates. We recommend that these efforts include investigating the treatment and control counts used by DNV and Oracle among other potential sources of differences.

PSE Response:

PSE has shared treatment and control customer counts provided by Oracle with DNV. Pending completion of the 2023 program year evaluation, PSE will review any customer count discrepancies, and work with the implementer and evaluator to investigate the cause of the difference.

Recommendation

2024 HER Mid-Year Unadjusted Analysis: DNV recommends a mid-year analysis in the summer of 2024 as a status check on how the HER program is performing in 2024 to help PSE improve its forecasts of expected program savings.

PSE Response:

DNV will conduct a mid-year analysis for PSE using usage data through May 2024. This will help PSE understand the accuracy of their pre-year savings forecasts and make possible in-year adjustment to those forecasts if necessary.

Recommendation

Underperforming Cohorts: DNV recommends formulating a strategy regarding underperforming cohorts. Currently, cohorts that generate negative savings are excluded from the total program savings if we believe them to be one-off occurrences. However, if we start seeing a trend over the next year with negative savings, then we believe the cohorts should either count against the total program savings or be removed from the program

PSE Response:

Pending completion of the Program evaluation for program year 2023 PSE will determine an appropriate course of action if cohorts with negative savings values have continued to persist.

Recommendation

Decarbonization: HERs are both an effective way to save energy and are broadly popular. Simple messages are remembered best. If PSE's goals evolve to focus on decarbonization instead of energy efficiency, a similar report recommending simple actions to achieve decarbonization is likely to be effective and well received.

PSE Response:

In 2024 PSE will explore using language that promotes the positive impact of decarbonization through energy efficiency and track how that messaging performs compared to standard cost savings messaging in Home Energy Reports.

Recommendation

Demand Response: Furthermore, as more customers electrify their homes, demand response programs will increase in importance. As PSE's demand response programs expand, HERs could include messages aimed at reducing electric consumption during peak hours and could also include information on how customers can enroll in demand response programs.

PSE Response:

Report recipients with electric service through PSE will receive Demand Response program promotion, and messaging around general peak and off-peak hours in 2024.

Recommendation

Spanish Language HERs: PSE should consider adding Spanish language HERs if they believe these may deliver additional cost effective savings from the program. According to the ACS, 9% of King County residents primarily speak Spanish at home.

PSE Response:

PSE is exploring with the vendor how identify customers who prefer to receive reports in Spanish, and what processes need to be updated to enable this new option.

Recommendation

Low Income Customers: Given that low income customers have a higher level of engagement with HERs than non-low income recipients, PSE should consider increasing communications about programs that are geared toward low income customers in the HERs sent to the low and moderate income, manufactured homes, and multifamily cohorts.

PSE Response:

Report recipients identified as being lower income, and those with "deepest need" (as defined in PSE's 2024-2025 BCP), will receive increased messaging about assistance programs, and other income qualifying programs.