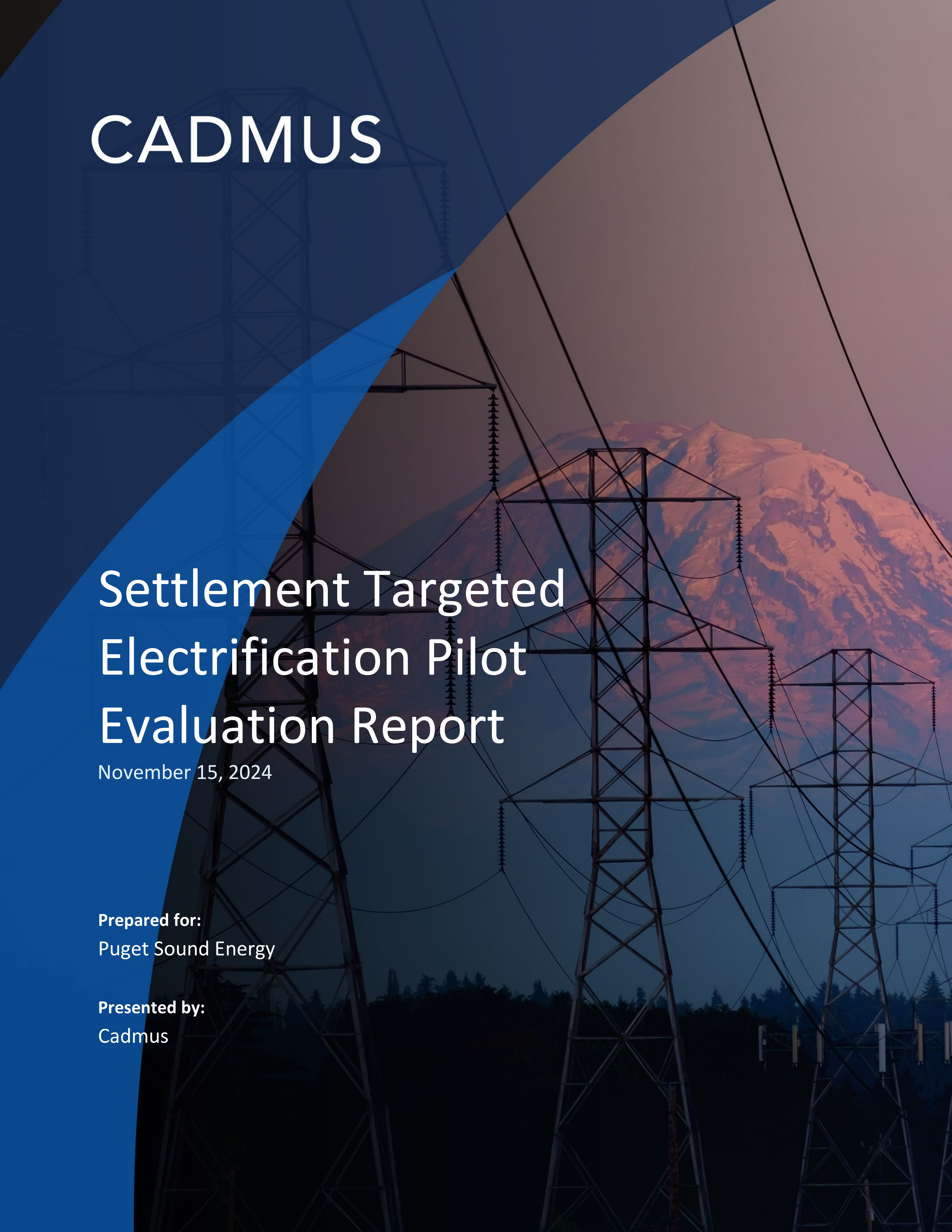

CADMUS

Settlement Targeted Electrification Pilot Evaluation Report

November 15, 2024

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Acronyms and Abbreviations

Abbreviation	Definition
AMI	Advance Metering Infrastructure
BDR	Bill Discount Rate
CBO	Community-Based Organization
CDD	Cooling Degree Day
DER	Distributed Energy Resources
eGRID	Emissions & Generation Resource Integrated Database
EM&V	Evaluation, Measurement, and Verification
EV	Electric Vehicles
HDD	Heating Degree Day
HDH	Heating Degree Hours
HEA	Home Energy Assessment
IPMVP	International Performance Measurement and Verification Protocol
NTG	Net to Gross
PRISM	Princeton Scorekeeping Method
PSE	Puget Sound Energy
QA/QC	Quality Assurance And Quality Control
STEP	Settlement Targeted Electrification Pilot
UMP	Uniform Methods Protocol
WUTC	Washington State Utilities Commission

Executive Summary

In 2022, Puget Sound Energy (PSE) filed a rate case with the Washington State Utilities Commission (WUTC).[1] After negotiation with WUTC and external parties representing public interests, a final settlement was reached. The settlement directed PSE to implement multiple initiatives, which include developing a targeted electrification strategy, implementing a targeted electrification pilot, and updating a previously filed PSE decarbonization study. The pilot and study are intended to inform the targeted electrification strategy. The Settlement Targeted Electrification Pilot (STEP) is a pilot that tests various approaches to education and incentives that could encourage the adoption of electrical home heating equipment and appliances. STEP development began early in 2023, with heat pump rebates officially offered in June 2023 and Home Electrification Assessments (HEA) offered starting in September 2023, both the two primary activities of the pilot. PSE implemented the HEA and heat pump rebate components independently from each other, allowing customers to participate in one or both.

Already contracted to perform evaluation of PSE's energy efficiency programs, PSE contracted Cadmus to also conduct evaluation, measurement, and verification (EM&V) of STEP, despite that the pilot was not fully complete at the time of evaluation. This report presents key findings from Cadmus' EM&V assessment of the pilot period from June 2023 through May 2024, including gross impacts, program performance, and operations, as well as opportunities for improvement. Cadmus will evaluate the implementation of the pilot in the second half of 2024 in 2025.

Table 1 summarizes the high-level findings of the STEP impact evaluation. During the evaluation period (June 2023 through May 2024), the pilot achieved a 30% reduction in energy use (MMBtus) for program participants and decreased site-based carbon emissions by 20%. Total PSE utility bill costs decreased by 3% for customers who participated in the pilot heat pump rebates. These quantitative results exceeded the statistical significance targets of ±10% precision at the 90% confidence level for all metrics, except for the combined gas and electric bill savings.

Table 1. STEP Annual Impacts Summary

Summary	Average Savings per Participant per Year	Percent Savings	Sample number of customers
Energy Savings	32 MMBtu	30%	658
Bill Savings	$72	3%	658
CO_2 Emissions Reduction	1.267 Metric Tons	19.7%	658

[1] Washington Utilities and Transportation Commission. Puget Sound Energy GRC, Docket UE-220066, UG-220067, UG-210918.

Conclusions and Recommendations

CONCLUSION 1: STEP met the settlement agreement stipulation of measuring both the reduction in natural gas use and the corresponding electricity and power impacts when customers upgraded from a natural gas furnace to a heat pump for space heating.

STEP heat pump rebate participants decreased natural gas use by an average of 64% and increased electric consumption by an average of 51%. The combined energy use for electric and natural gas resulted in a 30% reduction in participants’ overall energy use.

CONCLUSION 2: STEP heat pump rebate participants decreased their energy use by 30%, but their utility bill costs remained steady.

STEP heat pump rebate participants realized a 64% reduction in natural gas consumption and natural gas bill costs. At the same time, participants saw a 51% increase in electricity use and electricity bill costs. These changes resulted in an average PSE natural gas bill reduction of $679 annually and a PSE electricity bill increase of $607 annually, for a net average bill decrease of approximately $72 per year. To offset potential cost increases, PSE promotes and enrolls qualified customers in bill discount rate programs, demand response, energy efficiency, and other programs that help offset costs. Further analysis of these programs' effects is recommended.

CONCLUSION 3: The main barrier to installing a heat pump is the initial cost of installation.

More than 50% of the participants that received a Home Energy Assessment (HEA) cited upfront cost as the main reason for not installing a heat pump. In a follow-up question, 54% reported being *very concerned* about the upfront costs of purchasing and installing a heat pump. Almost 50% of HEA respondents said they would be *very likely* to pursue home electrification or heat pump installation if additional incentives were available for households in their income bracket. Similarly, nearly half (49%) of Deepest Needs participants said they were *likely* to pursue additional home electrification if additional incentives were available.

RECOMMENDATION 1

Provide information to PSE customers on existing third-party options to cover the costs of installing a heat pump, such as state and federal programs and financing options, low-interest loans, and other resources, in addition to PSE rebates.

CONCLUSION 4: Most participants said they were well informed about heat pumps as an option after their assessments or installations, but customer education on heat pump functionality, usage, operating cost, and potential savings remains a significant barrier to heat pump adoption.

PSE's customer education efforts, including clear materials such as door hangers, bilingual program overviews, and detailed brochures, provided accessible information about electrification and pilot offerings. This is reflected in the data, where a majority of participants (76% HEA survey, 84% heat pump survey) reported having their concerns clarified after the assessments or installations. However, 25% of those who received the assessment said their concerns had not been clarified. Moreover, among the top reasons for not installing a heat pump, HEA survey participants said uncertainty about offsetting the initial costs (20%), uncertainty about home suitability (9%), unfamiliarity with available rebates (9%), and unfamiliarity with heat pump technology (6%), signaling a need for enhanced customer education on topics such as how the heat pump works and best ways to offset initial costs with energy savings.

RECOMMENDATION 2

Provide program participants with easy-to-understand written and graphic information. Prior to an assessment, include information about heat pumps, upfront costs, rebates, and available financing options. After an assessment or installation, share information about maintenance costs, projected savings, and heat pump usage functionality. Consider offering these materials in multiple languages.

CONCLUSION 5: Both HEA and heat pump rebate participants perceived program communication as good, with room for improvement.

In the heat pump rebate survey, 18% of respondents said the program could improve its communication and education on the best ways to use the equipment. Among respondents from Named Communities, this concern was even more pronounced, with two-thirds (66%) reporting the need for better communication regarding both the rebates and the equipment.

The HEA survey showed that while the majority (69%) of respondents found rebate information clear and easy to understand, 18% found it challenging. Confidence levels in understanding the rebates were mixed. Only 24% of all HEA respondents and 23% of Named Community respondents were *very confident*, and 32% of HEA respondents and 34% from Named Communities were *somewhat confident*, indicating a need for additional communication and outreach.

Among participants classified as Deepest Need, responses varied: 27% were *very confident* in their understanding of PSE rebates, 21% were *not at all confident,* and 36% were *somewhat confident*. This variability underscores the importance of tailored communication efforts.

RECOMMENDATION 3

Diversify marketing tools beyond the available written (print and email) materials. In email communications, deliver multimedia messages using formats such as infographics, videos, and FAQs. Provide a platform to ask questions in real time, such as live webinars or community-led events.

Conduct targeted email campaigns based on the customer's HEA results to provide personalized rebate information. Consider delivering marketing materials in multiple languages.

Engage in community partnerships within Named Communities to promote the heat pump rebates component; for the HEA component, engage local communities earlier in the process and more frequently to ensure the dissemination of materials and provide additional support.

When implementing written communication, dedicated newsletters and materials about heat pump functionality (especially in cold weather), with easy-to-understand graphic depictions of heat pump functionality and usage, may attract more attention and increase participation. Duplicating the partnership campaign with Energy Smart Eastside is recommended.

CONCLUSION 6: Participants are influenced by financial incentives and environmental considerations when deciding to purchase a heat pump.

Environmental friendliness, rebates, and federal tax credits were the main motivators for participation in the pilot, particularly among Named Communities. The desire to add cooling to homes was also a prominent motivating factor. Participants were highly satisfied with heat pump reliability, program incentive amounts, and communication with contractors and PSE—aspects that PSE should preserve to enhance participation via word-of-mouth recommendations. However, there is also the opportunity to further highlight the benefits of electrification and increase adoption rates.

RECOMMENDATION 4

In outreach campaigns, emphasize heat pumps' non-energy benefits, such as environmental impacts. Provide educational resources (e.g., videos, infographics, and guides) that explain the full range of benefits associated with heat pumps (e.g., energy savings, environmental impact, and financial incentives). Interactive tools, such as online calculators, would allow customers to estimate their potential savings and the environmental impact of switching to a heat pump.

A consistent message emphasizing environmental impacts relative to gas heating, particularly among Named Communities, could boost adoption.

CONCLUSION 7: Participants are willing to pursue home electrification and participate in distributed energy resources (DERs) programs if incentivized.

Participants had mixed levels of familiarity with and integration of DERs. While 40% were somewhat familiar with DERs, those who installed a cold climate heat pump reported more familiarity with the concept than those who installed standard ducted heat pumps (38% of whom reported being not very familiar with DERs). Nonetheless, there is a clear interest in learning more about these resources, particularly among Named Community respondents, with 59% in this group expressing a desire to understand how DERs can enhance energy savings. Over 50% of survey respondents said they do not incorporate DERs into their homes but expressed an interest in participating in DER programs if PSE provided incentives. Incentives significantly increased interest from 57% to 65% among the general respondents and 59% to 65% among Named Community respondents. Similarly, 49% of HEA Survey respondents said they would be very likely to pursue electrification if additional incentives were available for households in their income bracket.

RECOMMENDATION 4

Develop educational campaigns that provide clear and accessible information about the characteristics, costs, and benefits of rooftop solar panels, batteries, and smart thermostats (or any other DER technology) to promote their adoption. Emphasize and cross-market current PSE offerings, such as the Virtual Power Plan solution and its rewards program, as well as other PSE financial incentives. Continue to expand financial incentives to encourage DER adoption and highlight incentives prominently in outreach materials to neighborhoods with high concentrations of Named Communities.

Given the high interest among Named Communities, create tailored outreach programs that highlight the potential energy savings and environmental benefits of DERs.

CONCLUSION 8: The program's engagement of non-English-speaking households was limited, indicating a need for more multilingual outreach efforts.

While 88% of survey respondents reported English as the primary language spoken in their households, 4% spoke Cantonese or Mandarin, 3% spoke Hindi, and less than 1% spoke Spanish. Notably, among Named Communities, 6% of respondents spoke Cantonese or Mandarin.

RECOMMENDATION 5

Consider offering educational material in Chinese (simplified and traditional) and Hindi, in addition to Spanish.

Program Description

In 2022, Puget Sound Energy (PSE) filed a rate case with the Washington State Utilities Commission (WUTC).[2] After negotiation with WUTC and external parties representing public interests, a final settlement was reached. The settlement directed PSE to implement multiple initiatives, including a strategy for targeted electrification. The goal of the strategy is to reduce carbon emissions by transitioning customers from gas to electric fuels while ensuring equitable treatment of customers with significant energy burdens. To inform the targeted electrification strategy, PSE is implementing a pilot program—the Settlement Targeted Electrification Pilot (STEP)—that tests various approaches to education and incentives that could encourage the adoption of electrical home heating equipment and appliances. The pilot ran from January 1, 2023, through 2024, and PSE contracted with Cadmus to conduct evaluation, measurement, and verification (EM&V) of the pilot. This report presents key findings from the EM&V assessment of the pilot, including gross impacts, program performance, and operations, as well as opportunities for improvement.

The pilot comprises three main components:

- **Home Electrification Assessments (HEAs).** A free HEA was available to active PSE natural gas and dual-fuel (natural gas and electricity) customers. As part of the home assessment, an electrification coach walked through customers' homes, answered customer questions, and provided a list of electrification recommendations. After completing the assessment, customers received an HEA report and a $50 gift card. PSE completed over 9,000 assessments by July 2024 and is on track to achieve the goal of 10,000 assessments by the end of 2024.
- **Heat Pump Rebates.** PSE offered rebates to dual-fuel customers who removed or decommissioned their existing natural gas heating systems and replaced them with a new ducted or ductless heat pump system. In 2023, rebates varied between $2,400 and $4,000 based on the application year and system type. In 2024, PSE updated rebate amounts and qualifications to increase eligibility and promote equity: a $3,000 rebate for ducted or ductless heat pumps and a $4,000 rebate for moderate-income customers (less than or equal to 90% of the area median income) for a ducted or ductless heat pump.
- **Low-Income Upgrade Track.** PSE is offering whole-home weatherization with space and water heating fuel switching for up to 50 single-family dual-fuel customers who met the low-income criterion—income less than 80% of gross area median income. Participants will have to completely remove or decommission existing natural gas heating systems and replace them with a new ducted or ductless heat pump system. Participants can also replace an existing natural gas water heater with a heat pump water heater at no cost. PSE is leveraging its existing Weatherization Assistance program, with the pilot adding the fuel-switching rebate feature. Cadmus will evaluate this component in mid-2025 as participation did not begin until the second half of 2024.

2 Washinton Utilities and Transportation Commission. Puget Sound Energy GRC, Docket UE-220066, UG-220067, UG-210918.

As the STEP implementer, Franklin Energy Services educates customers in PSE communities through marketing strategies, deploys home assessments to participating customers (conducting most of their outreach in Named Communities), collects data on home systems to assess electrification potential, and provided further education on each home's potential (including referrals to PSE for rebates or other incentives).

PSE established specific rebates for STEP, providing varying levels of incentives for customers depending on the qualifying specifications of the heat pump the customer chose to install.

Community Action Agencies (King County Housing Authority, Community Action Council of Lewis, Mason & Thurston, HomeWise, and Pierce County Human Services) are integrating pilot electrification funding with Washington State Commerce and PSE Conservation funds to complete the projects within the Low-Income Upgrade Track.

Research Objectives

According to the language of the final WUTC settlement, the pilot's objectives included the following:

- Identify barriers and recommendations for improving heat pump market penetration
- Identify barriers to Named Communities accessing heat pumps
- Develop policies and programs to support the adoption of heat pump technologies by Named Communities
- Provide and measure demonstrated material benefits to low-income participants and include appropriate low-income customer protections
- Identify opportunities for incremental distributed energy resource (DER) investment as a mechanism to offset electric system reliability risk during peak load events and begin deploying these investments
- Evaluate whether providing a financial incentive to existing gas customers for fuel switching to electric-only appliances would incentivize and promote increased adoption of high-efficiency electric-only appliances
- Engage 10,000 customers through at least two measures (education, assessments, or heat pump rebates)
- Deploy strategies to maximize effective carbon reduction measures (heat pumps)
- Inform targeted electrification strategy development

In addition to meeting the stipulations of the settlement, PSE desired to collect data that would further inform their electrification strategy, including the following:

- Participation rate (customer activity as a percentage of participants reached)
- Bill impacts based on customer choices
- Outreach impact—the success of various channels as well as customers' perceptions about their participation, whether customers are more educated about energy options, etc.
- Customer eligibility for technologies (based on existing electrical systems)
- Served customer segments
- Customers that pursue full electrification versus partial
- The effect of partnerships with other utilities

Approach

Impact Evaluation Approach

Impact evaluation activities focused on assessing participants' energy use before and after participating in the pilot. Cadmus determined each participant's electric energy, winter electric energy demand, and natural gas energy savings. We also evaluated the reduction of greenhouse gas emissions, participant energy use, and cost savings due to the pilot. This section describes Cadmus' impact evaluation plan and methods.

Tracking Database Review

Cadmus reviewed program-tracking datasets to identify and resolve any potential data-quality issues. This preliminary review included the following activities:

- Identify potentially duplicated records
- Check for missing or inaccurate data, including participant location, name, contact information, premise ID, account number, measure type (e.g., HEA, heat pump install), measure implementation date, and other PSE program participation measure flags (i.e., STEP participants who received incentives and reported savings through measures from other PSE energy efficiency programs in 2022 or 2023)

Utility Bill Analysis

Cadmus followed industry best practices and methods from the International Performance Measurement and Verification Protocol (IPMVP) and the Uniform Methods Protocol (UMP) to evaluate the energy and demand impacts of the STEP pilot. IPMVP Options A through D define the foundational methods for measuring and verifying the savings of energy efficiency measures at the site or project level. The UMP chapters draw on the IPMVP but offer methods for evaluating savings more broadly at the measure, program, and portfolio levels. They also address EM&V methods for circumstances where IPMVP options are not practicable or sufficiently specific. For the pilot evaluation, Cadmus followed the methodologies outlined in IPMVP Option C: Whole Facility and UMP Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol.[3, 4] We used the following data to analyze program savings:

- Tracking data for 801 heat pump participants
- Hourly advanced metering infrastructure (AMI) data and daily natural gas CCF usage data from January 2022 to April 2024
- Monthly electric and gas billed usage and the billed amounts from January 2022 to June 2023
- Daily and hourly weather data from January 2022 to April 2024

The preferred approach for obtaining energy and demand estimates is the Princeton Scorekeeping Method (PRISM) modeling of site-level data (daily, hourly, and pre- and post-installation). However, due to limited post-period data,[5] Cadmus conducted a baseline modeling approach that compared predicted usage to actual post-usage data. The baseline predicted usage uses the baseline model to predict the usage based on the actual weather observed in the post-period. We defined the site-level pre-installation period as the 12-month period before the measure's installation date.

Cadmus used the following modeling approaches to determine the program impacts:

- **Electric energy savings**: Site-level daily PRISM modeling with heating degree days (HDD),[6] cooling degree days (CDD)—baseline period, predicted usage compared to actual post-period weather data.
- **Gas energy savings**: Site-level daily PRISM modeling with HDD—baseline period, predicted usage compared to actual post-period weather data.
- **Demand savings peak period**: Site-level hourly day-type models with heating degree hours (HDH) and cooling degree hours—baseline period, predicted demand compared to actual post-period weather data.
- **Billed cost savings**: Site-level pre-billed amounts to develop effective per-usage unit rates. Applied per-usage billed rates to energy usage and savings to determine cost savings.

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3 Efficiency Valuation Organization. 2022. "International Performance Measurement and Verification Protocol (IMPVP)." IPMVP - Efficiency Valuation Organization (EVO) (evo-world.org)

4 National Renewable Energy Laboratory. November 2017. *Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol.* Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol: The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures (nrel.gov)

5 Figure 1 shows the installations by month. On average, the participants only had six months of post-heat pump usage and AMI data. The analysis included partial coverage of the winter period. Cadmus could not determine summer impacts in the analysis. There were insufficient data to estimate post-period PRISM models.

6 Cadmus aggregated the electric hourly AMI data to the daily level for the electricity energy usage analysis.

Process Evaluation Approach

Cadmus developed a set of customized research activities relevant to the given target audience for each research objective. These activities are described in detail below.

Program Staff Interviews

Cadmus interviewed PSE program staff and Franklin Energy staff to gain insight into program design, goals, processes, marketing, and administration. We used these interviews to determine if the pilot performed consistently and achieved PSE's objectives (including hitting participation targets) within the program budget. The interview guide incorporated questions specifically designed to understand the program's performance. Cadmus also leveraged interviews with the program staff to understand areas of interest and refine research objectives for other evaluation activities, such as participant surveys and materials review.

Participant Surveys

Cadmus implemented two online surveys through Qualtrics, an online survey management and distribution platform. We sent the first one, fielded from May 30 to June 21, to HEA participants (23% response rate) and the second one, fielded from June 21 to July 2, to heat pump rebate participants (27% response rate). Those who participated in both pilot components only completed the heat pump survey.

Each survey underwent rigorous quality assurance and quality control (QA/QC) procedures to ensure it followed best practices. This included piloting each data collection instrument with a subset of the participant population before the full launch to identify needed adjustments, optimizing accessibility for desktops and mobile devices, and pre-testing its technical aspects.

Cadmus fulfilled several research objectives through participant surveys:

- Identify barriers, challenges, and recommendations for improving heat pump market penetration and electrification adoption
- Assess DER-readiness among respondents
- Investigate benefits from program participation (including non-energy benefits), freeridership and spillover, and several aspects of program delivery and satisfaction
- Analyze the responses of Named Community participants in detail, identifying obstacles to their participation in electrification programs and providing targeted recommendations
- Identify the characteristics of electrification participants, such as race, age, ethnicity, language, education level, and household size

Materials Review

Cadmus reviewed program materials to thoroughly understand the program processes and assess the quality, relevance, and effectiveness of the PSE's materials. We assessed the accuracy and consistency of the information participants received, evaluating the clarity and comprehensibility of the materials, assessing the relevance and alignment of the materials with the program's objectives, and enhancing engagement and motivation. The materials review addressed the objective of evaluating the performance of PSE's outreach channels to enhance implementation, delivery, and participant experience while optimizing resources.

The review included the following items:

- Program plan
- HEA program overview
- HEA leave-behind brochure
- Post-HEA report sample

Benchmarking

Cadmus conducted a benchmarking exercise to compare PSE's programs against similar programs delivered by other utilities. The benchmarking review fulfilled the research objective of identifying opportunities for incremental DER investment as a mechanism to offset electric system reliability risk during peak load events and begin deploying these investments.

The benchmarking exercise included program aspects, such as delivery, incentive structure, and the measure mix contributing to savings (as applicable). The benchmarking review provided valuable insights into best practices and areas for improvement. Cadmus also used benchmarking results to inform other process evaluation activities, such as participant surveys, to help identify potential solutions to existing challenges. Cadmus only benchmarked programs run by utilities operating in the Pacific Northwest, including Avista, Idaho Power Company, Pacific Power, and Portland General Electric. DER programs had to meet one of the following definitions to be included in the analysis:

- Incentivizes or otherwise supports DERs, such as rooftop solar or battery storage.
- Incentivizes or otherwise supports automatic or manual demand response mechanisms.

Cadmus reviewed the following program elements during this activity (however, not all elements were reported for all programs):

- Program type (e.g., net metering, demand response, and on-site resources)
- Program start year and years active
- Participating sector(s)
- Measures included
- Incentive structure
- Number of participants
- Planned and actual saving
- Marketing channels

Pilot Attribution Activities

To fulfill the objective of quantifying the attribution of the STEP heat pump rebates on customers' decision to fuel switch, Cadmus estimated net-to-gross (NTG) ratios from participant self-report survey results. Two components—freeridership and participant spillover—constitute NTG. Cadmus combined the estimates of the two components to estimate an NTG ratio for STEP heat pump rebates using the following equation:

$$\textbf{NTG} = \textbf{100\%} - \textbf{Freeridership} + \textbf{Participant Spillover}$$

Freeridership refers to energy savings that would have occurred in the absence of STEP. To mitigate self-report bias, Cadmus used a battery of freeridership questions that collected data on each participant's intention and factors that might have had an influence. We combined the two types of freeridership to align with industry best practices:

- *Intention freeridership* relies on customers' self-reported intention to purchase a measure in the absence of the PSE program. Survey items addressed the offering's affect on the efficiency and timing of purchases.
- *Influence freeridership* relies on the influence of PSE-related elements on the customer's decision to purchase a measure. PSE influences included the PSE incentive, information provided by PSE on energy-saving opportunities, or previous participation in a PSE energy efficiency program.

The intention and influence scores contributed equally to the total freeridership score. Cadmus estimated an intention freeridership score and an influence freeridership score ranging from 0% to 100% for each surveyed heat pump rebate participant. We calculated the PSE heat pump rebate reporting category-level intention and influence freeridership scores by weighing the individual freeridership component scores by the respondents' verified gross MMBtu savings. The specific intention and influence freeridership questions, response options, and scoring methodology we used are presented in the *Program Process Findings* section.

By savings-weighting the intention methodology with an influence methodology, Cadmus produced a freeridership score for the offering. We calculated the arithmetic mean of intention and influence freeridership components to estimate the final freeridership score for the offering, as shown in the following equation:

$$\text{Final Freeridership} = \frac{Intention\ \text{FR Score}\ + Influence\ \text{FR Score}}{2}$$

Participant spillover refers to energy savings resulting from the pilot's influence on customers' decisions to invest in additional energy efficiency measures for which they did not receive any incentives from PSE or another organization. Cadmus measured spillover by asking participants if they installed another efficient measure or undertook another energy efficiency activity because of their participation in the PSE rebate program. Respondents rated the offering's (and incentive's) relative importance, using a scale from 1, meaning *not at all important*, to 5, meaning the PSE rebate program was *extremely important* in their decisions to pursue additional savings. Cadmus also included measures eligible for a PSE program rebate (known as "like spillover"). We considered additional measure purchases associated with an *extremely important* program rating for spillover attribution to the program. To calculate a spillover percentage for the PSE heat pump rebate program, we divided the sum of additional spillover savings reported by respondents by total gross savings achieved by all respondents in the offering category, as in the following equation:

$$Spillover\ \% = \frac{\sum \text{Spillover Measure Gross MMBtu Savings for All Survey Respondents}}{\sum \text{Program Measure Verified Gross MMBtu Savings for All Survey Respondents}}$$

Findings

Impact Evaluation Findings

Summary

The impact evaluation focused on the heat pump rebate component of the pilot. These customers decommissioned existing natural gas home heating systems and installed new ductless or ducted heat pumps. Evaluated pilot participants exhibited an average of a 64% reduction in natural gas consumption, a 51% increase in electric energy use, and a 3% decrease in total utility bill costs. When Cadmus converted electricity and natural gas to BTUs and combined energy use, the pilot achieved 30% less energy consumption per year. Peak electric demand, on average, increased for all customers from 60% to 139%, depending on the peak period of interest.[7] While the average total utility bill costs for participants decreased by $72 per year, some customers also participated in bill rebate programs to limit the impact of increased electricity costs. Table 2 summarizes the overall energy, demand, bill, and emissions impacts resulting from the pilot.

[7] Summer peak period impacts are not reported in this work due to a lack of post-period data during summer months. PSE peak periods are defined as follows:

- Summer: June to September, non-holiday weekdays only, 4:00 p.m. to 7:59 p.m.
- Winter morning peak: November to February, non-holiday weekdays, 7:00 a.m. to 9:59 a.m.
- Winter evening peak: November to February, non-holiday weekdays, 5:00 p.m. to 7:59 p.m.

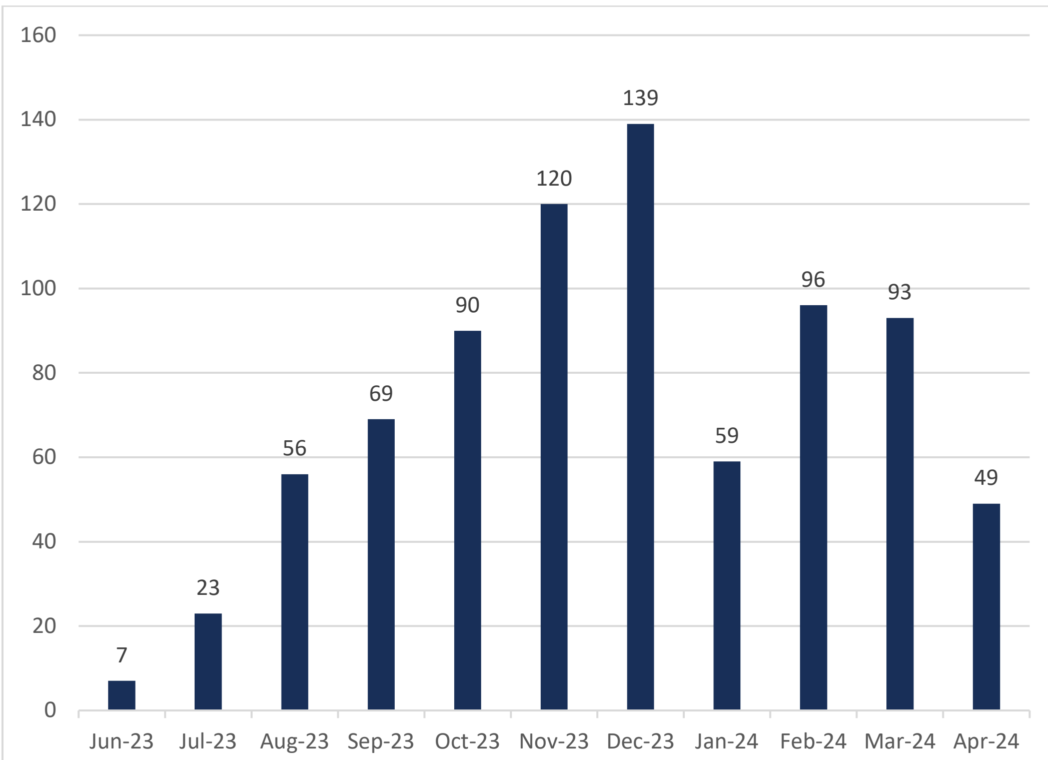
Table 2. STEP Annual Impacts Summary

Summary	Units	Sample number of customers	Predicted Baseline	Actual Post	Average Savings per Participant per Year	Percent Savings	Precision with 90% Confidence
Total Energy Savings	**MMBtu**	**658**	**106**	**74**	**32**	**30%**	**3%**
Natural Gas Savings	Therms	599	748	273	475	64%	3%
Electricity Savings	kWh	658	9,010	13,597	-4,588	-51%	5%
Average Winter Peak Demand Reduction	kW	531	1.34	2.60	-1.26	-94%	3%
Morning Winter Peak Demand Reduction	kW	531	1.15	2.75	-1.60	-139%	4%
Evening Winter Peak Demand Reduction	kW	531	1.52	2.44	-0.92	-60%	5%
Total Bill Savings	**$**	**658**	**$2,261**	**$2,214**	**$72**	**3%**	**NA**
Natural Gas Bill Savings	$	599	$1,069	$390	$679	64%	5%
Electric Bill Savings	$	658	$1,193	$1,800	-$607	-51%	9%
CO_2 Emissions Reduction	**Metric Tons**		**6.429**	**5.162**	**1.267**	**19.7%**	**3%**
CH_4 Emissions Reduction	Kg		75.0	27.6	47.4	63.2%	3%
N_2O Emissions Reduction	Kg		7.5	2.8	4.73	63.0%	3%

Program Participation

STEP heat pump rebates for natural gas heating replacements began in June 2023, with a consistent ramp-up in participation through December 2023. Based on customer and contractor feedback and to further increase participation rates, PSE re-designed the rebate offerings, reduced the equipment requirements, and introduced an increased incentive for moderate-income customers, effective January 1, 2024. Figure 1 reflects this transition as slowed participation between January 2024 and April 2024, with an average of 74 heat pump installations per month. Program participation continued beyond April 2024 and through the end of July 2024; however, due to evaluation time constraints, this research focused on participation from June 2023 through April 2024. In total, Cadmus evaluated energy use for 801 heat pump electrification participants during this period. Figure 1 shows the number of heat pump installations by month.

Figure 1. Participation Counts by Installation Month



Annual Electric Energy Impacts

This section summarizes the results of the annual electric energy impacts from heat pump installations. The electric energy impacts analysis includes 658 of the 801 participants (82%).[8]

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8 Cadmus removed 143 participants from the analysis. Of those, we removed 73% because they did not have AMI meters or had insufficient baseline data. We removed the remaining 27% because of vacancies, failed baseline models, or missing data.

A customer's average predicted annual usage before installing a heat pump was 9,010 kWh. After replacing fossil fuel-fired heating systems with a heat pump, a customer's average annual electricity energy use increased to 13,597 kWh—a 51% increase in annual energy usage from the baseline period. Cadmus did not evaluate summer impacts from fossil fuel-fired heating system replacements during this study because of the limited number of replacements prior to the summer period. Table 3 summarizes the predicted baseline usage and the actual usage overall by pre-period usage quartile. Quartiles represent the customer groups as a function of predicted baseline annual electricity use. Quartile 1 represents customers with the lowest predicted baseline annual electricity use, while Quartile 4 represents the customers with the greatest predicted baseline annual electricity use.[9] Customers in the lowest quartile exhibited the greatest percentage of increase in annual electricity use, while customers in the highest quartile saw the lowest percentage of increase in annual electricity use. These differences may be due to a number of factors associated with larger homes, including multiple heating systems, higher plug loads (e.g., televisions, computers, and appliances), and more occupants.

Table 3. Electric Energy Usage and Savings Summary

Group	Sample number of customers	Actual Energy Use Prior to Conversion	Predicted Baseline Energy Use	Actual Post-Conversion Energy Use	Savings (kWh)	Savings (%)	Precision at 90% Confidence	Average Home Size (sq ft)
Quartile 1	164	4,432	4,385	9,607	-5,223	-119%	6%	1,928
Quartile 2	164	6,841	6,695	12,133	-5,437	-81%	8%	1,993
Quartile 3	167	9,432	9,059	13,697	-4,638	-51%	9%	2,190
Quartile 4	163	16,193	15,940	18,983	-3,043	-19%	22%	2,573
Overall	**658**	**9,215**	**9,010**	**13,597**	**-4,588**	**-51%**	**5%**	**2,171**

Figure 2 illustrates the predicted baseline and post-conversion energy usage results overall and by the usage quartile summarized in Table 3.

[9] For the highest usage quartile group, there was an indication of electric heating in the home prior to the heat pump installations. It is unclear whether this was primary heating or secondary electric heating.

Figure 2. Electric Usage Before and After Electrification

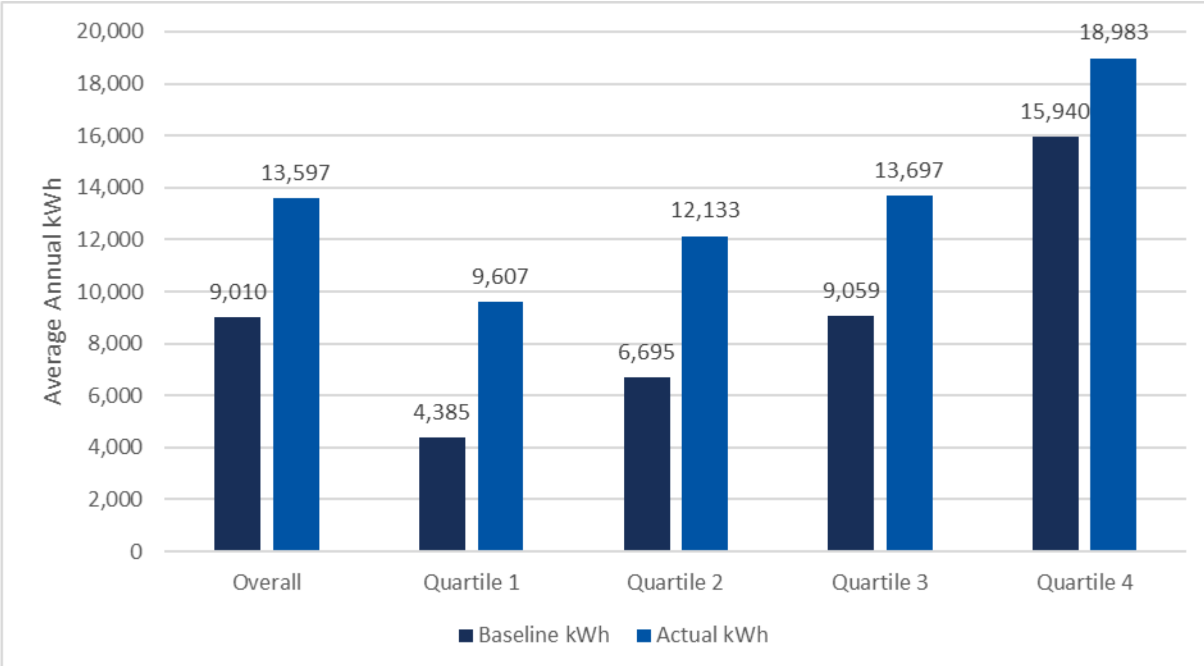


Figure 3 illustrates the average actual usage and the predicted baseline usage for the analysis period. In the post-installation period beginning in October 2023, the added load from the heat pumps is evident. The post-period included a cold period event on January 13, 2024. The average model-predicted electric baseline usage was approximately 40 kWh per day, while the average participant exhibited an average usage of nearly 100 kWh per day after heat pump installation.

Figure 3. Actual and Modeled Predicted Daily Usage

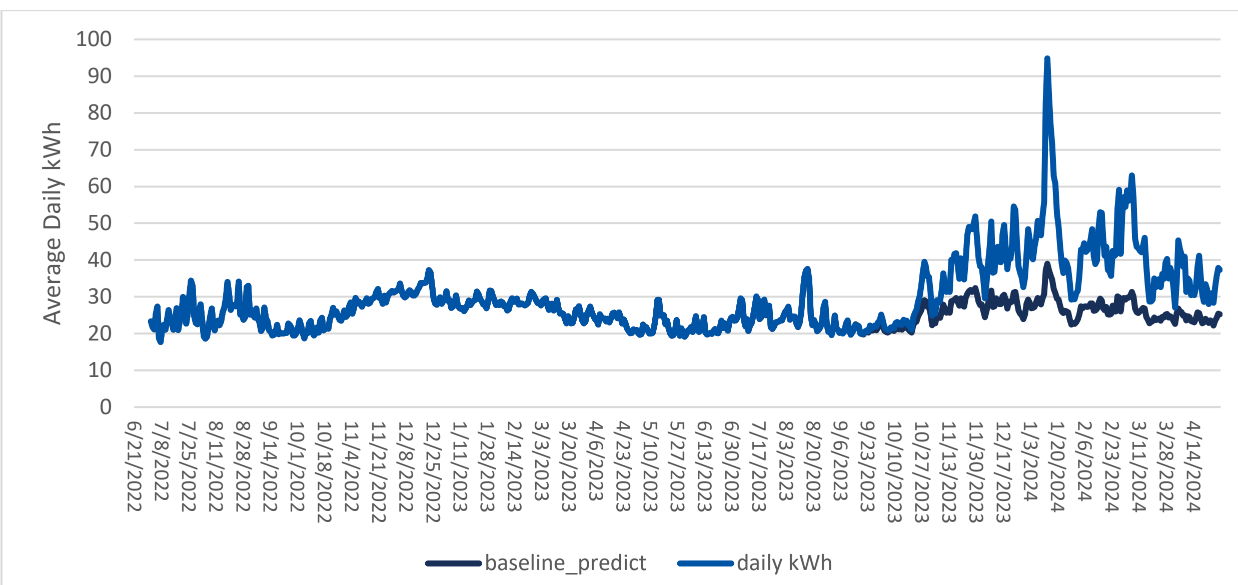
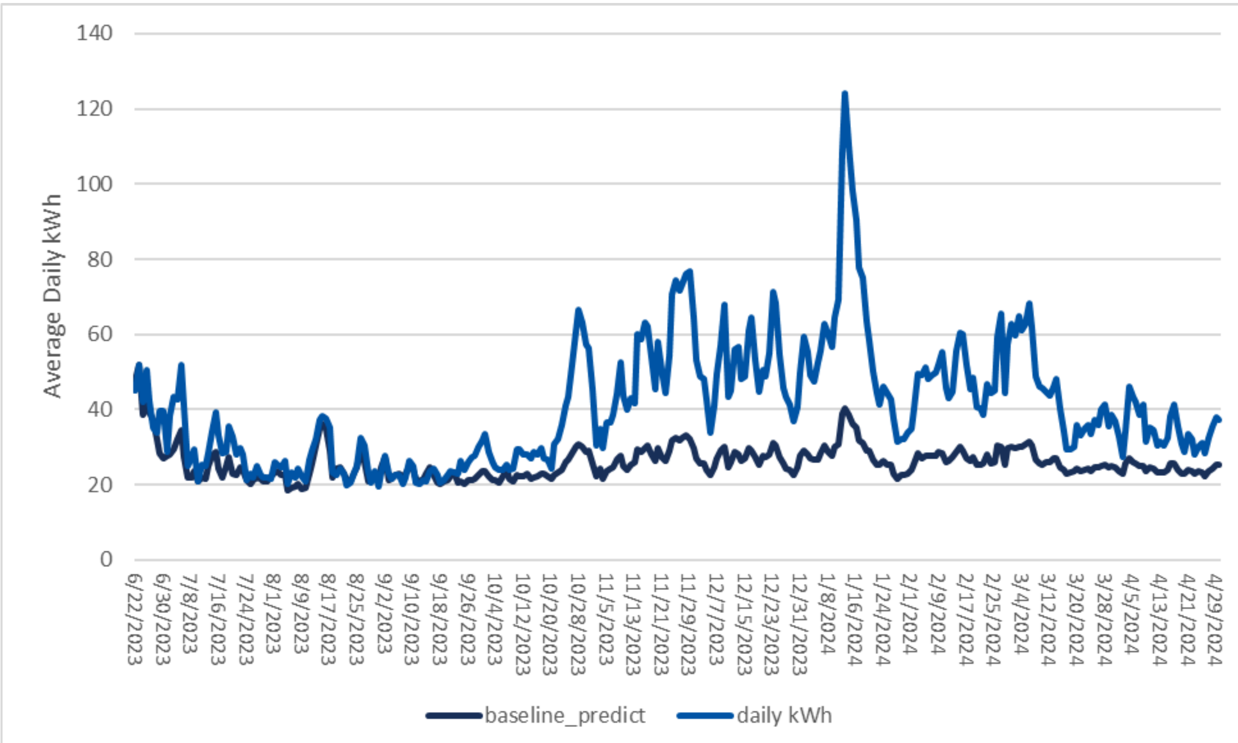
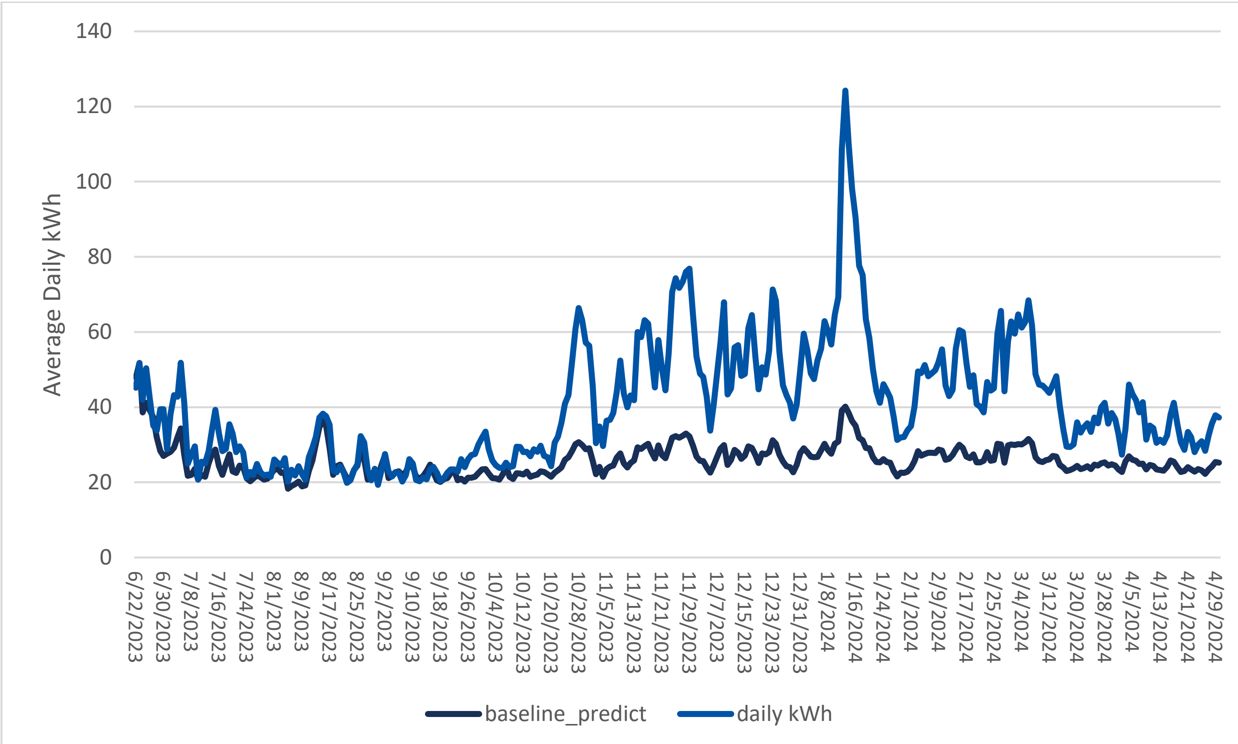


Figure 4 shows the model-predicted baseline usage and actual post-period usage for the post-installation period only. Cadmus calculated the predicted energy increase in usage by taking the difference between the actual post-period usage (the blue line) and the predicted baseline usage (the black line). The figure shows average energy estimates across all participants included in the electricity energy impacts analysis. The average model-predicted electric usage was nearly 40 kWh per day, while the average participant usage increased approximately 120 kWh per day after electrification.[10]

Figure 4. Predicted Baseline Versus Actual Post-Period Usage



[10] Figure 3 shows the average usage for a given date and does not account for partial post-period data. Figure 4 shows the average usage for post-period only accounting for partial post-period data. The 100 kWh value for the peak day in Figure 3 includes some pre-period data and represents an average across ALL the participants. However, the 120 kWh value is for actual post-installation usage after the heat pump installation.



The limited post-period data in the electric energy analysis created additional challenges. As previously noted, participants had limited post-period usage data, with some only having one month of post-period data. Since it is necessary to estimate the annualized baseline and annualized post-period usage, Cadmus applied usage factors to the partial post-period usage to obtain annualized usage estimates. We calculated these factors for an annual period from May 1, 2023, through April 30, 2024. For the baseline period, the usage factors ranged from 0.93 to 1.05, and for the actual post-period, the usage factors ranged from 0.76 to 1.15. By applying the factors for each installation date, Cadmus could more accurately annualize baseline and post-usage based on partial months. Taking the actual partial post-period usage and annualizing it by the number of days would have provided a biased estimate of annual usage since the average daily usage and weather for that specific period can vary from the average annual usage pattern. Intuitively, the baseline usage factors are close to 1 because the predicted baseline usage has little weather variability. However, the adjustments are important for the post-period actuals since there is substantial variability in weather usage, and obtaining accurate annual estimates requires the usage factors.

Annual Natural Gas Impacts

This section summarizes the results of the annual natural gas energy impacts from the heat pump installations. The natural gas energy impact analysis includes 599 of the 801 participants (75%).[11]

Table 4 summarizes predicted baseline usage and actual usage overall and by pre-period usage quartile. On average, the predicted annual usage before the heat pump installation is 748 therms, and the usage after the heat pump installation is 273 kWh. Natural gas usage decreased by 475 therms—a 64% decrease in annual energy usage from the baseline period. Table 4 also shows the results of the pre-period actual usage before the conversion by quartiles. For the lowest usage quartile, the natural gas usage after installation decreased from 420 therms to 168 therms. For the highest usage quartile, the usage dropped from 1,147 therms to 410 therms. The percentage of reduction by quartile for natural gas usage is consistent throughout, ranging from 60% to 65%. These results are comparable to the total PRISM modeled usage of approximately 75%, indicating that natural gas heating usage is almost entirely removed through participation in the program.[12]

Table 4. Natural Gas Energy Usage and Savings Summary

Group	Sample	Actual Natural Gas Use Prior to Conversion	Predicted Baseline Natural Gas Use	Actual Post-Conversion Energy Use[a]	Savings (Therms)	Savings (%)	Actual Natural Gas Usage Prior to Conversion	Precision at 90% Confidence	Average Home Size (sq ft)
Quartile 1	149	465	420	168	253	60%	71%	7%	1,743
Quartile 2	151	679	627	218	409	65%	74%	4%	2,046
Quartile 3	150	853	797	296	501	63%	77%	5%	2,268
Quartile 4	149	1,253	1,147	410	737	64%	75%	5%	2,750
Overall	**599**	**812**	**748**	**273**	**475**	**64%**	**75%**	**3%**	**2,201**

[a] The post-installation period usage likely includes water heating, fireplaces, and cooking systems that remained after the furnace was removed.

Figure 5 illustrates the predicted baseline and post-conversion energy usage results overall and by the usage quartile shown in Table 4.

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11 Not all natural gas customers have hourly gas meters. The daily gas data are limited to customers who have an hourly gas meter.

12 The water heating usage has some seasonality; thus, the 75% PRISM heating estimate may include some water heating usage. As such, it is possible the 64% heating reduction may have offset the entire heating usage.

Figure 5. Natural Gas Usage Before and After Electrification

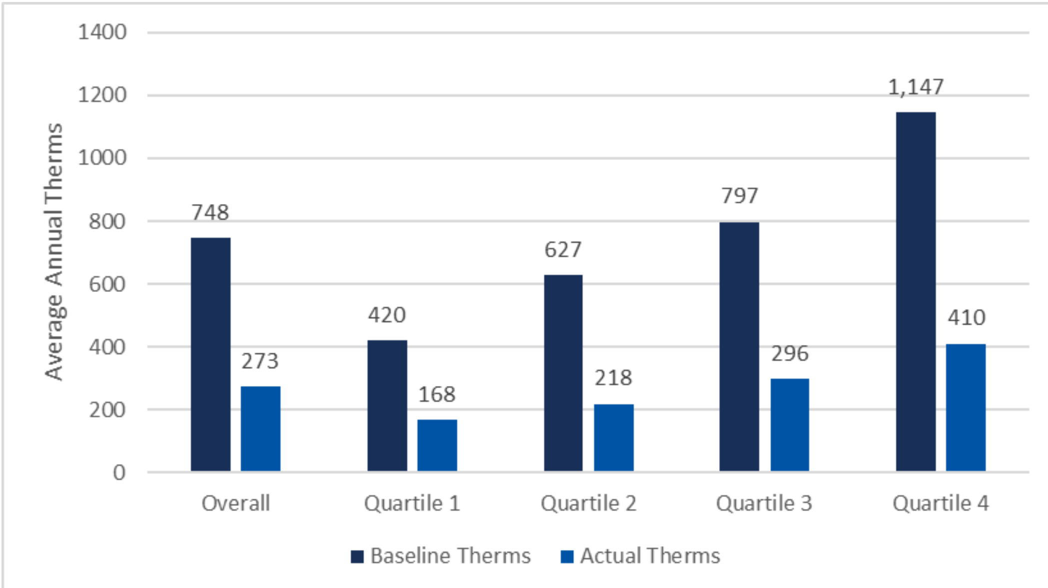


Figure 6 shows the average actual usage and the predicted baseline usage for the analysis period. For the post-winter period beginning in October 2023, the reduced natural gas usage from heat pumps is evident. The post-period included a cold-period event around January 13, 2024. The average model-predicted natural gas usage was nearly 7 CCF per day, but the average participant usage is about half of that at approximately 3.5 CCF per day after the heat pump installation.

Figure 6. Actual and Modeled Predicted Daily Natural Gas Usage

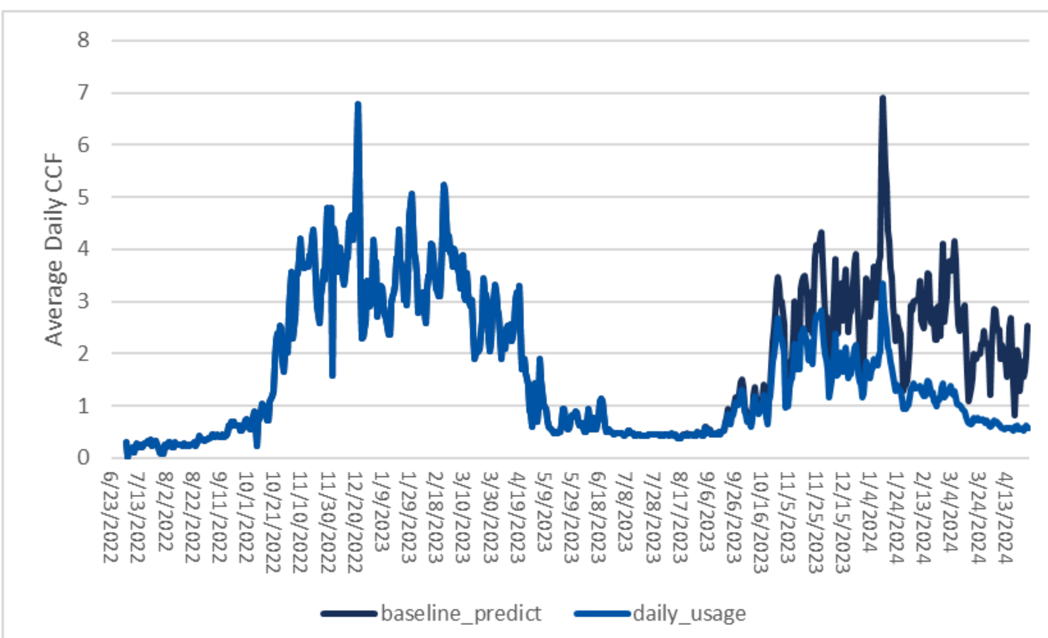
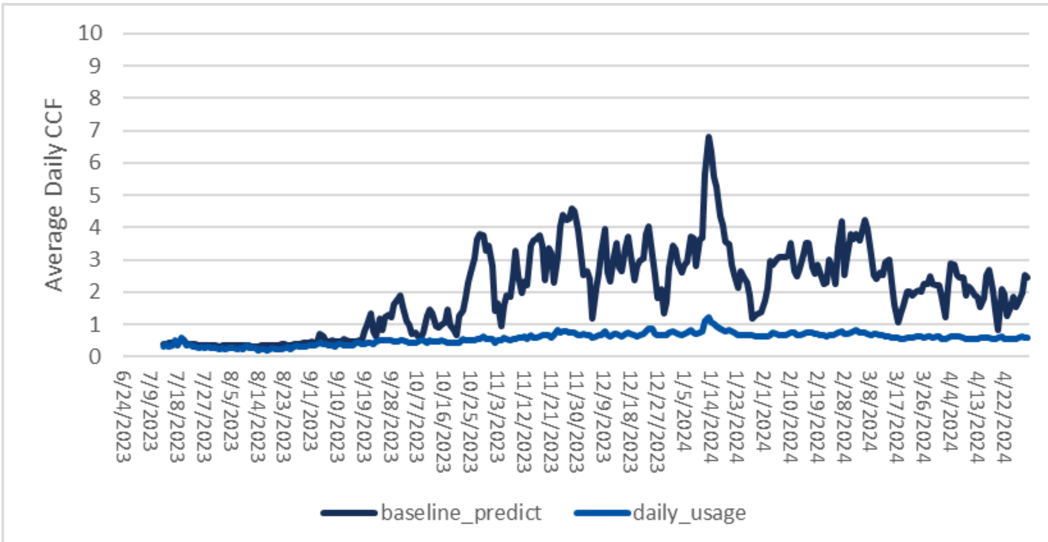


Figure 7 shows the model-predicted baseline usage and actual post-period usage for the post-installation period only. Cadmus estimated the predicted energy decrease in usage by taking the difference between the actual post-period usage (the blue line) and the predicted baseline usage (the black line). These are average energy estimates across all participants included in the natural gas energy impacts analysis. The average model-predicted natural gas usage was nearly 7 CCF per day, but the average participant usage was approximately 1 CCF per day after electrification.

Figure 7. Predicted Baseline Versus Actual Post-Period Usage



The limited post-period data in the natural gas analysis created additional challenges. As mentioned earlier, some participants had only one month of post-period data. To estimate the annualized baseline and annualized post-period usage, Cadmus applied usage factors to the partial post-period usage to obtain annualized usage. We calculated these factors for the annual period from May 1, 2023, through April 30, 2024. For the baseline period, the usage factors ranged from 0.63 to 1.00, and for the actual post-period, the usage factors ranged from 0.79 to 1.00. By applying the factors for each installation date, we were able to accurately annualize baseline and post-period usage based on partial months. As previously noted, annualizing the actual partial post-period usage by the number of days provides a biased estimate of annual usage since the average daily usage and weather for that specific period can vary from the average annual usage pattern. Intuitively, the post-period factors are closer to 1 because the actual post-period usage has little weather variability. However, adjustments for the baseline period are important since there is substantial weather usage variability, and obtaining accurate annual estimates requires the usage factors.

Electric Demand Impacts

This section summarizes the results of the winter period demand impacts from the heat pump installations. The natural gas energy impact analysis includes 531 of the 801 participants (66%).[13]

The PSE peak periods are defined as follows:

- Summer: June to September, non-holiday weekdays only, 4:00 p.m. to 7:59 p.m.[14]
- Winter morning peak: November to February, non-holiday weekdays, 7:00 a.m. to 9:59 a.m.
- Winter evening peak: November to February, non-holiday weekdays, 5:00 p.m. to 7:59 p.m.

Table 5 summarizes the average demand impacts for the winter months. In the morning peak, the baseline predicted demand is 1.15 kW, and the actual post-period demand is 2.75 kW—a 1.60 kW increase (139%) after electrification.[15] For the evening peak period, the baseline predicted demand is 1.52 kW, and the actual post-period demand is 2.44 kW—a 0.92 kW increase (139%) after electrification. For the combined average peak, Cadmus combined the morning peak and evening peak results. The average peak for all hours shows that across the entire winter peak period, the baseline predicted demand was 1.16 kW, and the actual post-period demand was 2.19 kW—a 1.04 kW increase (90%) after electrification.

Table 5. Winter Demand Results

Time Period	Baseline Predicted Demand (kW)	Actual Post Demand (kW)	Electric Demand Added (kW)	Electric Demand (% increase)	Precision at 90% Confidence Level
Morning Peak: 7:00 a.m. – 9:59 a.m.	1.15	2.75	1.60	139%	4%
Evening Peak: 5:00 p.m. – 7:59 p.m.	1.52	2.44	0.92	60%	5%
Average Peak	1.34	2.60	1.26	94%	3%
Average All Hours	**1.16**	**2.19**	**1.04**	**90%**	**2%**

Figure 8 shows a visual representation of the load profiles for the winter peak period. The dotted line shows the baseline predicted load across the winter peak period months. The baseline demand varies on average from 0.75 kW to 1.50 kW. The black line shows the post-electrification demand, which

13 The winter peak months are defined from November to February. Cadmus excluded any installations that occurred from March 1, 2024, or later because there were no post-period data matching the peak winter months.

14 Due to insufficient post-period usage data, Cadmus could not estimate summer demand.

15 Cadmus calculated these results using a weighted day approach. Since the sample sizes were highest for the later participants in February, we weighted the earlier installations in November more heavily. We performed sensitivity testing on these weighted demand results—without any weights and subsetting to customers who installed before November 1, 2023—that have peak period data for all the days (n=189). All these methods provided similar results to the day-weighted numbers with sample sizes larger than n=531.

ranged from approximately 1.70 kW to 3 kW. The dotted blue line shows the increase in demand from electrification, which shows increases in demand from approximately 0.7 kW to 2.0 kW.

The profiles show that the winter morning peak for heat pumps occurs as early as 5:00 a.m.—earlier than the beginning of PSE's defined winter morning peak at 7:00 a.m. These peak-period profiles provide averages across the entire winter period and are not representative of peak-day load shapes.

Figure 8. Average Winter Peak Period Impacts Chart

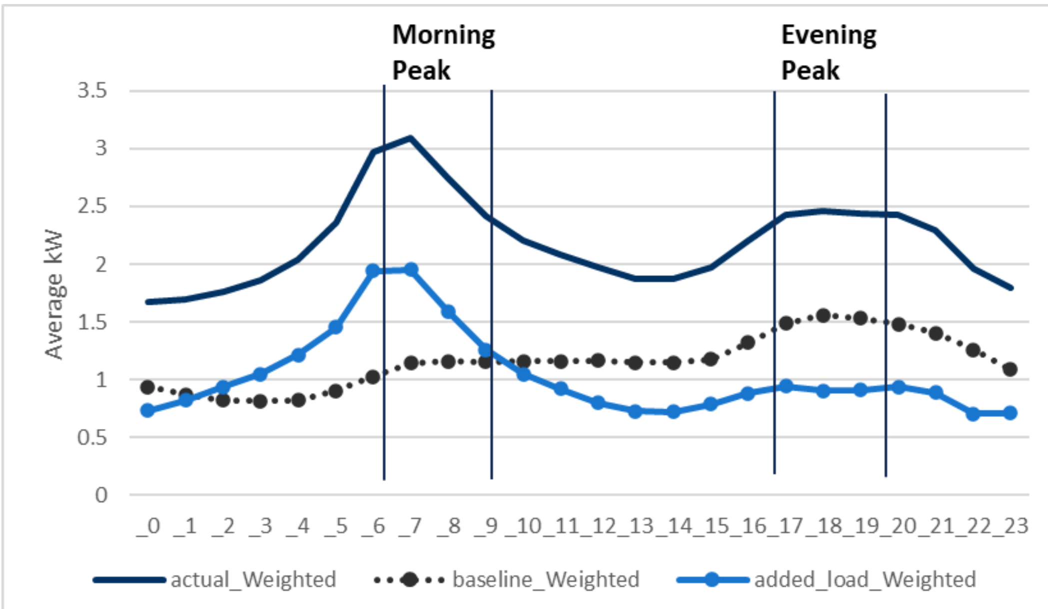


Figure 9 compares the baseline and actual post-electrification variation by month. The dotted lines are the baseline demands, which show little variation by month. The black solid line shows the average demand for January during the coldest weather period. The blue solid line for February shows milder demand.

Figure 9. Predicted Baseline and Actual Demand by Average Winter Month

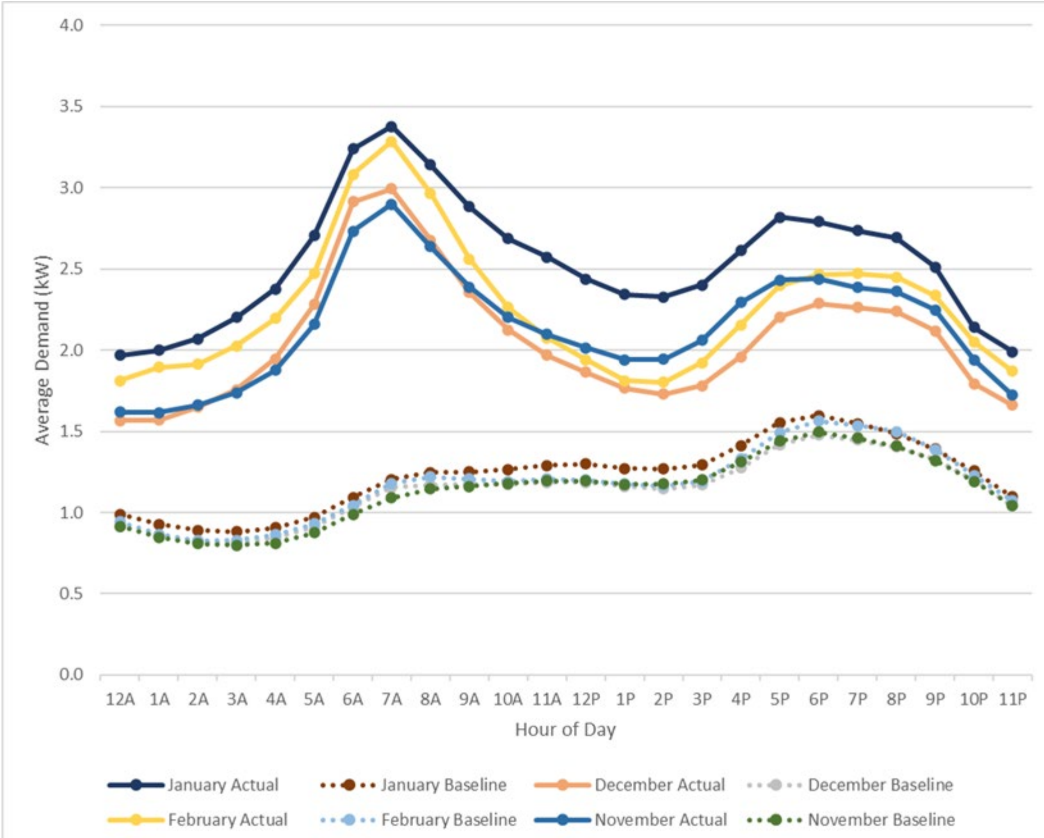


Figure 10 shows the average actual demand across the entire analysis period. Before electrification, the demand was around 1 kW, and as electrification ramped up, demand increased to a maximum of nearly 5 kW for the cold post-period January months.

Figure 10. Actual Average kW in the Analysis Period

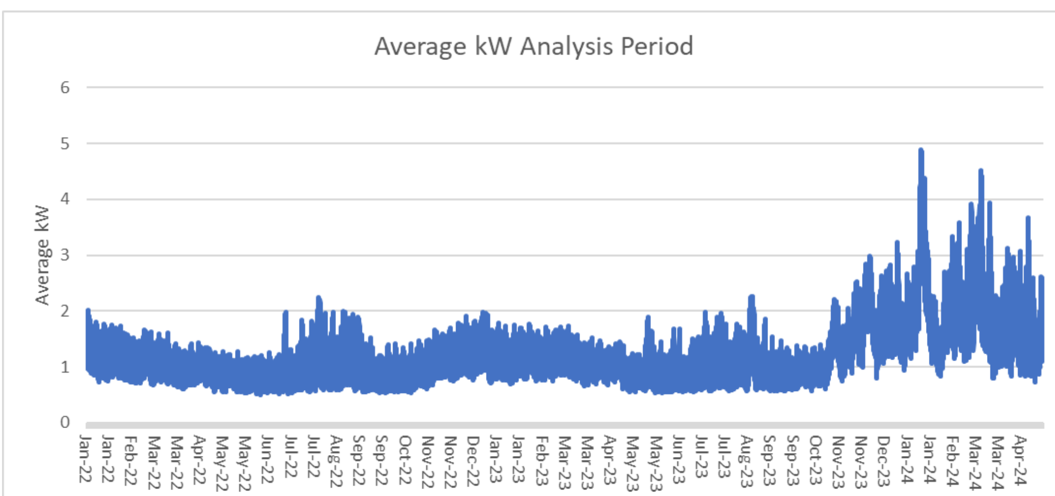
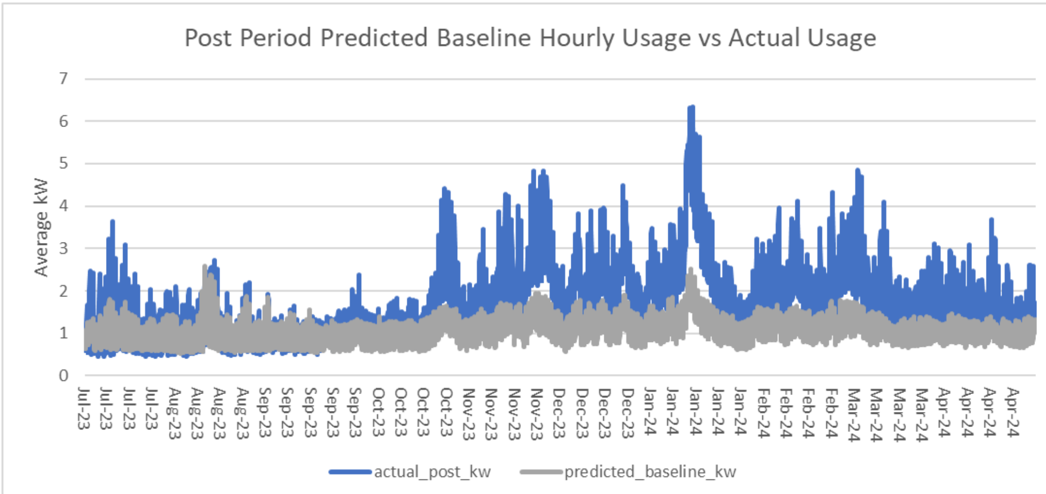


Figure 11 shows the predicted demand and actual demand in the post-period analysis period. In the coldest period of January, the average predicted baseline demand was around 2.5 kW, while the post-period actual demand was around 6.5 kW.

Figure 11. Baseline Predicted Demand Versus Actual Demand in the Post-Period



These summaries show that the average peak-period winter demand impacts varied significantly depending on temperature. Cadmus developed the average peak demand from days that varied from mild to cold, extreme weather days.

The following sections present the correlation between demand impacts after electrification and temperature, showing the expected demand increase based on hourly and average daily temperature. Figure 12 through Figure 14 show relationships between increased demand during winter peak hours and hourly temperatures. Figure 15 shows winter load shapes based on the average daily temperature range. Figure 16 shows increased winter load by average daily temperature range.

Figure 12 summarizes the added load from electrification during morning winter peak hours.[16] There is a strong relationship between the additional load from electrification and hourly temperature. The average increase in peak demand for all morning winter peak hours is around 1.6 kW based on the results shown in Table 5. During the coldest period, when hourly temperatures ranged from 20°F to 30°F, the demand was higher, ranging from 3 kW to 4 kW.

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[16] Cadmus estimated increased load by taking the difference between the model-predicted baseline kW and the actual kW: in effect, the additional load due to electrification.

Figure 12. Increased Demand During Morning Winter Peak Hours by Hourly Temperature

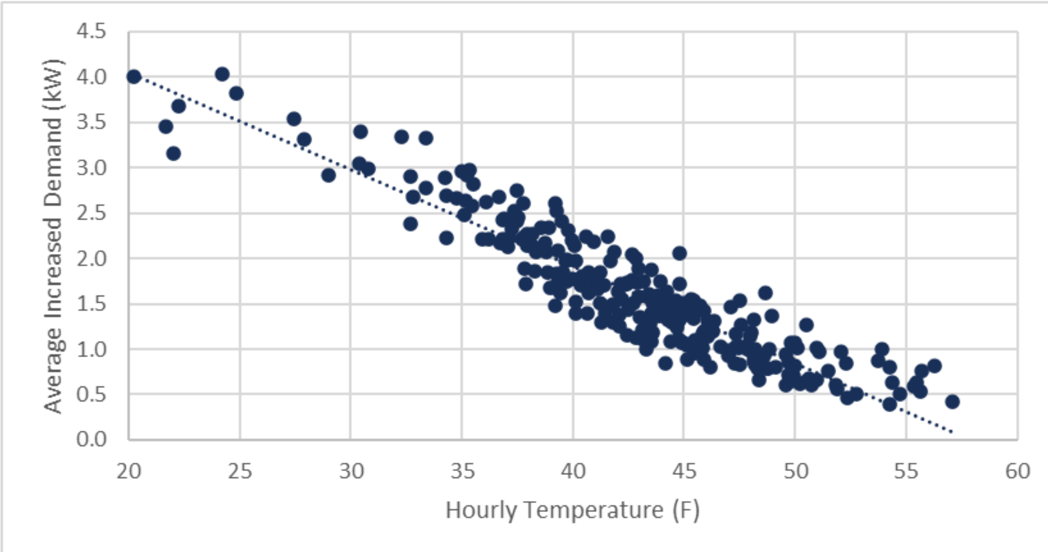


Figure 13 summarizes the added load from electrification for the evening winter peak hours. There is a strong relationship between the additional load from electrification and hourly temperature. The average added peak demand for all the evening winter peak hours was around 0.9 kW based on the results in Table 5. During the coldest period, when hourly temperatures ranged from 18°F to 30°F, the added demand was higher, ranging from 2 kW to 3 kW.

Figure 13. Increased Demand During Evening Winter Peak Hours by Hourly Temperature

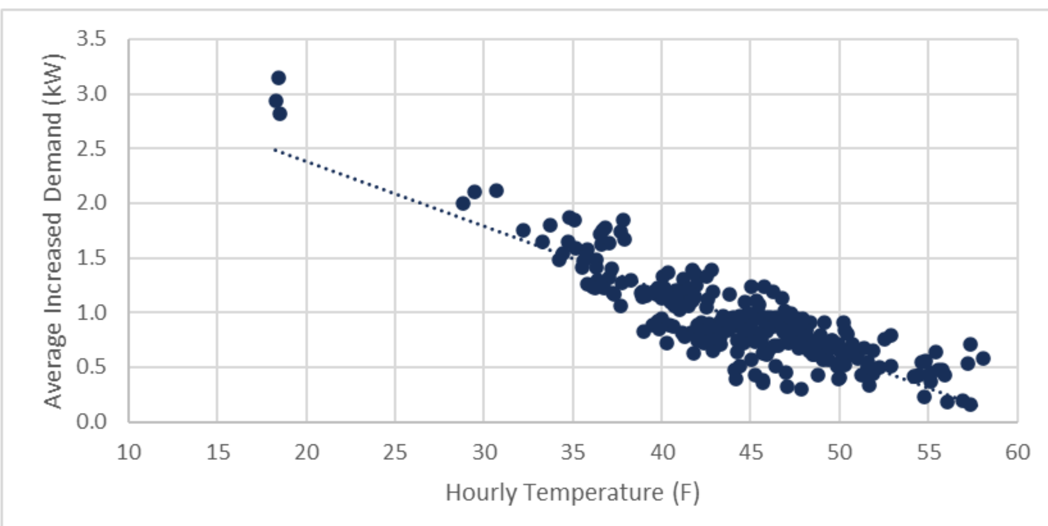


Figure 14 summarizes the added load from electrification for all winter hours from November to February. There is a strong relationship between the additional load from electrification and hourly temperature. The average increased demand for all winter hours from November to February was around 1 kW based on the results in Table 5. During the coldest period, when hourly temperatures ranged from 18°F to 30°F, the added demand was higher, ranging from 1.5 kW to 4 kW.

Figure 14. Increased Demand During All Winter Hours by Hourly Temperature

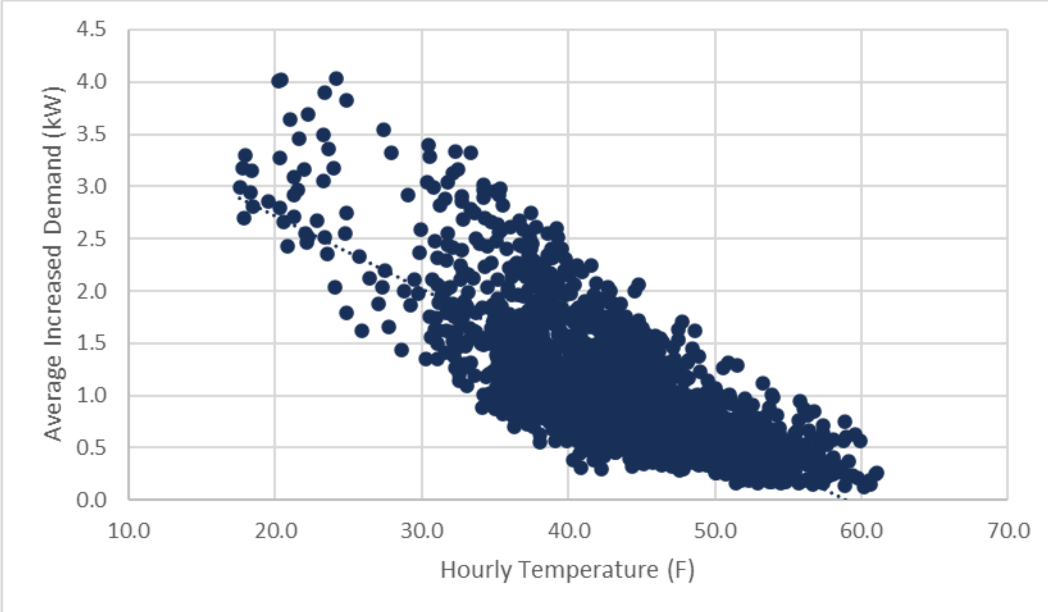


Figure 15 presents the actual load shape of post-period winter demand by average daily temperature bin for all winter hours from November to February. The top line shows the post-period demand load shape for average daily temperatures from 20°F to 30°F. The average demand for this period was consistently above 3 kW during milder winter days, with average daily temperatures between 50°F and 60°F. On these days, the demand ranges from 1 kW to 2 kW. This graph shows only the average demand post heat pump installation and not the incremental increase in demand due to electrification.

Figure 15. Average Post-Electrification Demand by Daily Temperature Bin

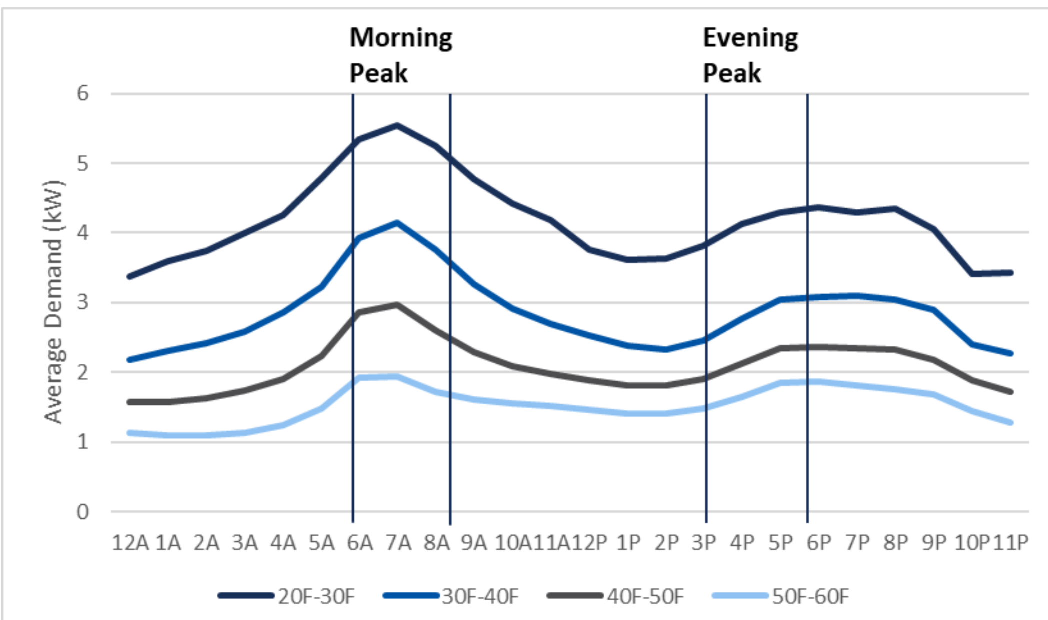
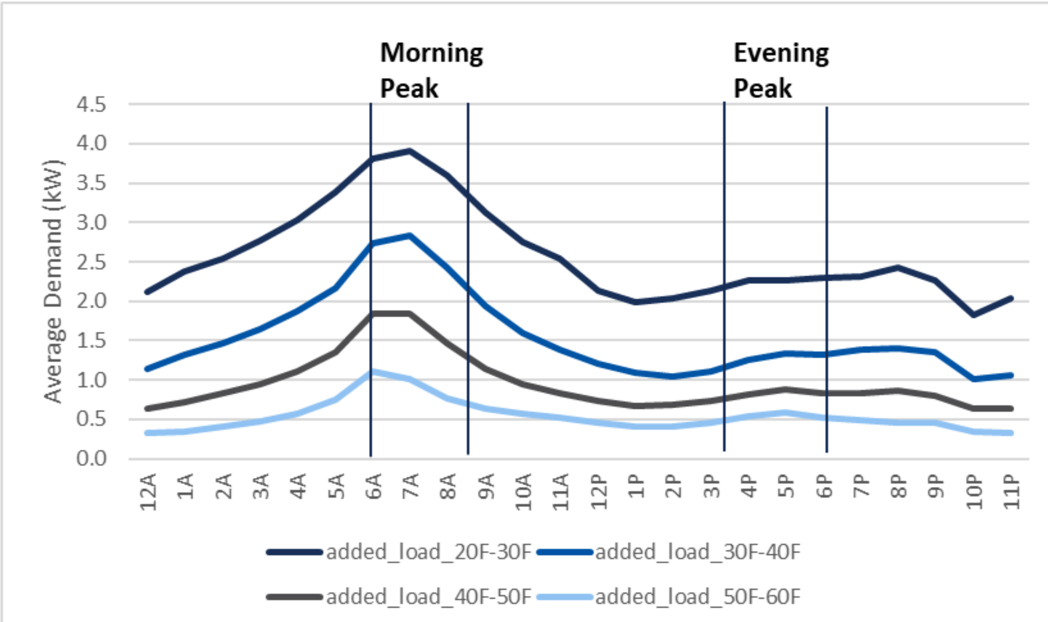


Figure 16 shows the actual load shape of added load by average daily temperature bin for all winter hours from November to February. The top line shows the post-period demand load shape for average daily temperatures ranging from 20°F to 30°F. The average added demand for this period was between 2 kW and 4 kW during milder winter days, with average daily temperatures ranging between 50°F and 60°F. For these days, the added demand ranged from approximately 0.5 kW to 1 kW.

Figure 16. Average Increased Load by Daily Temperature Bin



Financial Impacts

The following section reports the pilot's impact on participants' utility bills. Cadmus calculated pilot impacts on utility bills in two steps:

1. We used the monthly billing data usage and associated billed dollar amounts to obtain average natural gas and electricity rates before participation in the pilot.
2. We applied the average rates obtained from the first step to the actual weather-normalized pre- and post-natural gas and electric usages to obtain estimates of the annual dollar amounts.

Table 6 provides an initial summary of the average rates, including base charges, usage charges, and bill credits for the 12 months before installation. Customers were encouraged to enroll in PSE's Bill Discount Rate (BDR) program while participating in the STEP program. The BDR program, funded by the Washington Families Clean Energy Credits Grant Program and by PSE ratepayers, provides financial support in the form of credits toward customer utility bills based on household income and size. While Cadmus did not analyze post-installation bills due to the impacts of fluctuations in natural gas and electricity prices, BDR credits may reduce between 5% and 45% of total utility bill costs. For natural gas, the pre-period usage was 812 therms, and the billed amount was $1,160, which resulted in an average pre-period gas rate of $1.43 per therm. For electricity, the pre-period usage was 9,180 kWh, and the billed amount was $1,215, which resulted in an average pre-period electric rate of $0.13 per kWh.

Table 6. Average Energy Use and Utility Bill Impacts

Group	Number of Participants[a]	Annual Usage Prior to Heat Pump Conversion (kWh, Therms, or MMBtus)	Annual Usage After Heat Pump Conversion (kWh, Therms, or MMBtus)	Change in Use (kWh, Therms, or MMBtus s)	Energy Use Difference (%)	Annual Utility Bill Cost Prior to Heat Pump Conversion
Gas	598	812	273	-539	-66%	$1,160
Electric	657	9,180	13,320	4,140	45%	$1,215
Overall		**112**	**73**	**-40**	**-35%**	**$2,375**

[a] The participant population for the utility bill impact rate analysis differed from that of the energy use analysis due to differences in the availability of utility bill data.

Table 7 summarizes the final weather normalized bill impacts. To estimate these impacts, Cadmus applied the rates developed in Table 6 to the actual weather normalized usages. Natural gas usage decreased from 748 therms to 273 therms, with a 475 therm (64%) reduction in usage. In the same period, the billed amounts dropped from $1,069 to $390, with a $679 (64%) reduction in bill costs. Electricity usage increased from 9,010 kWh to 13,597 kWh, with a 4,588 kWh (51%) increase in usage. In the same period, the billed amounts increased from $1,193 to $1,800, with a $607 (51%) increase in bill costs.

Overall, the usage decreased from 106 MMBtu to 74 MMBtu, with a 32 MMBtu (30%) decrease in usage. In the same period, the billed amounts decreased from $2,261 to $2,190, with a $72 (3%) decrease in annual bill costs.

Table 7. Final Weather Normalized Bill Impacts

Group	Number of Participants	Annual Usage Prior to Heat Pump Conversion (kWh, Therms, or MMBtus)	Annual Usage After Heat Pump Conversion (kWh, Therms, or MMBtus)	Change in Use (kWh, Therms, or MMBtus)	Energy Use Difference (%)	Annual Utility Bill Cost Prior to Heat Pump Conversion	Annual Utility Bill Cost after Heat Pump Conversion	Annual Utility Bill Cost Difference ($)	Annual Utility Bill Impact (%)
Gas	599	748	273	-475	-64%	$1,069	$390	-$679	-63.5%
Electric	658	9,010	13,597	4,588	51%	$1,193	$1,800	$607	50.9%
Overall		**106**	**74**	**-32**	**-30%**	**$2,261**	**$2,190**	**-$72**	**-3.2%**

Decarbonization Impacts

The removal of natural gas-fired heating systems and replacement with heat pumps through the STEP pilot resulted in a 51% increase in electricity usage and a 64% decrease in natural gas consumption. When converted to MMBtus, this is equivalent to an average increase of 15.65 MMBtus for electricity and an average decrease of 27.29 MMBtus for natural gas, per participant. In total, the 18-month pilot achieved a reduction of 31.24 MMBtus per customer (a 29.8% reduction in energy use).

The burning of natural gas in residential heating systems produces more greenhouse gas emissions than the electricity provided by PSE to power heat pump systems. When we compared annual greenhouse gas emissions before and after participants converted to heat pumps, carbon dioxide emissions were reduced by 19.7%, methane emissions were reduced by 63.2%, and nitrous oxide emissions were reduced by 63.0%. Table 8 summarizes the average greenhouse gas impacts from STEP heat pump rebate participation. The Environmental Protection Agency provides an Emissions & Generation Resource Integrated Database (eGRID) as a source for greenhouse gas emissions factors for electricity regions throughout the United States.[17] PSE's territory lies within eGRID's Western Electricity Coordinating Council Northwest region. PSE's specific emissions factors may vary from the eGRID's estimates.

Table 8. Average Greenhouse Gas Emissions Impact

GHG	GHG Emissions Prior to Heat Pump Conversion (kg)	GHG Emissions after Heat Pump Conversion (kg)	GHG Emissions Due to Heat Pump Conversion (kg)	Change (%)
CO2 (kg)	6,428.8	5,161.7	-1,267.1	-19.7%
CH4 (kg)	75.0	27.6	-47.4	-63.2%
N2O (kg)	7.5	2.8	-4.73	-63.0%

Program Process Findings

This section of the report presents the findings from Cadmus' process evaluation. Our comprehensive analysis approach included multiple research methods: interviews, surveys, benchmarking, and materials review. The objective of the process evaluation was to provide a thorough assessment of the pilot by capturing insights from various stakeholders, evaluating current practices, and identifying areas for enhancement. Cadmus integrated diverse sources of information to conduct a well-rounded and evidence-based assessment of the pilot. Our findings highlight the pilot's strengths, identify gaps, and provide the basis for actionable strategies to improve pilot performance.

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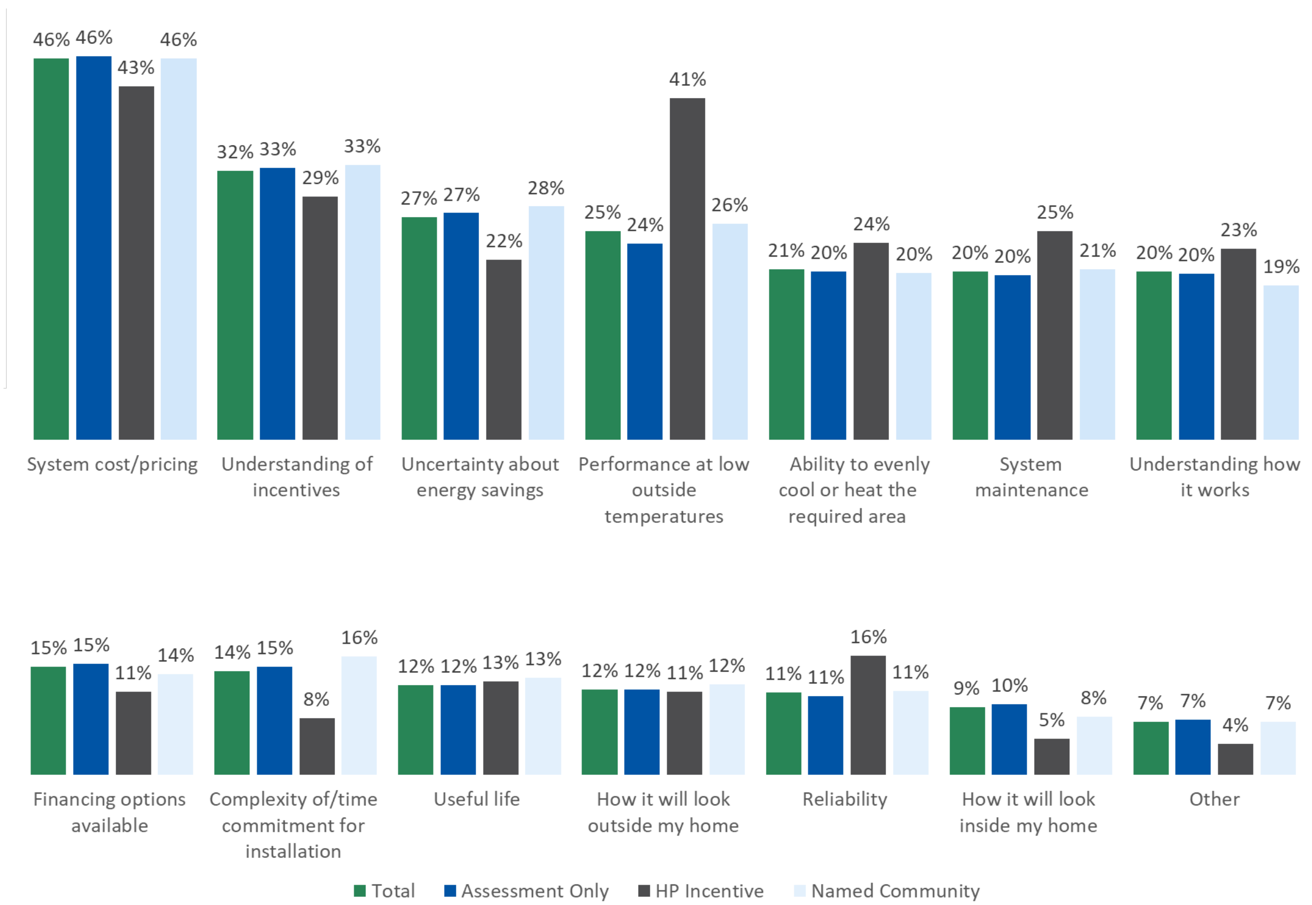
17 Environmental Protection Agency. Last Modified June 5, 2024. "Emission Factors for Greenhouse Gas Inventories." https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.xlsx

Barriers to Heat Pump Adoption

This section addresses the research objectives of identifying barriers to heat pump market penetration and electrification and assessing whether a financial incentive to switch to electric-only appliances would motivate customers and promote increased adoption of high-efficiency electric-only appliances.

Cadmus asked respondents of the HEA and heat pump rebate surveys what concerns they had about heat pump adoption before participating in the pilot. Respondents had the option of selecting more than one answer. As shown in Figure 17, overall, system cost/pricing was the top reason (46% for both surveys), followed by understanding the incentives (between 29% and 33%) and uncertainty about energy savings (between 22% and 28%). However, for heat pump survey respondents, performance at low outside temperatures was the second highest concern. On average, Named Community responses were similar to those of non-Named Community responses.

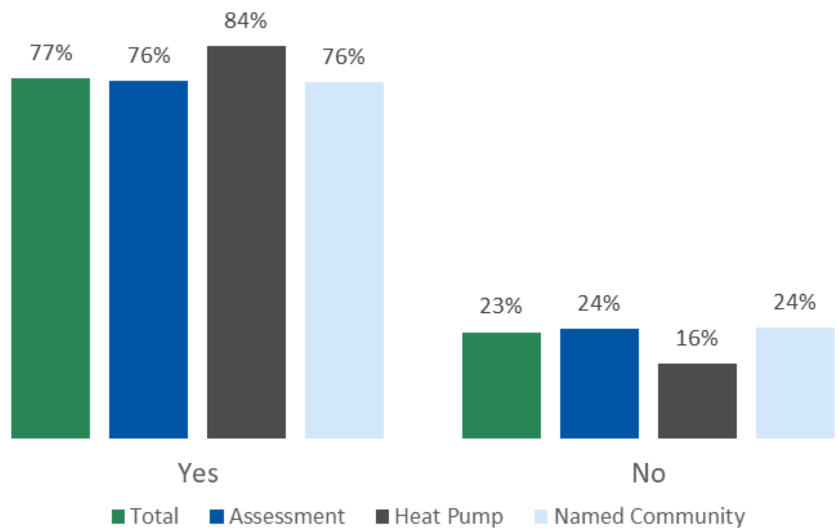
Figure 17. Questions and Concerns about the Heat Pump Prior to the Assessment



Source: Survey question B5/E3: "Did you have any questions/concerns about the heat pump prior to the assessment? Please select all that apply." (n=1,622)

As shown in Figure 18, the majority of respondents (between 76% and 84%) confirmed their concerns were clarified after the assessment or installation. More heat pump survey respondents reported that their concerns were clarified than HEA respondents.

Figure 18. Respondents' Perceptions of Whether Questions Were Clarified after the Assessment

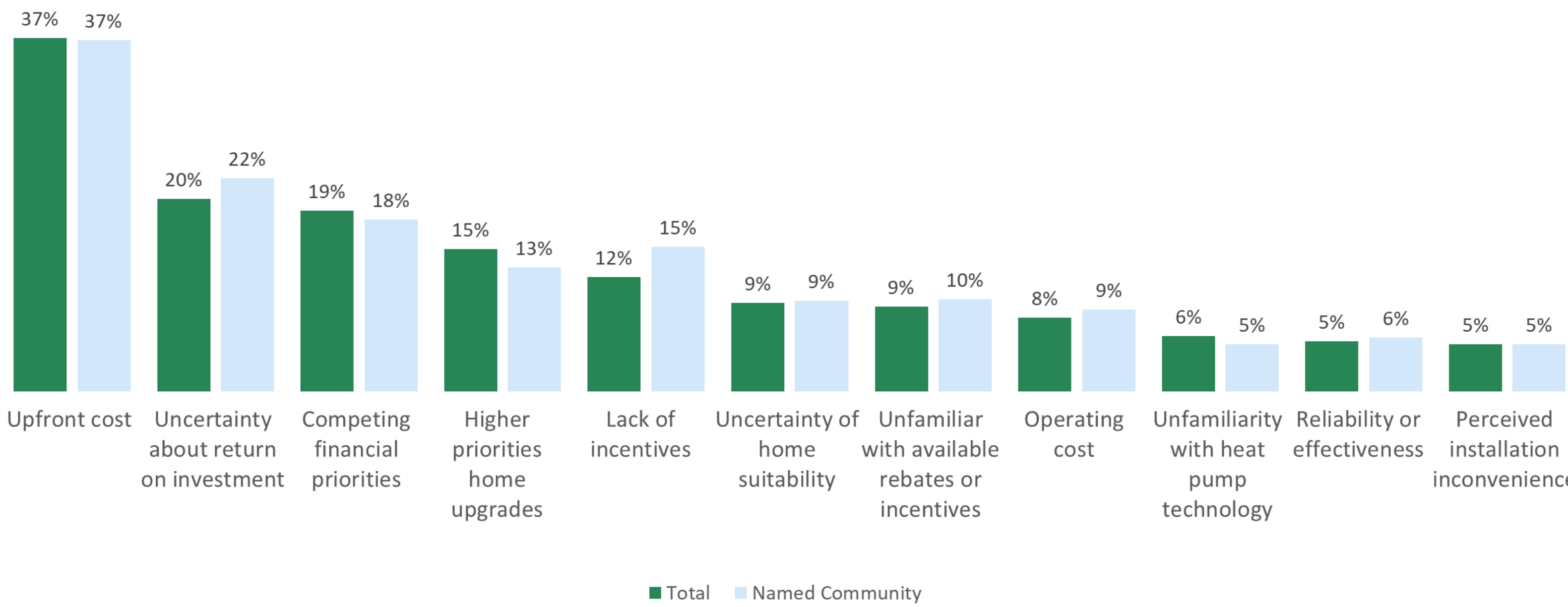


Source: Survey question B6/E4: "After receiving the assessment/after your heat pump was installed, were your questions and concerns clarified?" (n=1,181)

The HEA survey asked what concerns respondents still had after the assessment. Almost 15% still had questions about the costs of acquiring, installing, and maintaining a heat pump, while 9% did not understand what rebates or incentives would be available to them. Another 9% claimed that they did not receive enough or adequate information during and after the assessment, and 5% were particularly hesitant about the performance of the heat pump in cold temperatures.

Figure 19 shows the reasons HEA respondents selected when asked why they did not purchase a heat pump. Respondents were able to select more than one reason.

Figure 19. Main Reasons HEA Survey Respondents Decided Not to Purchase a Heat Pump



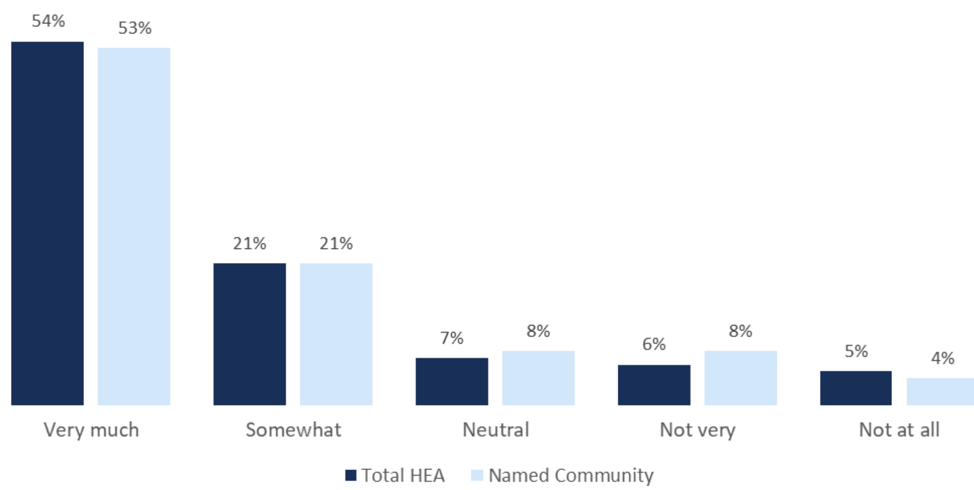
Source: Survey question B9: "What are the main reasons you decided not to purchase a heat pump? Select all that apply." (n=1,479)

While the Named Communities' responses were similar to those of non-Named Communities, Figure 19 shows that a higher percentage (15%) of Named Community respondents said a lack of incentives was the reason for not installing it, compared to 12% among the non-Named Community respondents. This difference is statistically significant.

A considerable percentage of respondents (10%) selected "other reasons" for choosing not to install the heat pump. Among these, 25% said their existing furnace was still working and did not need a heat pump, while 15% said that they had other financial priorities for home improvements and could not afford a heat pump.

When prompted to select a single reason they did not install a heat pump, 52% of HEA respondents chose upfront cost. In a follow-up question, 54% reported being *very much* concerned about the upfront costs of purchasing and installing a heat pump (Figure 20).

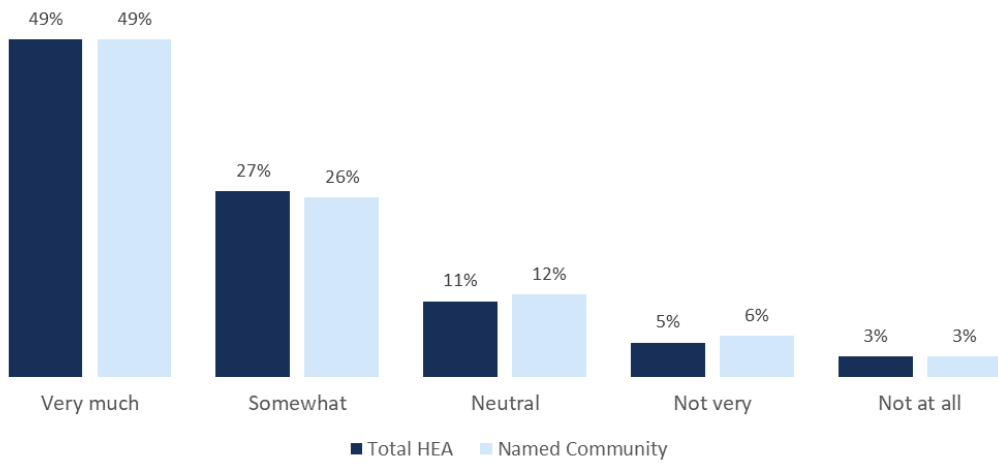
Figure 20. How Concerned Survey Respondents Are about the Upfront Cost of New Heat Pump



Source: Survey question B12_A: "How concerned are you about the upfront cost of purchasing and installing a heat pump in your home?" (n=1,397)

In line with these findings, almost 50% of respondents said they would be *very likely* to pursue home electrification or heat pump installation if additional incentives were available for households in their income bracket, whereas 27% would be *somewhat likely* to pursue installation (Figure 21).

Figure 21. How Likely Respondents Are to Pursue Home Electrification with Additional Incentives

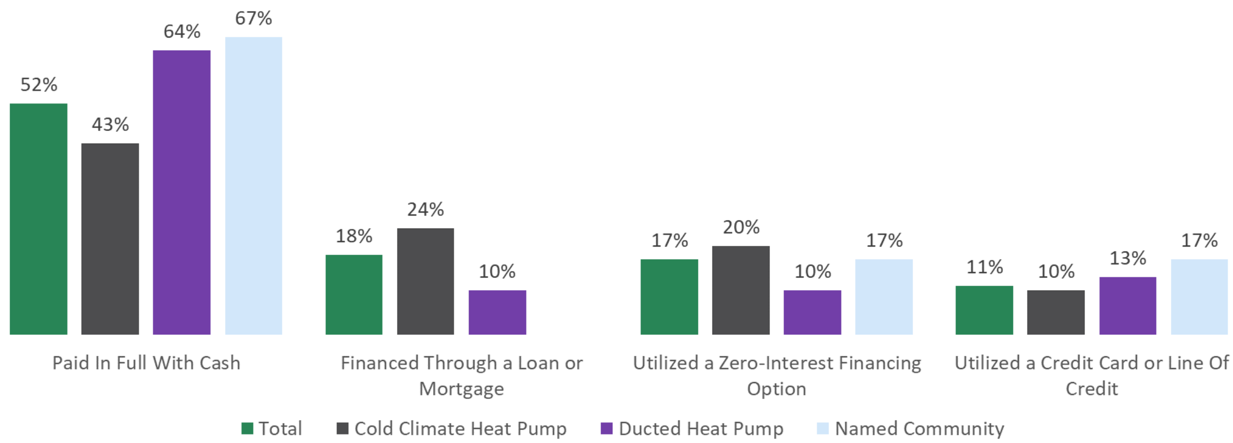


Source: Survey question B12_D: "How likely are you to pursue home electrification and/or heat pump installation if additional incentives were available for households in your income bracket?" (n=1,394)

Moreover, the heat pump survey asked how participants financed their heat pump. A high percentage of the total population (52%) and Named Community respondents (67%) reported they paid in cash. The higher percentage among Named Communities may indicate that these communities have restricted access to financial institutions, limited education about financing options, or face higher obstacles to accessing financial products like loans. Moreover, as shown in Figure 25, Named Community respondents said the main reason they installed a heat pump was to add cooling to their home (67%), which may indicate an intention to purchase a heat pump and save money for it.

Among the heat pump survey respondents, 24% of those who installed a cold climate heat pump used a loan, and 20% used a zero-interest financing option. For Named Community respondents, 17% used their credit cards, 17% used zero-interest financing, and no one used a loan or mortgage (Figure 22).

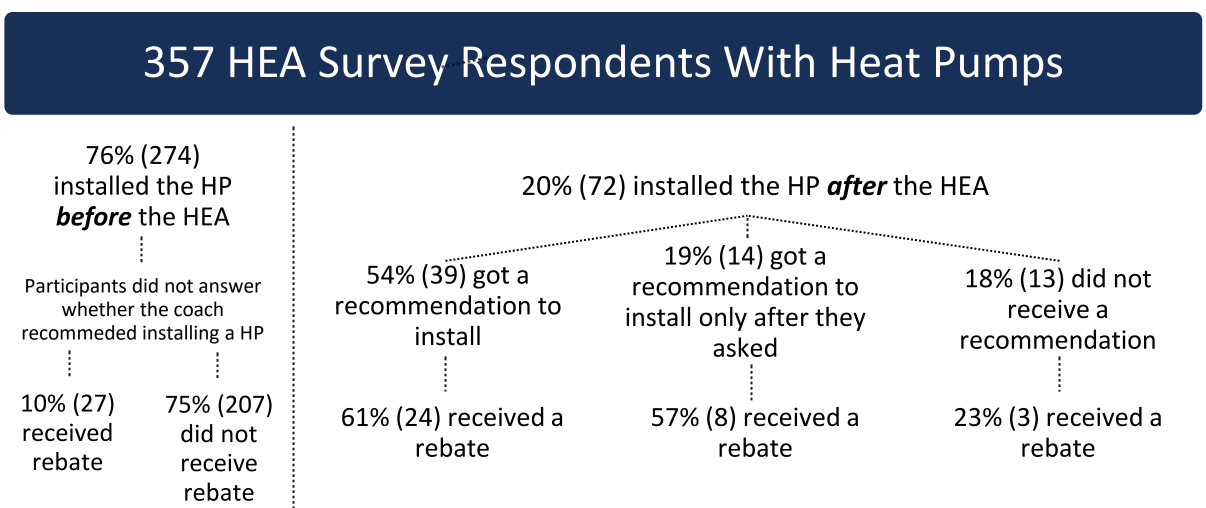
Figure 22. How Heat Pump Survey Respondents Financed the Purchase of Their Heat Pumps



Source: Survey question D6: "Please select the option that best describes how you financed the purchase of your heat pump..." (n=119)

Finally, the HEA survey included questions to assess whether participants installed a heat pump and received a PSE rebate after receiving education and recommendations from the electrification coach. At the time of the survey, 26% (n=357) of respondents who participated in the home assessment had a heat pump installed in their home, as shown in Figure 23.

Figure 23. HEA Survey Respondents Who Received PSE Rebates



Note: The program design does not intentionally prescribe a participation sequence between the HEA and receiving a heat pump incentive. The two tracks are parallel and independent from each other. Totals in Figure 23 do not add up because "Don't know" responses are not included in the figure.

Of these 357 households, 76% had a heat pump installed before the assessment. Among them, 10% received a rebate, indicating participation in the heat pump rebate component prior to the assessment, 75% reported not receiving a rebate, and 14% (n=40) did not know. Out of the 75% who did not receive a rebate, some may have installed prior to the pilot period, some may not have been eligible for the rebate, and some may not have been aware that a rebate was available or may not have wanted to follow through the process of getting the rebate.

Of the participants who reported having a heat pump at the time of the survey, 20% installed a heat pump after receiving PSE's HEA, indicating knowledge of the offering prior to installation. All respondents (n=72) belonged to a Named Community, and one respondent was a Deepest Need customer. Among the homes that received the assessment, 54% reported they received a recommendation to install a heat pump from the electrification coach, and 61% of those who received the recommendation received a rebate. Nineteen percent of HEA respondents said they only received the recommendation to install a heat pump after they expressed their interest in it to the electrification coach—57% of these respondents received a rebate. Alternatively,, 18% of HEA respondents said they had not received a recommendation to install a heat pump but installed the equipment anyway—23% of those respondents received a rebate. Two respondents did not know if the coach had recommended it but installed a heat pump and received a rebate. In total, 51% of the 72 participants who installed a heat pump after receiving a home assessment received a pilot-funded rebate.

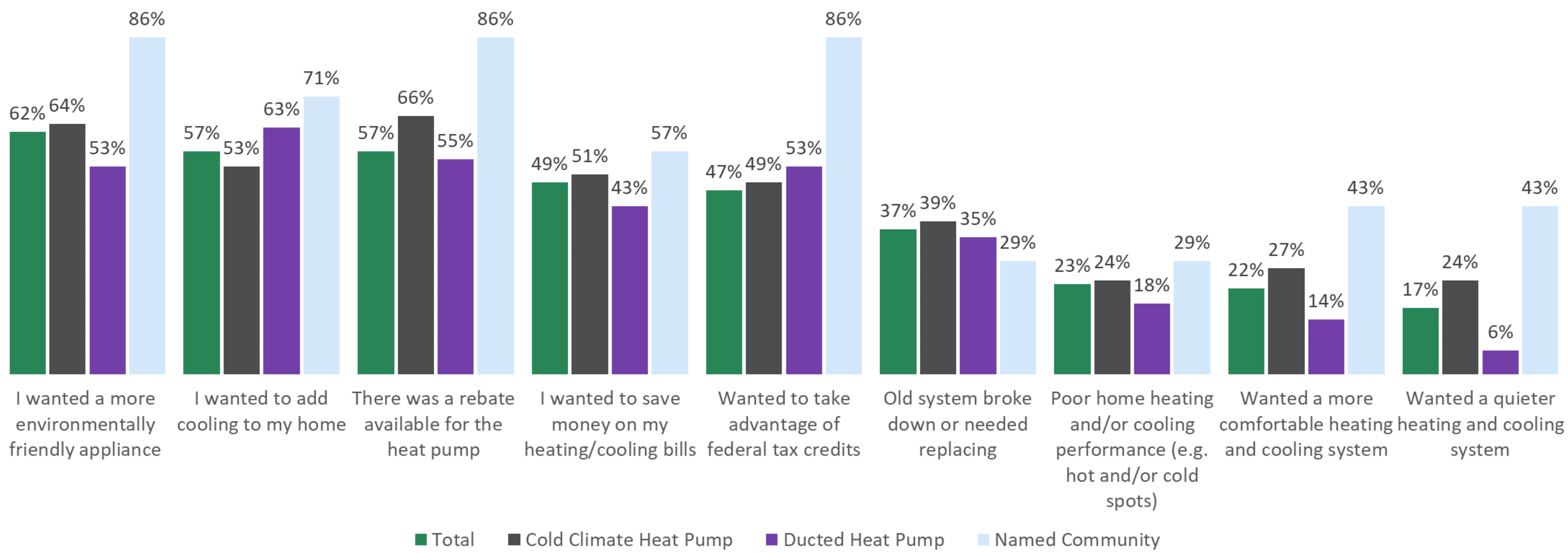
Benefits of Electrification

This section of the report addresses the research objectives of identifying barriers and recommendations for improving heat pump market penetration, developing policies to support the adoption of heat pump technologies—especially among Named Communities—and investigating benefits from program participation, including non-energy benefits, as well as several aspects of program delivery and satisfaction.

The heat pump rebate survey asked respondents what factors influenced their decision to purchase a heat pump and gave them the option of selecting multiple choices with energy and non-energy benefits. Among Named Communities, the main reasons were environmental friendliness (86%, or six respondents), the existence of a rebate (86%), a federal tax credit (86%), and wanting to cool the home (71%, or five respondents). Among those who purchased a cold climate heat pump, environmentalism (64%, or 38) and access to a rebate (66%, or 39) were most frequently selected.

Figure 24 presents a complete breakdown of survey responses.

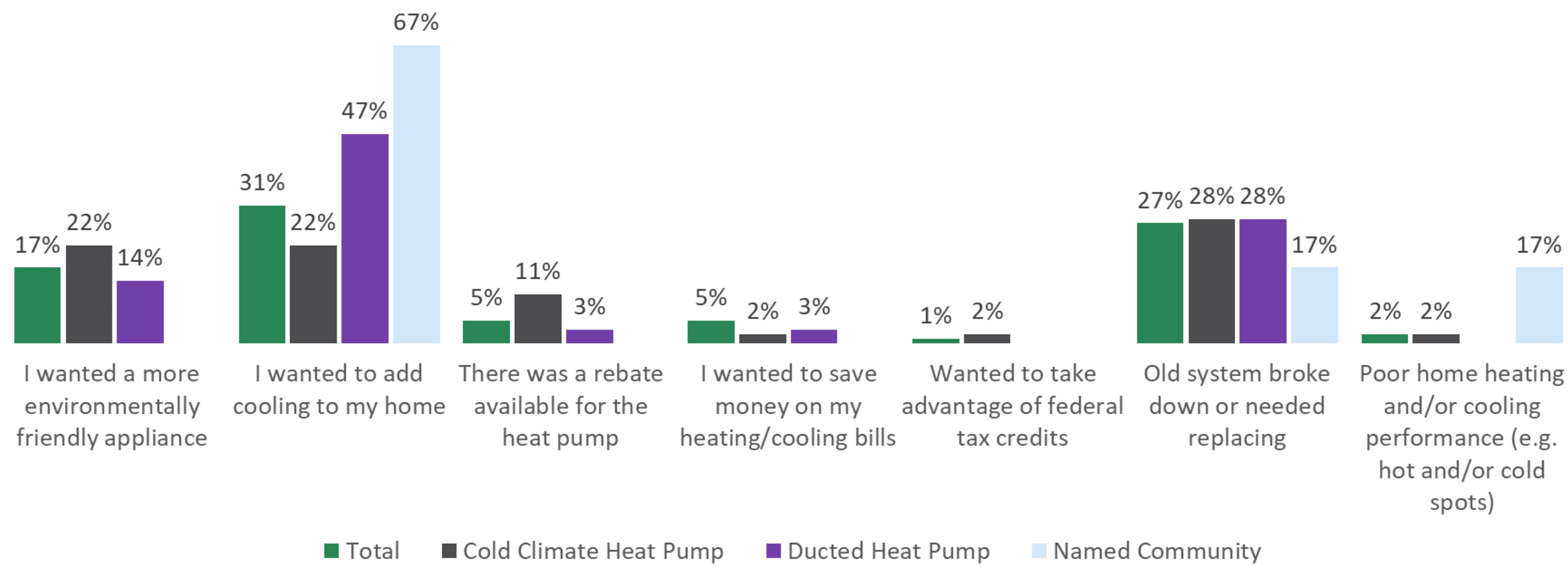
Figure 24. Factors That Influenced Heat Pump Survey Participants' Decision to Purchase a Heat Pump



Source: Survey question E1: "What factors influenced your decision to purchase a heat pump? Select all that apply." (n=143)

When prompted to select a single reason, wanting to add cooling to their home was the top selection among all groups (31%), with 67% of Named Community respondents selecting it as the most influential reason. However, as shown in Figure 25, those who purchased a cold climate heat pump selected needing a replacement as their main reason (28%).

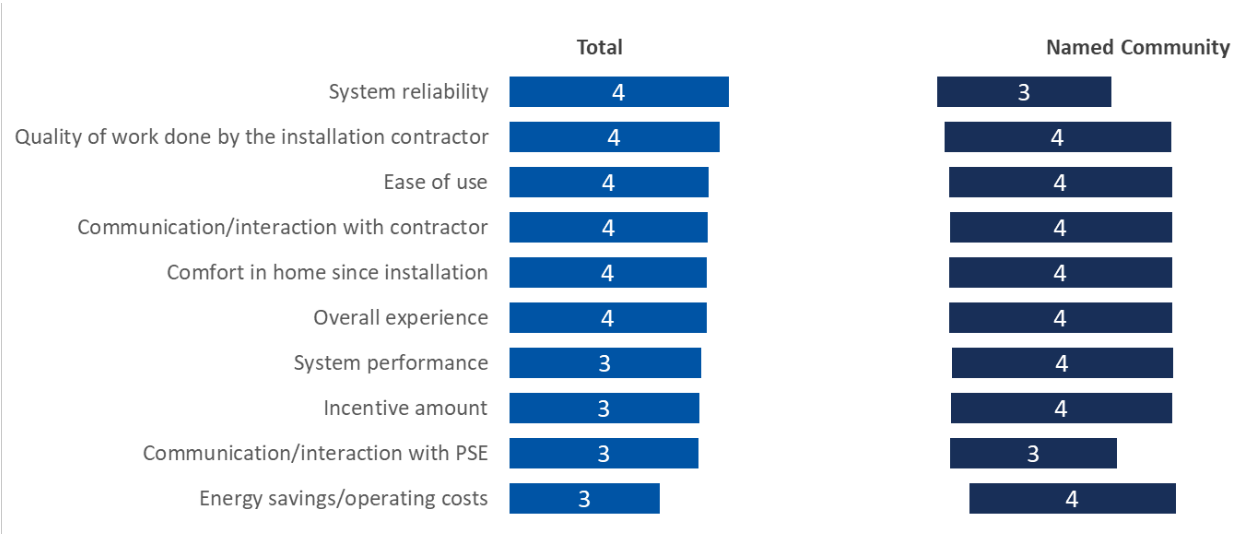
Figure 25. Single Most Influential Factor in Purchasing a Heat Pump



Source: Survey question E2: “You mentioned the following factors were influential in your decision to install a heat pump. Which of these factors was most important?” (n=110)

The heat pump survey asked respondents to rate their level of satisfaction using a scale of 1 to 5, where 1 means *very dissatisfied* and 5 means *very satisfied*. Figure 26 shows their level of satisfaction with different aspects of the program.

Figure 26. Respondents' Level of Satisfaction with Different Aspects of the Heat Pump Incentive Program

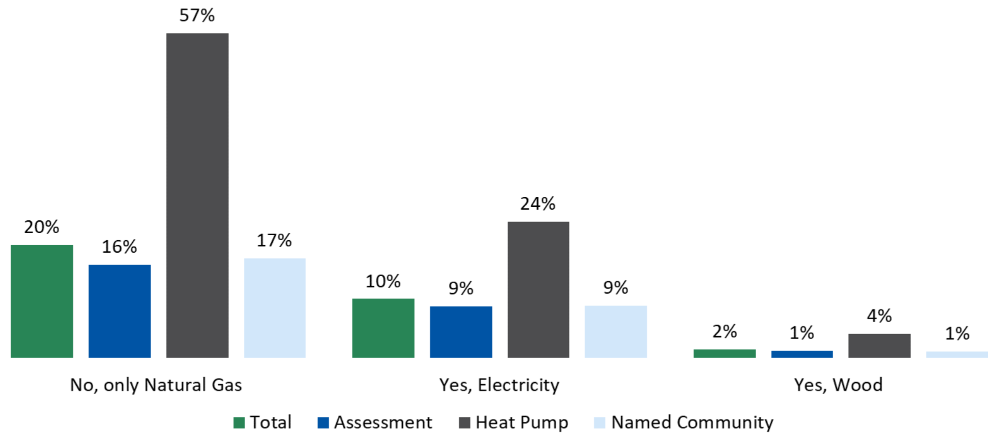


Source: Survey question D1: "Using a scale of 1 to 5 where 1 means very dissatisfied, 2 is somewhat dissatisfied, 3 is neither satisfied nor dissatisfied, 4 is somewhat satisfied, and 5 is very satisfied, please indicate your level of satisfaction with the following aspects of the program..." (n=123)

Most aspects of the heat pump rebate program scored a 4 (satisfied) or higher, with the top-rated aspect being system reliability. There was not a significant difference between respondents who installed a cold climate heat pump and those with a ducted heat pump. Among the non-energy benefits, respondents were satisfied with the incentive amount and communication with the contractor and PSE.

Another benefit identified from the heat pump survey was that 4% of those who installed a heat pump had previously used wood for their heating fuel (Figure 27).

Figure 27. Fuels Respondents Previously Used Other Than Gas



Source: Survey question D1/J1: “Before the heat pump system was installed, were you using any fuels besides natural gas for your heating equipment? Please select all that apply.” (n=562)

Pilot Attribution and Net Impact Results

This section of the report addresses the research objective of quantifying the attribution of the STEP heat pump rebates to a customer’s decision to fuel switch. To fulfill that objective, Cadmus estimated net-to-gross (NTG) ratios from participant self-report survey results. Two components—freeridership and participant spillover—constitute NTG. Cadmus combined the estimates of the two components to estimate an NTG ratio for STEP heat pump rebates using the following equation:

$$\textbf{NTG} = \textbf{100\%} - \textbf{Freeridership} + \textbf{Participant Spillover}$$

Cadmus calculated freeridership and spillover for the heat pump rebate component using findings from survey responses to NTG questions. Table 9 summarizes the freeridership, spillover, and NTG results for the heat pump rebate component by cold climate heat pumps and non-cold climate heat pumps.

Table 9. 2024 STEP Heat Pump Rebates Net-to-Gross Ratio

Analysis Category	n	Freeridership	Spillover	NTG Ratio
Cold Climate Heat Pump	49	16%[a]	0%	84%
Non-Cold Climate Heat Pump	69	27%[a]	0%	73%

[a] Weighted by evaluated *ex post* program MMBtu savings.

Freeridership Findings

Intention Freeridership Score

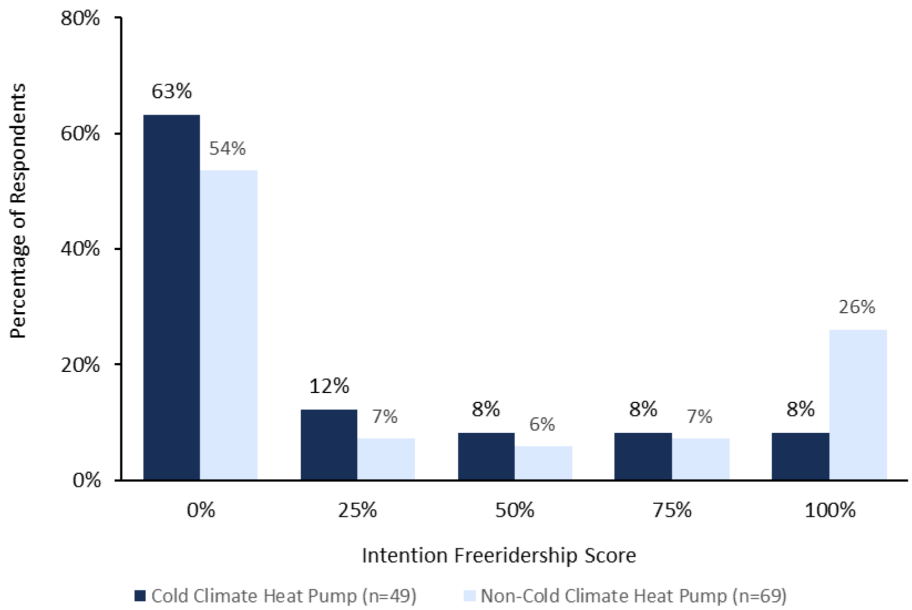
The intention freeridership score relies on customers’ self-reported intention to purchase a measure in the absence of the pilot. Cadmus estimated intention freeridership scores for all participants based on their responses to the intention-focused freeridership questions. Table 10 illustrates how we translated initial responses into “yes,” “no,” or “partially” to indicate freeridership (in parentheses). The value in brackets is the scoring decrement associated with each response option. Each participant's freeridership score starts at 100%, which we decremented based on the responses to the questions. After assigning an *intention* freeridership score to every survey respondent, Cadmus calculated savings-weighted average *intention* freerider scores of 21% and 36% for the cold climate heat pump and non-cold climate heat pump analysis categories, respectively.

Table 10. 2023 Raw Survey Responses Translation to Intention Freeridership Scoring Matrix Terminology and Scoring for STEP Heat Pump Rebates

H2. Did you have specific plans to install the [MEASURE] BEFORE learning about the PSE program incentive?	H3. [ASK IF H2= Yes OR Don't know] Had you ALREADY ordered or purchased the [MEASURE] BEFORE you heard about the program?	H4. [ASK IF H3=Yes] To confirm, you installed your new [MEASURE] before you heard anything about the PSE program incentive, correct?	H5. Without the incentive and information or education from PSE, would you have still purchased the [MEASURE]?	H6. [ASK IF H5= No] So, without the incentive and information or education from PSE, you would not have installed [MEASURE] at all. Is that correct?	H8. Without the incentive and information or education from PSE, what efficiency level of [MEASURE] equipment would you most likely have purchased?	H9. Without the incentive and information or education from PSE, when would you most likely have installed this equipment without the program? Would you have installed it …
Yes (Yes) [-0%]	Yes (Yes) [-0%]	Yes (Yes) [100% FR Assigned]	Yes (Yes) [-0%]	Yes/correct, we would not have installed anything without the program incentive (Yes) [-100%]	Same efficiency as purchased or higher (Yes) [-0%]	At the same time (Yes) [-0%]
No (No) [-50%]	No (No) [-0%]	No (No) [-0%]	No (No) [-50%]	No/not correct, we would have installed something without the incentive (No) [-0%]	Lower efficiency (Partial2) [-50%]	Later, but within one year (Partial2) [-50%]
Don't know (Partial) [-25%]	Don't know (No) [-0%]	Don't know (No) [-0%]	Don't know (Partial) [-25%]	Don't know (Partial) [-25%]	Lowest efficiency or lowest cost option available (No) [-100%]	Within one to two years (No) [-100%]
					Don't know (Partial) [-25%]	More than two years (No) [-100%]
						Never (No) [-100%]
						Don't know (Partial) [-25%]

Figure 28 shows the distribution of intention freeridership estimates Cadmus assigned to participant responses to the pure intention-based freeridership method.

Figure 28. 2024 STEP Heat Pump Rebates Self-Report Intention Freeridership Distribution by Estimate



Influence Freeridership Score

Table 11 shows the distribution of responses to the influence question: “For the [MEASURE] purchase, on a scale from 1 to 5, with 1 being *not at all important* and 5 being *extremely important*, how important were each of the following factors in deciding to install high-efficiency equipment.” Cadmus assessed influence freeridership from participants’ ratings to the relative importance of PSE-related elements in their purchasing decisions.

Table 11. 2024 STEP Heat Pump Rebates Freeridership Influence Responses (n=118)

Response Options.	Influence Score	The PSE Incentive		Information Provided by PSE on Energy-Saving Opportunities		Previous Participation in a PSE Energy Efficiency Program	
		Cold Climate Heat Pump (n=49)	Non-Cold Climate Heat Pump (n=69)	Cold Climate Heat Pump (n=49)	Non-Cold Climate Heat Pump (n=69)	Cold Climate Heat Pump (n=49)	Non-Cold Climate Heat Pump (n=69)
1 – Not at all important	100%	0	2	2	8	10	13
2	75%	0	3	0	4	5	3
3	50%	3	7	6	13	5	10
4	25%	15	21	21	19	9	12
5 – Extremely important	0%	31	34	16	14	8	3
Don't Know	50%	0	2	2	6	5	4
Not Applicable	50%	0	0	2	5	7	24
Average Rating		**4.6**	**4.2**	**4.1**	**3.5**	**3.0**	**2.7**

Cadmus used the maximum rating given by each participant for any factor in Table 11 to determine the participant's influence score presented in Table 12. We weighed individual influence scores by each participant's respective total survey sample *ex post* gross savings to arrive at savings-weighted average influence scores by analysis category.

Table 12. 2024 STEP Heat Pump Rebates Influence Freeridership Score (n=118)

Maximum *Influence* Rating	Influence Score	Cold Climate Heat Pump (n=49)	Non-Cold Climate Heat Pump (n=69)
1 – Not at all important	100%	0	2
2	75%	0	2
3	50%	3	7
4	25%	13	21
5 – Extremely important	0%	33	36
Don't know / Not Applicable	50%	0	1
Average Maximum Influence Rating - Simple Average		**4.6**	**4.3**
Average Influence Score - Weighted by Verified Gross MMBtu Savings		**10%**	**18%**

Final Freeridership Score

Cadmus calculated the arithmetic mean of the intention and influence freeridership components to estimate a final freeridership by analysis category, weighted by *ex post* gross program savings. The higher the freeridership score, the more savings are deducted from the gross savings estimates. Table 13 summarizes the intention, influence, and freeridership scores for each analysis category.

Table 13. 2024 STEP Heat Pump Rebates Intention/Influence Freeridership Score

Analysis Category	n	Intention Score	Influence Score	Freeridership Score
Cold Climate Heat Pump	49	21%	10%	16%
Non-Cold Climate Heat Pump	69	36%	18%	27%

Participant Spillover Findings

None of the surveyed participants reported that, after participating in the program, they had installed additional PSE program-qualifying high-efficiency equipment for which they did not receive an incentive and that participation in the program was extremely important in their decision. Therefore, no spillover is attributed to the program.

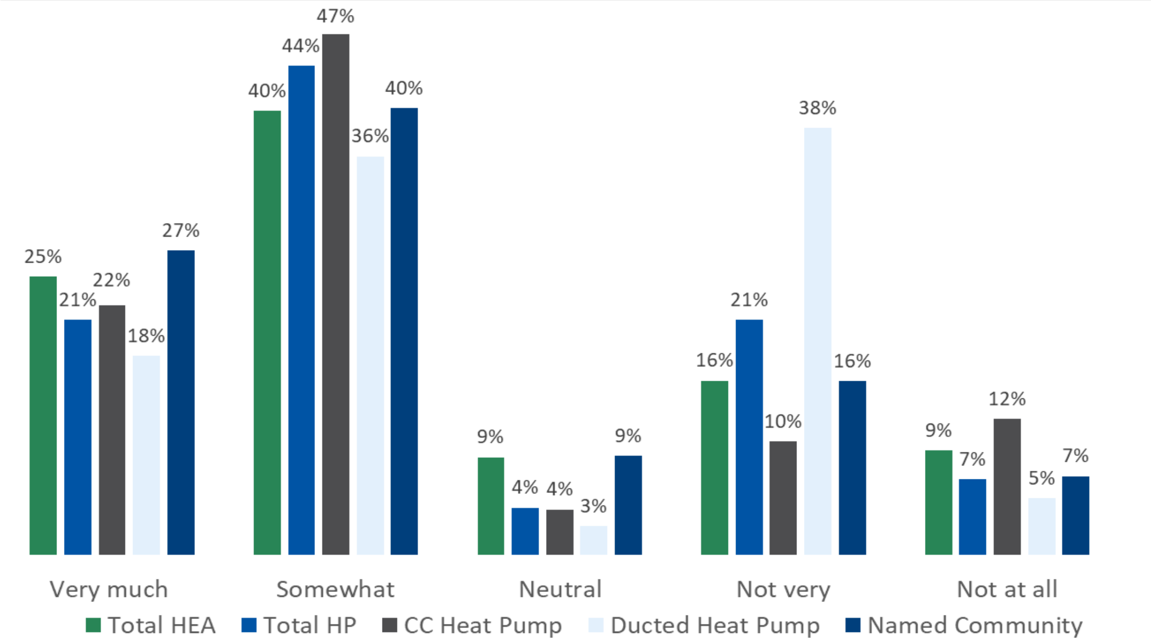
DER Readiness

This section of the report addresses the research objectives of identifying opportunities for incremental DER investment and identifying barriers and recommendations for improving heat pump market penetration.

Cadmus designed both surveys to assess baseline understanding, readiness, and willingness to incorporate DERs. In both, respondents were given the following PSE description of DERs: *Distributed Energy Resources are small-scale energy sources or devices that can generate, store, or manage electricity closer to where it is used, instead of relying solely on big power plants. Examples include rooftop solar panels, batteries for storing energy, smart thermostats, electric vehicles, and other gadgets that can help save or produce power.*

Figure 29 shows the baseline familiarity of heat pump rebate survey respondents with the DER concept at the time of the survey. The majority of respondents reported they were *somewhat familiar*. Those who installed a cold climate heat pump reported more familiarity with the concept in general compared to those who installed a ducted heat pump, who reported they were *not very familiar* with DERs (38%). A larger percentage of Named Communities, compared to other groups, reported they were *very familiar* (27%).

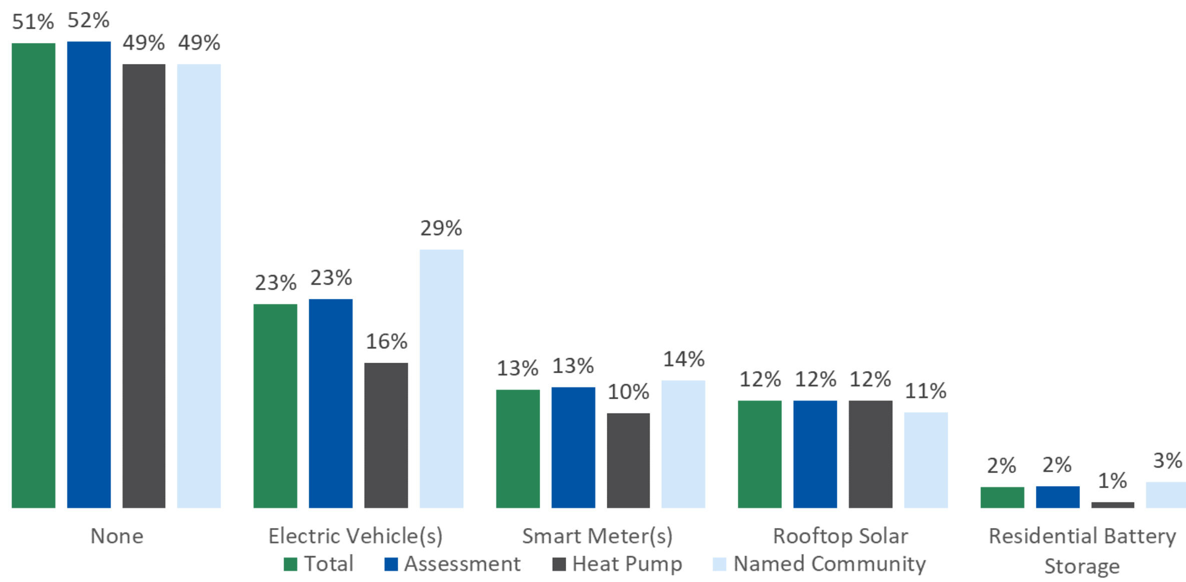
Figure 29. Familiarity of Heat Pump Rebate Survey Respondents with the DER Concept



Source: Survey question C1/G1: "On a scale of 1 to 5, where 1 is *not at all* and 5 is *very much*, how familiar are you with the concept of DER, such as rooftop solar, smart meters, and residential battery storage, etc.?" (n=987)

According to Figure 30, most respondents (51%) did not incorporate DERs into their homes at the time of the survey. For respondents who had DERs installed at their homes, EVs were the most prevalent (23%), with 29% of Named Community respondents reporting that they owned an EV. In total, 13% of respondents reported they had installed a smart meter, and 12% had installed a rooftop solar.

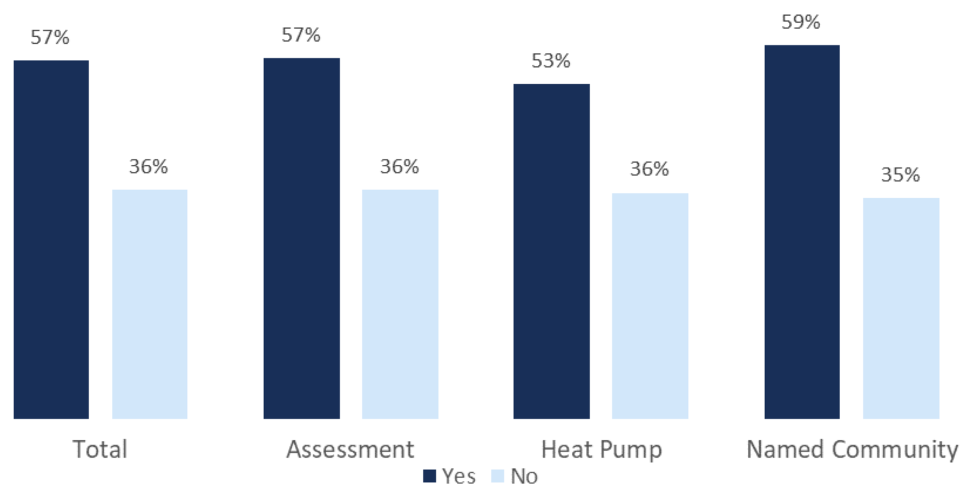
Figure 30. DERs Installed in Respondents' Homes or in Use



Source: Survey question C3/G3: "Do you have any of the following distributed energy resources installed in your home or in use?" (n=1,639)

Even though the majority of respondents did not integrate a DER, they are interested in learning about DERs and how they can improve energy savings. As Figure 31 shows, the interest is particularly high among Named Community respondents (59%) and HEA respondents (57%). Over a third of the total respondents (36%), however, reported no interest in DERs.

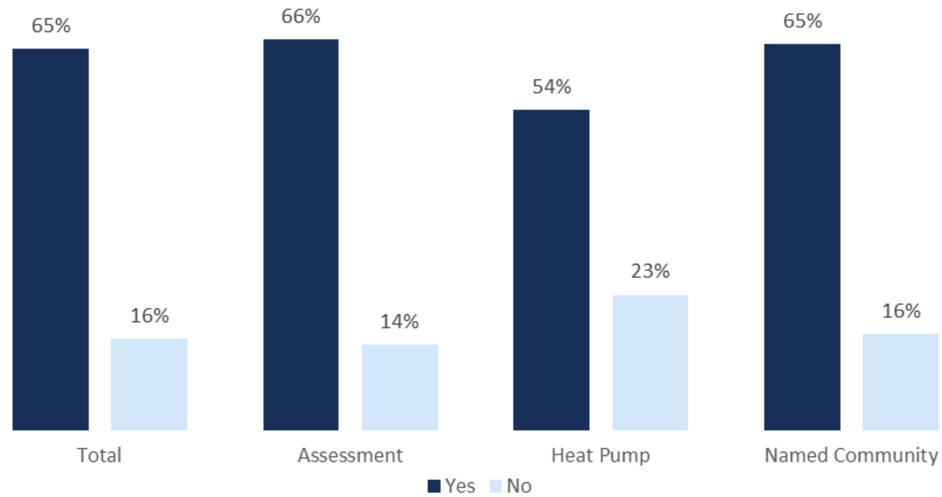
Figure 31. Respondents That Considered Integrating DERs into Their Home Energy System



Source: Survey question C4/G4: "Have you considered integrating DERs, such as rooftop solar, smart meters, residential battery storage, etc., into your home energy system?" (n=835)

As a follow-up question, the survey asked whether respondents would be interested in participating in PSE-led programs that incentivized the adoption of DERs. The possibility of receiving an incentive did increase respondents' interest in participating in DER programs, from 57% (Figure 31) to 65% (Figure 32) among the general population and 59% (Figure 31) to 65% (Figure 32) among Named Communities.

Figure 32. Interest in Participating in PSE-Led Programs That Incentivize the Adoption of DERs



Source: Survey question C6/G6: "Are you interested in participating in PSE-led programs that incentivize the adoption of DERs, such as the solar energy or smart meter offerings?" (n=884)

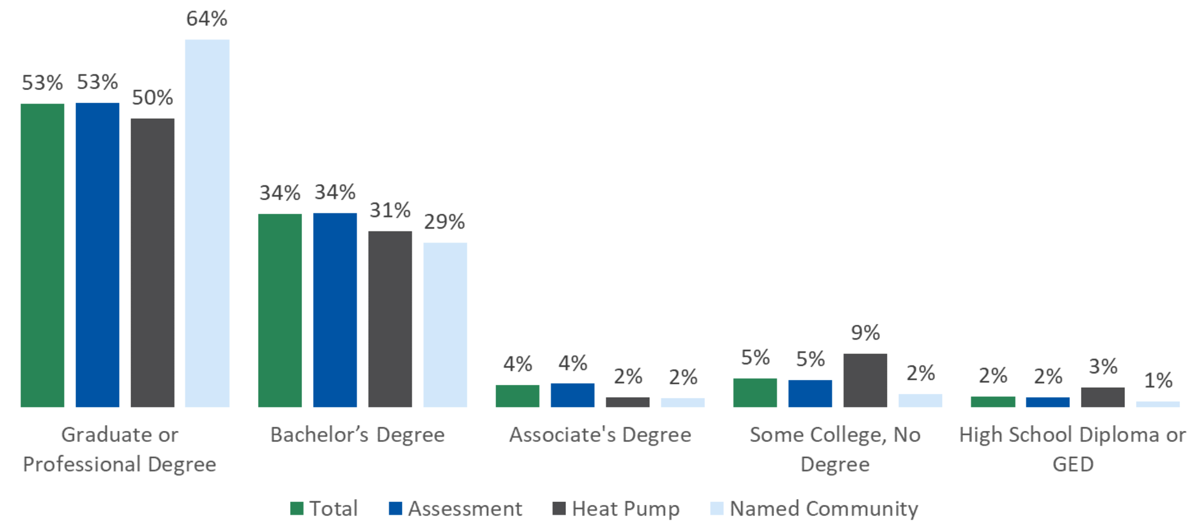
When asked how important DER was to them when it came to their energy use, 30% of respondents said that it was *very important*, 32% said it was *somewhat important*, and 20% were *neutral*. Around 14% reported that it was *not very* or *not at all important*. The percentages were almost identical for Named Communities.

Demographics

This section addresses the research objective of identifying the characteristics of electrification participants. The surveys incorporated questions designed to learn participants' race, age, ethnicity, language, education level, and household size.

In general, most survey respondents reported a higher level of education (Figure 33). More than 50% of the respondents reported that the highest level of education attained by a resident of their home was a graduate or professional degree, a percentage that was higher (64%) among Named Communities, while 34% of participants reported a bachelor's degree as the highest level of education. In total, 4% reported an associate's degree, 5% some college, 2% a high-school diploma or GED, and 2% some high school.

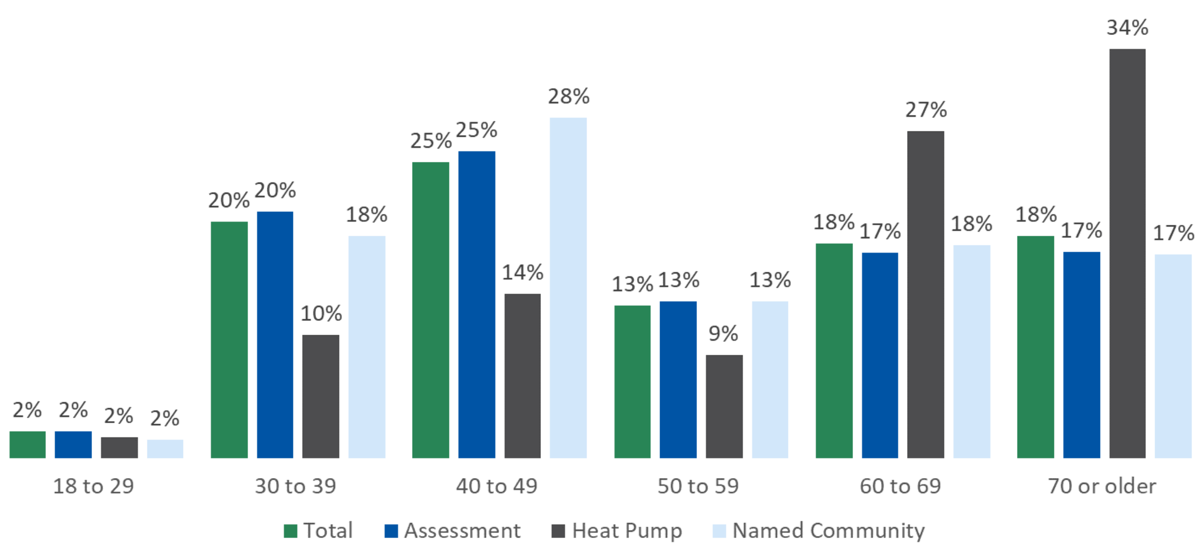
Figure 33. Highest Level of Education Completed by a Resident of a Respondent's Home



Source: Survey question D2/J2: "What is the highest level of education completed by a resident of your home?" (n=1,494)

As shown in Figure 34, 25% of the HEA survey respondents were between 40 and 49 years old, while 20% were between 30 and 39. The age brackets between 60 and 69 and 70 and older had 17% each, and 13% of respondents were between 50 and 59 years old. Only 2% of respondents were between the ages of 18 and 29. Overall, heat pump survey respondents reported older ages: 27% were between 60 and 69 years old, 34% were 70 or older, 14% were between 40 and 49, and 9% were between 50 and 59. A minority of 2% were between ages 18 to 29.

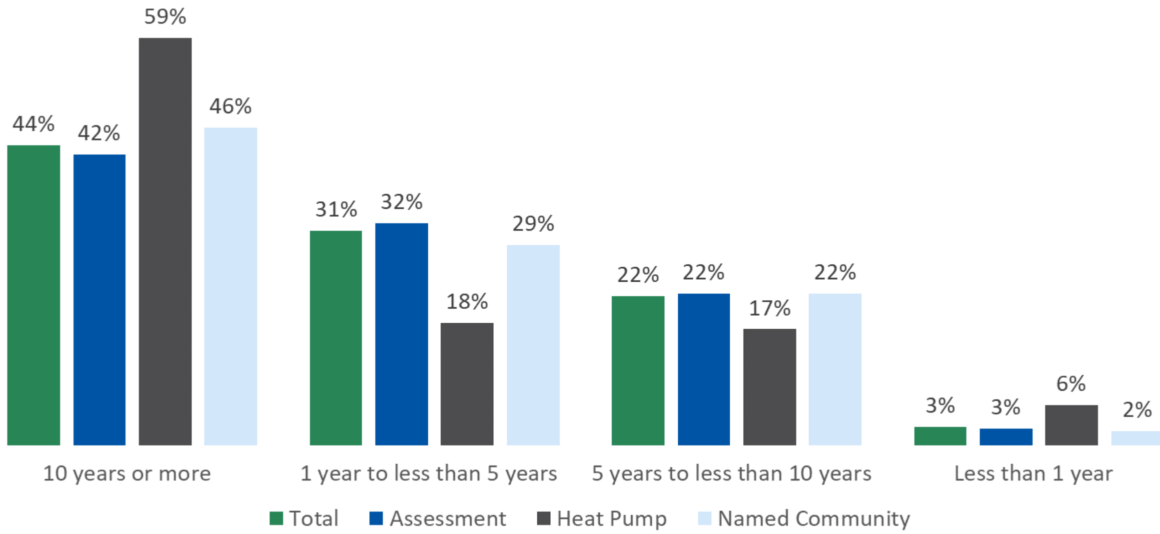
Figure 34. Survey Respondent's Age



Source: Survey question D5/J5: "What is your age?" (n=1,498)

As shown in Figure 35, 59% of heat pump rebate survey respondents who installed a cold climate heat pump had lived in their home for 10 or more years (signaling the need for an update), 18% from 1 to 5 years, 17% from 5 to 10 years, and 6% less than a year.

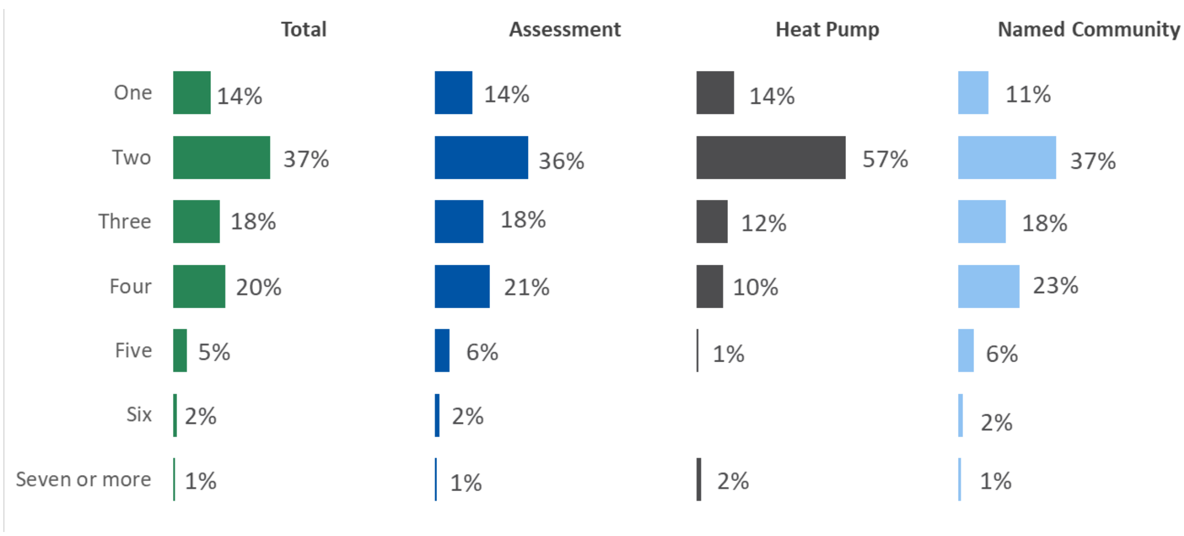
Figure 35. How Long Respondents Have Lived in Their Current Homes



Source: Survey question D3/J3: "How many years have you lived in your current home?" (n=1,499)

As shown in Figure 36, 36% of HEA survey respondents reported that their household size was two, 23% that it was four, 18% that it was three, 14% that it was one, 6% that it was five, and 2% that it was six. Among heat pump survey respondents, 57% of the respondents reported a two-member household, 14% in a one-member household, 12% in a three-member household, 10% in a four-member household, and 2% in a seven-member household.

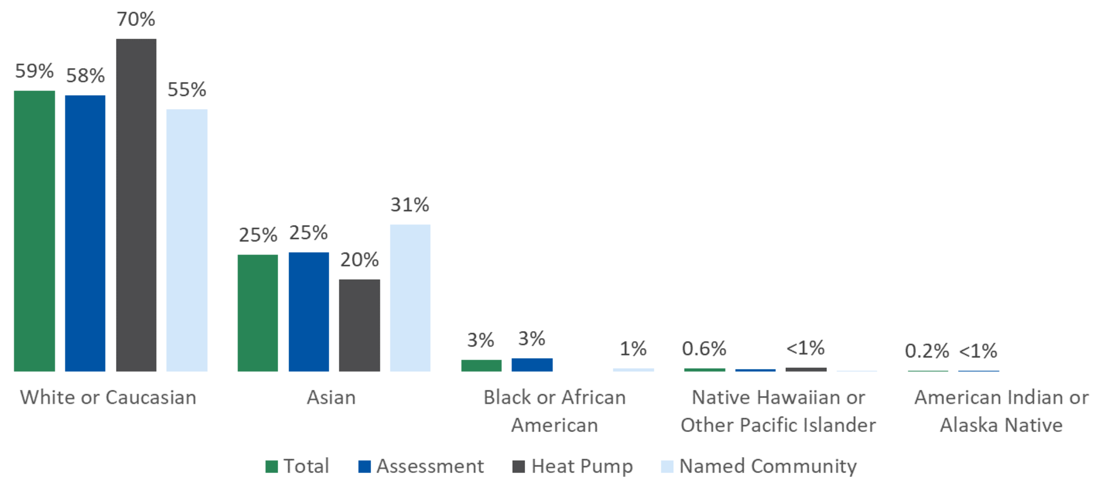
Figure 36. The Number of People Living Full-Time in Respondent's Home



Source: Survey question D4/J4: "How many people, including yourself, live in your home full-time?" (n=1,499)

Of the total survey respondents, only 4% reported being Hispanic, Latino, or of Spanish origin. The percentage was lower (1%) among heat pump survey respondents. As shown in Figure 37, the majority of participants identified as White (59%), followed by 25% who identified as Asian. Only 3% identified as Black or African American, whereas 12% preferred not to answer. Thirty-one percent of Named Communities identified as Asian. The percentage of White respondents was particularly high (70%) among those who participated in the heat pump rebates component.

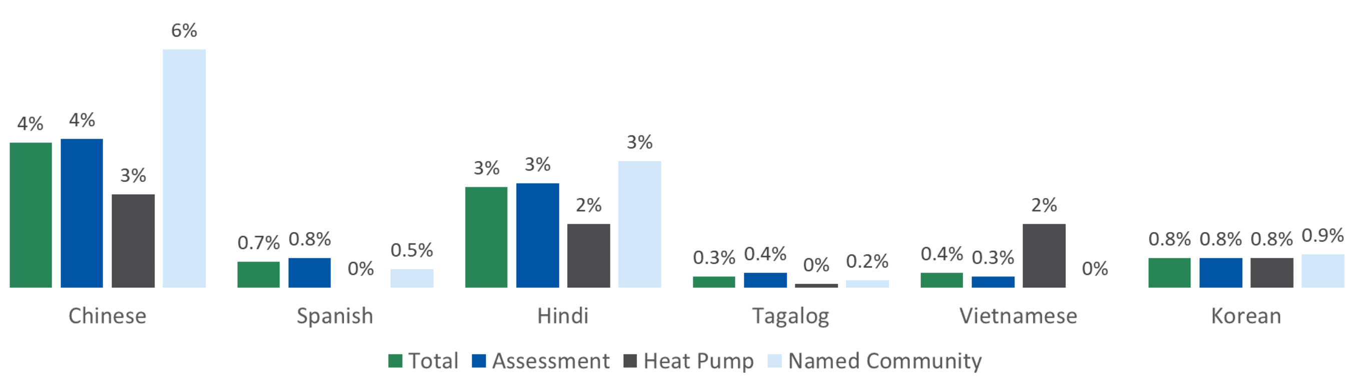
Figure 37. How Respondents Describe Themselves Racially



Source: Survey question D7/J8: "How would you describe yourself?" (n=1,445)

As shown in Figure 38, 88% of respondents reported that English was the primary language spoken in their household. Four percent spoke Cantonese or Mandarin, and 3% spoke Hindi. Less than 1% spoke Spanish. Of the Named Community respondents, 6% spoke Cantonese or Mandarin.

Figure 38. Primary Household Language Other than English



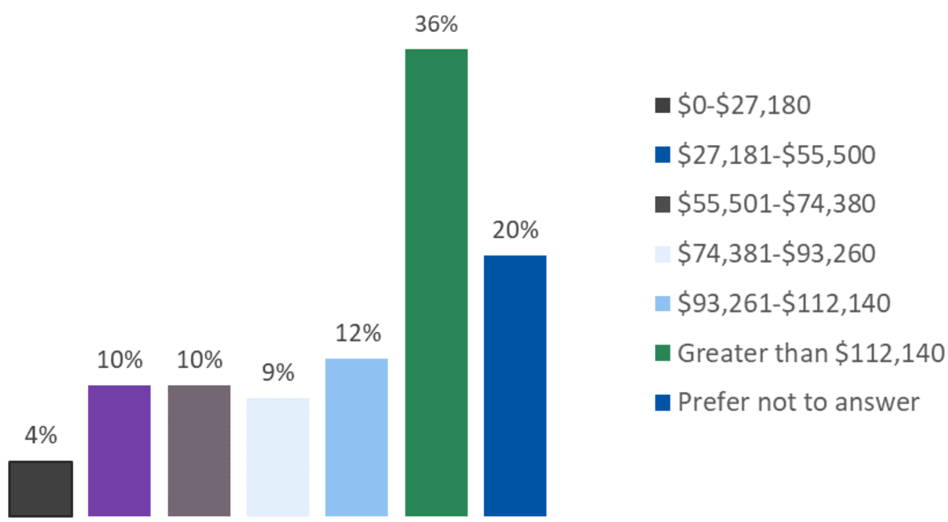
Source: Survey question D8/J10: "What is the primary language in your household?" (n=1,450)

Income Distribution

This section presents the income distribution among survey respondents based on two sources: self-reported data and area median income data at the county level.

Figure 39 shows the self-reported income of the HEA participants. The survey asked respondents to select one of six income ranges. Most (36%) of respondents reported a household income that was greater than $112,140, followed by 12% who reported an income between $93,261 and $112,140, and 9% who reported an income between $74,381 and $93,260. Income brackets between $27,181 and $55,500 and $55,501 and $74,380 were evenly split with 10% of respondents apiece. Only 4% of respondents reported an income of $27,180 or less, and 20% preferred not to answer.

Figure 39. Self-Reported Income Among HEA Survey Participants

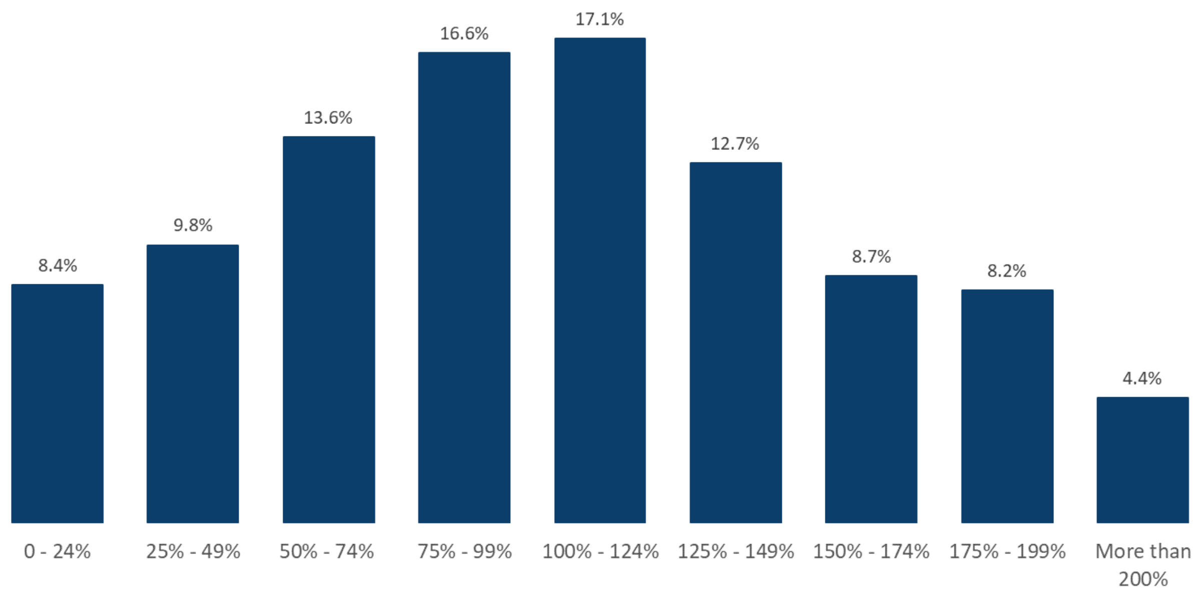


Source: Data provided by PSE (n=1,476)

During the assessment, participants could choose from 11 income-range options or select “prefer not to answer.” The income range between $27,181 and $55,500 (which 10% of respondents selected in Figure 39) was further broken down into three categories with the following response rates: between $27,181 and $36,620 (3%), $36,621 and $46,060 (3%), and $46,061 and $55,500 (4%). Additionally, the following income ranges were split in two: $55,501 and $74,380; $74,381 and $93,261; and $93,261 and $112,140. Cadmus grouped them for a more concise visual representation since the difference between groups was not larger than 1%. Regardless of grouping, different representations of Figure 39 do not resemble a bell curve, like Figure 40, and all are skewed toward the higher income ranges. Cadmus has no means of corroborating the accuracy of these data.

Figure 40 shows the income distribution according to the percentile of the county area median income where the respondents reside.

Figure 40. Income Distribution among HEA Survey Participants Based on Area Median Income Data



Source: Data provided by PSE (n=1,476)

As mentioned above, the majority (75%) of respondents who had a heat pump at the time of the HEA survey did not receive a PSE rebate, and a considerable percentage did not know whether they received one. Cadmus' analysis of participants who received a rebate indicates that income does not have a statistically significant influence on program participation. Participants with a higher income receive rebates (18%) at the same frequency as those with a lower income (17%).

Across all income levels, upfront cost was the main reason HEA survey respondents decided not to purchase a heat pump. Whereas 37% of total participants selected this reason, a higher percentage of respondents (43%) with an income between 100% and 124% of their county's area median income selected upfront costs. Also, regardless of income, most respondents were *very concerned* about upfront costs (54%), but the percentage was higher among those with an income between 100% and 124% of their county's area median income (59%).

Although 24% of HEA survey respondents reported they were *very confident* in their understanding of the PSE rebates available to them, a higher percentage of those with an income from 25% to 49% of their county's area median income reported they were *very confident* (29%). Moreover, a higher percentage of those with an income up to 24% of their county's area median income were *not very confident* in their understanding of the PSE rebates available to them (16%) compared to the total respondents (8%).

Across income levels, the majority of the HEA survey respondents (36%) were *somewhat familiar* with other electrification rebates or incentives, such as federal tax credits. Respondents with an income between 150% and 174% of their county's area median income reported the most familiarity (20% were *very familiar*) compared to other income groups. Those with an income up to 24% of their county's area median income were the least familiar (15% reported being *not at all familiar*). Regardless of income, most respondents said they were *very likely* to pursue home electrification or heat pump installation if additional incentives were available for households in their income bracket (48%). However, this percentage was higher among those with higher income (55% among those with an income between 125% and 149% of their county's area median income; 57% among respondents with an income between 150% and 174% of their county's area median income; and 59% among participants with an income greater than 200% of their county's area median income).

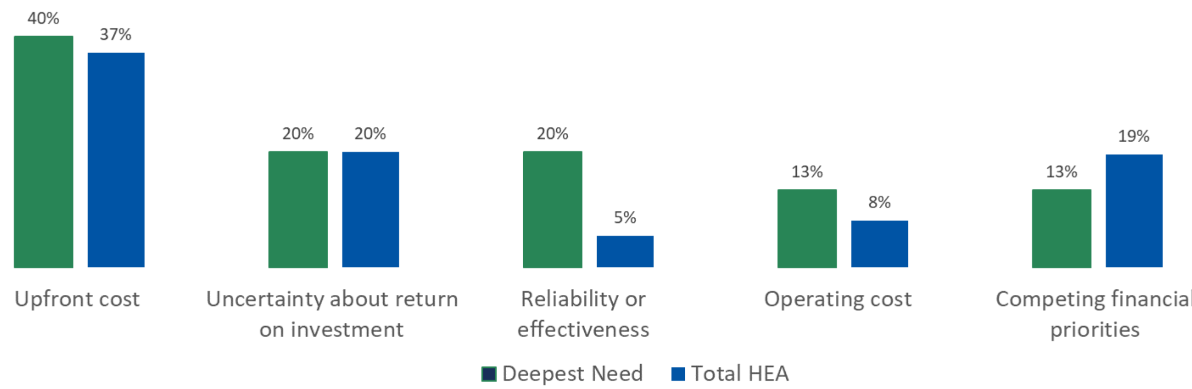
Thirty-nine percent of HEA survey respondents in all income categories reported cost savings as the top factor influencing their decision to adopt DERs for their homes. However, this factor was reported by a higher percentage among those with an income up to 24% of their county's area median income (44%), between 25% and 49% of their county's area median income (41%), between 50% and 74% of their county's area median income (40%), and between 75% and 99% of their county's area median income (41%). Fifty-two percent of respondents with an income more than 200% of their county's area median income reported this factor.

Deepest Need Participants

This section of the report presents the responses of Deepest Need participants in both the HEA and heat pump rebate surveys. PSE defines customers and communities with the deepest need as those living in areas identified as clusters of severe energy burden and multiple compounding factors hindering the ability to access adequate resources. PSE considers economic and non-economic factors in the definition; among them are poor housing quality, extreme heat risk factors, populations of customers belonging to Black, Indigenous, People of Color, or populations with existing health conditions. When asked if they had a heat pump installed before the assessment, one Deepest Need HEA survey respondent had and did not receive a PSE rebate. Another installed it after the assessment but did not know if they received a PSE rebate. After receiving the assessment, seven of the Deepest Need respondents considered their concerns clarified, while three still had questions.

Figure 41 shows the Deepest Need respondents' main reasons for not installing a heat pump (in green) compared to the total respondents of the HEA survey (in blue). Both groups said upfront cost was the main reason for not installing the heat pump, with similar percentages (40%, or six respondents, for Deepest Need respondents and 37% for all the HEA survey respondents), and both were similarly concerned about the return on investment (20% each, three Deepest Need respondents). However, Deepest Needs respondents were more concerned about the reliability or effectiveness (20%, or three respondents) and operating cost (13%, or two respondents) compared to total respondents (5% and 8%, respectively). While 19% of total respondents had other competing financial priorities, (13%, or two respondents) of Deepest Need respondents chose this reason for not installing the heat pump.

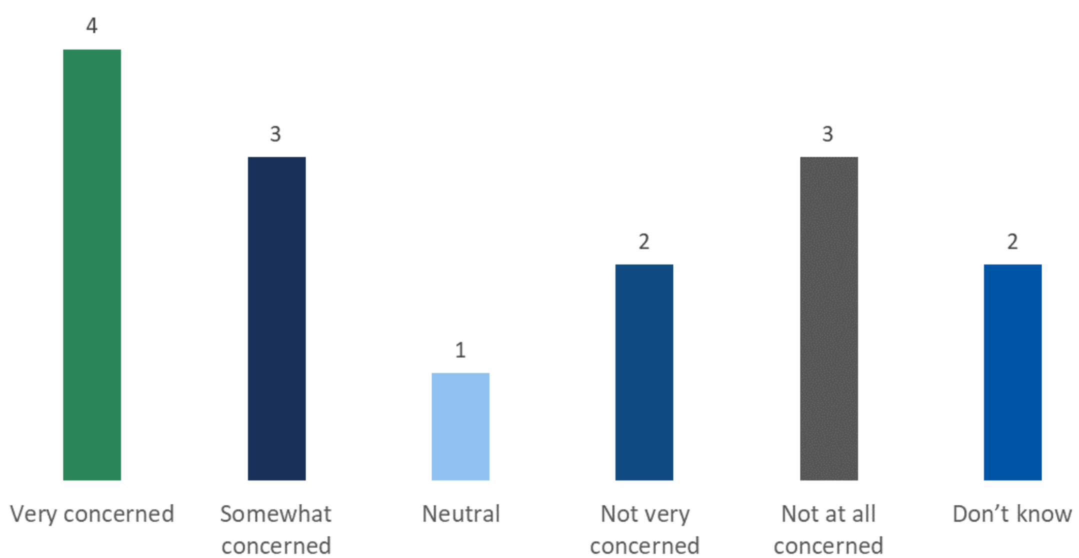
Figure 41. Reasons for Not Installing a Heat Pump—HEA Survey



Source: Survey question B9: "What are the main reasons you decided not to purchase a heat pump? Select all that apply." (n=15)

As shown in Figure 42, among the 15 Deepest Need participants who took the HEA survey, four said they were *very concerned* about the upfront costs of the heat pump, three were *somewhat concerned,* one was *neutral*, two were *not very concerned*, three were *not at all concerned*, and two did not know.

Figure 42. Deepest Need Participants' Level of Concern About Upfront Costs—HEA Survey

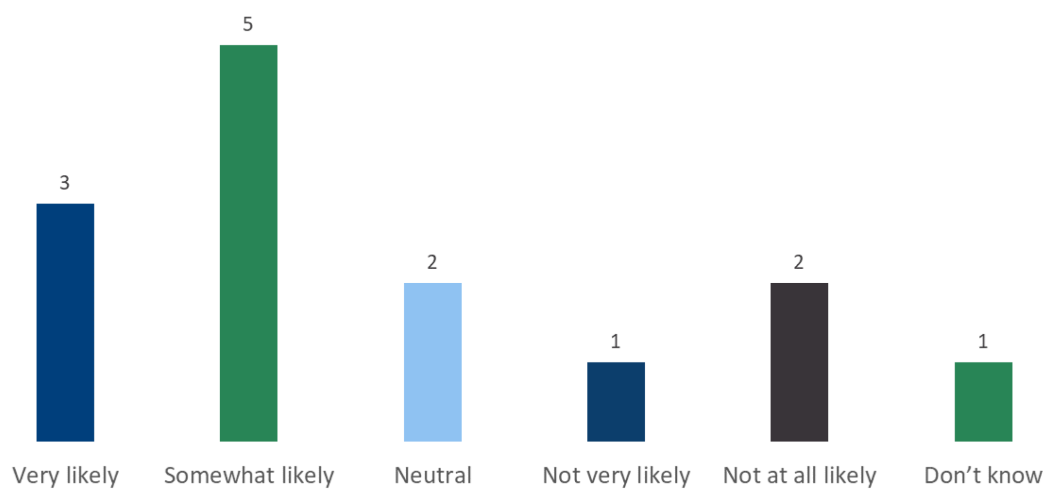


Source: Survey question B12_A: "How concerned are you about the upfront cost of purchasing and installing a heat pump in your home?" (n=15)

Additionally, three Deepest Need respondents said they were *not at all confident* in their understanding of the PSE rebate options available to them, while five were *somewhat confident*. In contrast, four respondents were *very much confident* in their understanding of PSE rebates, one was *neutral*, and one did not know.

However, as Figure 43 demonstrates, five of 14 Deepest Need HEA respondents were *somewhat likely* to pursue home electrification or heat pump installation if additional incentives were available for households in their income bracket, and three were *very likely*. In contrast, two respondents were *not at all likely* and one *not very likely* (7%). Two respondents were neutral, and one did not know.

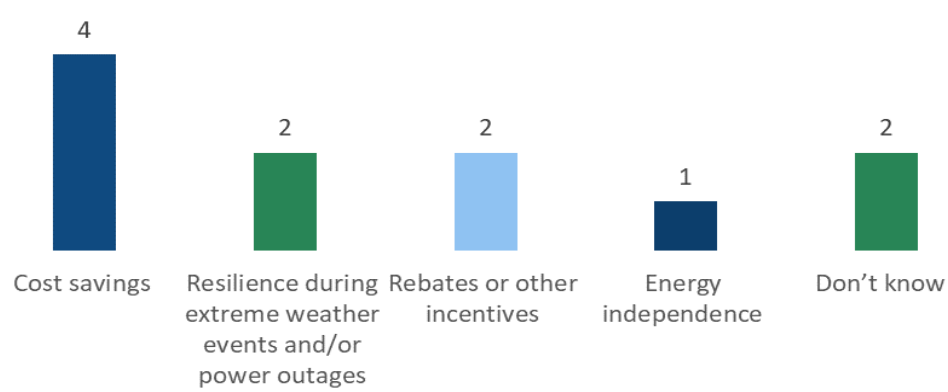
Figure 43. Deepest Need Participants' Likelihood to Pursue Home Electrification with Additional Incentives—HEA Survey



Source: Survey question B12_A: "How likely are you to pursue home electrification and/or heat pump installation if additional incentives were available for households in your income bracket?" (n=14)

In terms of readiness for DER, four of 11 Deepest Need HEA respondents reported cost savings as the most influential factor in their decision to potentially adopt these resources (Figure 44). Two respondents selected resilience during extreme weather events and/or power outages, two selected rebates or other incentives, one selected energy independence, and two did not know.

Figure 44. Factors Influencing Deepest Need Participants to Potentially Adopt a DER—HEA Survey



Source: Survey question C5: "What factors would influence your decision to adopt DERs for your home?" (n=11)

The heat pump rebate survey asked participants (n=4) about their satisfaction with different aspects of the heat pump rebate component on a scale from 1 (*very dissatisfied*) to 5 (*very satisfied*). Regarding the incentive amount, one Deepest Need respondent was *very satisfied*, one was *somewhat satisfied*, one was *very dissatisfied*, and one did not know. Similarly, one Deepest Need respondent was *very satisfied* with communication with PSE, one was *somewhat satisfied*, one was *very dissatisfied*, and one was *neither satisfied nor dissatisfied*.

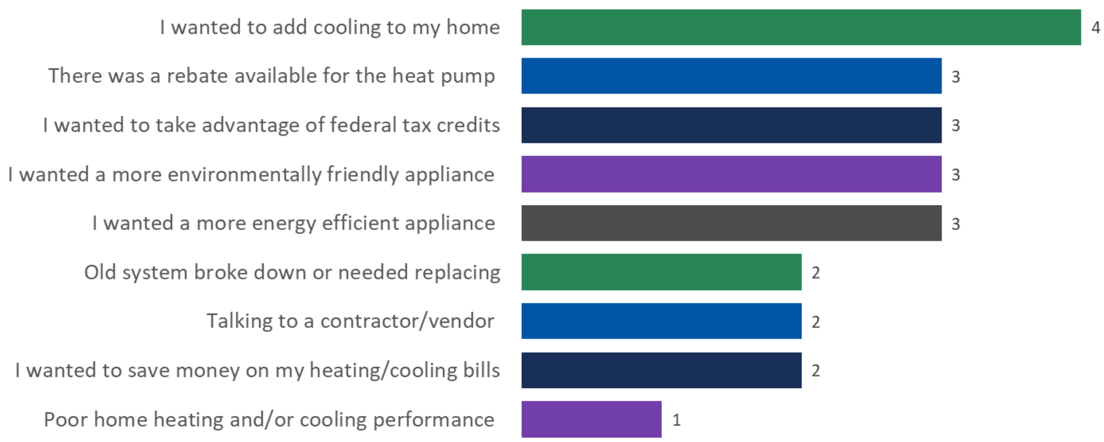
Regarding the energy savings and operating costs of the heat pump, two Deepest Need respondents were *somewhat satisfied,* one was *very satisfied,* and one was *neither satisfied nor dissatisfied*. Regarding ease of use, system reliability, and comfort in the home since installation, all four Deepest Need respondents were *very satisfied*, and regarding system performance and quality of work done by the installation contractor, three were *very satisfied* with each category. Moreover, all four Deepest Need respondents were *very satisfied* with the overall experience.

When asked what aspects of the heat pump rebates went well, one Deepest Need respondent said the quality of the product, one enjoyed working with a contractor they chose themselves, and one more said that the overall experience had gone well. All four Deepest Need respondents said they would be *very likely* to recommend a similar heat pump system to a friend or family member.

In terms of how they financed their heat pump, one Deepest Need respondent paid in full with cash, one used a zero-interest financing option, and one used a credit card or line of credit. One participant chose “other” but did not specify the form of payment.

Figure 45 shows the factors the Deepest Need heat pump survey respondents selected when asked what influenced their decision to purchase a heat pump. Respondents had the option to select more than one answer. All four Deepest Need respondents reported they wanted to add cooling to their homes, and one apiece reported they were influenced by rebate availability, taking advantage of federal tax credits, wanting a more environmentally friendly appliance, and wanting a more energy-efficient appliance.

Figure 45. Factors That Influenced Deepest Need Participants' Decision to Purchase a Heat Pump—Heat Pump Rebate Survey



Source: Survey question C5: "What factors influenced your decision to purchase a heat pump? Select all that apply." (n=4)

The heat pump survey asked respondents to select a single, most influential reason. Two out of four respondents said that they wanted a more environmentally friendly appliance, one wanted to take advantage of federal tax credits, and one wanted to replace an old or broken-down system.

One Deepest Need heat pump survey respondent reported using an electric clothes dryer since installing the heat pump, one a natural gas water heater, and one reported using the new thermostat installed with the heat pump. Two Deepest Need respondents had a programmable thermostat, and two had a smart thermostat.

Regarding familiarity with DER, two of the four Deepest Need heat pump survey respondents said they were *somewhat familiar* with these resources, one was *very much familiar*, and one was *not at all familiar*. Additionally, when asked how important DERs were when it came to their energy use, two respondents said DERs were *very important,* and two said DERs were *somewhat important*. When asked what would influence their decision to adopt DERs in the future, two of the three participants who answered this question said cost savings and one said rebates or other incentives.

Of the four Deepest Need heat pump survey respondents, two were White or Caucasian, one was Asian, and one preferred not to respond.

Program Marketing and Outreach

This section of the report addresses the research objectives of evaluating marketing and outreach efforts and investigates several aspects of program delivery and satisfaction.

Marketing and Outreach Activities

Franklin Energy marketed HEAs through email neighborhood campaigns that were activated as additional program uptake was needed to minimize the average wait time for an assessment. This approach proved successful, as the average waiting time to receive an assessment was 19 days. Through mid-May 2024, Franklin Energy ran 19 neighborhood campaigns. Additionally, two Named Community campaigns leveraged marketing materials with tailored messaging for more intensive outreach within Named Communities. These campaigns occasionally included paid social media ads and direct mail (postcards) targeted to these communities' zip codes. Seven outreach managers were active across PSE's service territory, and program staff attended and promoted the program at five various community events.

Email messaging led with the benefits of electrification and included a $50 gift card offer. Among Named Communities, the $50 gift card was given prominence in the marketing materials. Emails had an average open rate of over 33% and an average of a 2% to 3% click-through rate. Customers were encouraged to schedule their assessment directly through a hyperlink in the email. Upon scheduling, customers received a confirmation email and reminder email before their assessment, and 24 hours after their assessment, they received a follow-up email asking about satisfaction with the process.

Additionally, four community-based organizations (CBOs) assisted with participant recruitment. Each CBO received a marketing toolkit, which included Facebook content, posters, program overviews in English and Spanish, and door hangers. CBOs received compensation for their efforts toward promoting the program within their communities.

A referral program was also offered as part of the program marketing to mitigate potential customer skepticism of utility program offerings. The program provided $25 e-gift cards for completed HEA referrals, up to two referrals per customer—through May 2024, 460 friends and family referrals have completed an HEA.

As a reference, Cadmus received door hangers, a program overview (in English and Spanish), the low-income HEA leave-behind brochure, and the standard HEA leave-behind brochure. Figure 46 shows a section of the leave-behind brochure in English. The materials delivered to HEA participants, including the HEA Program Overview*,* provide clear directions for application and information on other PSE programs. Moreover, the HEA Program Overview provides a detailed description of the different paths to electrification and energy savings. The leave-behind brochure also includes information about electrification and DERs in general (e.g., electric vehicles, solar panels, and battery storage) and about the specific benefits of the pilot (heat pumps). After the HEA, income-eligible customers received additional information about the income-eligible programs available through the pilot and their local agencies. Income was self-declared by HEA participants at the time of registration and was not verified by PSE, nor was it used to qualify for other pilot or other income-qualified programs.

Figure 46. Section of HEA Leave-Behind Brochure

The benefits are electrifying

Switching from gas to electric is becoming more and more common. In fact, one in four U.S. homes is currently all-electric,* and the numbers are quickly rising. Whether you're interested in the energy efficiency, positive environmental impact, flexibility for future energy upgrades, or all of the above, here are some of the most effective ways you can enjoy the benefits of electrification.

Heat pumps

Electric heat pumps are up to four times more efficient than traditional HVAC sources, such as furnaces or central air conditioners. And because heat pumps heat and cool your home through a single system, making the switch can lead to lower energy costs all year-round.

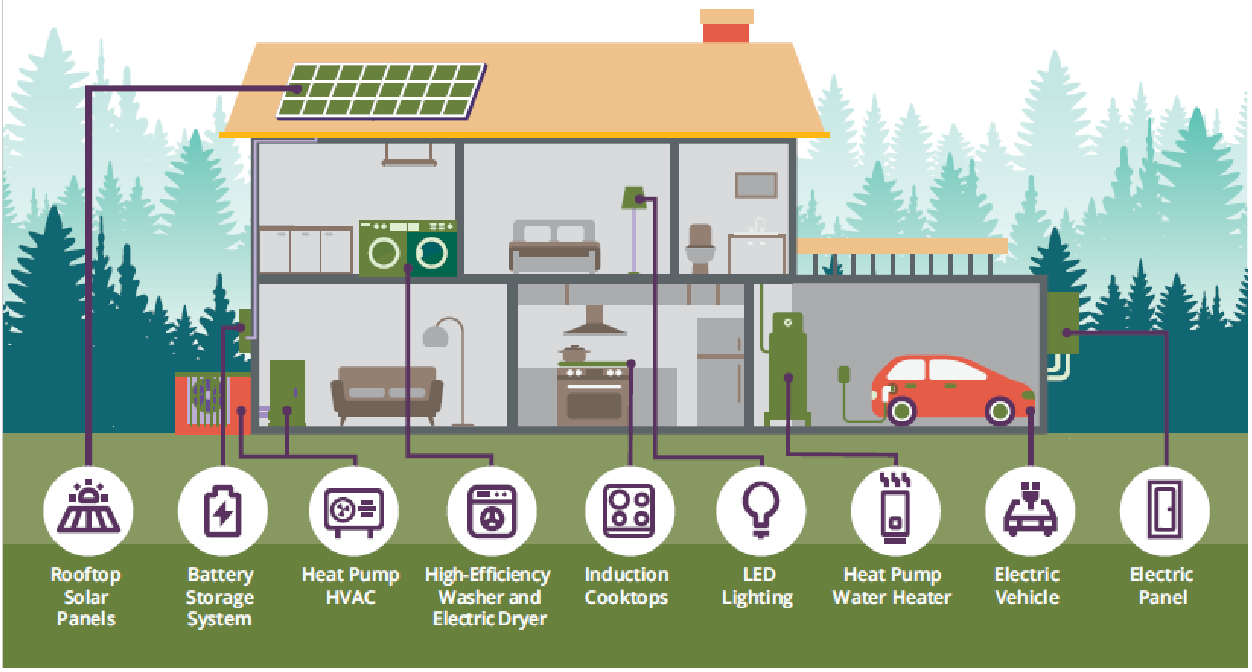
Heat pump water heaters

Compared to a standard water heater, heat pump water heaters can be three times as efficient while still delivering the hot water your household needs. Considering that water heating is one of the highest contributors to the average energy bill, it's a smart choice.

Appliances

Upgrading to ENERGY STAR® certified electric kitchen and laundry appliances is a great way to lower your energy use, without sacrificing reliability or quality. These models also feature innovative technologies that can improve safety and your experience.

* U.S. Energy Information Administration, Residential Energy Consumption Survey (RECS), www.eia.gov/consumption/residential



The in-person home energy assessments were a critical component of the pilot's success, since 76% of HEA survey respondents confirmed their concerns were clarified after the assessment. A minority shared the concerns they still had after the assessment, which included questions about costs of acquiring, installing, and maintaining a heat pump (15%), the rebates available to them (9%), clarifications during and after the assessment (9%), and heat pump performance in cold temperatures (5%).

Heat pump rebate program ads were displayed digitally on consumer websites and on Nextdoor, which resulted in 11,105 clicks on the fuel-switching heat pump rebates website. The click-through rate was 0.42% on Nextdoor and 0.09% on consumer websites.

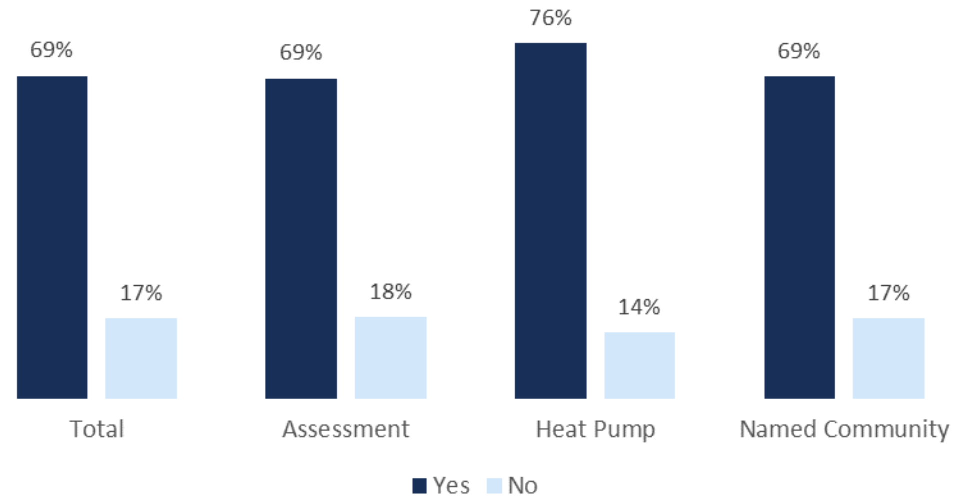
PSE's website had a page dedicated to fuel-switching rebates that included clear and useful information about rebate eligibility and the benefits of switching to a heat pump. The content was available in seven languages and included information on additional incentives for income-eligible customers. Pilot staff also featured the heat pump rebates in the newsletter, *The Voice of my PSE*, in January 2024 as another strategy to increase the pilot's visibility as it goes to 820,000 PSE customers. The newsletter section, "Stay Comfortable and Save on a Heat Pump," highlights the benefits of switching to a heat pump and provides education about heat pumps and HEAs.

Another set of materials on the income-qualified weatherization with electrification program includes information about heat pumps' energy usage and what to expect when switching from natural gas to electric heat pump heating. Duplicating the partnership campaign with Energy Smart Eastside is recommended; the co-designed postcard with the regional non-profit was mailed to approximately 78,000 PSE gas heating customers and described how heat pumps work well in cold temperatures.

Survey Responses to Program Materials

In both surveys, a high percentage (69%) of the respondents said the information about the rebates was clear and easy to understand, as shown in Figure 47. Still, 18% of HEA respondents reported the information was not easy to understand. Among Named Community respondents, 17% reported that the information was not clear.

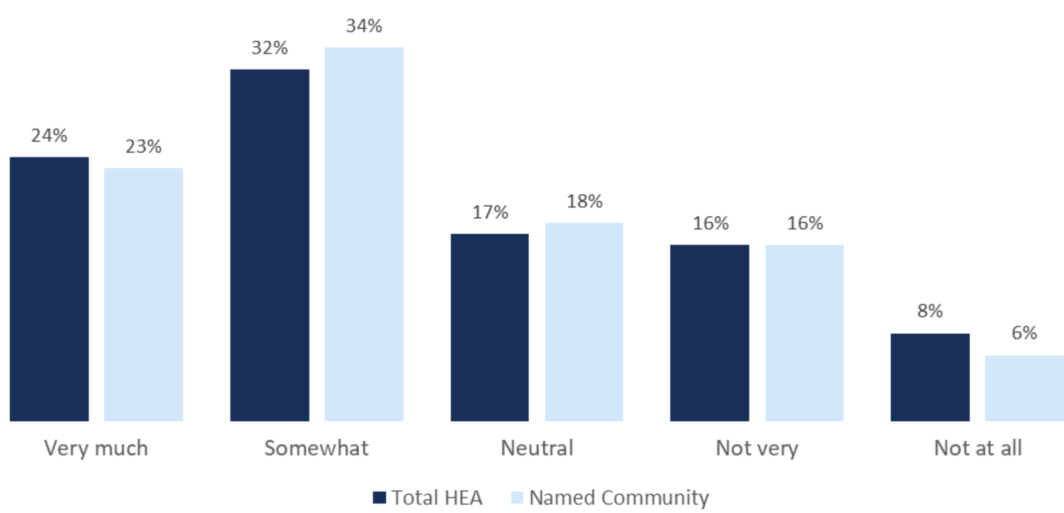
Figure 47. Respondents' Perceptions of Whether the Information about PSE Rebates Was Clear and Easy to Understand



Source: Survey question B8/E6: "Did you find the information about the PSE rebates clear and easy to understand?" (n=1,548)

The HEA survey asked participants how confident they were in their understanding of the PSE rebates available to them. Figure 48 shows that while 24% of respondents felt *very much* confident, the majority felt *somewhat* (32%), *neutral* (17%), *not very* (16%), and *not at all* (8%) confident. The response rates were almost identical among Named Community respondents.

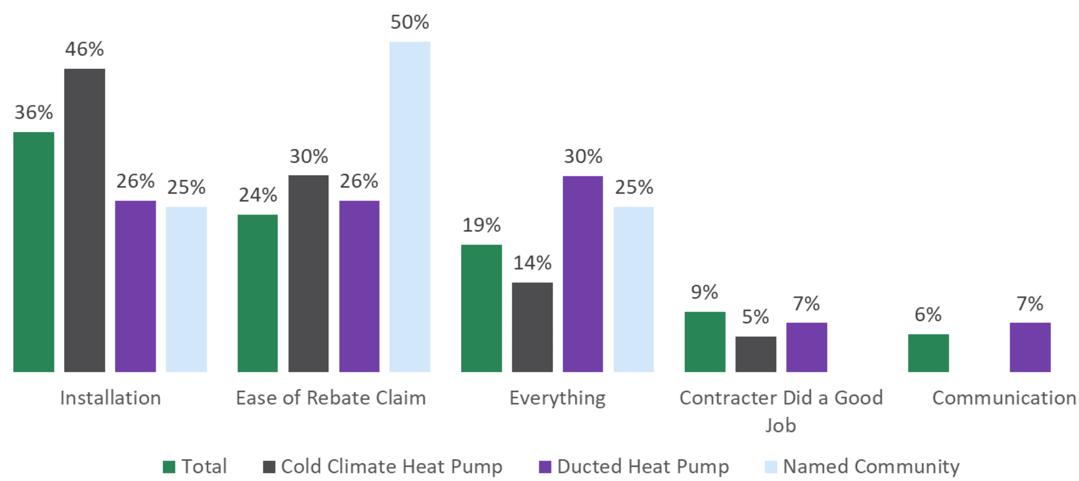
Figure 48. How Confident HEA Respondents Felt in Their Understanding of PSE's Rebate Options



Source: Survey question B12_B: "How confident do you feel in your understanding of the rebate options available to you from PSE?" (n=1,395)

While there is room for improvement to maximize customer clarity on rebates and their eligibility, they were satisfied with various aspects of the pilot, including the ease of claiming the rebate (Figure 49). Of the 88 respondents who responded to this question, 36% reported being satisfied with their installation. Two of the four Named Community respondents said that claiming the rebate went particularly well. Among all respondents, 36% said that the installation went well.

Figure 49. Aspects of the Heat Pump Rebate Component That Went Well

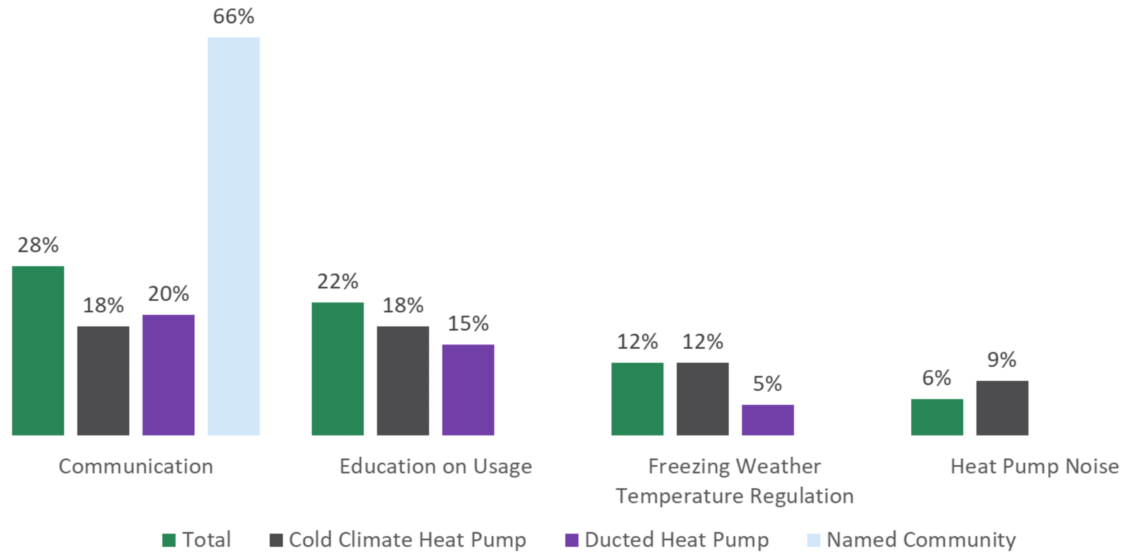


Source: Survey question D3: "What aspects of the program went well?" (n=88)

However, two of three Named Community respondents said that the program could improve communications about the rebates and the equipment. Named Communities' responses included: "Communication as to what heating systems were included in the rebate," and "The online rebate application was hard to find and some questions confusing."

Moreover, 18% of respondents who installed a cold climate heat pump said the program could improve communication and education on usage (six respondents in each category) (Figure 50). Responses included: "Clarity on savings in energy usage," "Clear rebate paperwork," "Figuring out how to utilize the system during a prolonged cold snap," "Hard to figure out which program I qualified for and which heat pumps qualify," "Knowledge sharing with customer," "A little handholding for using the highly-versatile multi-function Wi-Fi-enabled Bryant(/TI) thermostat," and "The online rebate application was hard to find and some questions confusing."

Figure 50. Aspects of the Heat Pump Rebate Component That Can Be Improved



Source: Survey question D4: "What aspects can be improved?" (n=65)

Benchmarking

This section addresses the research objective of informing a targeted electrification strategy development and future Biennial Conservation Plan cycles. The two broad types of DER programs run by utilities in the Pacific Northwest are demand response programs and customer generation programs, with demand response programs being the most prevalent. Idaho Power Company and Portland General Electric run four programs across the residential, commercial, industrial, and agricultural sectors. Pacific Power and Portland General Electric run customer generation programs that span all building sectors. Table 14 summarizes these programs.

Though cost and cost-effectiveness information were unavailable for the benchmarked programs, all demand response programs resulted in significant energy savings on peak demand days. The on-site solar program operated by Pacific Power and Portland General Electric also resulted in meaningful energy savings.

Table 14. Benchmarked DER Programs

Utility (State)	Program	Sector	Program Design	Incentive Type	Participants	Actual Savings
Idaho Power Company (ID, OR)	Flex Peak Program	Commercial/ Industrial	Manual or automatic demand response for commercial and industrial customers	Rebate check or bill credit	139 sites from 61 customers	22.6 MW claimed average demand reduction
Idaho Power Company (ID, OR)	A/C Cool Credit Residential Demand Response	Residential	Manual demand response with dispatchable load control device for residential customers	Bill credit	20,995	18.35 MW claimed average demand reduction
Idaho Power Company (ID, OR)	Irrigation Peak Rewards	Agricultural	Manual or automatic demand response for agricultural customers	Bill credit	2,235	65-235 MW claimed demand reduction on each of 8 peak load days
Pacific Power (OR)	Customer Generation	All sectors	Feed-in tariffs and net metering	Bill credit	Not given	Not given
Portland General Electric (OR)	Flex Pricing and Behavioral Demand Response	Residential	Time-of-use rates, peak-time rebates, behavioral demand response, and hybrid demand response	Rebate check	14,012	2-23% demand reduction in summer; 1-12% demand reduction in winter
Portland General Electric and Pacific Power (OR)	On-site solar	Residential/ Commercial	Incentives and federal tax credits for on-site solar and solar + storage projects	Bill credit	407 commercial; 5,323 residential	Commercial: 33,900 MWh Residential: 30,050 MWh

The benchmarking analysis revealed that DER programs, such as demand response initiatives and on-site solar projects, significantly mitigate system risks through peak demand reduction. Idaho Power's Flex Peak and A/C Cool Credit programs demonstrate the potential of manual and automatic demand response mechanisms to achieve substantial demand reductions, with average reductions of 22.6 MW and 18.35 MW, respectively. This indicates a readiness to handle peak loads and suggests these programs can effectively mitigate system risks by reducing strain during high-demand periods. Additionally, the Irrigation Peak Rewards program for the agricultural sector claims reductions between 65 MW and 235 MW during peak load days, highlighting its effectiveness in managing load among high-volume end users.

Pacific Power's feed-in tariff and net metering programs suggest a strategic approach to integrating distributed generation, although detailed performance data are lacking. This indicates room for improvement in data collection and analysis to understand the impacts of customer generation-based DER programs on system risk mitigation. Regarding electrification outreach, Portland General Electric's Flex Pricing and Behavioral Demand Response program shows a solid participant base with 14,012 participants, achieving demand reduction of 2% to 23% in summer and 1% to 12% in winter. This indicates that time-of-use rates and behavioral incentives effectively drive customer participation and allow utilities to achieve demand-side management goals.

Portland General Electric and Pacific Power's joint on-site solar program reflects the growing adoption of distributed generation resources. With significant energy savings reported (33,900 MWh for commercial and 30,050 MWh for residential), the program underscores the potential of solar incentives and federal tax credits in boosting electrification efforts and reducing grid dependency.

Overall, the benchmarking analysis indicates that programs offering diverse incentives and leveraging advanced demand response technologies are more successful in achieving substantial demand reductions and engaging participants in end-user programs, both behavioral and equipment-based. Moreover, integrating distributed generation through solar projects provides a robust pathway for enhancing DER readiness and electrification efforts, contributing to more resilient energy systems.

Appendix A. Benchmarking Matrix

Table A-1 shows the details of the information collected during the benchmarking analysis.

Table A-1. Benchmarking Results

Utility (Year Reported)	State	Program	Year Start	Customer Population	Description	Measures	Delivery Channel	Incentive Structure	Low Income or Priority Corridor Initiative	Total Number of Participants	Savings Claimed	Average Incentive ($ Per Participant)	Marketing Channels
Avista (2023)	ID	Net metering	1999	All sectors	Net metering tariff for residential buildings.	Bill credit	Demand side	According to Schedule 63	No	Not given	Not given	Not given	Not given
Idaho Power Company (2022)	ID, OR	Flex Peak Program	2015	Commercial, Industrial	The program pays participants a financial incentive for reducing load within their facility. Customers with the ability to nominate or provide load reduction of at least 20 kW are eligible to enroll in the program. Participants receive notification of a load reduction event two hours before the start of a peak event, and events last between two to four hours.	Incentive check or bill credit	Demand side	Fixed-capacity payment rate: $3.25 per weekly effective kW reduction; adjustment of $2 per kW not achieved up to nomination Variable energy payment rate: $0.16 per kWh; adjustment of $0.25 per kW not achieved up to nomination	No	139 sites from 61 customers	Claimed average demand reduction: 22.6 MW	Not given	Not given
Idaho Power Company (2021)	ID, OR	A/C Cool Credit Residential Demand Response	2002	Residential	A voluntary, dispatchable demand response program for residential customers in Idaho and Oregon, the ACCC program curtails energy use during peak demand periods via direct load control devices installed on A/C units. Eligible customers are provided $5 monthly incentives for three months during the air conditioning season to participate in curtailment events.	Bill credit	Demand side	$5 monthly incentive for three months during the air conditioning season	No	20,995	18351.2 kW	$5 per household per month	Not given

Utility (Year Reported)	State	Program	Year Start	Customer Population	Description	Measures	Delivery Channel	Incentive Structure	Low Income or Priority Corridor Initiative	Total Number of Participants	Savings Claimed	Average Incentive ($ Per Participant)	Marketing Channels
Idaho Power Company (2021)	ID, OR	Irrigation Peak Rewards Program	2004	Agricultural	IPR pays irrigation customers a financial incentive for the ability to turn off participating irrigation pumps at potentially high system load periods (summer peak).	Irrigation pump demand response (direct control)	Demand side	$5 per billed kW + $0.0076 per billed kWh Variable credit payments after third demand response event: Standard interruption: $0.148 * event duration * billed kW Extended interruption: $0.198 * event duration * billed kW	No	2,235	Load reduction on eight event days, ranging from 65 to 234 MW of 401.4 MW enrolled	Not given	Physical mail, outreach from IPC reps
Pacific Power (2024)	OR	Customer generation	2007	All sectors	Pacific Power maintains feed-in tariffs and net metering.	Bill credits	Demand side	According to Net Metering tariff	No	Not given	Not given	Not given	Website only
Portland General Electric (2018)	OR	Flex Pricing and Behavioral Demand Response (BDR)	2016	Residential	In 2016, Portland General Electric launched Flex, a pricing and behavioral demand response (BDR) pilot program aimed at reducing residential peak demand during summer and winter months. The treatments featured three time-of-use (TOU) rates, three peak-time rebates (PTR), BDR, four hybrid demand response treatments (TOU pricing in combination with PTR or BDR), and opt-out BDR and PTR demand response that automatically enrolled customers.	Time-of-use rates, peak-time rebates, BDR, hybrid demand response (TOU + PTR/BDR), opt-out BDR and PTR	Demand side	PTR: $0.80 per kWh, $1.55 per kWh, or $2.25 per kWh BDR: no incentives	No	14,012	Opt-in PTR: 17-21% summer; 7-12% winter. Opt-out PTR/BDR: 7% / 2% summer, 5% / 1% winter. Hybrid TOU + PTR/BDR: 8-23% summer; 1-5% winter.	Summer: $10 to $30 per customer Winter: $6 to $20 per customer Totals not given	Email, direct mail, website
Portland General Electric and Pacific Power (2016)	OR	On-site solar	2011	Residential, Commercial	Incentives and federal tax credits for on-site solar and solar + storage projects	Incentives; federal tax credits	Demand side	Portland General Electric: $1,000 per home for solar only; $500 per kWh to a maximum of $6,000 per home for battery storage Pacific Power: $1,200 per home for solar only; $500 per kWh to a maximum of $6,000 per home for battery storage	Yes (Solar Within Reach)	Commercial: 407 Residential: 5,323	Commercial: 33,899,958 kWh Residential: 30,050,110 kWh	Not given	Not given