Opinion Dynamics

TECH CLEAN CALIFORNIA: INSIGHTS INTO CUSTOMER EXPERIENCE AND SATISFACTION

WAVE 2

MARCH 27, 2025

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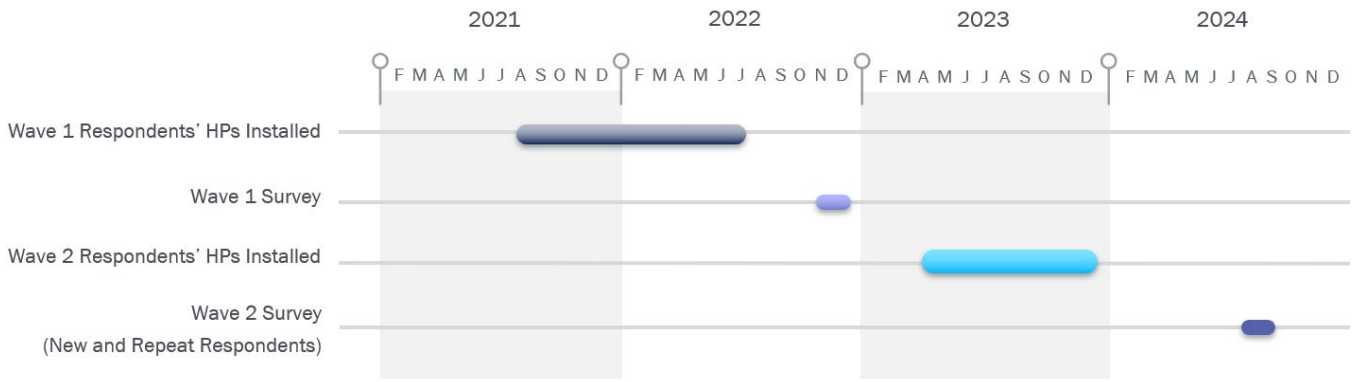
I. EXECUTIVE SUMMARY

The Technology and Equipment for Clean Heating (TECH Clean California) initiative is a pilot program designed to help advance California's mission to achieve carbon neutrality by driving the market adoption of low-emission space- and water-heating technologies in existing single-family and multifamily residential homes. The TECH Clean California Initiative began in late 2021 and incentivizes the installation of heat pump water heaters (HPWHs) and heating, ventilation, and air conditioning (HVAC) heat pump equipment in existing California homes. As the third-party independent evaluator, Opinion Dynamics had the opportunity to investigate TECH Clean California customers' satisfaction and experience with the heat pump equipment. With an improved understanding of the customer experience, we can pinpoint what is needed to ensure customer acceptance of the equipment and expand the market for home electrification products.

Opinion Dynamics has conducted two waves of our online customer experience survey for single-family homeowners and renters who received a TECH Clean California incented heat pump water heater (HPWH) or HVAC heat pump. The primary objectives of the survey were to capture customer experiences with their new heat pump equipment, understand any issues they may have encountered, and see if they noticed any changes to their utility bills. The first wave of responses was collected in November and December of 2022; respondents in this wave installed their heat pumps between August 2021 and July 2022 (Figure 1). The second wave was collected in August and September of 2024. The second wave invited some respondents from the first wave plus more recent TECH Clean California customers who installed their heat pumps between April and December 2023. We invited 4,376 TECH Clean California customers to complete wave 2 of the survey, including 853 who installed their equipment between August 2021 and July 2022 (these customers took the first survey and we refer to throughout this report as "repeat respondents"), and 3,836 who installed their equipment between April and December 2023 (who we refer to throughout this report as "new respondents"). It's important to note that TECH Clean California launched a new HPWH incentive, the Self-Generation Incentive Program (SGIP) HPWH Program on October 31st, 2023, and thus a portion of the new respondents were eligible for this incentive if they met program requirements.

Figure 1. Timeline of Installations and Survey Waves



We received a total of 935 surveys for an overall response rate of 21%. Table 1 shows the survey responses by respondent type and heat pump equipment type.[1]

Table 1. Survey Completes by Heat Pump Equipment

Equipment Type	Repeat Respondents (Installations Between August 2021 and July 2022)	New Respondents (Installations Between April and December 2023)
HPWH	140	161[b]
Ducted HVAC [a]	159	281
Ductless Mini-Split HVAC	59	135
Total	**358**	577

[a] Includes customers who received a split unitary system or packaged unitary system.
[b] Includes 122 customers whose HPWHs were installed on or after 10/31/2023, when the Self Generation Incentive Program (SGIP) incentives became available under the TECH Clean California program.

Many of the survey questions were the same in wave 1 and 2. To examine how TECH Clean California customer experiences might be changing over time, we compared survey answers from repeat respondents to those from new respondents. We report all statistically significant differences between new and repeat respondents throughout the report. To determine if satisfaction with heat pumps has changed over time, we also compared repeat respondents' satisfaction-related survey answers across both waves of the survey.

Below, we share key findings for HPWHs and HVAC heat pumps and then offer conclusions and recommendations.

Solar is common in TECH Clean California households that purchased either HPWHs or HVAC heat pumps. Fifty-one percent of HPWH customers (154 of 301) had a solar PV system and 11% were planning to install one (33 of 301). Similarly, fifty-two percent of HVAC customers (332 of 634), whether they purchased a ducted or ductless system, had a solar PV system and 10% were planning to install one (63 of 634).

Most TECH Clean California customers did not need electrical panel upgrades to accommodate their HPWHs or HVAC heat pumps. Nearly one-fourth of HPWH customers required panel optimization[2] (72 of 301; 24%) and 9% (27 of 301) required a complete panel replacement. Among ductless HVAC heat pump customers, 11% (21 of 194) needed a panel replacement and 20% (39 of 194) required panel optimization. For ducted HVAC heat pumps, 5% (22 of 440) of customers needed a panel replacement and 16% (70 of 440) needed panel optimization.

HPWH FINDINGS

Although the majority of TECH Clean California HPWH customers (188 of 301; 63%) did not need to upgrade their electrical panel to accommodate the installation of their new HPWH, nearly one-fourth required panel optimization (72 of 301; 24%) and 9% required a complete panel replacement. Panel optimization refers to electrical panel modifications that can include load-sharing to free up a panel slot or adding a sub-panel.

HPWHs were most often set on the most efficient heat pump mode (139 of 301; 46%), with 46 of those customers having installed their HPWH on or after October 31, 2023. Just over one-third were reportedly set to the less efficient hybrid mode (105 of 301; 35%), while the remainder of customers were unaware of their equipment's

[1] A small minority of TECH Clean California customers (675 of 28,149; 2%) received both a HPWH and an HVAC heat pump. Customers who purchased more than one type of heat pump were asked about their HPWH in the survey because there were many fewer HPWH customers than HVAC heat pump customers. All customers were asked about one type of heat pump in the survey (either HPWH or HVAC heat pump).
[2] Panel optimization refers to any panel modifications like load-sharing to free up a slot or adding a subpanel.

operating mode (57 of 301; 19%). Overall, most customers whose original operating mode was set to hybrid or heat pump mode did not change it (189 of 236). However, for customers whose operating mode was originally hybrid and changed the mode, all changed it to heat pump mode.

Most HPWH customers did not need to repair, replace, or troubleshoot issues with their HPWHs (235 of 301; 78%). However, 14% (42 of 301) had at least one issue that required troubleshooting, seven% (21 of 301) required repairs, and 3% (9 of 301) required their entire HPWH to be replaced. There were no notable differences between repeat respondents and new respondents in needing work done on their equipment.

Customers were likely to recommend a HPWH to others. Using a scale from 0 ("not at all likely" to recommend) to 10 ("extremely likely" to recommend), the average rating was an 8.3. Similarly, most customers reported they were "very satisfied" with their HPWH (220 of 301; 73%).

Nearly two-thirds of customers (196 of 301; 64%) had not experienced common issues associated with HPWHs (e.g., excessive noise, increase of cold air, excessive vibration). Excessive noise was the most often reported of these common issues, with more than one-fourth (78 of 301; 26%) of customers reporting it. Repeat respondents (n=140) were significantly more likely than new respondents (n=161) to have experienced any of the common issues (42% vs. 29%, respectively). Repeat respondents were significantly more likely than new respondents to have experienced excessive noise (31% vs 22%, respectively) and an excessive increase of cold air near their units (14% vs. 7%, respectively).

Although most customers reported having enough hot water to meet their needs (214 of 301; 71%), more than one-fourth experienced an issue with hot water availability (87 of 301; 29%). Reasons for running out of water included:

- 42% (35 of 85) said the HPWH does not heat the water fast enough
- 35% (30 of 85) said they had a circumstance where they needed more hot water than usual
- 14% (12 of 85) said the tank might not be big enough

A few customers–31 of 301–rated their HPWH as "not a good value." Higher cost of operation than a gas system and high upfront cost were the most common reasons for a low value rating. Out of the 31 HPWH customers that rated their HPWH as "not a good value," seven of them had their HPWHs installed on or after October 31, 2023.

Customers who reported a higher or lower energy bill (192 of 301) most frequently mentioned adding battery storage (56 of 192) and/or a change in electricity rates (53 of 192) as the primary reasons for the increase or decrease in their bill. These electric rate changes were perceived as involuntary by most (45 of 53; 85%) who reported it.

HVAC HEAT PUMP FINDINGS

Most HVAC heat pumps require a new thermostat. 91% of HVAC heat pump customers received a new thermostat (577 of 634). Most TECH Clean California customers have found their new thermostat to be similar or easier to operate than their old thermostat, but around one-third of customers with ductless HVAC heat pumps reported difficulty with their new thermostat (59 of 190; 31%). More than one in five customers (40 of 190; 21%) needed more than three weeks to feel comfortable with their ductless thermostat, including some who have yet to feel comfortable.

The majority of ducted heat pump customers adjusted their new thermostat less often or about the same amount compared to their old one (249 of 437; 57%), but thermostat use varies between ducted and ductless system users. In contrast, 31% of ductless customers (58 of 190) adjust their new thermostat less often or about the same amount.

The most common areas of the home served by ductless heat pumps were larger living areas such as the living room, family room, dining room, or den (169 of 194; 87%). Other commonly reported rooms served by ductless systems were the master bedroom (159 of 194; 82%) or other bedrooms (136 of 194; 70%).

Both ducted and ductless HVAC heat pumps have been effective at cooling customers' homes. Customers rated the cooling effectiveness of their heat pump using a scale from zero (not at all effective) to 10 (extremely effective). More than four-fifths of customers provided a rating of eight or higher for ducted (356 of 424; 84%) and ductless systems (160 of 182; 88%). Qualitative comments revealed improvements to quality of life in the home due to cooling, especially among respondents who did not previously have air conditioning. Additionally, customers with ducted heat pumps were less likely to use additional cooling equipment than customers with ductless systems; 18% of those with ducted systems used supplemental cooling compared to 35% of ductless heat pump customers.

Customers reported that both ducted and ductless heat pumps have been effective at heating their homes. The majority of customers provided a rating of eight or higher for ducted (348 of 424; 82%) and ductless (149 of 182; 82%) systems. Customers who gave lower ratings felt that the heat pump did not heat their house as well compared to their old system, both from a comfort and speed perspective (e.g., time it takes to adequately heat the home).

Most customers (72% of ducted and 71% of ductless) have not required any work on their HVAC heat pump since it was installed. The most common need for both ducted (83 of 440; 19%) and ductless customers (40 of 194; 21%) was troubleshooting. Most common customer-identified troubleshooting issues were with thermostats (21 of 163; 13%), performance (19 of 163; 12%), a part repaired or replaced (18 of 163; 11%) or an electrical issue (16 of 163; 10%). Of the respondents who mentioned needing to troubleshoot, repair, or replace their HVAC equipment, 25 of them were repeat respondents who previously reported needing work done on their HVAC systems. A little more than half (13 of 25; 52%) needed service to address the same persisting equipment issues they reported when they first took this survey over a year ago.

Although more than half of respondents had not experienced issues with their HVAC heat pump, some issues were relatively common. Issues reported were similar across both ducted and ductless. The most common issue was insufficient heating or cooling in certain spaces of the home, with 19% of ducted (83 of 437) and 16% of ductless customers (30 of 190) reporting this problem. The next most common issues were certain spaces being overly heated or cooled, excessive noise, and a change in the air temperature coming out of vents in the case of ducted systems.

More than two-thirds of customers said their monthly bills decreased or remained the same after getting their HVAC heat pump (451 of 634; 71%). Forty percent (76 of 189) of customers who did not have air conditioning before getting their heat pump reported lower monthly bills. Nearly two-thirds of all customers whose monthly energy bills went down had a solar PV system that generated electricity for their home (203 of 311; 65%).

Overall, customers were very satisfied with their HVAC heat pump. Those with a ductless system were more satisfied overall (184 of 190; 97%) than those with a ducted system (398 of 437; 91%). Additionally, new respondents were slightly more satisfied with their ducted equipment (258 of 280; 92%) than repeat respondents were with theirs (141 of 157; 90%).

A few customers—44 (44 of 633; 7%) —rate their HVAC heat pump as "not a good value." They most often cited high upfront costs (16 of 44; 36%), the cost to operate the system (10 of 44; 23%), and insufficient cooling and heating (10 of 44; 23%) as the reasons for their rating.

Customers' perceived value of their HVAC heat pump improves over time. Repeat respondents were significantly more likely to perceive the value of their equipment as "a great value" at the time of the wave 2 survey than when they took the wave 1 survey in 2023. Most of the respondents whose opinion of their heat pump improved to "a

great value" had initially rated their heat pump as "a good value," though one person's opinion changed from "not a good value" in wave 1. Customers who perceived the value of their equipment as "a great value" most frequently gave the following reasons – the monthly and long-term cost savings (93 of 225; 41%), their home temperature being comfortable (63 of 225; 28%), and the environmental benefit of no longer using gas (36 of 225; 16%).

CONCLUSIONS AND RECOMMENDATIONS

Based on our findings, we offer the following conclusions and recommendations.

Conclusion: Generally good performance and willingness to recommend HPWHs suggest a technology that is poised to become more mainstream. Most customers experienced consistent, satisfactory HPWH performance, and this may be improving over time. Willingness to recommend a HPWH is high (a mean of 8.3 on a 10-point scale).

Conclusion: Contractor installation practices for HPWHs may be changing in ways that improve customer experiences with their equipment. New respondents were significantly less likely than repeat respondents to indicate their HPWHs had been installed in conditioned spaces (basements and laundry rooms) and report common complaints about HPWHs, including excessive noise and excessive increase in cold air near their units.

Conclusion: HPWHs are not functioning as a heat pump all of the time, which means the equipment is not maximizing greenhouse gas emissions reductions. Less than half of customers had their HPWH set to the most efficient mode (heat pump mode). Repeat respondents who changed their mode all changed it from hybrid to heat pump, suggesting heat pump mode is sufficient to produce enough hot water for their household needs.

> **Recommendation**: TECH Clean California should explore adding a recommendation to their guidance documentation for contractors that encourages setting the HPWH on heat pump mode. Such exploration should entail consultation with contractors, manufacturers, and other stakeholders to ensure guidance is informed by multiple experts. TECH Clean California could also add customer-facing educational materials highlighting the efficiency of HPWH heat pump mode on the Switch is On website.

Conclusion: Solar is a key driver of the choice to install a HPWH and the perceived value of investment. Half of HPWH customers had a solar PV system and 91% of HPWH customers who said their monthly bills went down had solar. Being able to take advantage of solar power also contributed to customers rating their purchase as a good or great value. The majority of customers who were extremely likely to recommend a HPWH had solar. In short: having solar PV may be a more important driver of HPWH adoption than incentives. TECH Clean California should explore additional customer targeting or program activities that prepare solar PV owners to switch to HPWHs.

> **Recommendation**: TECH Clean California should investigate options to conduct targeted marketing for HPWHs to customers who already have solar PV within the constraints of program resources. They may also consider exploring ways to partner with solar installation companies for promotion of HPWHs.

Conclusion: High purchase prices associated with HPWHs continue to undermine perceptions of value. Customers are sensitive to equipment prices and increased electricity rates. High prices may limit the appeal of HPWHs for the general public and hamper their widespread adoption.

> **Recommendation**: Current TECH Clean California customer households are wealthier than average, and lower income Californians who may be struggling with high energy burden need efficient equipment. This underscores the need for TECH Clean California to continue offering incentives to income-qualified customers and to explore additional programmatic activities tailored to the needs of disadvantaged communities. Consultation with experts and representatives from DACs should be part of such exploration.

Conclusion: Customers are generally pleased with their HVAC heat pumps. Whether ducted or ductless, for heating or cooling, more than 80% of customers rated their heat pumps as at least highly effective. Perceptions of value increased with the length of time customers had their HVAC heat pump; repeat respondents were significantly more likely to rate their equipment as "a great value" at the time of wave 2 survey than when they took the wave 1 survey.

> **Recommendation:** TECH Clean California should consider publicizing these findings to further boost the appeal of HVAC heat pumps and support confidence in their performance.

Conclusion: Ductless heat pump users require more support for their thermostats to enhance system efficiency. Ductless heat pump users in particular were troubled by their thermostats, with about one-third of customers finding their ductless thermostat harder to use than their prior thermostat. A minority of ductless heat pump customers (39%) felt comfortable using their thermostat right away. New TECH Clean California respondents more frequently reported these struggles than repeat respondents. Ductless heat pump customers also reported adjusting their thermostats more frequently than ducted heat pump customers, which is a less efficient way of operating the equipment.

> **Recommendation:** There is a need for additional customer education and support regarding the use of ductless heat pump thermostats. TECH Clean California could collaborate with manufacturers to improve customer resources, such as hotlines and troubleshooting guides. Some difficulties may arise from Wi-Fi connectivity issues, which HVAC contractors may not be knowledgeable about, and these will need to be addressed by the customers themselves. Therefore, it is important to enhance end-user guides and manuals to empower customers to troubleshoot issues as effectively as possible.

Conclusion: As with HPWHs, more than half of HVAC heat pump customers have solar PV systems. Solar is a driver for HVAC heat pump adoption and satisfaction.

> **Recommendation**: TECH Clean California should investigate options to conduct targeted marketing for HVAC heat pumps to customers who already have solar PV. They may also consider exploring ways to partner with solar installation companies for promotion of HVAC heat pumps.

Conclusion: Despite generally positive ratings, 30% of ducted and ductless customers needed troubleshooting, repair, or replacement on their HVAC heat pump system, including a small number of repeat respondents reporting the same persistent issues in two waves of the survey. The most commonly reported issues included those related to maintaining the home's temperature.

> **Recommendation:** TECH Clean California should consider re-instating the contractor bonus incentives that offered additional money for completing Manual J calculations and performing duct sealing. The added financial reward should encourage greater adherence to quality installation practices, thus reducing these system issues.

Conclusion: Despite representing a minority of customers, high prices for HVAC heat pumps and high utility bills are the top two reasons for perceiving their HVAC heat pump as not a good value, followed by insufficient heating or cooling. The high upfront cost of the system was still an issue, even for those who rated their equipment as "a good value."

> **Recommendation:** High purchase price will inhibit equitable adoption. These findings point to the need for TECH Clean California to maintain financial incentives as a core program offering and offer enhanced incentives to income-qualified customers if TECH Clean California is to achieve more widespread heat pump penetration. TECH Clean California should explore additional incentive designs in consultation with DAC community members and HVAC experts.

2. INTRODUCTION AND METHODS

The TECH Clean California initiative launched in December 2021 with $120 million in funding from a version of the California Air Resources Board's Cap and Trade program, which generates revenue from the sale of GHG emissions allowances to gas investor-owned utilities (IOUs).[3] The TECH Initiative is designed to help advance the state's mission to achieve carbon neutrality by driving the market adoption of low-emissions space- and water-heating technologies for existing single-family and multifamily residential homes. The TECH Initiative was created as part of California Senate Bill 1477. The Assembly Trailer Bill, or Assembly Bill 179 (Ting, 2022), released on August 31, 2022, allocated an additional $50 million in General Fund money for TECH Clean California to use beginning in 2023.[4] Through a combination of market incentives, supply chain engagement, workforce development, consumer education, regional pilots, and Quick Start Grants, the TECH initiative installs low-emissions space- and water-heating technologies in existing California homes. The TECH Initiative is publicly known as TECH Clean California. TECH Clean California enrolls contractors who apply for incentives and pass the incentives on to their customers. All incentivized heat pumps must be installed by a contractor enrolled in TECH Clean California. California contractors must meet licensure and insurance requirements to be eligible to participate in the TECH Initiative. General B, C20, and C36 licensed contractors are eligible for HPWH incentives, while General B and C20 are eligible for HVAC heat pump incentives. TECH Clean California launched a new HPWH incentive via the Self-Generation Incentive Program (SGIP) HPWH Program, on October 31st, 2023. The SGIP HPWH incentive requires HPWHs have a thermostatic mixing value and customers enroll in a demand response where they agree to reduce their electricity use for a brief time during a severe heatwave of other grid emergency.[5]

We define the four types of heat pump systems incentivized by TECH Clean California below:

- **Heat pump water heater:** These are sometimes referred to as hybrid electric water heaters. They use electricity to extract heat from the surrounding air and transfer it to water in its tank. They can be up to three times as efficient as conventional electric resistance water heaters. They have three modes: heat pump mode, electric resistance mode, and a hybrid mode that uses both heating elements (the heat pump and the backup electric resistance element). Some models also have a vacation mode that lets the unit save energy while the user is away.
- **Ducted HVAC, split unitary system:** As the most common type of space conditioning heat pump, these systems look just like air conditioners. The indoor unit connects to the central ducting of the home. The outdoor compressor unit can be single-speed, two-speed, or variable speed, and its efficiency increases in multi-speed systems.
- **Ducted HVAC, packaged unitary system:** This heat pump system contains all components in a single "package" and connects to the home's ductwork. Due to the units being installed outside of the home, this is a good option for those with limited indoor space. Although typically installed on the ground, packaged units can also go on rooftops.
- **Ductless HVAC:** Mini- or multi-split systems are smaller versions of the unitary split system, and each indoor unit usually serves one room or space in the house. The indoor unit can be wall-mounted, which avoids the need for ductwork. Multi-split systems have multiple indoor units connected to a single outdoor unit.

Opinion Dynamics is conducting Whole Independent Systems Evaluation™ (WISE™) of TECH Clean California, where we evaluate the TECH Initiative alongside, but independently, of the TECH Initiative implementer, Energy Solutions.

[3] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M331/K772/331772660.PDF
[4] https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB179
[5] https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-provides-additional-incentives-and-framework-for-electric-heat-pump-water-heater-program

This position allows us to quickly deliver feedback to improve program operations. Our approach creates effective feedback loops to help all parties better understand complex market adoption patterns, the effectiveness of program strategies, and opportunities for course correction.

This report extends our evaluation of TECH Clean California's customer experiences with HPWHs and HVAC heat pumps installed in their homes. The first Insights into Customer Experience and Satisfaction Report was published in September 2023.[6] That report shared findings from the first wave of our online customer experience survey for single-family homeowners and renters who received a TECH Clean California-incented HPWH or HVAC heat pump survey. The primary objectives of the survey were to capture customer experiences with their heat pump equipment, understand any issues they may have encountered, and see if they self-report any changes to their utility bills.

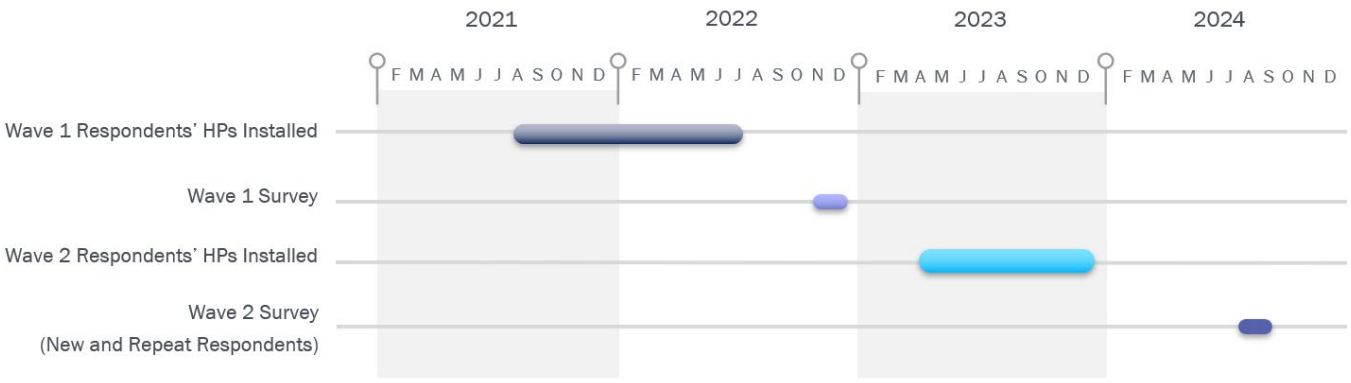
2.1 SAMPLE FRAME AND METHODS

This report includes findings from wave 2 of the Customer Experience Survey. In July of 2024, we developed a sample frame of 4,689 customers who had a TECH Clean California enrolled contractor install new heat pump equipment in their homes. This sample frame was composed of two customer groups:

- 853 customers who installed their equipment between August 2021 and July 2022, and completed the wave 1 survey; and
- 3,836 customers who installed their equipment between April 2023 and December 2023.

Throughout the report, we refer to the former as "repeat respondents" and the latter as "new respondents." For the new respondent sample, we targeted customers who, according to their installation date, were likely to have had the equipment installed for at least eight months (see Figure 2). This timing would have allowed HVAC heat pump owners to have operated their equipment in both heating and cooling seasons, permitting them to experience the full range of performance of their HVAC equipment.

Figure 2. Timeline of Installations and Survey Waves



We sent one email invitation and up to three email reminders to each customer. A total of 935 customers completed the survey, resulting in a 21% response rate (Table 2). Of those customers, 358 of them were repeat respondents and 577 were new respondents. The response rate for repeat respondents was 42% and 16% for new respondents.

[6] The first Insights into Customer Experience and Satisfaction report is available here: https://techTECH Clean Californiacleanca.com/documents/2377/TECHTECH CLEAN CALIFORNIA_Customer_Experience_and_Satisfaction_Final_Report_9.15.23.pdf

Respondents received a $15 gift card for completing the survey. Ducted HVAC heat pump survey data includes responses from customers who installed either a split unitary or packaged unitary system.

Table 2. Survey Sample Frame and Response by Equipment Type

Equipment Type	Number of Customers Contacted	Number of Wave 2 Survey Respondents	Number of Repeat Respondents	Number of New Respondents	Response Rate
HPWH	1,121	301	140	161[a]	27%
Ducted HVAC	1,996	440	159	281	22%
Ductless HVAC	1,259	194	59	135	15%
Total	**4,376**	**935**	**358**	**577**	**21%**

[a] Includes 122 customers whose HPWHs were installed on or after 10/31/2023.

Since all repeat respondents completed the wave 1 survey in 2023, they were excluded from questions about their decision-making (e.g., how important it was for their new heat pump equipment to use electricity over gas) and those that may not have been relevant at the time of their heat pump installation (e.g., demand response requirement). Nonetheless, most survey items were the same across waves one and two allowing our team to make comparisons over time.

To assess the extent to which TECH Clean California customer experiences have changed, we conducted statistical testing comparing responses between new and repeat survey respondents. Our team used pairwise t-tests with a 90% confidence level ($p \leq 0.1$) to identify significant differences. We also compared repeat respondents' equipment satisfaction ratings and likelihood to recommend their equipment between survey waves 1 and 2 to determine if there are significant changes over time as customers gained more experience operating their heat pump equipment. For this comparison, we carried out paired-sample z-tests, also with a 90% confidence level ($p \leq 0.1$). We document instances of significance throughout the report where applicable.

2.2 RESPONDENT DEMOGRAPHICS

Most of the surveyed TECH Clean California customers were in PG&E's gas service territory, including the majority of HPWH customers who responded to the survey (245 of 301; 81%), as shown in Table 3. This breakdown is consistent with the population of TECH Clean California customers, whereby most HPWH customers (78%) and over half of HVAC heat pump customers (51%) were in the PG&E territory.

Table 3. Survey Respondents by Gas IOU

Gas IOU	Equipment Type	Survey Respondents	Survey Respondents Percent	TECH CLEAN CALIFORNIA Projects
Pacific Gas and Electric	HVAC heat pump	397 (43%)	69%	56%
	HPWH	245 (26%)		
Southern California Gas	HVAC heat pump	169 (18%)	23%	34%
	HPWH	47 (5%)		
San Diego Gas and Electric	HVAC heat pump	68 (7%)	8%	9%
	HPWH	9 (1%)		

Gas IOU	Equipment Type	Survey Respondents	Survey Respondents Percent	TECH CLEAN CALIFORNIA Projects
Total		935	100%	34,645

Note: One HPWH project was not tied to a gas IOU territory in the TECH Clean California project tracking data. This project is included in the total row. TECH Clean California program tracking data is through July 11, 2024.

The TECH Clean California customers we surveyed were mostly in climate zones 3, 10, and 12 (Table 4). Climate zone 3 is the Bay Area with moderate temperatures year-round and with precipitation in the winter and fog likely in the summer. Climate zone 10 is the high desert with moderate weather patterns compared to the low desert and southern California regions, while climate zone 12 has cooler winters and hotter summers than the Bay Area. The distribution of all 16 climate zones by equipment type is available in Table 4.

Table 4. Survey Respondents and TECH CLEAN CALIFORNIA Population by Climate Zone

Climate Zone	Percent of Survey Respondents (n=935)	Percent of All TECH Clean California Customers (n=34,645)
1	1%	<1%
2	7%	4%
3	17%	10%
4	7%	5%
5	<1%	0%
6	5%	4%
7	6%	6%
8	3%	5%
9	4%	6%
10	5%	9%
11	3%	3%
12	33%	33%
13	4%	5%
14	<1%	2%
15	5%	7%
16	1%	<1%
Not available	<1%	<1%

Note: These breakdowns reflect customers who had their heat pump installed for at least eight months at the time of the survey in August 2024.

Survey respondents' household income before taxes skewed high (Table 5. Key Demographic Information for Survey Respondents), with 27% (253 of 935) reporting income higher than $200,000 per year; US Census data shows 19% of California households earn more than $200,000 annually.[7] The overwhelming majority of survey respondents spoke English at home (881 of 935; 94%). Additionally, nearly all respondents were homeowners (928 of 935),

[7] S1901: Income in the Past 12 Months ... - Census Bureau Table

while the remaining seven were renters. Because of the small number of renters, we did not segment renter data for additional analysis.

Table 5. Key Demographic Information for Survey Respondents (n=935)

Key Demographic Information	Count of Respondents
Respondent Household Income (before taxes)	
Under $80,000	114
$80-$149,999	243
$150-$199,999	134
$200,000+	253
Refused	191
Languages Spoken at Home	
English	881
Spanish	49
Mandarin	22
Cantonese	12
Vietnamese	10
Filipino/Tagalog	8
French	7
Russian	6
Korean	5
German	5
Japanese	4
Other	14
Prefer not to say	38
Respondent Home Ownership	
Owner	928
Renter	7

Please keep in mind that the findings we share reflect the sample of TECH Clean California customers who responded to the survey. They are not intended to be extrapolated to the population of TECH Clean California participants or California homeowners.

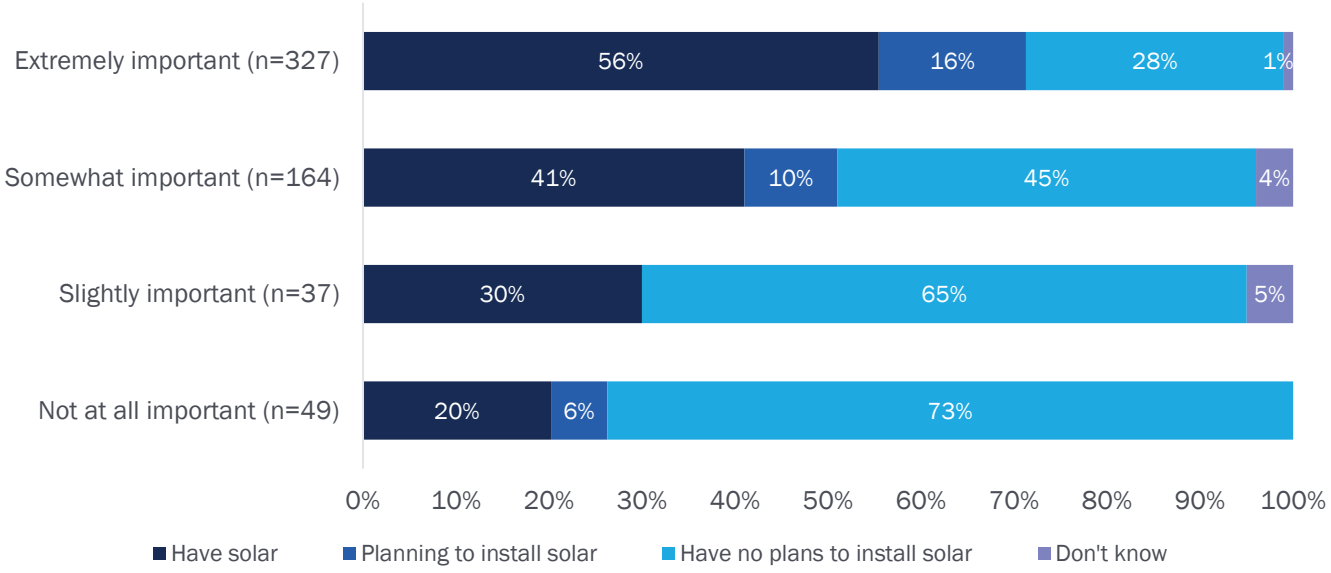
3. FINDINGS

In this section, we present findings about customers' motivations for selecting heat pump equipment and their experiences using the heat pump equipment in their homes. We start by presenting motivations overall for selecting electric equipment. Then, we split out the experience with the equipment by space-conditioning heat pumps and water-heating heat pumps.

3.1 MOTIVATIONS FOR SELECTING ELECTRIC EQUIPMENT

The fact that the heat pump uses electricity instead of gas or propane was an important decision-making factor for new respondents; 85% of them said it was at least somewhat important that their heat pump uses electricity instead of gas or propane (491 of 577). This level of importance varied considerably depending upon whether the customer had solar PV at their house (Figure 3). Of new respondents who said it was extremely important that their heat pump uses electricity instead of gas or propane, 56% of them have solar (183 of 327) and 16% are planning to install solar (52 of 327). Meanwhile, most customers who said it was slightly important (24 of 37; 65%) or not at all important (36 of 49; 73%) have no plans to install solar.

Figure 3. Importance that Equipment Uses Electricity by Customer Plans for Solar (n=577)



Note: We did not ask repeat respondents this question in this survey wave.

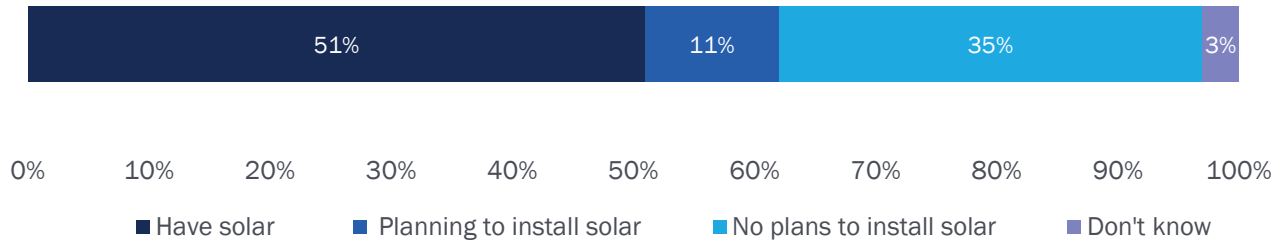
3.2 HEAT PUMP WATER HEATERS

The following sections provide findings about the TECH Clean California customers' experience with their new HPWH. We report statistically significant differences between repeat and new respondents, and between waves 1 and 2 for repeat respondents.

3.2.1 HOME FEATURES

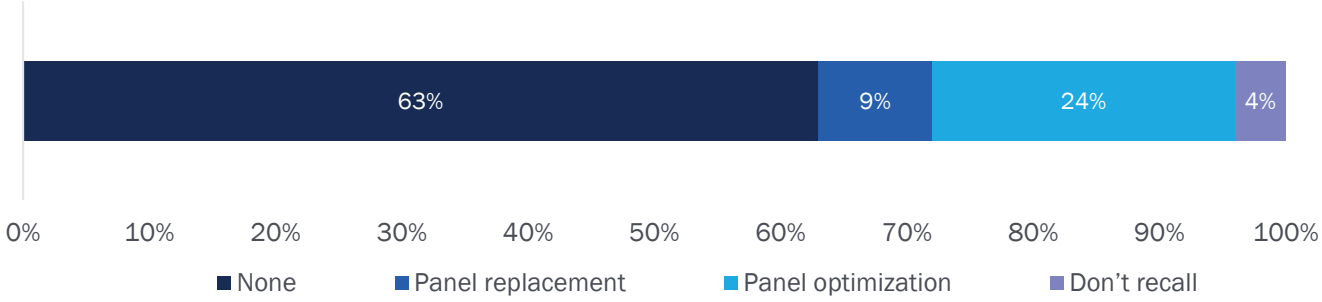
HPWH respondents were primarily homeowners (299 of 301; 99%). The remaining two respondents rented their home where the TECH Clean California-incented HPWH was installed. Nearly all the TECH Clean California-incented HPWHs were installed in customers' primary residences (294 of 300; 98%). More than half of residences where a HPWH was installed (153 of 301; 51%) had a solar PV system that generates electricity for the home (Figure 4). A minority of HPWH customers reported they had no plans to install solar in the future (105 of 301; 35%).

Figure 4. Whether Customers Have or Are Planning to Install Solar (n=301)



More than half of TECH Clean California customers (188 of 301; 63%) did not need to upgrade their electrical panel to accommodate the installation of their new HPWH (Figure 5). Of those customers, 56% of them had solar installed at their home (106 of 188). Nearly one-fourth of HPWH customers required panel optimization (72 of 301; 24%) to accommodate the HPWH, and 9% required a complete panel replacement. Panel optimization refers to electrical panel modifications that can include load-sharing to free up a panel slot or adding a sub-panel, suggesting one in three HPWH customers will need to perform some work on their electrical panel to accommodate the HPWH.

Figure 5. Whether Customers Needed to Upgrade Their Electrical Panel (n=301)



3.2.2 DESCRIPTION OF EQUIPMENT

We asked TECH Clean California customers who had an HPWH installed in their home to list the first three words that came to mind when thinking about their new equipment. Customers called out several positive

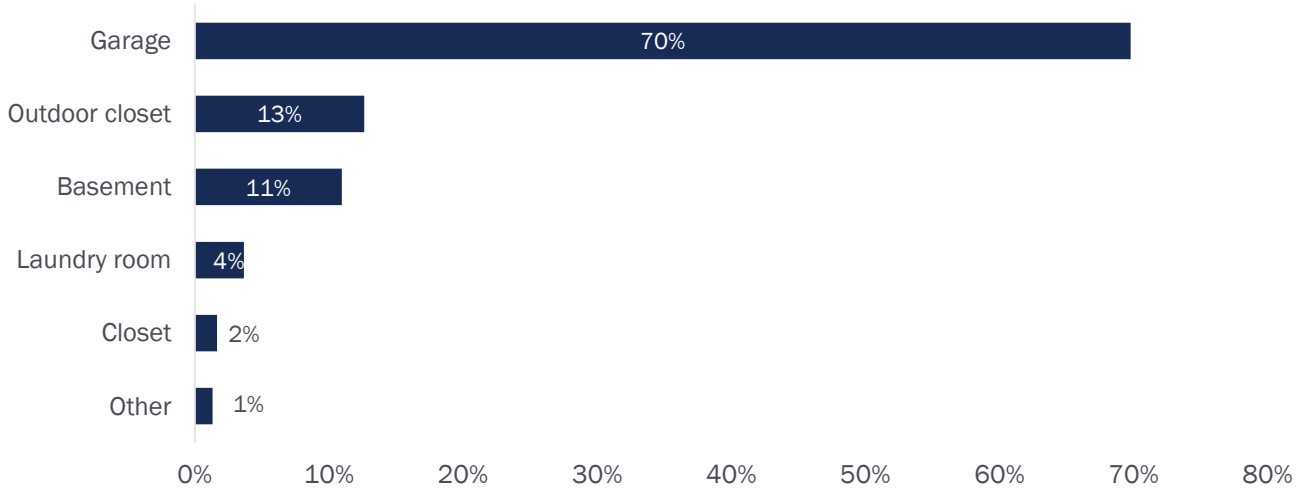
features about their new HPWH, including that it was reliable, efficient, and yielded cost savings. Some negative aspects included that the HPWH was large, noisy, and expensive.

Figure 6. Customers' Top Three Words Describing Their HPWH (n=301)

3.2.3 EQUIPMENT LOCATION

HPWHs were typically located in an unconditioned space in customers' homes (271 of 301; 90%). The majority of HPWHs were located in a space separate from the main living area such as the garage (211 of 301; 70%), outside of the home in an outdoor closet (39 of 301; 13%), or in the basement (33 of 301; 11%), as shown in Figure 7.

Figure 7. HPWH Location (n=301)



Repeat respondents were significantly more likely than new respondents to have their HPWH installed in their basement (16% vs. 7%) and laundry room (6% vs. 2%) as shown in Table 6. New respondents, however, were significantly more likely to have their HPWHs installed in their garages than repeat respondents (76% vs. 62%, respectively).

Table 6. Location of Customers' HPWHs

Location	Repeat Respondents (n=140)	New Respondents (n=161)
Garage	62%	76%*
Outdoor closet	13%	12%
Basement	16%*	7%
Laundry room	6%*	2%
Closet	1%	2%
Other	2%	1%

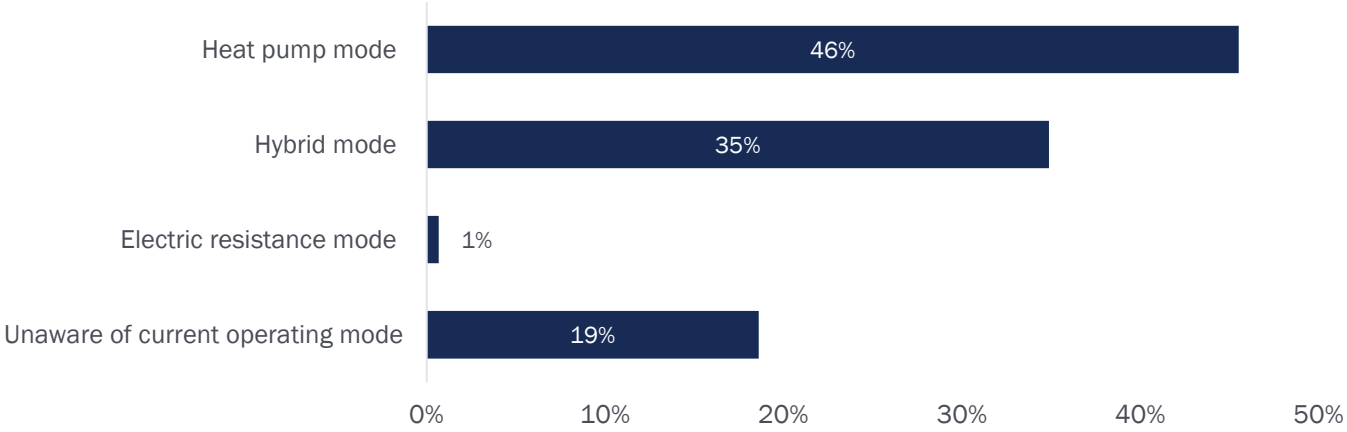
Note: Asterisk indicates significance at $p \leq 0.1$.

3.2.4 EQUIPMENT SETTINGS

Most respondents (244 of 301; 81%) knew their HPWH's current operating mode (Figure 8). Survey respondents reported their HPWHs were most frequently set on heat pump mode (139 of 301; 46%), while just over one-third were set to hybrid mode (105 of 301; 35%). Heat pump mode uses only the heat pump to heat the water (which is the most energy-efficient operating mode), while hybrid mode can switch to the electric resistance heater to heat the water faster than on heat pump-only mode (which is less energy-

efficient). About one-fifth of surveyed customers did not know the current operating mode their HPWH was set to (57 of 301; 19%).

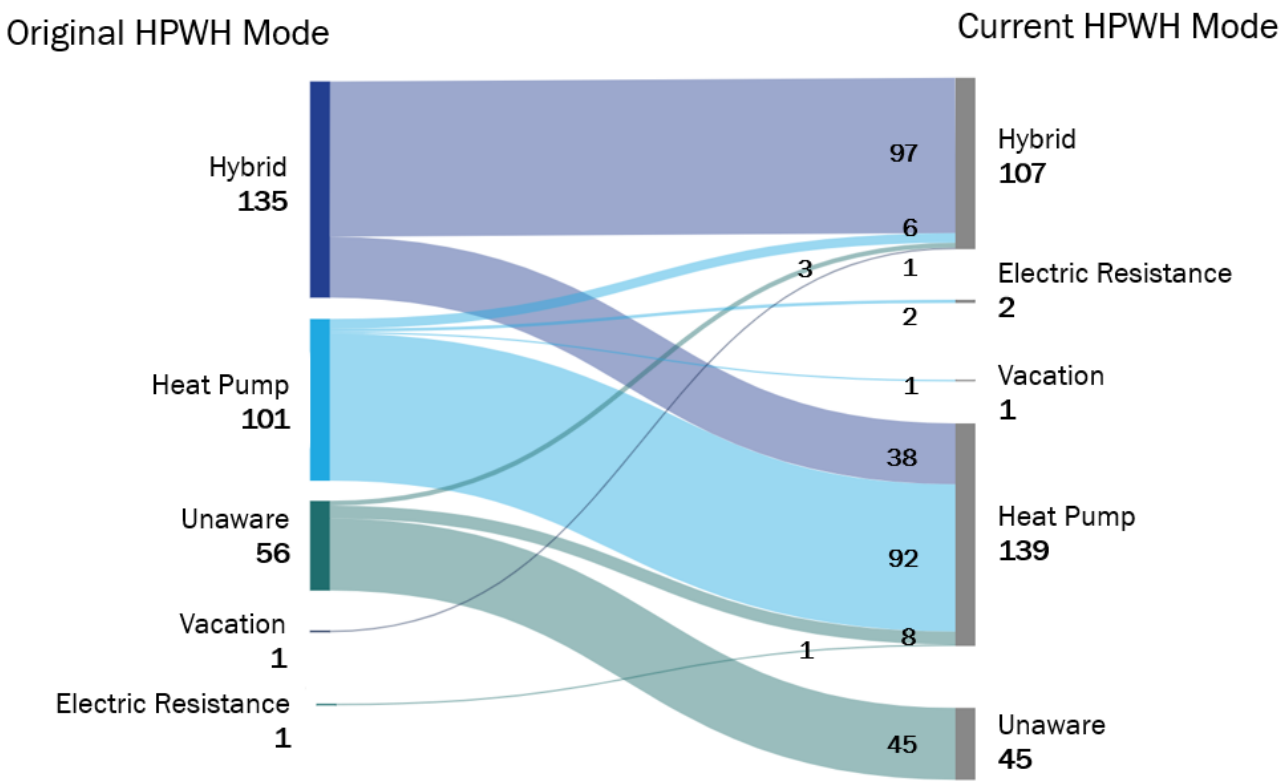
Figure 8. Heat Pump Operating Modes (n=301)



Note: Of the 122 HPWH respondents who had a HPWH installed on or after October 31, 2023, 46 respondents had their HPWH set to heat pump mode, 51 respondents to hybrid mode, one respondent to electric resistance mode, and 24 respondents were unaware of their current operating mode.

Figure 9 shows whether customers changed their HPWH's original operating mode since having it installed or kept it the same. Overall, most customers whose original operating mode was set to hybrid or heat pump mode did not change it (189 of 236). However, among customers whose operating mode was initially hybrid and then changed, all 38 of them changed it to heat pump mode. Those who were unaware of their original operating mode were likely to remain unaware of their current operating mode.

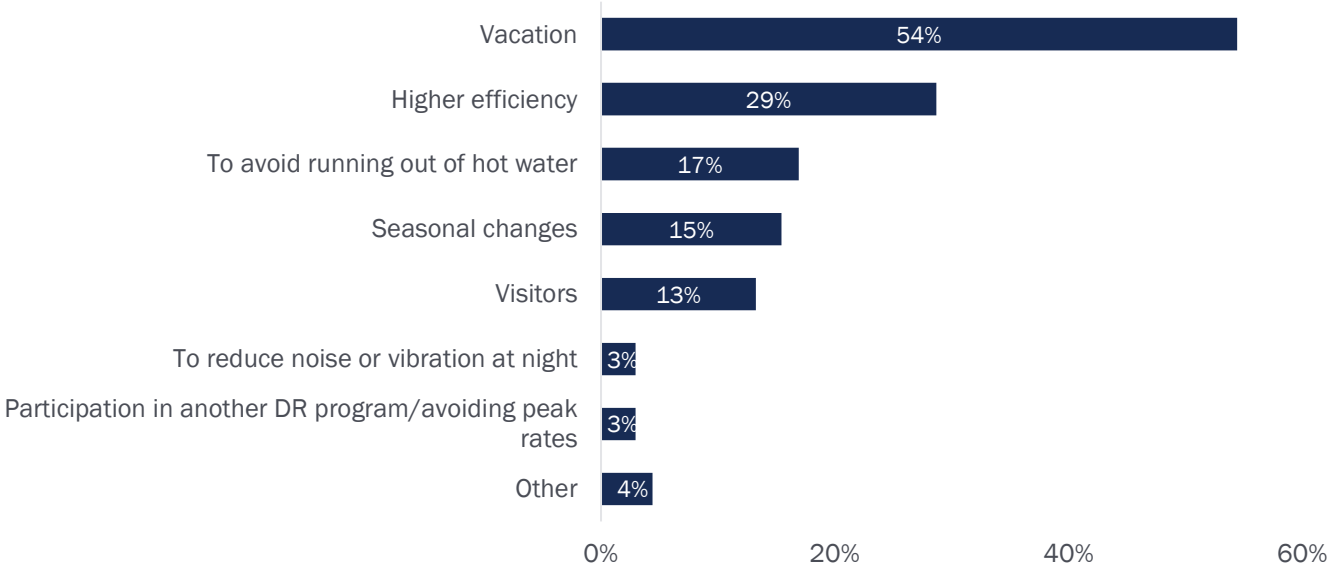
Figure 9: Original and Current HPWH Operating Mode (n=244)



Note: Figure excludes respondents who reported they did not know if their operating mode had been changed since installation.

The most common reasons customers had changed the mode included leaving for vacation (73 of 136; 54%) or to achieve higher operating efficiency (39 of 136; 29%), as shown in Figure 10. A bit less than one-fifth of customers adjusted their mode to avoid running out of hot water (23 of 136; 17%), suggesting they had already experienced this issue with their new equipment.

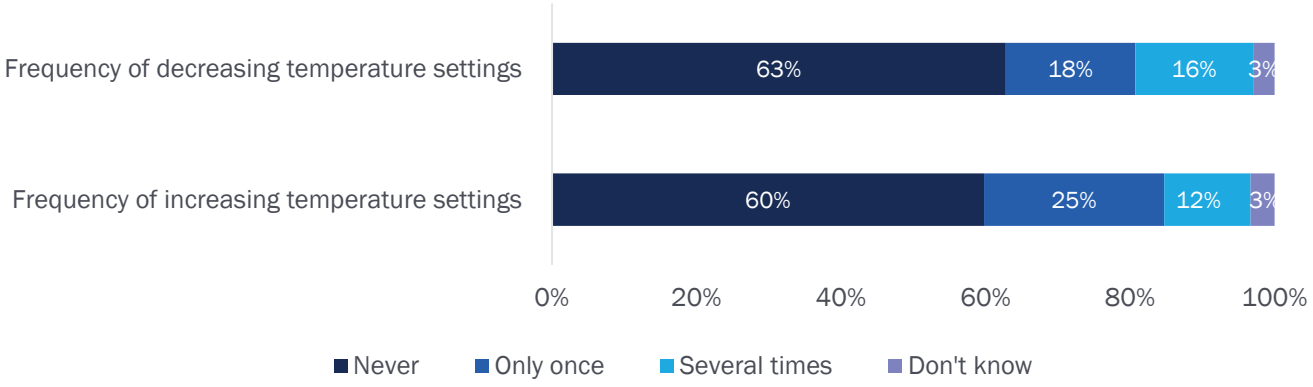
Figure 10. Reasons Customers Changed HPWH Operating Mode (n=136)



Note: Multiple responses allowed.

Most respondents had also not adjusted their HPWH temperature (Figure 11). However, around one-third of customers reported decreasing the temperature settings at least once (102 of 301; 34%), while 37% reported increasing the temperature settings at least once (111 of 301). Of the 111 customers who either decreased or increased the temperature settings of their HPWHs at least once, around half of them (54 of 111; 49%) both increased and decreased the temperature settings of their HPWH at least once.

Figure 11. How Often Customers Adjusted HPWH Temperature Settings (n=301)



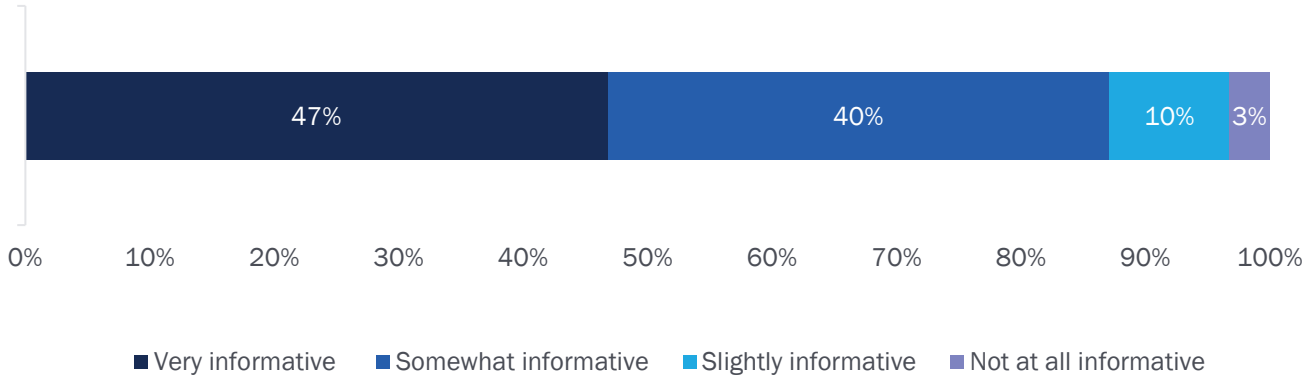
Repeat respondents (n=161) were significantly more likely than new respondents (n=140) to have decreased the temperature settings on their heat pump water heater several times (21% vs. 12%, respectively).

3.2.5 DEMAND RESPONSE REQUIREMENT

As of October 31, 2023, the TECH Initiative required that certain customers who received a HPWH enroll in a qualifying demand response program.[8] We asked new respondents who had their equipment installed between November 1, 2023 and December 31, 2023 whether they recalled their contractor mentioning anything about enrolling in a demand response program. A little more than half recalled their contractor mentioning enrollment in a demand response program (62 of 121; 51%).

We asked the 62 respondents who recalled their contractor mentioning enrollment in a demand response program how informative their contractor's explanation was (Figure 12). Most customers felt the information their contractor shared was at least somewhat informative (54 of 62; 87%). A little more than half of these customers said this information caused them to enroll in a demand response program (33 of 62; 53%); nearly one-fifth of these customers were already enrolled in a demand response program prior to receiving the TECH Clean California-incentivized HPWH (12 of 62; 19%).

Figure 12. How Informative Customers Found Demand Response Program Information Shared by Contractors (n=62)

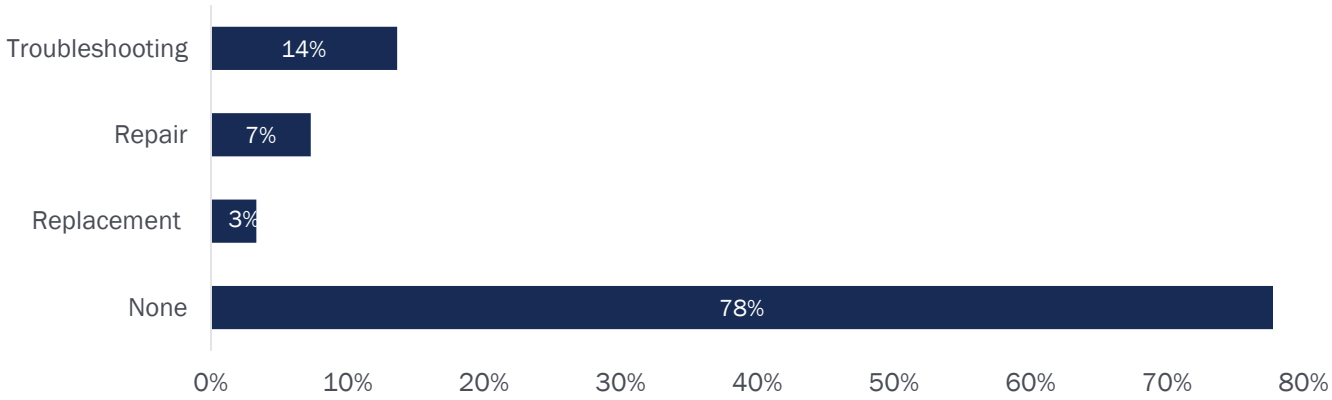


3.2.6 ISSUES WITH EQUIPMENT

Most HPWH customers did not need to repair, replace, or troubleshoot issues with their equipment (235 of 301; 78%), as shown in Figure 13. However, 14% (42 of 301) had at least one issue that required troubleshooting, 7% (21 of 301) required repairs, and 3% (9 of 301) required their entire HPWH to be replaced. There were no notable differences between repeat respondents and new respondents in needing work done on their equipment.

[8] https://frontierenergy-techTECH Clean California.my.site.com/contractorsupport/s/article/Demand-Response-Requirements

Figure 13. Work Required on HPWH Equipment Since Installing (n=301)



Note: Response option "None" is exclusive. Multiple responses allowed.

The 58 TECH Clean California customers who mentioned needing to repair, replace, or troubleshoot an issue were asked to describe the issue they had. Respondents provided their answers in an open-ended format, which we thematically coded. The most common issues respondents described related to their equipment needing a part repaired or replaced, as shown in Table 7.

Table 7. HPWH Equipment Issues (n=58)

Issue	Number of Respondents	Percent of Respondents
Equipment part repaired or replaced	12	21%
Performance issue	11	19%
Difficulties with app or Wi-Fi	10	17%
Installation issue	6	10%
Noise	5	9%
Electrical issue	5	9%
Whole unit replaced	3	5%
Filter issues	3	5%
Temperature control issue	2	3%
Water leak from system	2	3%
Other	5	9%

Note: Some responses are coded under multiple categories, thus the sum of values in the 'Number of Respondents' column exceeds the n value. Multiple responses allowed.

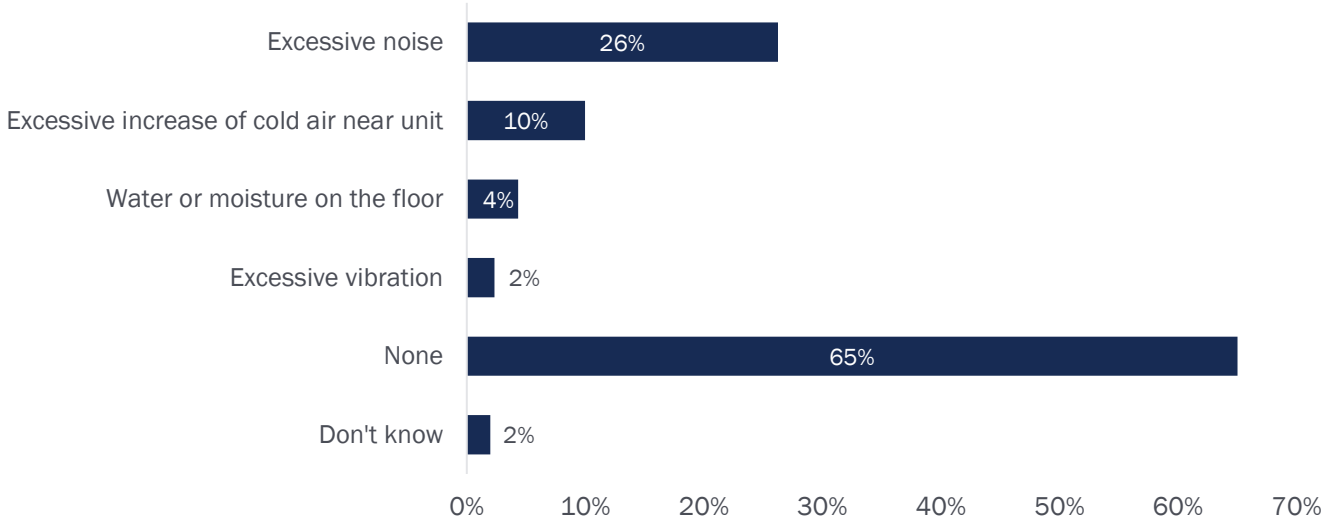
We elaborate on each issue reported by respondents below:

- **Equipment part repaired or replaced (12 of 58).** To resolve an equipment issue, these customers had a follow-up visit from a contractor where a specific part of the equipment was repaired or replaced. A few examples of these parts included a valve, temperature sensor, fan motor, and battery.

- **Performance issue (11 of 58).** These were cases where no other obvious issues existed, but the system still failed to operate as designed, such as water temperature varying from set temperature or the equipment not turning on.
- **Difficulties with app or Wi-Fi (10 of 58).** Across various manufacturers, 10 respondents had difficulty connecting their equipment to their Wi-Fi and controlling their HPWH using the corresponding online app. Responses indicated challenges with apps crashing, not being able to maintain a Wi-Fi connection, control modes not staying to what they were set to, and difficulty adjusting the water temperature.
- **Installation issue (6 of 58).** Six customers had to schedule follow-up visits with contractors to address issues that occurred during installation such as incorrect plumbing and a damaged circuit breaker.
- **Noise (5 of 58).** Respondents reported loud noises coming from their system. Most did not specify what was producing the noise or how they addressed it. One customer said their contractor came back out and installed a noise reduction kit and other insulation measures which helped reduce the noise coming from what was likely the compressor.
- **Electrical issue (5 of 58).** A few customers reported electrical issues with their equipment that included needing a wiring reconfiguration, replacement of a fuse, needing a new type of fuse, and fixing a breaker that kept flipping when the HPWH would turn on.
- **Whole unit replaced (3 of 58).** These were cases where a full unit replacement was necessary to correct the issue.
- **Filter issues (3 of 58).** A few customers mentioned issues that arose with their equipment's' filters needing to be cleaned or replaced.
- **Temperature control issue (2 of 58).** These issues were with the thermostat or temperature control system, including faulty temperature sensors.
- **Water leak from system (2 of 58).** These customers reported water leaking from their equipment or pipes and generally indicated that it was an easy fix during a follow-up visit from their contractor.
- **Other (5 of 58).** These additional issues included not passing inspection, lime appearing in the water, the heat pump turning completely off at random, and the system beeping occasionally.

In addition to the equipment issues discussed above, we directly asked respondents about specific issues known to occur with HPWHs (Figure 14). More than half of respondents had not experienced any of these common issues (196 of 301; 64%); excessive noise was reported by slightly more than one-fourth of them (78 of 301; 26%).

Figure 14. Other HPWH Equipment Issues (n=301)

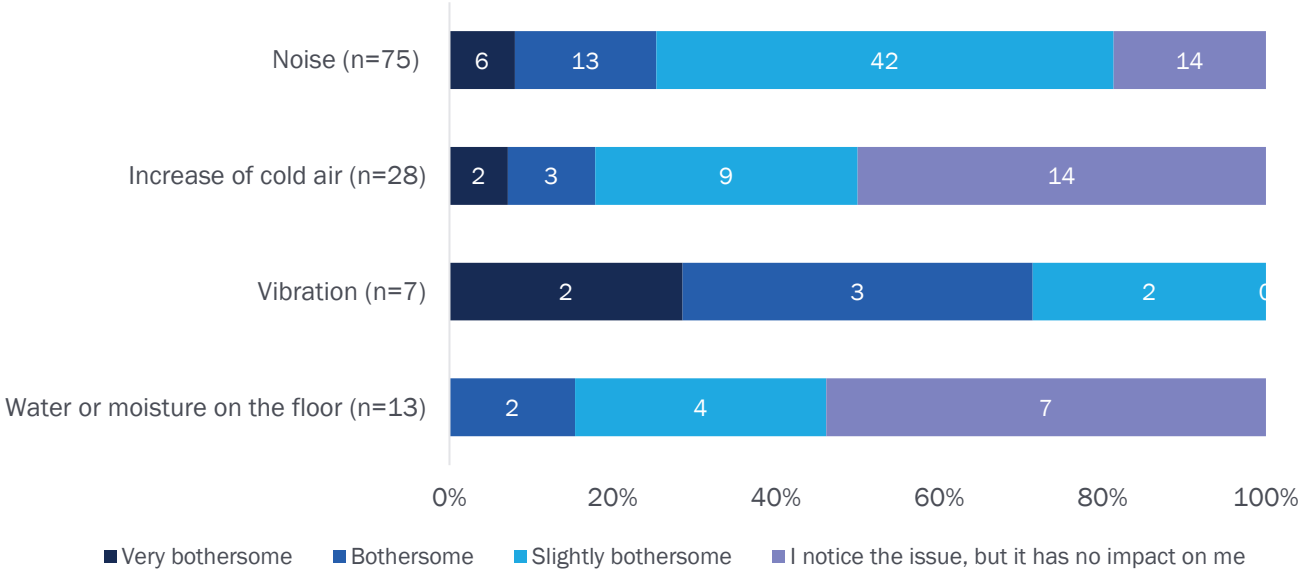


Note: Response options "None" and "Don't know" are exclusive.

We asked the 97 customers who had experienced one or more of these issues follow-up questions to gauge how bothersome they found each to be in their home (Figure 15). Most respondents' equipment issues were noticeable but did not cause disruption in their home. Vibration issues were reported as "most bothersome" to respondents but affected a small number of customers (7 of 97; 7%). The majority of those who noticed an increase in cold air near the equipment were not bothered by it (14 of 28; 50%). Nine of these 14 customers had their heat pump installed in their garage. Lastly, noise was the most frequently noticed issue reported by respondents, with 81% of those customers describing it at least as slightly bothersome (61 of 75).

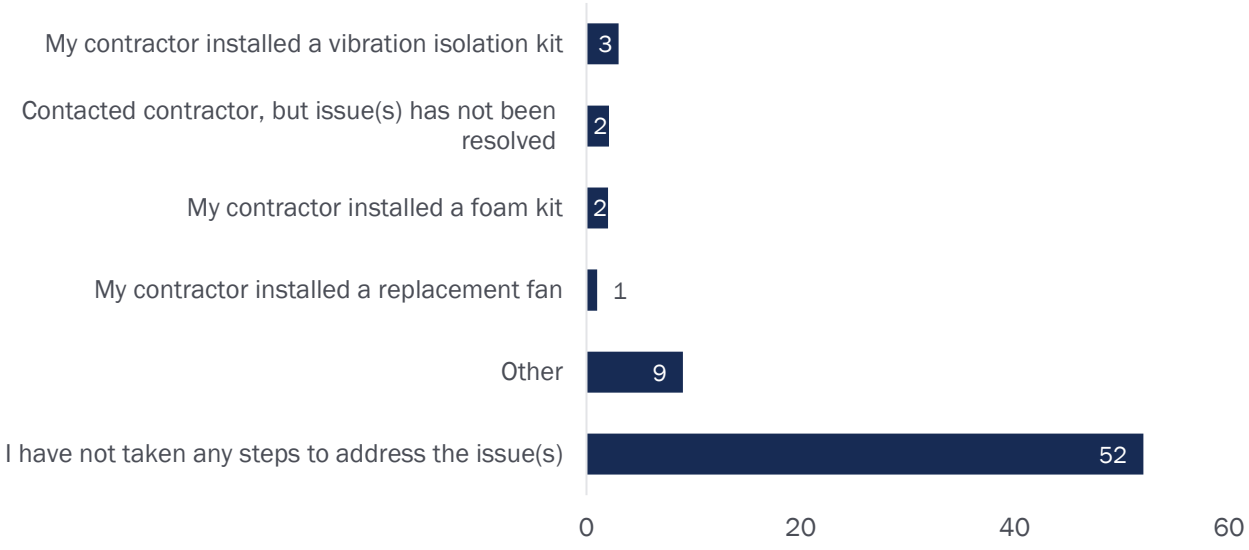
Repeat respondents (n=140) were significantly more likely than new respondents (n=161) to have experienced one of the common issues reported with their HPWHs (42% vs. 29%, respectively). Repeat respondents were significantly more likely than new respondents to have experienced excessive noise (31% vs 22%, respectively) and excessive increase of cold air near their units (14% vs. 7%, respectively).

Figure 15. Extent HPWH Issues Bother Customer (n=97)



Of the 70 customers bothered by HPWH issues, most had not taken any steps to address the issue (Figure 16). For six customers, the contractor came back to the home and installed a foam kit, vibration isolation kit, or a replacement fan to address the issue. Two respondents had reported that they contacted a contractor, but the issue had still not been resolved; they were both experiencing excessive noise. Nine respondents attempted to resolve their issues another way, including adding padding but not full isolation, adjusting the vents, rerouting the exhaust, tightening a pipe, or cleaning the air filter.

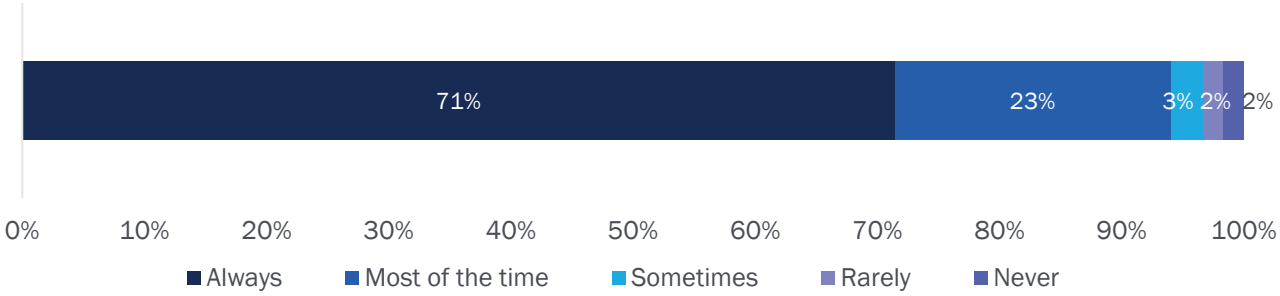
Figure 16: Steps Taken to Address HPWH Issues (n=70)



HOT WATER AVAILABILITY

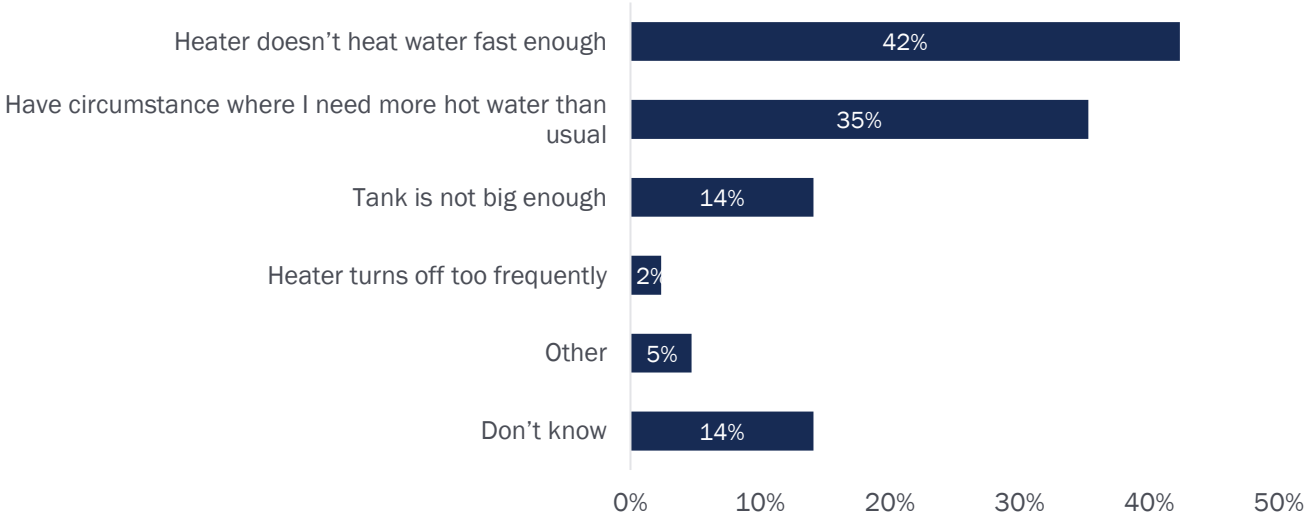
The HPWHs met the hot water needs of most respondent households (Figure 17), with 71% (214 of 301) of customers reporting that they always have enough hot water to meet their needs. However, more than one-fourth of customers experienced an issue with hot water availability to some extent in the period since the HPWH was installed (87 of 301; 29%).

Figure 17. How Often Customers Have Enough Hot Water to Meet Household Needs (n=301)



We asked the 85 customers who experienced hot water limitations what they thought could be causing the issue (Figure 18). Forty-two percent (35 of 85) of those customers reported the HPWH does not heat the water fast enough, while 35% (30 of 85) reported they had a circumstance where they needed more hot water than usual. Fourteen percent (12 of 85) also reported that their hot water tank might not be big enough for what they need; 2% (2 of 85) reported that the heater turns off too frequently. Slightly less than one-sixth of respondents (12 of 85; 14%) did not know what could be causing them to run out of hot water.

Figure 18. Reasons Customers Ran Out of Hot Water (n=85)

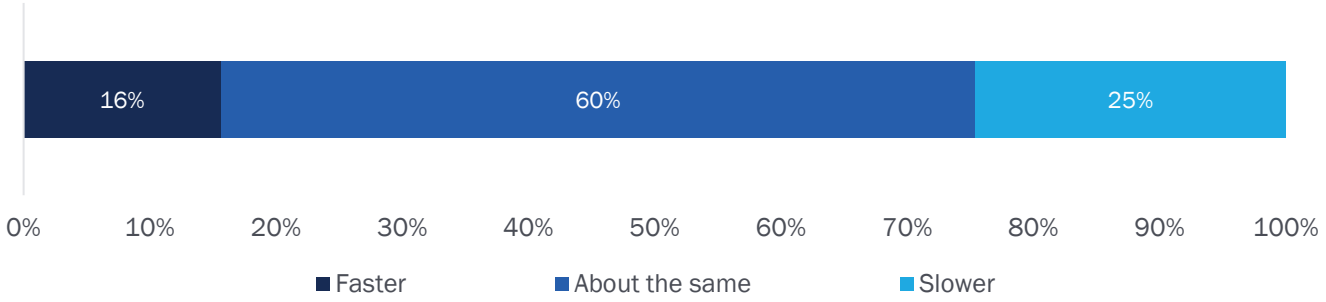


Note: Response option "Don't know" is exclusive. Multiple responses allowed.

We also asked customers about the recovery rate of hot water compared to their previous water heater. In the survey, we defined the recovery rate for the respondents as "the length of time the system takes to

produce hot water after the existing supply has run out." A majority of respondents reported that it was about the same (181 of 301; 60%), while 16% (48 of 301) said their new HPWH's recovery rate was faster (Figure 19). Notably, one-fourth of customers reported that the recovery rate was slower than their previous water heater.

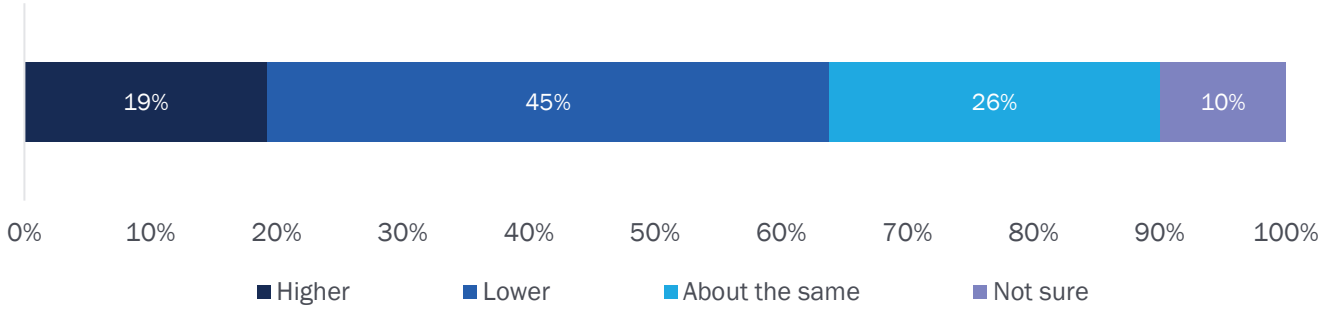
Figure 19. Recovery Rate Compared to Previous Water Heater (n=301)



3.2.7 ENERGY BILLS

Since having their new HPWH installed, almost half of respondents reported that their monthly energy bills decreased (135 of 301; 45%). More than two-thirds of HPWH customers whose monthly energy bills went down mentioned they have a solar PV system that generates electricity for their home (91 of 135; 67%). Respondents were instructed to consider both gas and electric utility bills combined, if applicable. We do not have insight into how the respondents calculated changes in monthly energy bills, therefore this information should be treated as the customers' perception of any changes. We did not have access to monthly bills or rate plan information.[9]

Figure 20. Perceived Change in Monthly Energy Bills Since Installing HPWH (n=301)



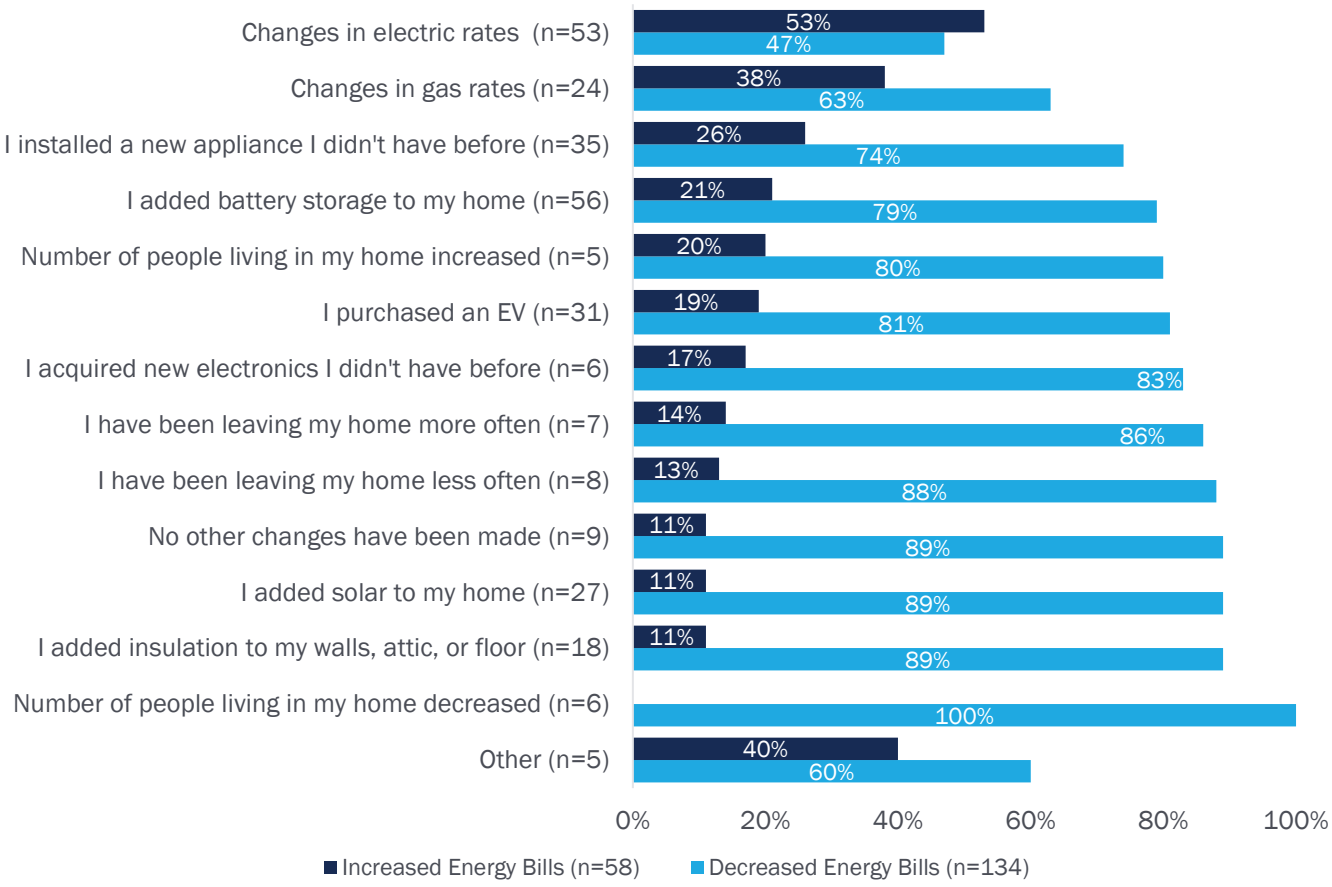
We asked the 192 survey respondents who reported higher or lower total energy bills about changes in their home that may have contributed to the difference in their bills other than their new heat pump. Changes in electric rates were the most common change reported, along with adding battery storage to the home (see

Figure 21). Interestingly, most customers who reported actions one would expect to increase their energy bills, such as an increase in the number people living in the home, leaving home less often, purchasing an

[9] Unfortunately, utility bill data to support analysis of site-level energy bill impacts were not available at the time of this report.

EV, and/or acquiring new electronics, nevertheless reported a decrease in their overall monthly energy bills since getting the HPWH.

Figure 21. Additional Changes That Might Impact Energy Bills



Note: Multiple responses allowed.

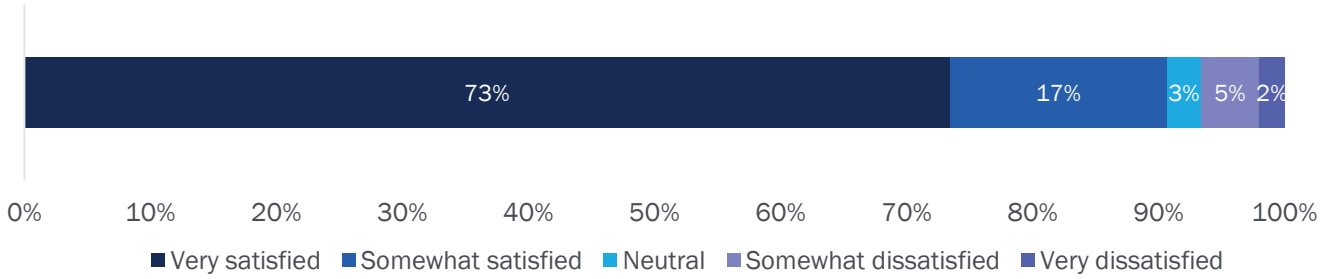
We asked respondents who reported a rate change to understand whether it was a voluntary adjustment in their rate plan, or an involuntary increase in fuel cost. Among those who reported a change in their electricity rate, 85% (45 of 53) shared this was due to their utility involuntarily raising their price of electricity, rather than the customer opting into a new rate plan. Similarly, 83% of those who reported a change in their gas rate said it was a result of their utility increasing the price (19 of 23).

3.2.8 SATISFACTION

Overall, customers were satisfied with their HPWH (Figure 22). Around three-quarters of respondents indicated they were very satisfied with their equipment (220 of 301: 73%). New respondents were slightly more likely to be at least somewhat satisfied with their equipment (143 of 161; 89%) compared to repeat respondents (113 of 140; 81%). The minority of respondents who expressed dissatisfaction with their

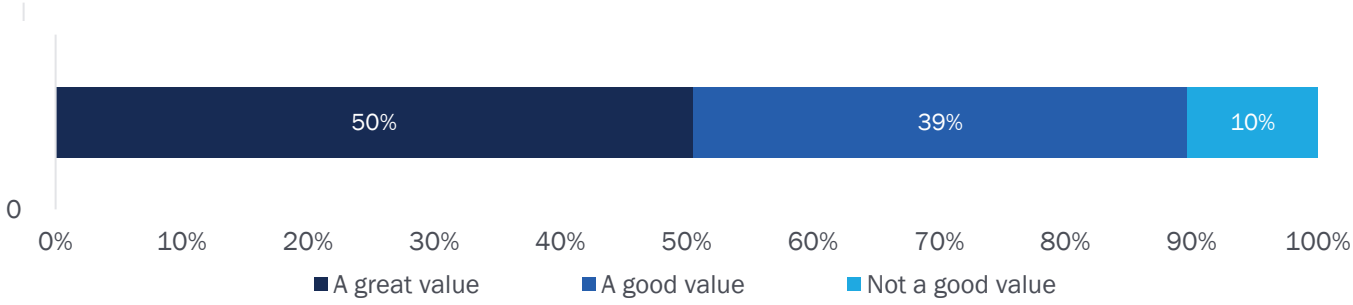
equipment (21 of 301; 7%) explained this is due to the noise from the equipment (8 of 21), difficultly operating the system (6 of 21), the lack of return on investment (6 of 21), the water taking too long to heat up (4 of 21), and the water not being hot enough when they need it (2 of 21). We found no movement in satisfaction scores when comparing repeat respondents' answers between the two survey waves, indicating their satisfaction did not change after living with their equipment an additional year.

Figure 22. Customer Satisfaction with HPWH (n=301)



In addition to being very satisfied overall, customers saw value in their HPWH (Figure 23). A larger proportion of customers rated the purchase as "a great value" (151 of 301; 50%) than "a good value" (117 of 301; 39%). Again, repeat respondents' perceived value of their HPWH did not change between the two survey waves.

Figure 23. Customer Perceived Value of HPWH (n=301)



We asked the 267 customers who rated their HPWH as "a great value" or "a good value" to explain why they provided this rating. They provided answers in an open-ended format, which we thematically coded into the categories shown in Table 8. We then examined the proportions of customers who rated their HPWH as "a great value" or "a good value" across each of the coded categories to better understand what made the difference for customers in rating the value of their equipment as "a great value" or "a good value." These proportions are color coded to highlight the reasons customers shared for their rating, with darker shades indicating a large proportion of customers and lighter shades indicating a smaller proportion of customers. The reason categories in the left column are ordered from the highest to lowest number of customers mentioning them, as well as grouped into two buckets – positive sentiments (denoted by bolded text) and mixed sentiments (denoted by non-bolded text).

Table 8. Reasons Why HPWH is a Good or Great Value (n=267)

Reason	Great Value	Good Value
The rebates made it worthwhile (n=102)	77%	23%
Environmental benefits/not using gas (n=62)	62%	38%
Monthly and long-term cost savings (n=57)	57%	43%
Efficiency of equipment (n=31)	77%	23%
Having solar made it even more worthwhile (n=31)	55%	45%
Performance of equipment (n=16)	44%	56%
Added benefit of a cooler room (n=4)	100%	0%
Good value, but still high upfront costs (n=25)	4%	96%
Good value, but electric bill has stayed the same or gone up (n=5)	0%	100%
Good value, but it takes longer to heat the water/slow recovery rate (n=2)	0%	100%
Other (n=16)	19%	81%

Note: Some responses are coded under multiple categories, thus the sum of values in the 'Number of Respondents' column exceeds the n value. Three respondents who reported "Don't know" have been excluded. Multiple responses allowed.

We elaborate on those reasons below:

- **The incentives made it worthwhile (102 of 267).** These customers expressed great satisfaction with the TECH Clean California incentive; for many, it significantly reduced the cost of the HPWH and made it much more attractive to them. Customers described the purchase of their HPWH as "excellent," "significant," and "affordable." Most of these customers (79 of 102; 77%) were much more likely to rate the purchase of their HPWH as a great value. As one customer wrote in the survey:

> *"With the rebates, it [the HPWH] was an excellent deal! Without rebates, it would have been very expensive, and I probably would have gotten a different type of water heater."*

- **Environmental benefits/not using gas. (62 of 267).** Switching from gas to electricity and the associated benefits to the environment were notable selling points for these customers; more than three-fifths of them rated their HPWH as a great value (40 of 65; 62%).
- **Monthly and long-term cost savings. (57 of 267).** For over one-fourth of all HPWH customers (75 of 267; 28%), the monthly and long-term reduction in their energy bills that they attributed to their HPWH was valuable. Nearly three-fifths of customers who provided this reason said their HPWH was a great value (43 of 75; 57%).

- **Efficiency of equipment (31 of 267).** Most customers who provided the efficiency of their HPWH as a reason for their rating said the investment in their HPWH was a great value (24 of 31; 77%). Some of these customers also mentioned the associated savings on their monthly electricity bills.
- **Having solar made it even more worthwhile (31 of 267).** All the customers who provided this reason had solar installed on their home. Generating their own electricity made the purchase of a high-efficiency electric appliance more worthwhile. More than half of these customers (17 of 31; 55%) rated the value of their HPWH as great. Some of these customers said that without having solar, they were unsure if the HPWH would yield as much benefit from a cost-savings perspective.
- **Performance of equipment (16 of 267).** These customers highlighted the performance of their equipment as the reason for rating the value of their HPWH as great or good. They most often mentioned that their HPWH works well and provides hot water when they need it. More than half rated the value of their investment as good as opposed to great (9 of 16).
- **Added benefit of a cooler room (4 of 267).** These four customers were pleased with the added benefit of a cooled space in the location surrounding their HPWH; all four of them rated the value of their investment as great.
- **High upfront costs (25 of 267).** The high upfront cost of the HPWH was the crucial factor in determining the perceived value of their equipment. Nearly all rated the value of their investment as "good" as opposed to "great" (24 of 25; 96%).
- **Electric bill has stayed the same or gone up (5 of 267).** While these customers felt their HPWH was a good value, the lack of realized cost savings on their electricity bills seems to have prevented them from rating their investment as a great value.
- **Takes longer to heat the water/slow recovery rate (2 of 267).** These two customers reported that their HPWHs take longer than they would like to heat their water and that they take a while to produce additional hot water once the tank is empty. For those reasons, they rated the value of their investment as good instead of great.
- **Other (16 of 267).** Most of the customers in this group rated the value of their HPWH as "a good value" as opposed to "a great value" (13 of 16). The reasons these customers provided were mixed. One customer said they do not use hot water often. A few customers said they have not owned it long enough to give a definitive reason. Two customers, while generally satisfied with the equipment, were experiencing issues related to a buildup of minerals in their water and an unidentified issue likely stemming from the installation of the system.

We also asked the 31 customers who rated their HPWH as "not a good value" to explain why they provided this rating. Table 9 presents reasons given by the surveyed customers. Please keep in mind that these 31 customers represent a minority of the total surveyed HPWH customers (31 of 301; 10%).

Table 9. Reasons Why HPWH is Not a Good Value (n=31)

Reason	Number of Respondents	Percent of Respondents
Higher cost to operate compared to a gas system	11	35%
Lack of return on investment/high upfront cost	11	35%
High cost of electricity	3	10%
Noisy	3	10%
Difficult to service or conduct maintenance on	3	10%
Poor performance	3	10%
Not enough hot water	2	6%
Other	4	13%

Note: Some responses are coded under multiple categories, thus the sum of values in the 'Number of Respondents' column exceeds the n value. Multiple responses allowed.

We elaborate on each reason shared by respondents below:

- **Higher cost to operate compared to a gas system (11 of 31).** These respondents emphasized their frustration with their HPWH's higher cost to operate compared to their previous gas hot water systems. Some even shared a comparison to their current costs to operate their HPWH and their old system, as illustrated below.

> *"My 20-year-old gas heater cost only 5 dollars per month for four people. Now this so-called energy efficient heater consumes at least 150 kwh per month, which can cost 70+ dollars depending on what time you take a shower."*

  Since HPWHs run on electricity, many customers who transitioned from a gas-powered water heater to heat pump equipment have seen an increase in their electric bill. This appliance now running on electricity, paired with rising electric rates in California, may partially explain the unanticipated electric costs that customers do not perceive are offset by a lower gas bill.

- **Lack of return on investment/high upfront cost (11 of 31).**[10] These individuals were not convinced they would ever save money on their monthly bills or see a return on their investment in the long run. Two of these customers also cited the fact that gas is a much cheaper fuel source to heat their water.

- **Poor performance (3 of 31).** These three customers were not pleased with the performance of their HPWHs. They felt that their equipment was not as effective as their previous water heaters and were not built to serve an entire household.

[10] The evaluation team does not have insight into how the respondent is estimating their return on investment; we assume these estimations are subjective.

- **High cost of electricity (3 of 31).** Given the increased cost of electricity in California, these customers felt that their HPWHs efficiency and generated savings would be outweighed by these increased rates. However, one customer mentioned that while this increased cost is disappointing, the HPWH's benefit to the environment is satisfying.
- **Noisy (3 of 31).** These customers complained about loud sounds produced by the heat pump. One customer shared that the noise can be heard in their office and master bedroom, which has been an inconvenience to their daily life. Another customer said it made them think of how quiet their gas heater was.
- **Difficult to service or conduct maintenance on (3 of 31).** These customers were frustrated about how complicated it was for their equipment to be serviced when they needed it. Given heat pumps are a relatively new technology for many companies, it may be more challenging to find service or maintenance compared to a traditional water heater.

> *"[The equipment is] difficult to service. We're on our second device after the first failed, no one in our area could fix it. I spent a lot of my time troubleshooting."*

- **Not enough hot water (2 of 31).** These customers were unhappy with instances of insufficient hot water to cover household needs or slow recovery rate of their HPWH.
- **Other (4 of 31).** These customers had different reasons for their dissatisfaction, including the complexity of the equipment, the complexity of its operation, the inconvenient location where the HPWH was installed, and poor communication with the equipment manufacturer when contacting them with questions after reading the HPWH manual.

Customers were likely to recommend a HPWH to others. More than half indicated they were extremely likely to recommend it (157 of 301; 52%). Respondents rated how likely they were to recommend a HPWH to their family and friends using a zero to 10 scale (zero was "not at all likely" and 10 was "extremely likely"). The average rating score across respondents was an 8.3. Most customers who were extremely likely to recommend a HPWH also indicated they had solar installed in their home (90 of 109; 83%).

Table 10 is organized into three columns based on likelihood to recommend; each of these columns was created by grouping together ratings, where "unlikely" includes customer ratings of one through six, "highly likely" includes customer ratings of seven through nine, and "extremely likely" is customer ratings of 10. The table also includes reasons customers provided in open-ended responses to explain why they gave the rating they did. The reasons in bold font correlate with higher likelihood to recommend a HPWH, while the reasons in normal font are why customers would be unlikely to recommend the equipment. For example, most customers who said the equipment was environmentally friendly and reliable were likely to recommend it, while those who said it was noisy and had a high upfront cost were unlikely to recommend it. The shading in the cells correlates with frequency; the darker cells represent greater proportions of TECH Clean California customers.

Table 10. Likelihood to Recommend HPWH by Reason (n=295)

Reason for Rating	0-6 Unlikely (n=48)	7-9 Highly Likely (n=91)	10 Extremely Likely (n=156)
All electric/environmental impact	3	16	58
Efficiency of equipment	0	15	50
Monthly cost savings	2	13	34
Effectiveness of the equipment	0	12	30
Incentives reduce upfront price	1	11	22
Equipment reliability	1	4	17
Easy to use	0	2	3
Perceived value	0	3	3
Noisy	16	10	1
High upfront cost	3	4	0
High electricity rates	7	3	0
Hot water limitations	8	1	0
High operating cost	2	1	0
Other	13	18	6

Note: Table excludes four respondents who selected "Don't know" when asked to rate their likelihood to recommend. Multiple reasons for rating allowed.

We summarize the reasons TECH Clean California customers gave for their likelihood-to-recommend rating below. Their answers were provided in an open-ended format, which we categorized. Sometimes respondents gave more than one reason for their rating.

- **All-electric/environment impact.** Most customers who either shared a desire to decarbonize their home's energy usage, wanted to make a positive impact on the environment, or wanted to mitigate climate change by switching their home appliances from gas to electric were highly or extremely likely to recommend a HPWH. Only three of these customers were unlikely to recommend the equipment.
- **Efficiency of equipment.** All customers were highly or extremely likely to recommend a HPWH given the efficiency of the equipment.
- **Monthly cost savings.** All but two customers who highlighted the cost effectiveness of their HPWHs were highly or extremely likely to recommend a HPWH. Respondents discussed how HPWHs use notably less energy, cost less to operate, and/or provide good value, even when considering the higher upfront cost compared to other HPWH equipment options.
- **Effectiveness of the equipment.** These 42 respondents were extremely pleased with the performance of their HPWH. Many described it as "great," "works well," and "reliable." All of them were highly or extremely likely to recommend a HPWH to others.
- **Incentives reduce upfront price.** All but one of these 34 customers were highly or extremely likely to recommend a HPWH to others due to incentives available for the equipment that significantly offset the high upfront price.

- **Equipment reliability.** Customers were pleased with the reliable operation of the HPWH; all but one were highly or extremely likely to recommend the equipment to others. One customer highlighted the fact that they never need to think about it and that hot water is always available. Another was pleased with how well the system was able to meet the needs of their entire family.
- **Easy to use.** All customers who described their HPWHs as easy to use were highly or extremely likely to recommend a HPWH to others. One customer was especially pleased with the ability to control the HPWH and its settings from a phone app.
- **Perceived value.** All six customers who highlighted the overall value of their HPWH were very likely to recommend it to others. These customers were especially happy with their purchase and the performance of their equipment.
- **Noisy.** More than half of customers who reported disruptions due to excessive noise produced by their HPWH were unlikely to recommend a HPWH to others (16 of 27). However, some customers, while bothered by the noise, were still pleased with the equipment and would recommend it to others.
- **High upfront cost.** Respondents found the higher initial cost of the HPWH equipment compared to that of a more typical gas-powered water heater unattractive. Although this factor made three respondents unlikely to recommend the equipment, others acknowledged this higher cost but said they would still recommend it. Therefore, for some, the performance and benefits of a heat pump outweigh this initial cost burden.
- **High electricity rates.** Most customers who cited the increased cost of electricity were unlikely to recommend a HPWH to others (7 of 10). However, despite high electricity costs, three customers were likely to recommend a HPWH, indicating that for some, the cost of electricity is not a significant enough barrier to dissuade them from recommending a HPWH.
- **Hot water limitations.** All but one customer who reported not having enough hot water or the water not heating up fast enough were unlikely to recommend a HPWH to others (8 of 9). One customer said that while their HPWH might be sufficient for two household occupants, it does not produce enough hot water for their entire household when they need it.
- **High operating cost.** Two customers who did not realize any monthly savings on their electricity bills were unlikely to recommend a HPWH to others.
- **Other.** These responses were mixed in terms of negative and positive reactions to HPWHs, as well as customers' likelihood to recommend the equipment to others. Some respondents said the equipment was worth the cost, was "the only way to go," was a good solution for their home, it was the right time to replace their old system, or they did not think about it other than the equipment is new and works. Others were unconvinced of its efficiency, felt it was overly complex for what should be a simple system, did not think it was a good match for most homes with medium to large-sized families, or would pose concerns if a power outage occurred given its total reliance on electricity.

3.3 HVAC HEAT PUMPS

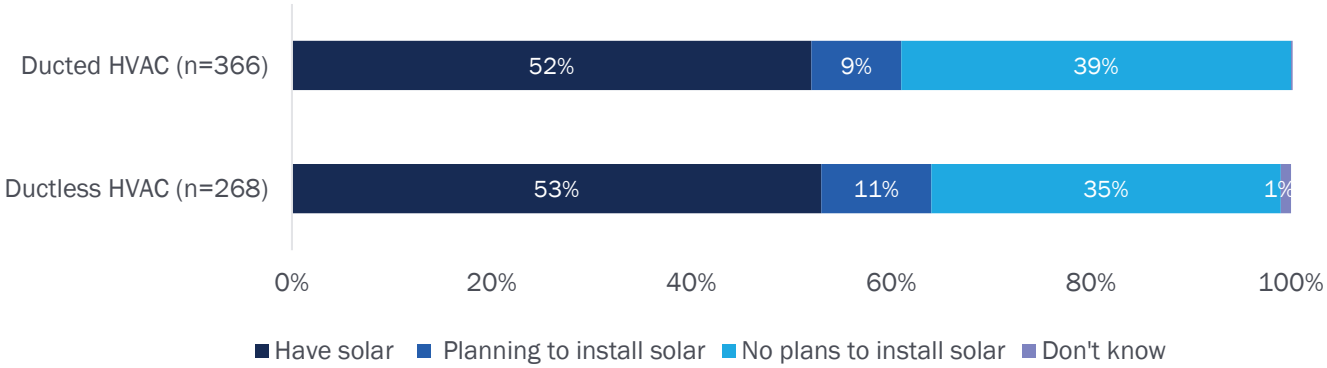
The following sections provide findings about the TECH CLEAN CALIFORNIA customers' experience with their new HVAC heat pump. We report statistically significant differences between repeat and new respondents, as well as between survey waves for repeat respondents, where applicable.

3.3.1 HOME FEATURES

HVAC heat pump respondents were almost all homeowners (629 of 634; 99%). The remaining five respondents rented the home where the TECH Clean California-incented HPWH was installed. Almost all surveyed HVAC heat pump customers had the equipment installed in their primary residence (598 of 634; 94%). Of those who had their equipment installed in their secondary residence or vacation home, more than half reported spending at least one-third of the year in this home (15 of 26; 58%). Among these respondents, half of them visited their secondary residence an evenly distributed amount of time throughout the year (13 of 26; 50%), while another sizeable proportion reported visiting their home primarily in the winter (12 of 26; 46%).

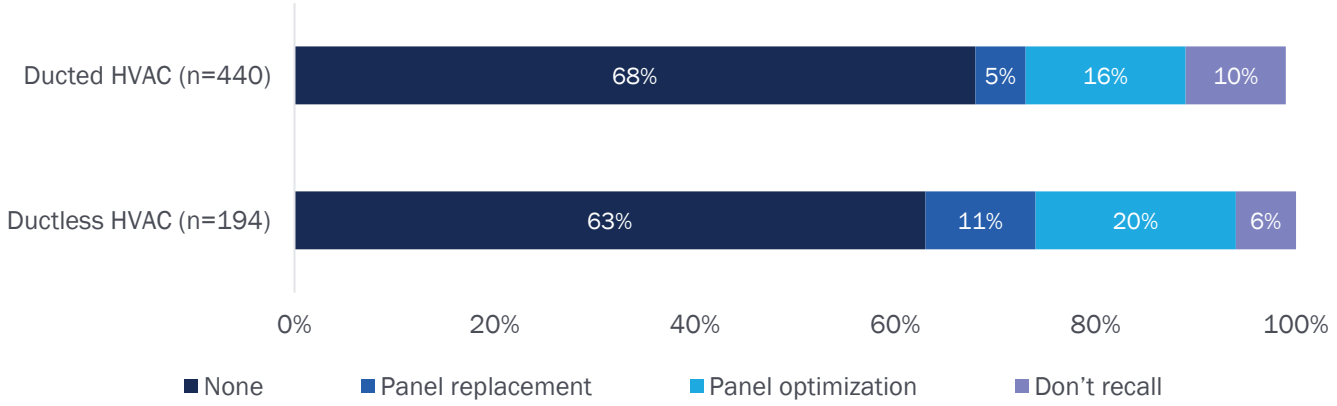
More than half of HVAC customers (395 of 634; 62%), whether they purchased a ducted or ductless system, had a solar PV system that generates electricity for their home or were planning to install a solar PV system (Figure 24).

Figure 24. Whether Customers Have or Are Planning to Install Solar (n=634)



Most customers did not need to upgrade their electrical panel to accommodate the installation of their new HVAC equipment; this was true for customers with ducted (299 of 440; 68%) or ductless systems (122 of 194; 63%), as shown in Figure 25. However, customers who installed ductless systems (21 of 194; 11%) were more likely to need a panel replacement than customers who installed ducted systems (22 of 440; 5%). Customers who installed ductless systems (39 of 194; 20%) were also more likely to require panel optimization than customers with ducted systems (70 of 440; 16%). Panel optimization refers to electrical panel modifications that can include load-sharing to free up a panel slot or adding a sub-panel.

Figure 25. Whether Customers Needed to Upgrade Their Electrical Panel (n=634)



While most customers did not need to upgrade their electrical panel to accommodate the HVAC heat pump, there were notable differences between customers who previously had central air conditioning (CAC) and customers who did not have CAC (Table 11). Customers who did not previously have CAC in their home were more likely to require a panel upgrade (83 of 245; 34%) than customers who previously had CAC (70 of 389; 18%).

Table 11. Whether Customers Needed to Upgrade Their Electrical Panel by Prior CAC Ownership (n=634)

CAC ownership before heat pump	Required a Panel Upgrade	Did Not Require a Panel Upgrade
Prior CAC (n=389)	18%	82%
No Prior CAC (n=245)	34%	66%

3.3.2 DESCRIPTION OF EQUIPMENT

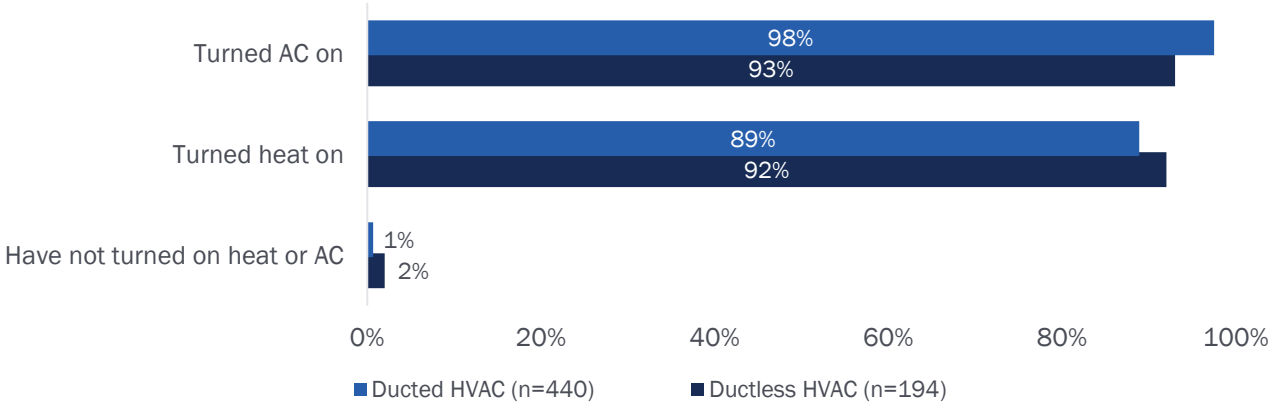
We asked TECH Clean California customers who had an HVAC heat pump installed in their home to list the first three words that came to mind when thinking about their equipment. Customers called out several positive features about their new HVAC heat pump, including that it was reliable, efficient, comfortable, economical, and quiet. The most frequently reported negative aspects were that the heat pump was expensive and noisy. HVAC heat pump customers wrote the word quiet 206 times, while the word noisy appeared only 23 times, suggesting it is more common for customers to find the equipment quiet.

Figure 26. Customers' Top Three Words to Describe Their HVAC Heat Pump (n=634)

3.3.3 EQUIPMENT USE IN HOME

Nearly all respondents had used their new heat pump system to heat (570 of 634; 90%) or cool (626 of 634; 99%) their home (Figure 27). More respondents had experience using the heat pump to cool their homes than to heat their homes. Only 1% of surveyed HVAC customers (7 of 634) had not yet used their heat pump; by equipment type, this accounted for 2% of ducted systems and 1% of ductless systems. Of the seven customers who had not yet used their heat pump, only one customer reported having another system that provides heat in their home and all seven used another cooling source.

Figure 27. Actions Taken by Customer Since Installed HVAC Heat Pump

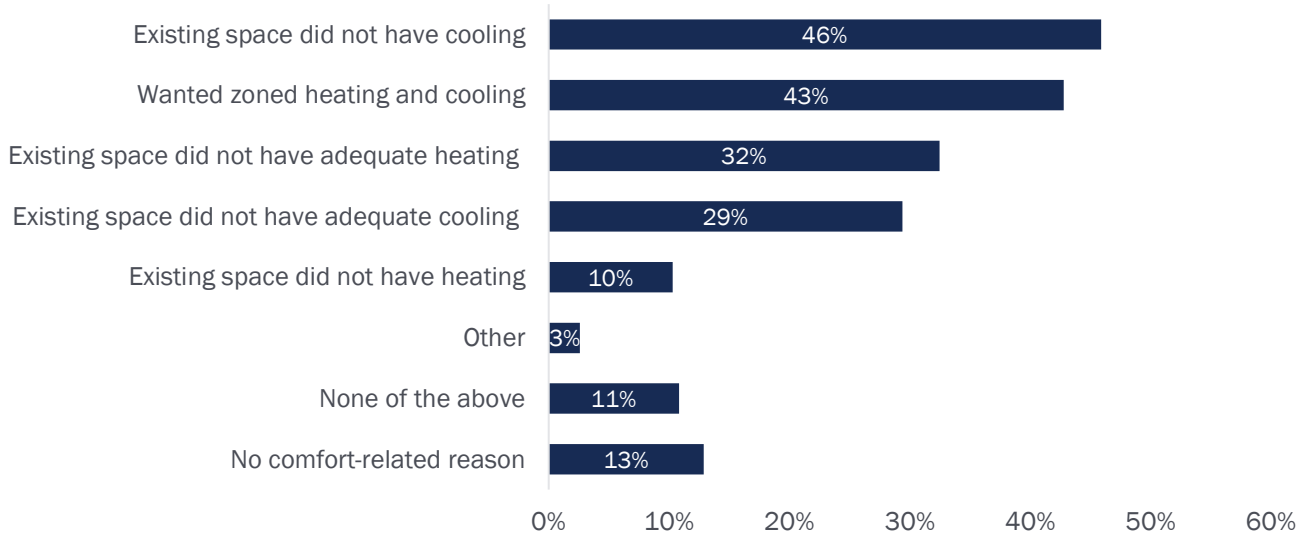


Note: Response option "Have not turned on heat or AC" is exclusive. Multiple responses allowed.

MOTIVATIONS FOR INSTALLING AND SPACES SERVED (DUCTLESS SYSTEMS ONLY)

We asked respondents who installed a ductless HVAC heat pump what comfort-related reasons motivated them to choose a ductless system (Figure 28). The most common reason was to add cooling to a space that did not previously have cooling (89 of 194; 46%), although a sizable proportion of respondents mentioned choosing the system due to the unique "zoned" temperature control capabilities (83 of 194; 43%) and the fact that the existing space did not have adequate heating (62 of 194; 32%). Twenty-five respondents provided additional non-comfort-related motivations for installing a ductless heat pump, including the equipment being a well-suited replacement for their previous equipment (13 of 25), the eco-friendliness of the heat pump (8 of 25), and that it was the most cost-effective option (4 of 25).

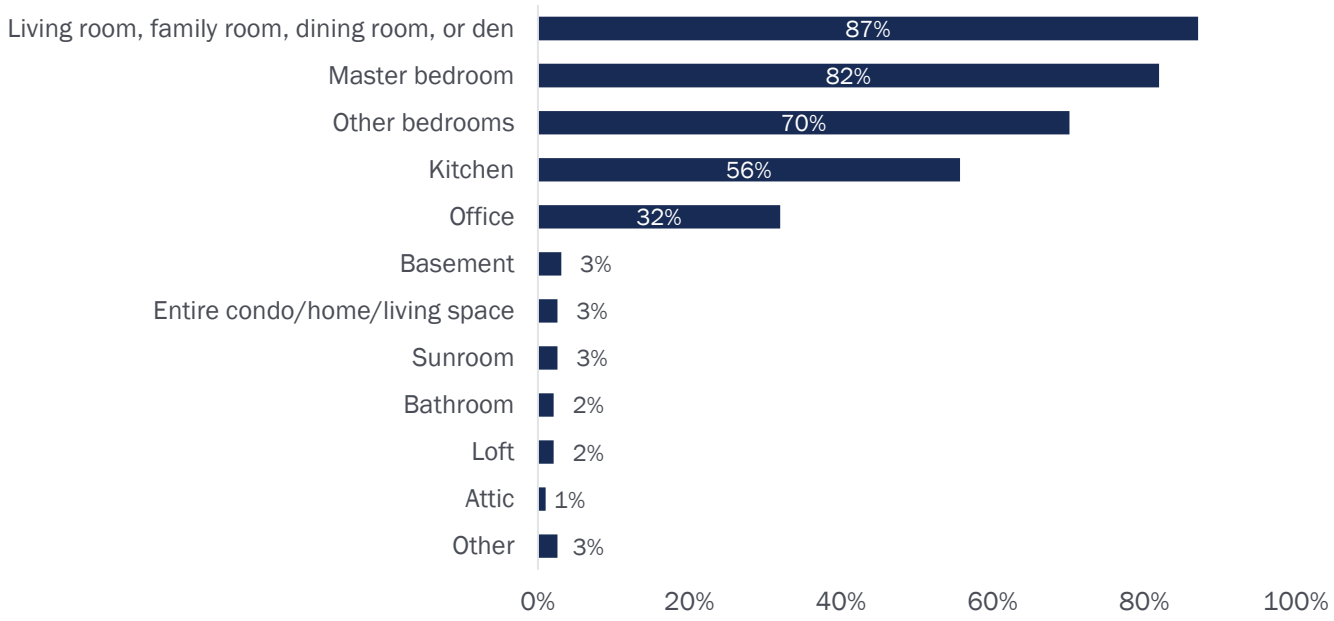
Figure 28. Comfort-Related Reasons That Motivated Customers to Select Ductless Heat Pump (n=194)



Note: Response option "No comfort-related reason" is exclusive. Multiple responses allowed.

When asked about the spaces served in their home by their ductless HVAC heat pump, respondents most commonly reported larger living areas such as the living room, family room, dining room, or den (169 of 194; 87%), as well as the master bedroom (159 of 194; 82%) or other bedrooms (136 of 194; 70%).

Figure 29. Spaces Ductless Heat Pump Served in Home (n=194)

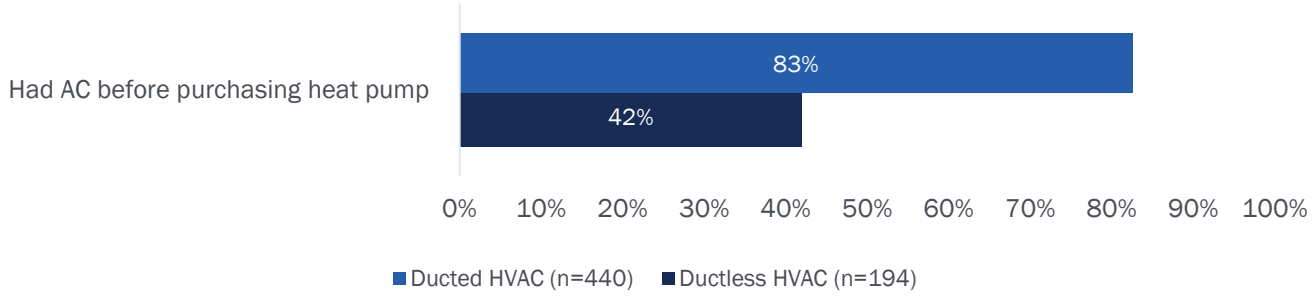


Note: Multiple responses allowed.

COOLING

Ducted heat pumps can often use the home's existing ductwork if it is in good condition, while ductless heat pumps are a good option for those with limited or poor ductwork. TECH Clean California customers who purchased a ducted HVAC heat pump (365 of 440; 83%) were twice as likely to have had air conditioning previously than those who purchased a ductless system (82 of 194; 42%), as shown in Figure 30.

Figure 30. Customers Who Had AC Before Installing HVAC Heat Pump



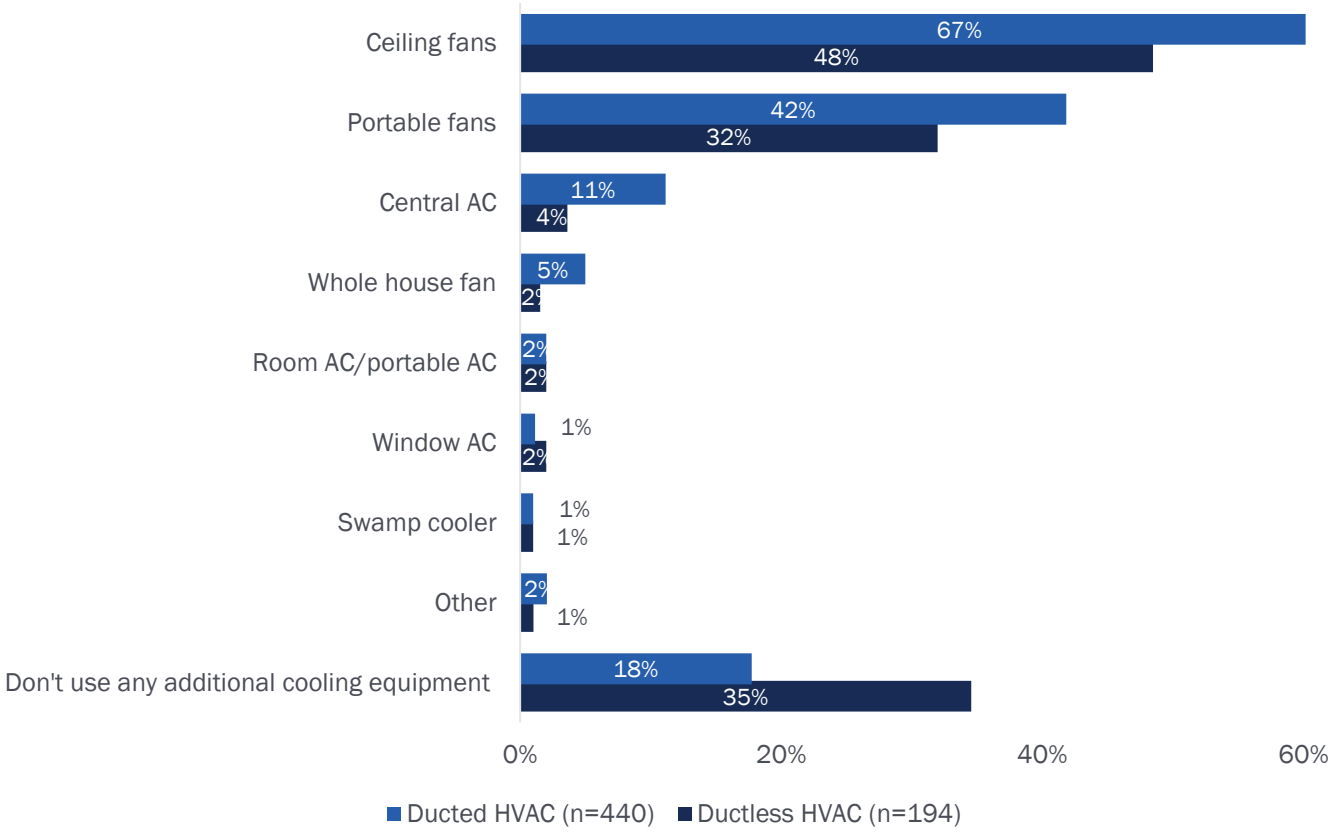
TECH Clean California customers who installed a ductless HVAC system (35 of 194; 18%) were more likely to have previously had a window or portable air conditioner than customers who installed a ducted HVAC system (22 of 440; 5%), whereas customers who installed a ducted system (343 of 440; 78%) were much more likely to have previously had central air conditioning than customers who installed a ductless system (47 of 194; 24%). Table 12 shows these breakdowns.

Table 12. Presence of AC In Home Before HVAC Heat Pump Installation by AC Type

Presence of AC In Home Before Installation	Ducted HVAC (n=440)	Ductless HVAC (n=194)
Yes, I had central air conditioning	78%	24%
Yes, I had a window or portable air conditioner	5%	18%
No, I did not previously have air conditioning	18%	58%

Newly installed HVAC heat pumps served as the primary air conditioner in nearly all customers' homes, both for ducted (422 of 440; 96%) and ductless (187 of 194; 96%) systems. Nevertheless, most respondents across both equipment types reported using at least one other type of cooling equipment regularly in their home; commonly ceiling fans and portable fans (Figure 31). Further, customers with ducted heat pumps were more likely to use supplemental cooling equipment than customers with ductless systems.

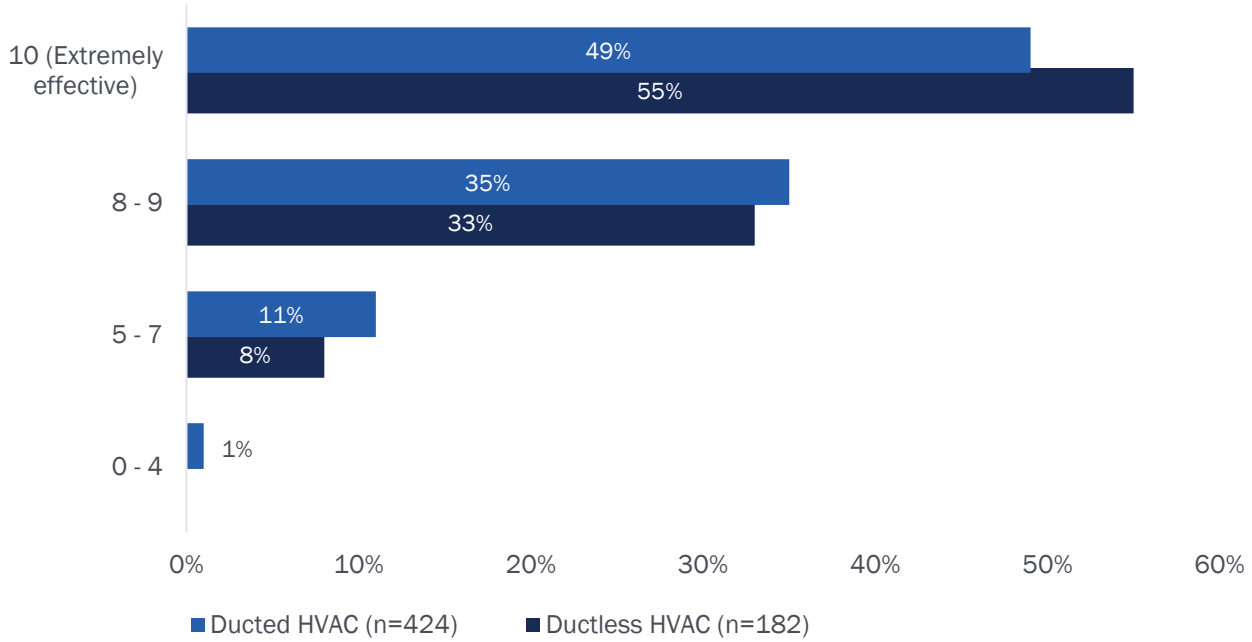
Figure 31. Other Cooling Equipment Regularly Used in Home



Note: Response option "Don't use any additional cooling equipment" is exclusive. Multiple responses allowed.

Both ducted and ductless HVAC heat pumps have been effective when cooling customers' homes (Figure 32). We asked customers who had used their HVAC heat pump for cooling to rate the cooling effectiveness of their heat pump using a scale from zero (not at all effective) to 10 (extremely effective). Customers indicated their system had been highly effective, with more than four-fifths of customers providing a rating of eight or higher for ducted (356 of 424; 84%) and ductless systems (160 of 182; 88%). Customers with ductless systems (100 of 182; 55%) were more likely to say their heat pump was "extremely effective" at cooling than those with ducted systems (208 of 424; 49%), whereas customers across both equipment types were almost equally likely to indicate their equipment was "effective" (rating of eight or nine) at cooling.

Figure 32: Customer Rating for HVAC Heat Pump Cooling Effectiveness

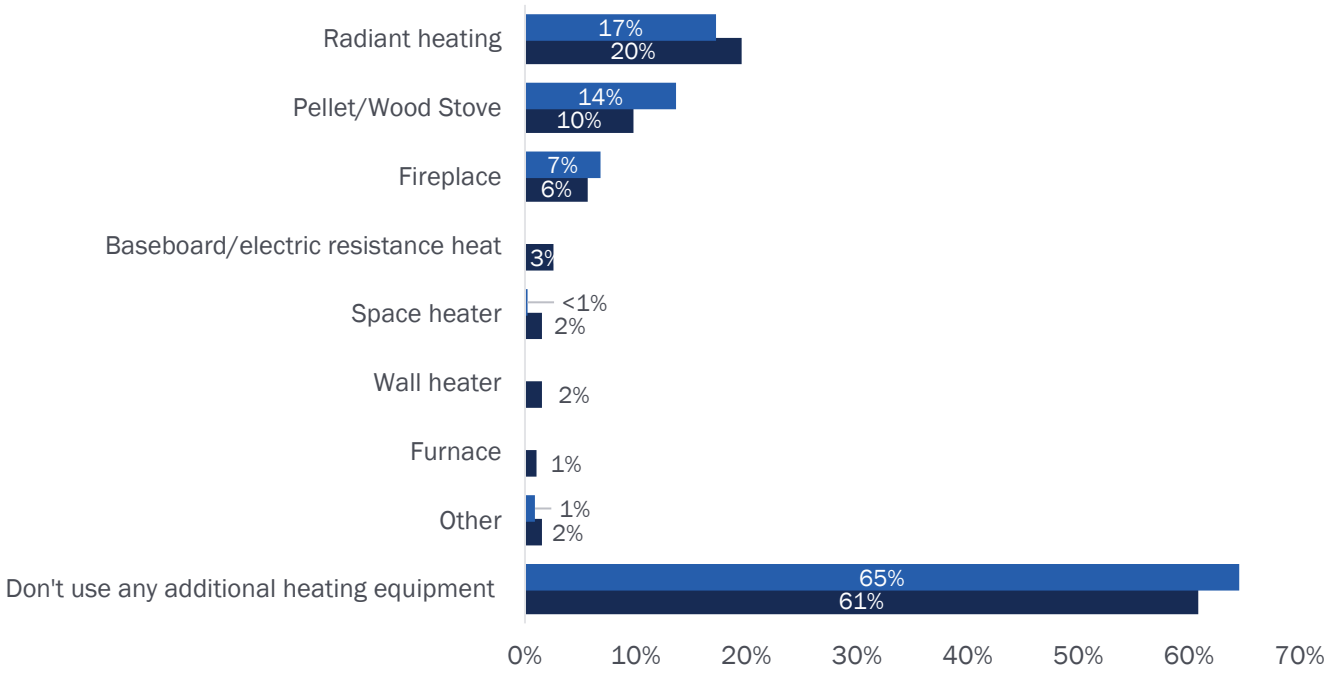


Note: Excludes 28 respondents who either have not used heat pump for cooling or who were unsure of how effective their heat pump cools.

HEATING

Most customers who installed a ducted (418 of 440; 95%) or ductless (178 of 194; 92%) heat pump reported using their new equipment as their primary heating system. Unlike for cooling, most customers reported *not* using supplemental heating equipment regularly in their home; this was true across customers who installed either ducted (286 of 440; 65%) or ductless (118 of 194; 61%) HVAC systems. Of those who regularly use other equipment for heating, they most commonly use radiant heating, a pellet or wood stove, or fireplace (see Figure 33).

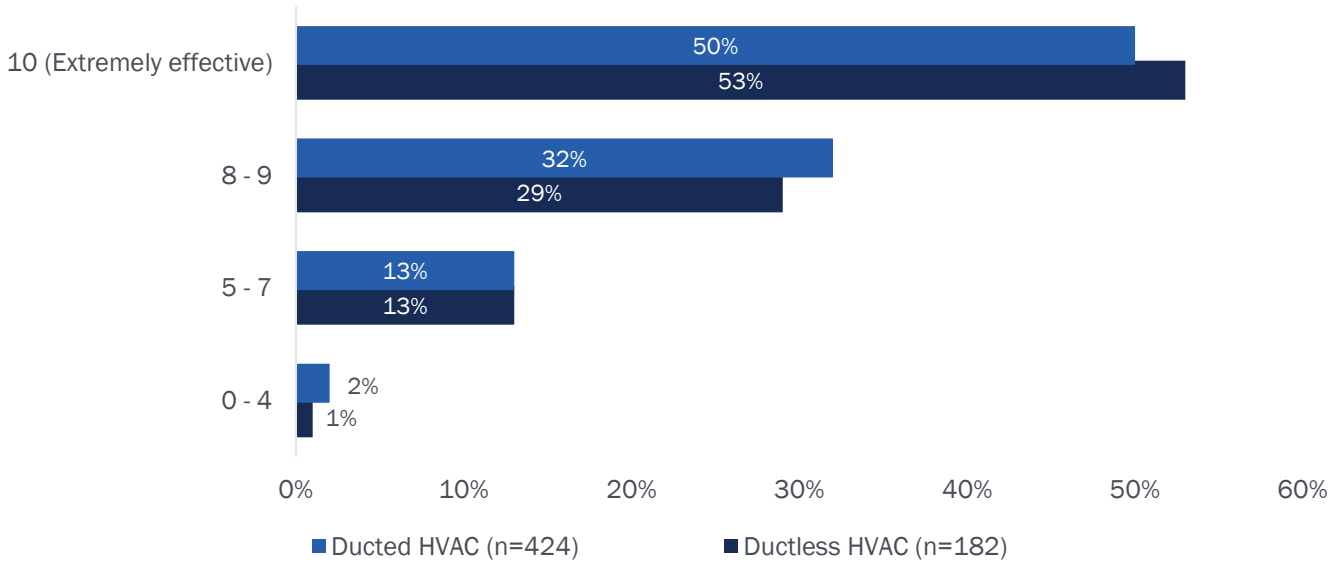
Figure 33. Other Heating Equipment Regularly Used in Home



Note: Response option "Don't use any additional heating equipment" is exclusive. Multiple responses allowed.

Customers reported that both ducted and ductless heat pumps have been effective when heating their homes (Figure 34). We asked customers who had used their HVAC heat pump for heating to rate the heating effectiveness of their heat pump using a scale from zero (not at all effective) to 10 (extremely effective). The majority of customers provided a rating of eight or higher for ducted (348 of 424; 82%) and ductless (149 of 182; 82%) systems. Customers with ductless systems (96 of 182; 53%) were slightly more likely to say their heat pump was "extremely effective" at heating than those with ducted systems (212 of 424; 50%). Customers who gave lower ratings felt that the heat pump did not heat their house as well compared to their old system, both from a comfort and speed perspective (e.g., time it takes to adequately heat the home).

Figure 34. Customer Rating for Heat Pump Heating Effectiveness

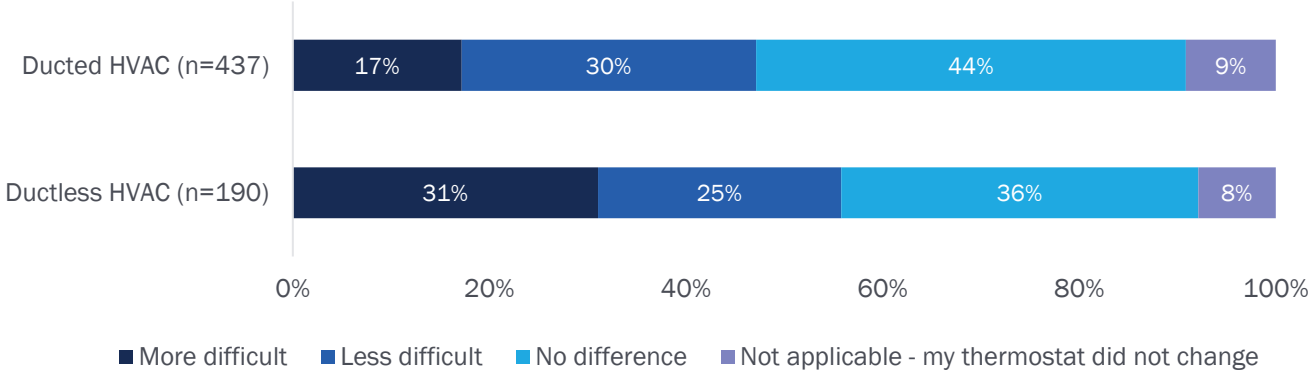


Note: Excludes 28 respondents who either have not used heat pump for cooling or who were unsure of how effective their heat pump cools.

THERMOSTATS

It is common for customers to get a new thermostat when purchasing an HVAC heat pump. Overall, 91% of surveyed TECH Clean California customers who purchased an HVAC heat pump received a new thermostat to control their equipment (577 of 634). Most customers have found their new thermostat to be similar or easier to operate than their old thermostat (Figure 35). However, around one-third of customers with ductless HVAC heat pumps reported difficulty with their new thermostat (59 of 190; 31%). Ductless systems often use a remote control to adjust the temperature settings, which can be a big departure from a wall-mounted thermostat. Of the 59 customers with ductless systems who reported having a more difficult time operating their new thermostat, most of them previously had a wall-mounted thermostat such as a manual thermostat, programmable thermostat, smart thermostat, or dial (47 of 59; 88%).

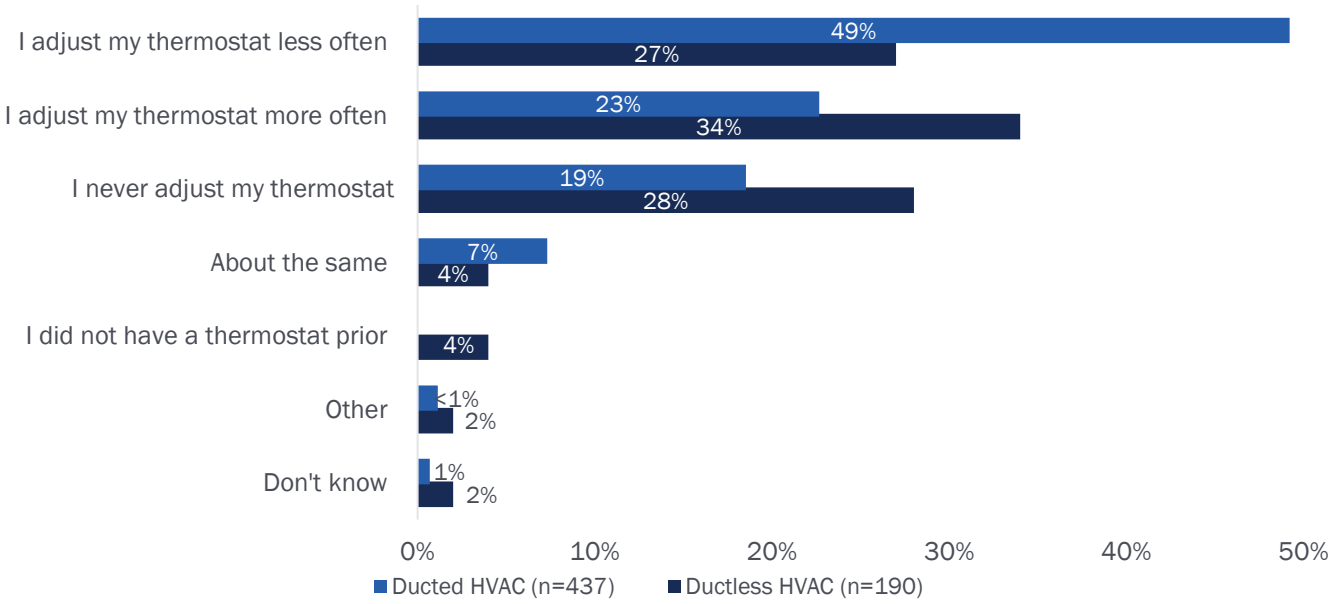
Figure 35: Level of Difficulty Operating New Thermostat Compared to Old System



Most customers who installed a ducted heat pump adjust their new thermostat less often or about the same amount compared to their old one (249 of 437; 57%). The fact that more than half of ducted customers are adjusting their thermostat less often aligns with the recommended operation for heat pumps, because heat pumps operate most efficiently when holding a steady temperature. Adjusting the temperature for short periods of time, like while asleep or away, will use more energy than leaving it on because it must work harder to come back to the desired temperature. However, the plurality of customers who installed a ductless heat pump adjust their new thermostat more often (65 of 190; 34%).

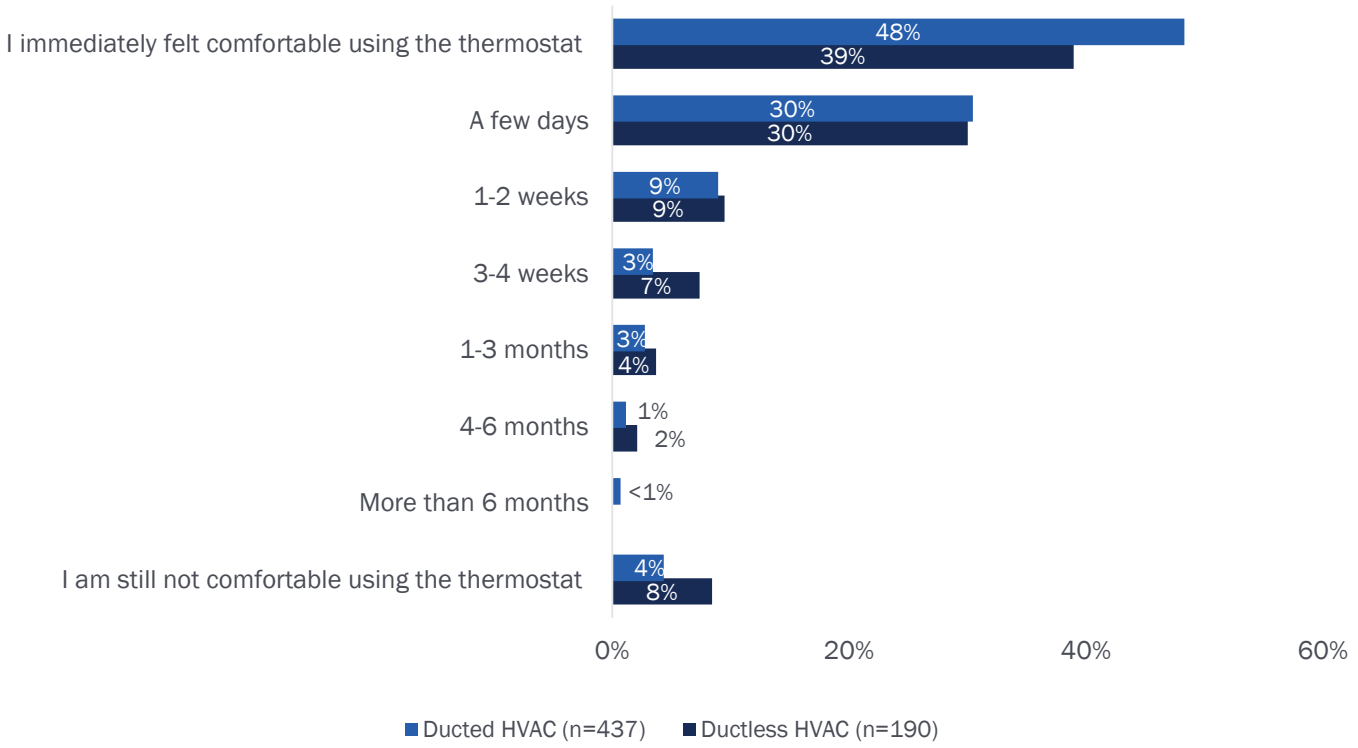
Repeat respondents with ductless systems (n=57) were significantly more likely than new respondents with ductless systems (n=133) to adjust their thermostat the same amount as they did with their prior HVAC equipment (9% vs. 2%).

Figure 36. How Often Customers Adjust Their Thermostat Compared to Old System



Two-thirds of customers who installed a ducted or ductless system felt comfortable using their new thermostat within a few days or less (472 of 627; 75%) in Figure 37. However, customers who installed ductless systems (40 of 190; 21%) more frequently took longer than three weeks to feel comfortable using their thermostat compared to customers who installed ducted systems (48 of 437; 11%). Additionally, customers with ductless systems (15 of 190; 8%) still did not feel comfortable using their thermostat, more often than customers with ducted systems (18 of 437; 4%). Repeat respondents who still did not feel comfortable using their thermostat after having their HVAC heat pump for two years were 6 of the 15 ducted and 4 of the 18 ductless customers.

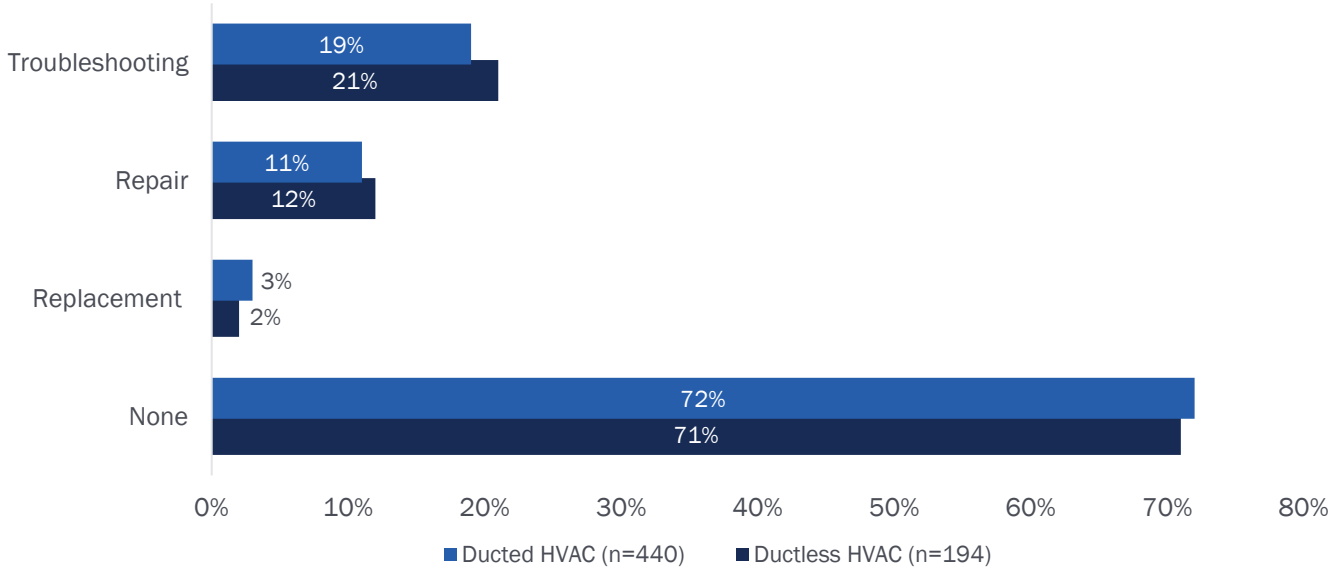
Figure 37. How Long It Took Customers to Feel Comfortable with New Thermostat



3.3.4 ISSUES WITH EQUIPMENT

Most customers had not experienced any issues with their HVAC heat pump since it was installed across both equipment types, though 28% did (178 of 634; Figure 38). For those who experienced an issue, a contractor addressed the issue for a majority of those with a ducted (98 of 122; 80%) or ductless (40 of 56; 71%) system. Issues with the HVAC equipment were severe enough to require replacing the entire unit for four customers who installed a ducted system; the three customers who reported needing replacement for their ductless systems only needed to replace parts.

Figure 38. Work Required on HVAC Equipment



Note: Response option "None" is exclusive. Multiple responses allowed.

TECH Clean California customers who mentioned needing to repair, replace, or troubleshoot an issue were asked to describe the issue they had. Respondents provided their answers in an open-ended format, which we thematically coded into the categories below. The most common issues respondents described related to their thermostat, general performance of the system, or equipment needing a part repaired or replaced, as shown in Table 13.

Table 13. HVAC Heat Pump Equipment Issues (n=163)

Issue	Number of Respondents	Percent of Respondents
Thermostat issue	21	13%
Performance issue	19	12%
Equipment part repaired or replaced	18	11%
Electrical issue	16	10%
Installation issue	15	9%
Noise	15	9%
Refrigerant issue	10	6%
Leak from system	8	6%
Insufficient heating/cooling	7	4%
Difficulties with app or Wi-Fi	6	4%
Whole unit replaced	5	3%
Filter Issues	4	2%
Condensation	4	2%

Issue	Number of Respondents	Percent of Respondents
Vibration	2	1%
Other	21	13%
None/Don't Recall	5	3%

Note: Some responses are coded under multiple categories, thus the sum of values in the 'Number of Respondents' column exceeds the n value. Multiple responses allowed.

We elaborate on each issue reported by respondents below:

- **Thermostat issue (21 of 163).** These customers reported issues with the overall temperature control system, such as temperatures in their homes differing from the set temperature or temperatures not following the programmed schedule. In some cases, respondents said their issue required replacement of the thermostat initially installed. Some customers mentioned the complexity of the thermostat and its controls in general.
- **Performance issue (19 of 163).** These were cases where no other obvious issues existed, but the system still failed to operate as expected. This included heat coming on very slowly, the system frequently blowing cool air when in heat mode, the system not starting when the system was turned on, no cool air coming out at all when in cool mode, and issues with the defrost cycle. Of the six customers who reported cool air blowing out when the system is in heat mode, three of them had their system troubleshooted, and then repaired.
- **Equipment part repaired or replaced (18 of 163).** To resolve an equipment issue, these customers had a follow-up visit from a contractor where a specific part of the equipment was repaired or replaced. A few examples of these parts included a moisture sensor, condensation catch basin, refrigerant coil, motor, thermostat, and reversing valve.
- **Electrical issue (16 of 163).** These respondents reported issues with the electrical setup of the equipment such as improper wiring, a faulty inverter board, circuit breaker malfunctions, and/or electrical surges when running the heat pump. Some of these customers reported these issues during installation, which we also coded as an "installation issue."
- **Installation issue (15 of 163).** Some examples of issues during installation included incorrect wiring, incorrect setting of the air handler, and errors with ductwork.
- **Noise (15 of 163).** These customers reported noisy equipment. Issues were most typically identified as noise produced by the compressor or fan, along with others that simply referred to a squeak, buzz, or hum when equipment was operating.
- **Refrigerant issue (10 of 163).** These customers reported a refrigerant or coolant leak, or a shortage of refrigerant in the system that needed to be corrected for the system to operate correctly.
- **Leak from system (10 of 163).** These responses refer to water leaking from the equipment that was not condensate.

- **Insufficient heating/cooling (7 of 163).** For these seven customers, their HVAC heat pump is not heating and/or cooling their homes sufficiently to reach the temperature setpoint. Six of these customers had ducted heat pumps and two were repeat respondents.
- **Difficulties with app or Wi-Fi (6 of 163).** Across various manufacturers, respondents had difficulty connecting their equipment to Wi-Fi and controlling their heat pump using the corresponding online app.
- **Whole unit replaced (4 of 163).** These responses include cases where a full unit replacement was necessary to fix the issue(s).
- **Filter issues (4 of 163).** These respondents mentioned complications around their equipment's filters, either being clogged or dirty.
- **Condensation (4 of 163).** These were issues related to condensate, specifically a faulty condensate pump, a faulty condensate drain, or condensate overflowing due to a blocked pipe.
- **Vibration (2 of 163).** Two customers mentioned disruption caused by excessive vibration produced by their equipment.
- **Other (21 of 163).** These responses included uneven air flow from vents, unspecified adjustments or repairs on equipment, loose areas of insulation around ductwork, dirt caught in the "condensation trap," anchors that were not up to code, incorrect fuse installation, a damaged circulating fan, a moldy or mildewy smell coming from the vents during cool mode, or a faulty air handler.

Of the 163 respondents who mentioned needing to troubleshoot, repair, or replace their HVAC equipment, 25 of them were repeat respondents who previously reported needing work done on their HVAC systems. A little more than half (13 of 25; 52%) needed service to address the same persisting equipment issues they reported when they first took this survey over a year ago. These issues included a condensate leak, a defective compressor, inability to cool or heat to the temperature setpoint, poor air flow, a damaged fan, and electrical issues. The work required previously to fix the issues was primarily troubleshooting (8 of 13), but also involved repairs for six of them and replacement for two of them. The remaining 12 participants needed service to address a new issue, seven of whom required troubleshooting, six required repair, and one required replacement. The new issues included condensate leaks from the system, faulty thermostats, a faulty water sensor,[11] electrical malfunctions associated with the circuit breaker and power supply cord, and loud noise.

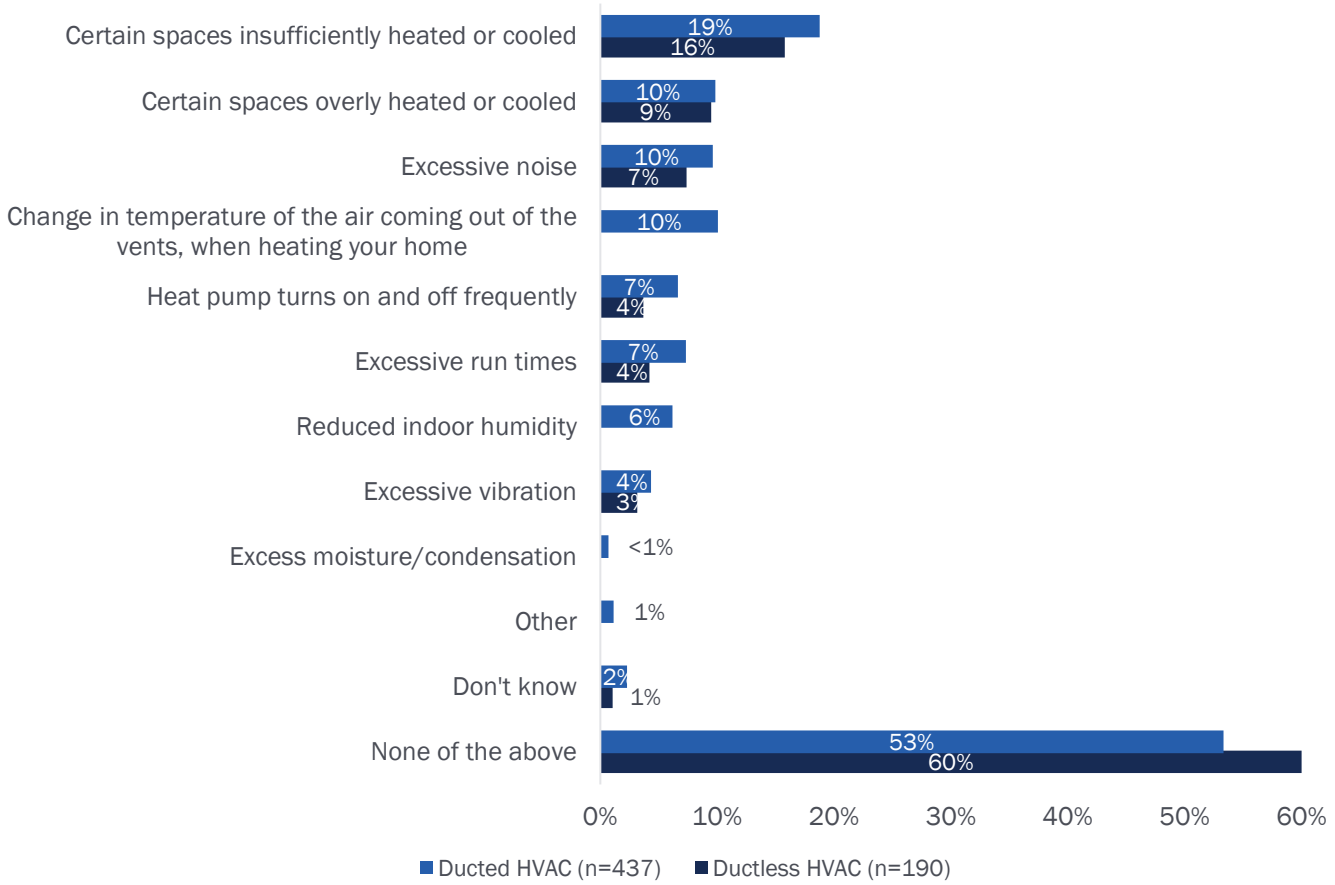
In addition to the issues above, we also asked respondents who installed an HVAC heat pump if they had experienced specific issues that are typical complaints about the equipment (Figure 39). More than half of respondents had not experienced any of these common issues. Issues reported were similar across both system types. The most common issue for both ducted and ductless systems was insufficient heating or cooling in certain spaces of the home yet was experienced by a minority of surveyed customers.

We found that repeat respondents with a ductless mini split system (n=57) were significantly more likely than new respondents with a ductless mini split system (n=133) to experience excessive noise (16% vs. 4%).

[11] While water sensors are not present in HVAC heat pump systems, this customer mentioned an issue with a "faulty water sensor."

New respondents, however, were significantly more likely than repeat respondents to experience reduced indoor humidity associated with their mini split system (10% vs. 4%).

Figure 39. HVAC Heat Pump Equipment Issues



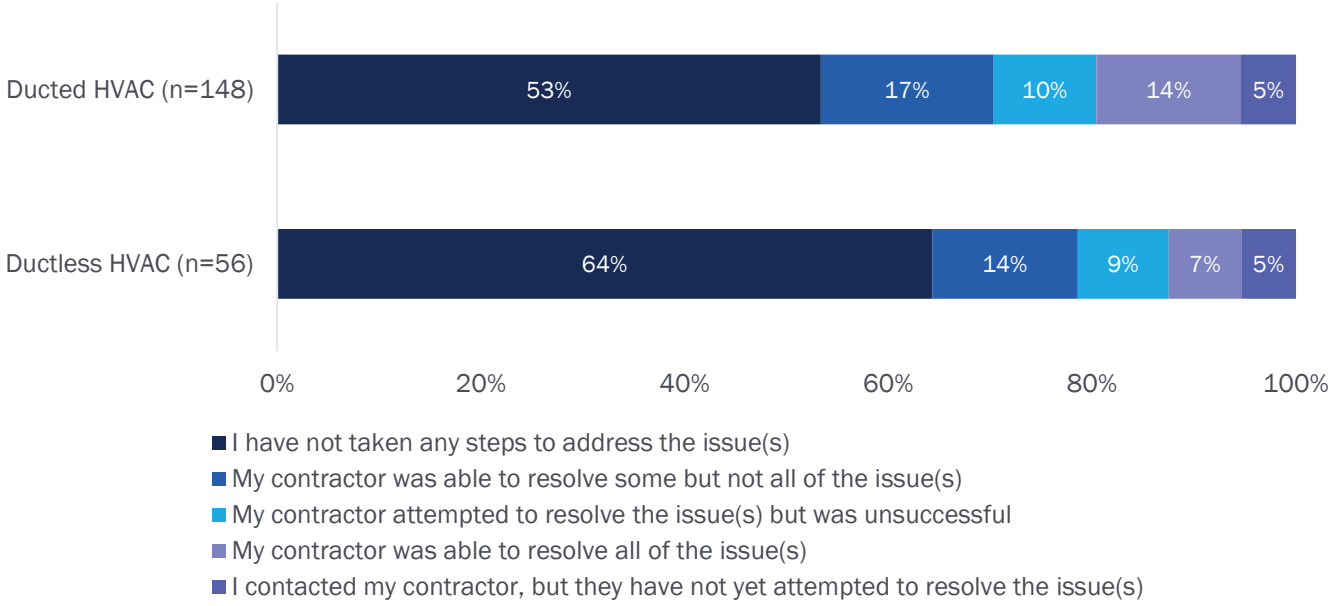
Note: The equipment issue "Change in temperature of air coming out of vents when heating home" was only asked of customers who installed a ducted heat pump. Response options "Don't know" and "None of the above" are exclusive. Multiple responses allowed.

We asked customers who had experienced one or more of these issues a follow-up question to gauge how bothersome they found each to be in their home (Figure 40). Customers who had a ducted system installed in their home were also asked whether the change in air temperature that comes out of the vents when heating was an issue for them; nearly half of them were bothered by the change (21 of 44; 48%). Respondents were most bothered by certain spaces being insufficiently heated or cooled and excessive noise. Three-quarters of customers who noticed excessive run-times were bothered by them (28 of 37; 76%). Customers were least bothered by reduced indoor humidity.

Figure 40. Extent HVAC Heat Pump Issues Bother Customer

Few customers had taken steps to address their heat pump's issues and ductless customers were more likely to not have addressed these issues (Figure 41). In cases where the customer contacted a contractor about the problem, there was double the rate of success resolving all of the issues with ducted systems (21 of 148; 14%) than with ductless (4 of 56; 7%).

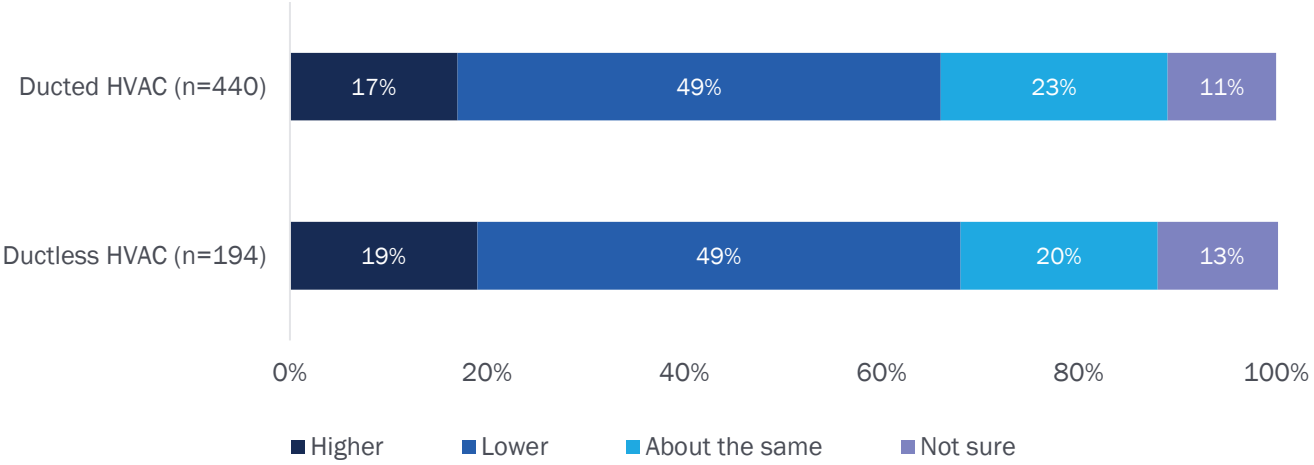
Figure 41. Steps Taken to Address Heat Pump HVAC Issues



3.3.5 ENERGY BILLS

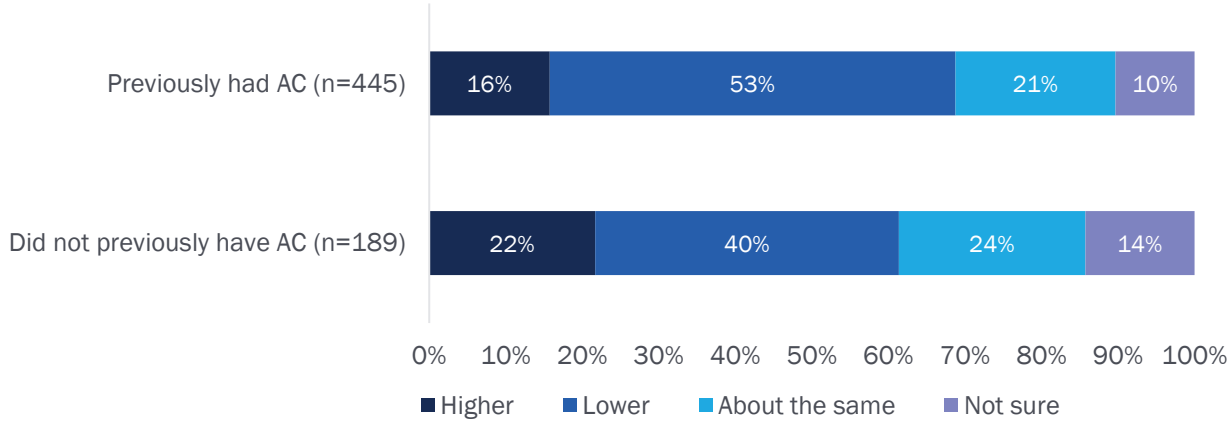
Whether respondents' energy bills went up or down was very similar between those with ducted and ductless systems (Figure 42). More than two-thirds of customers said their monthly bills decreased or remained the same (451 of 634; 71%). Nearly two-thirds of all customers whose monthly energy bills went down had a solar PV system that generated electricity for their home (203 of 311; 65%). Respondents were instructed to consider both gas and electric utility bills combined, if applicable.

Figure 42. Perceived Change in Monthly Energy Bills by HVAC Types



Another way to examine change in monthly energy bills is to compare TECH Clean California customers who had air conditioning before they purchased their HVAC heat pump to those who did not (Figure 43).[12] More than half of those with air conditioning before reported a decrease in their bills (236 of 445; 53%), while two-fifths of customers without air conditioning prior experienced a decrease (76 of 189). Slightly more than one-fifth of customers who did not have air conditioning previously (42 of 189; 22%) reported higher monthly energy bills since having their HVAC heat pump installed.

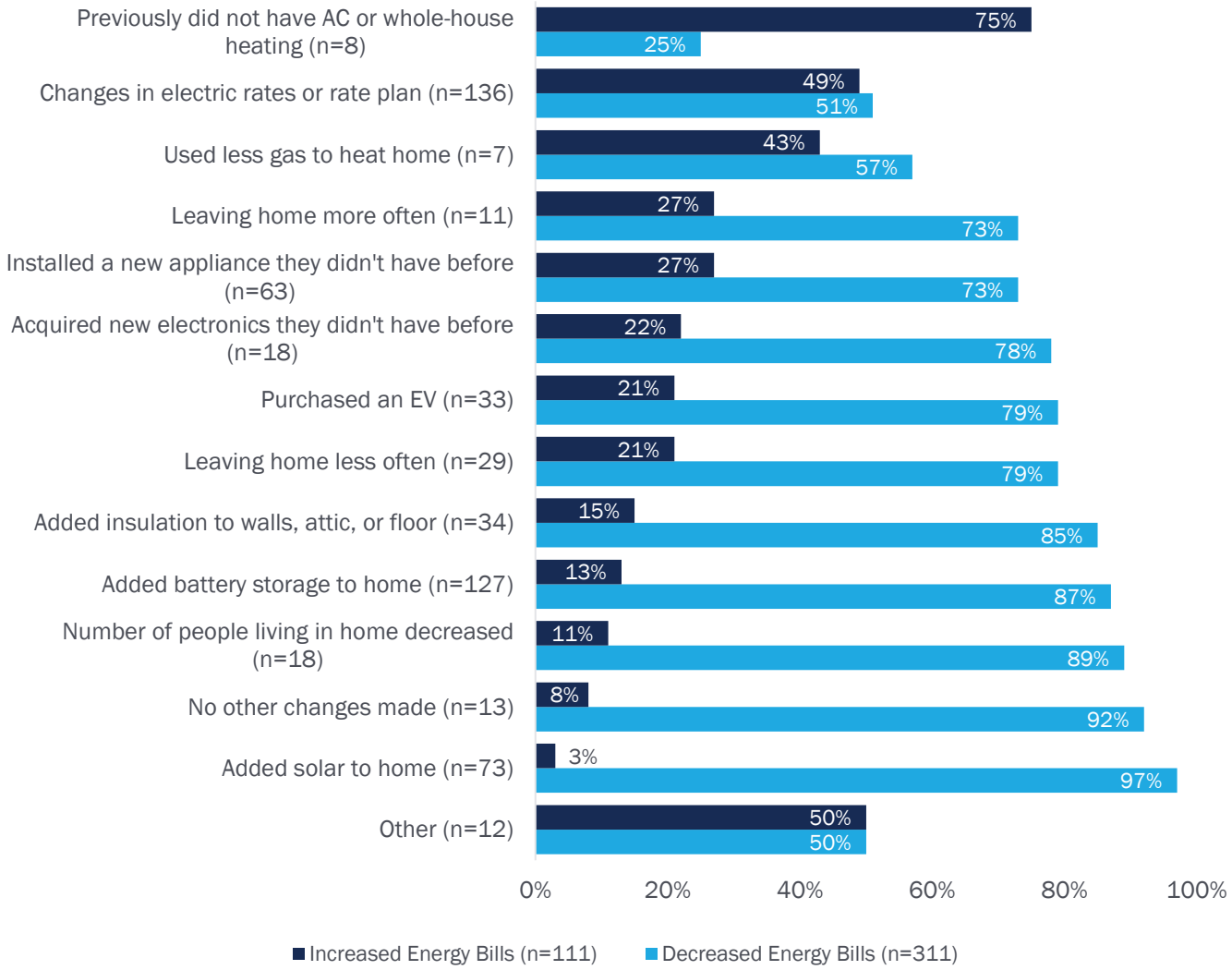
Figure 43. Perceived Change in Monthly Energy Bills by Whether Customer Had AC Before



We asked HVAC heat pump respondents who experienced higher or lower total energy bills about changes in their home that may have contributed to the difference in their bills other than their new heat pump. Changes in electric rates were among the most common changes reported, along with adding battery storage to the home (Figure 44). Those who added battery storage or solar to their homes were highly likely to report a decrease in their energy bills.

[12] Please note that the presence of air conditioning includes both central air conditioning and/or window/portable air conditioning.

Figure 44. Additional Changes That Might Impact Energy Bills, HVAC Customers



We asked respondents who reported a rate change to understand if the adjustment was voluntary, such as switching to a different rate plan, or if the change was an involuntary increase in fuel cost. Among those who reported a change in their electricity rate, nearly all (122 of 131; 93%) said this was due to their utility involuntarily raising their price of electricity. Additionally, among those who reported a change in their gas rate, most (40 of 48; 83%) reported this was due to their utility also involuntarily raising their price of gas.

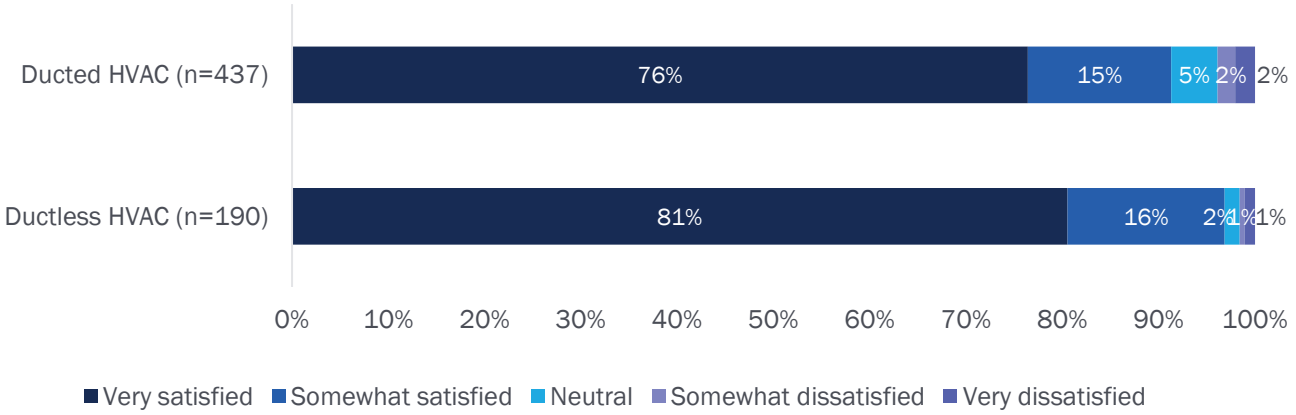
3.3.6 SATISFACTION

Overall, customers were very satisfied with their HVAC heat pump (Figure 45). Those with a ductless system were more satisfied overall (184 of 190; 97%) than those with a ducted system (398 of 437; 91%)[13].

[13] Overall satisfaction was determined by combining respondents who said they were "very satisfied" or "somewhat satisfied."

Additionally, new respondents were equally as satisfied with their ductless equipment as repeat respondents; new respondents were slightly more satisfied with their ducted equipment (258 of 280; 92%) than repeat respondents (141 of 157; 90%).[14] Respondents who expressed dissatisfaction with their ducted system (17 of 437; 4%) shared the reason(s) for their low rating. Surveyed customers were most dissatisfied with their ducted heat pump due to insufficient heating and/or cooling (10 of 17). They were also dissatisfied with the lack of return on investment (6 of 17), as well as the noise of the system (3 of 14). Of the three dissatisfied customers who installed ductless systems, none provided additional context.

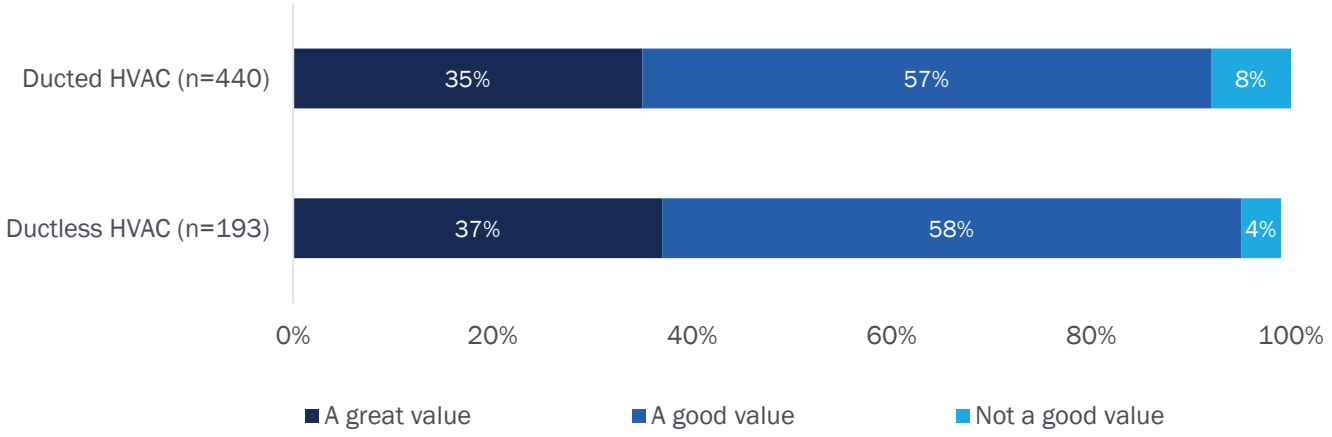
Figure 45. Customer Satisfaction with HVAC Heat Pump



In general, a large majority of surveyed customers saw value in their HVAC heat pump investment (Figure 46). Although, customers were more likely to rate the value as "good" rather than "great." We also found that new respondents (387 of 416; 93%) were equally as likely as repeat respondents (201 of 218; 92%) to rate the value of their investment as "good" or "great."

[14] These counts include customers who selected "Very satisfied" or "Somewhat satisfied."

Figure 46. Customer Perceived Value in HVAC Heat Pump Investment



Note: One respondent was a renter who reported they did not purchase the new heat pump equipment and was unable to rate the value of the investment; this respondent is excluded from the figure.

We asked the 563 customers who rated their HVAC heat pump as "a great value" or "a good value" to explain why they provided this rating. Answers were provided in an open-ended format, which we thematically coded into the categories shown in Table 14. We then examined the proportions of customers who rated their equipment as "a great value" or "a good value" across each of the coded categories to better understand what made the difference for customers in rating the value of their equipment. The reasons are listed below from greatest to least number of customers mentioning them. Darker shades indicate a large proportion of customers reported that reason and lighter shades indicate a smaller proportion of customers. The reason categories in the left column are ordered from the highest to lowest number of customers mentioning them, as well as grouped into two buckets – positive sentiments (denoted by bolded text) and mixed sentiments (denoted by non-bolded text).

Table 14. Reasons Why HVAC Heat Pump is a Good or Great Value (n=563)

Reason	Great Value	Good Value
Monthly and long-term cost savings (n=166)	56%	44%
Home temperature is comfortable (n=100)	63%	37%
Efficiency of equipment (n=76)	46%	54%
Environmental benefits/not using gas (n=76)	47%	53%
The rebates made it worthwhile (n=58)	59%	41%
Having solar made it even more worthwhile (n=54)	56%	44%
Performance of equipment (n=41)	61%	39%
High upfront costs (n=124)	3%	97%

Reason	Great Value	Good Value
Electric bill has stayed the same or gone up (n=19)	5%	95%
Other (n=77)	29%	71%

Note: Twenty-six respondents who reported "Don't know" have been excluded. Some respondents provided multiple reasons for their rating, and thus n values provided for reasons may sum beyond the total number of respondents (n=563).

We provide and elaborate on those reasons below:

- **Monthly and long-term cost savings (166 of 563).** Cost savings were the most frequently cited reason for customers who viewed their heat pump as a valuable investment. More than half of customers who provided this reason for their value rating said their HVAC heat pump was a great value (93 of 166; 56%). These customers often mentioned the noticeable reduction in their energy bills and the upfront cost savings associated with the TECH Clean California incentive.
- **Home temperature is comfortable (100 of 563).** A little less than two-thirds of customers (63 of 100; 63%) who provided the thermal comfort of their home as a reason for their rating said their HVAC heat pump was "a great value." These customers were particularly happy with their systems' ability to keep their home comfortably cool and warm when they wanted. Some even highlighted vast improvements to their quality of life in the home, especially among folks who reported they did not previously have AC. One of these respondents wrote in the survey:

> *I have never had AC in my life and now I do. I operate it without pause and it works well. It also heats the house amazingly well.*

- **Efficiency of equipment (76 of 563).** Customers who provided the efficiency of their HVAC heat pump as a reason for their rating were mixed on whether it was a great or good value. Slightly more than half of these customers rated the value of their investment as good rather than great (41 of 76; 54%). Despite this, most of these customers expressed positive feedback about their equipment. Many said it was more efficient than their previous equipment and liked the fact that it runs on electricity rather than gas. A few of these customers expressed that, despite the equipment's high efficiency, the high upfront cost of purchasing the system was still notable.
- **Environmental benefits/not using gas (76 of 563).** Customers who mentioned switching from gas to electricity and the added benefits to the environment as reasons for their rating were mixed on whether the value of their HVAC heat pump was great or good; slightly more than half rated the value of their investment as "a good value" as opposed to "a great value" (40 of 76; 53%).
- **The rebates made it worthwhile (58 of 563).** These customers expressed great satisfaction with the incentive; for many, it significantly reduced the cost of the HVAC heat pump and made it much more attractive to them. Customers described the purchase of their HVAC heat pump as "fair," "affordable,"

"competitive," and a "crazy deal." Nearly three-fifths of these customers (34 of 58; 59%) were much more likely to rate the purchase of their HVAC heat pump as a great value as opposed to a good value.

- **Having solar made it even more worthwhile (54 of 563).** All the customers who provided this reason had solar installed on their home. Being able to use the electricity generated from their solar panels for their new electric equipment made these customers feel their HVAC heat pump purchase was worthwhile. More than half of these customers (30 of 54; 56%) rated the value of their HVAC heat pump as great. However, 44% of these customers (24 of 54) rated the value of their investment as "a good value" instead of "a great value." Some of these customers said that without having solar, they were unsure if the HVAC heat pump would yield as much benefit from a cost-savings perspective.

> *"I needed to replace my HVAC system and I was planning to get solar, so it was a good investment. My gas bill is definitely lower. Not sure what the energy bill would have been without solar."*

- **Performance of equipment (41 of 563).** These customers highlighted the performance of their equipment as the reason for rating the value of their HVAC heat pump as great or good. They most often mentioned that their equipment works well and cools/heats their home as intended. More than three-fifths rated the value of their investment as great as opposed to good (25 of 41; 61%).
- **High upfront costs (124 of 563).** Nearly all customers who mentioned the high upfront cost rated the value of their investment as "good" as opposed to "great" (120 of 124; 97%). One of them said:

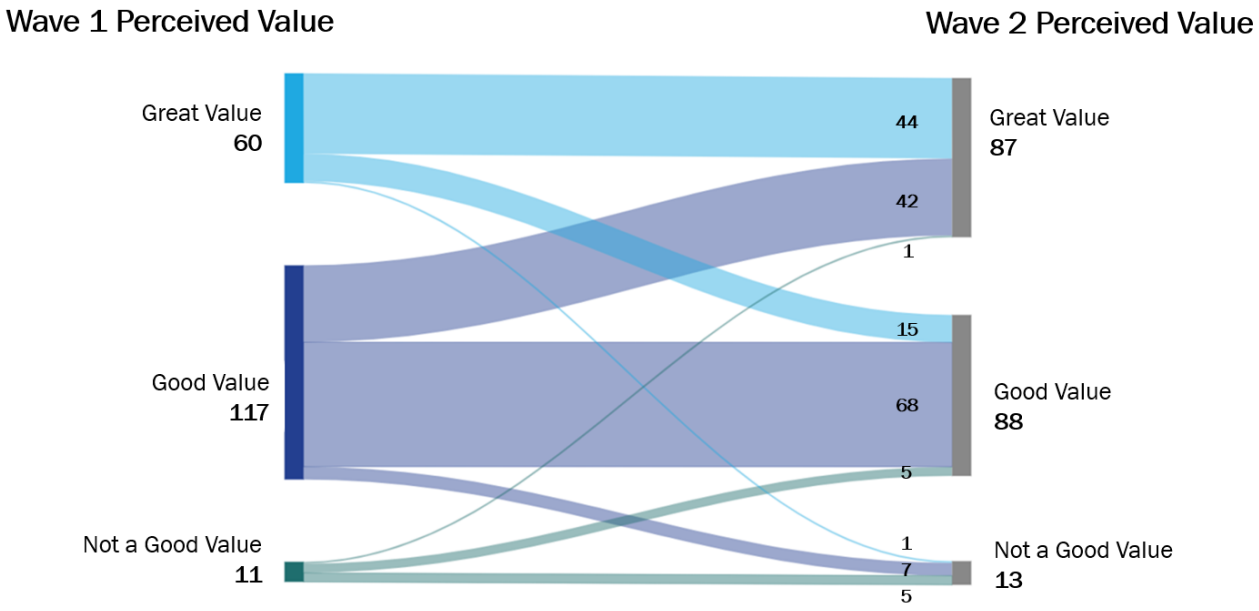
> *"Overall, it was expensive, but appears to be a good investment."*

- **Electric bill has stayed the same or gone up (19 of 563).** While these customers felt their HVAC heat pump was a good value (18 of 19), the lack of realized cost savings on their electricity bills seems to have prevented most of them from rating their investment as a great value.
- **Other (77 of 563).** Most of the customers in this group rated the value of their HVAC heat pump as "a good value" as opposed to "a great value" (55 of 77; 71%). The reasons these customers provided were generally positive. Some described their equipment as a "good product," "getting what I paid for," "meets expectations," and "adequate." Others said they were happy with their system and glad they decided to purchase one. Several said it was simply time to replace their old equipment. Some customers did not have a reason other than the fact that they felt it was a good value.

Additionally, we investigated changes in the perceived value of HVAC heat pumps for repeat respondents, as they had additional experience with their heat pump since they took the wave 1 survey. Figure 47 illustrates changes in perceived value of HVAC heat pumps between the two survey waves. Repeat respondents were significantly more likely to rate their equipment as "a great value" at the time of wave 2 survey than when they took the wave 1 survey Most of the respondents whose opinion of their heat pump improved to "a great

value" had initially rated their heat pump as "a good value," though one person's opinion changed from "not a good value" in wave 1.

Figure 47: Repeat Participants' Perceived Value Over Time (n=188)



Customers who rated their HVAC heat pump as "not a good value" in wave 2 most often cited high upfront costs (16 of 44; 36%), the cost to operate the system (10 of 44; 23%), and insufficient cooling and heating (10 of 44; 23%). Table 15 presents additional reasons shared by customers, as well as elaboration on each reason below.

Table 15. Reasons HVAC Heat Pump is Not a Good Value (n=44)

Reason	Number of Respondents	Percent of Respondents
High upfront cost	16	36%
High cost of operation	10	23%
Insufficient heating/cooling	10	23%
High cost of electricity	7	16%
Lack of return on investment	7	16%
Noisy	4	9%
Difficult to service or conduct maintenance on	1	2%
Other	3	7%

Note: Some responses are coded under multiple categories, thus the sum of values in the 'Number of Respondents' column exceeds the n value. Multiple responses allowed.

- **High upfront cost (16 of 44).** The initial cost of the heat pump equipment and installation is generally higher than other HVAC equipment options. Some of these customers viewed their previous equipment more favorably than their new heat pump given this high-cost burden.
- **High cost of operation (10 of 44).** Since heat pumps run on electricity and provide both heating and cooling, customers who transitioned from a gas-powered heater, or did not previously have air conditioning, saw an increase in their monthly electric bill. Additionally, as with the high upfront cost, respondents did not feel the various benefits of the equipment outweighed the high cost to operate.
- **Insufficient heating and/or cooling (10 of 44).** Some customers felt their new HVAC heat pump was unable to sufficiently heat and/or cool certain spaces in the home, or in some cases their whole home, as effectively as their previous equipment. Two customers specifically pointed out the equipment's diminished capacity to heat their home with outside temperatures under 40 degrees Fahrenheit.
- **High cost of electricity (7 of 44).** Given the increased cost of electricity in California, these customers felt that their new systems' efficiency and generated savings would be outweighed by increased electricity rates. They doubted the incentives would outweigh the cost burden imposed by the high upfront cost of the equipment and the increased utility rates.
- **Lack of return on investment (7 of 44)** [15]**.** These customers have not realized any savings at all on their monthly bills, or, even if they have saved a little here and there, they do not see how they will ever get the return on their investment in the long term. Two customers said they spend the same amount on their electric bill for heating and cooling their home as they did with their previous equipment. One customer even said they regret replacing their old system.
- **Noisy (4 of 44).** A few customers expressed frustration with the level of noise produced by their HVAC heat pump; some said it created an added inconvenience they did not have with their previous equipment.
- **Other (3 of 44)**. These few customers had other reasons for their dissatisfaction, including poor service from their TECH Clean California contractor, bad communication from the manufacturer, and just generally not feeling this purchase was a good value.

Customers were likely to recommend an HVAC heat pump to others. In fact, more than half indicated they were extremely likely to recommend it (355 of 622; 57%). Respondents rated how likely they were to recommend an HVAC heat pump to their family and friends using a zero to 10 scale (zero was "not at all likely" and 10 was "extremely likely"). The average rating score across respondents was 8.7 for those with a ducted system and 9.0 for those with a ductless system. Most customers who were extremely likely to recommend the equipment also indicated they had solar installed in their home, both for customers with ducted (144 of 169; 85%) and ductless (67 of 77; 87%) systems.

Table 16 is organized into three columns based on likelihood to recommend; each of these columns was created by grouping together ratings, where "unlikely" includes customer ratings of one through six, "highly likely" includes customer ratings of seven through nine, and "extremely likely" is customer ratings of 10. It also includes reasons customers provided in open-ended responses to explain why they gave the rating they

[15] The evaluation team does not have insight into how the respondent is estimating their ROI. Due to the heat pump equipment having been installed less than a year prior to completing the survey, we assume these estimations are subjective.

did. The reasons in bold font correlate with higher likelihood to recommend an HVAC heat pump, while the reasons in normal font are why customers would be unlikely to recommend the equipment. For example, most customers who said the equipment was efficient and quiet were likely to recommend it, while those who said it had a high upfront cost and did not cool or heat their home sufficiently were unlikely to recommend it.

New respondents were significantly more likely to recommend a ductless HVAC heat pump to friends and family (124 of 133; 93%) than repeat respondents with a ductless HVAC heat pump (47 of 57; 82%).[16]

Table 16.Likelihood to Recommend HVAC Heat Pump by Reason (n=591)

Reason for Rating	0-6 Unlikely (n=64)	7-9 Highly Likely (n=174)	10 Extremely Likely (n=353)
Efficiency of equipment	2	34	126
All-electric/environmental impact	1	28	91
Monthly cost savings	2	18	68
Effectiveness of the equipment	0	12	54
Comfort in the home	0	8	46
Quiet	0	9	35
Easy to use	1	7	30
General positive feedback	0	6	23
Positive installation experience	0	5	10
Equipment reliability	1	3	8
Ability for zoned heating and cooling	1	3	9
Incentive availability	0	7	7
High upfront cost	13	18	3
Insufficient heating and cooling	20	3	0
Energy bills the same or increased	12	0	0
Suitability of equipment dependent on customer	3	13	1
Noisy	4	5	0
Thermostat Issues	2	2	0
Other	12	28	24

Note: Table excludes 19 respondents who selected "Don't know" response when asked to rate their likelihood to recommend. Multiple reasons for rating allowed.

We elaborate on each reason provided by respondents below.

[16] For this significance test, we grouped new and repeat respondents into two categories based on their responses - "likely" (respondents who gave a rating of 7 – 10) and "not likely" (respondents who gave a rating of 0 – 6). We used pairwise t-tests with a 90% confidence level to identify significant differences.

- **Efficiency of the equipment**. All but two customers who mentioned the efficiency of their equipment as a reason for their rating were highly or extremely likely to recommend an HVAC heat pump.
- **All-electric/environmental impact**. Most customers who either shared a desire to decarbonize their home's energy usage or make a positive impact on the environment/mitigate climate change by switching from gas to electric appliances were highly or extremely likely to recommend an HVAC heat pump; only one of these customers was unlikely to recommend the equipment.
- **Monthly cost savings**. All but two customers who highlighted the cost effectiveness of their heat pumps were highly or extremely likely to recommend an HVAC heat pump. Respondents discussed how heat pumps use notably less energy, cost less to operate, and/or provide good value to their homes, even when considering the higher upfront cost compared to other HVAC equipment options.
- **Effectiveness of the equipment**. These 66 respondents had experienced their heat pump effectively heating and/or cooling their home as intended, causing them all to be highly or extremely likely to recommend an HVAC heat pump to others, and many said they had already done so.
- **Comfort in the home.** Respondents who mentioned comfort in the home because of their HVAC heat pump most often discussed the well-regulated temperature in their home, as well as the cleaner air circulated throughout. All 54 of them were at least highly likely to recommend an HVAC heat pump.
- **Quiet**. These 44 customers were at least highly likely to recommend a HVAC heat pump due to their satisfaction with the low or unnoticeable noise produced by their equipment when operating.
- **Easy to use.** All but one customer who said their HVAC heat pump was easy to use were highly or extremely likely to recommend the equipment as they found it easy to operate and a simple, straightforward system. For ductless specifically, some highlighted the ease and convenience of a remote-control thermostat. These 38 customers represent 6% of all surveyed TECH Clean California HVAC customers.
- **General positive feedback**. All 29 customers who shared general positive feedback were highly or extremely likely to recommend their equipment to others. Specially, these customers mentioned they were generally satisfied and had their needs met by the equipment.
- **Positive installation experience.** These customers were pleased with their HVAC heat pump's easy installation process, making them at least highly likely to recommend it to others. Specifically, they highlighted their experiences with the individual installer and installing company's professionalism.
- **Equipment reliability.** All but one of the 12 customers who mentioned the reliability of their HVAC heat pump were highly or extremely likely to recommend the equipment to others.
- **Ability for zoned heating and cooling**. For ductless systems specifically, customers were happy with the ability to control heating/cooling in their homes by specific zones or areas; they described it as convenient, economical, and efficient. All but one of these customers were highly or extremely likely to recommend the equipment.
- **Incentive availability.** These 14 respondents were highly or extremely likely to recommend the equipment to others due to incentives available for the equipment that significantly offset the high upfront cost.

- **High upfront cost**. These respondents found the higher initial cost of a heat pump in comparison to other HVAC equipment options unattractive. Although the high upfront cost made more than one-third of these respondents unlikely to recommend the equipment (13 of 34), the majority said they would still recommend it (21 of 34). Therefore, the performance or benefits of a heat pump seem to outweigh the initial cost burden for these customers.
- **Insufficient heating and cooling.** Nearly all customers who experienced insufficient heating or cooling when operating their HVAC heat pump were unlikely to recommend it to others. Respondents most often complained about the system not cooling or heating their home to the desired temperature during heat waves or cold snaps (both ducted and ductless), or the fact that the system operated better or worse depending on the space in the home (specific to ductless systems). Only three customers from this group were still likely to recommend the equipment despite these issues.
- **Energy bills were the same or increased.** All 12 customers who reported that their energy bills have not changed or have increased since installing and operating their HVAC heat pump were unlikely to recommend the equipment to others.
- **Suitability of equipment dependent on customer**. Customers acknowledged that heat pumps may not be appropriate for all people and their home needs. Respondents shared criteria they thought impacted home fit such as affordability, location options in home to install the heat pump, size and layout of home, and number of people living in the home. Still, most of these customers were highly or extremely likely to recommend an HVAC heat pump to others (14 of 17).
- **Noisy**. Of the nine customers who mentioned the noisiness of their HVAC heat pump, five of them were still likely to recommend the equipment to others, despite the disruptiveness in their home; four were unlikely to recommend an HVAC heat pump.
- **Thermostat issues.** The four customers in this group had a poor experience using the thermostat, including general difficulty operating the equipment and setting the temperature, as well as needing to constantly adjust for heating/cooling. Despite this, two of these respondents were still highly likely to recommend a HVAC heat pump to others.
- **Other.** These responses were mixed in terms of negative and positive reactions to HVAC heat pumps; however, most were still likely to recommend the equipment to others (52 of 64). Some respondents said the equipment was worth the cost, made sense given the retirement of their old equipment, was a good solution for their home, and/or they did not think about it other than the equipment is new and works. Others felt the equipment was "gimmicky" in terms of energy and cost savings, difficult to learn and become accustomed to, worked "too well" (overheating or overcooling the home), and/or would pose concerns during the winter given it is relying entirely on electricity.

3.4 CUSTOMER SUGGESTIONS FOR IMPROVEMENT

At the end of the survey, we provided the surveyed customers an opportunity to share any final comments. More than a third of those who offered comments (88 of 232; 38%) provided positive feedback, mentioning how happy they were with their system. These customers were especially happy with the performance of the equipment, its efficiency, associated cost savings, its eco-friendliness, and the fact that it is safer than gas.

Several respondents offered suggestions they thought would help improve heat pump adoption and ease the customer experience when using their new heat pump equipment. These customer suggestions included the following:

- Consider applying the rebate at the time of sale to prevent long wait times and/or delays in the customer receiving the rebate
- Determine and reassess rebate amounts over time so that they align with the average cost of electricity in California at any given point in time
- Offer or make clearer the different heat pump models available so that customers have more decision-making power
- Provide educational resources and materials around the basics of using a heat pump, such as HPWH operating modes, HPWH controls, and HVAC heat pump thermostats
- Provide additional assistance to customers with enrolling in a demand response program to fulfill the HPWH enrollment requirement

4. CONCLUSIONS AND RECOMMENDATIONS

Based on our findings, we offer the following conclusions and recommendations.

Conclusion: Generally good performance and willingness to recommend HPWHs suggest a technology that is poised to become more mainstream. Most customers experienced consistent, satisfactory HPWH performance, and this may be improving over time. Willingness to recommend a HPWH is high (a mean of 8.3 on a 10-point scale).

Conclusion: Contractor installation practices for HPWHs may be changing in ways that improve customer experiences with their equipment. New respondents were significantly less likely than repeat respondents to indicate their HPWHs had been installed in conditioned spaces (basements and laundry rooms) and report common complaints about HPWHs, including excessive noise and excessive increase in cold air near their units.

Conclusion: HPWHs are not functioning as a heat pump all of the time, which means the equipment is not maximizing greenhouse gas emissions reductions. Less than half of customers had their HPWH set to the most efficient mode (heat pump mode). Repeat respondents who changed their mode all changed it from hybrid to heat pump, suggesting heat pump mode is sufficient to produce enough hot water for their household needs.

> **Recommendation**: TECH Clean California should explore adding a recommendation to their guidance documentation for contractors that encourages setting the HPWH on heat pump mode. Such exploration should entail consultation with contractors, manufacturers, and other stakeholders to ensure guidance is informed by multiple experts. TECH Clean California could also add customer-facing educational materials highlighting the efficiency of HPWH heat pump mode on the Switch is On website.

Conclusion: Solar is a key driver of the choice to install a HPWH and the perceived value of investment. Half of HPWH customers had a solar PV system and 91% of HPWH customers who said their monthly bills went down had solar. Being able to take advantage of solar power also contributed to customers rating their purchase as a good or great value. The majority of customers who were extremely likely to recommend a HPWH had solar. In short: having solar PV may be a more important driver of HPWH adoption than incentives. TECH Clean California should explore additional customer targeting or program activities that prepare solar PV owners to switch to HPWHs.

> **Recommendation**: TECH Clean California should investigate options to conduct targeted marketing for HPWHs to customers who already have solar PV within the constraints of program resources. They may also consider exploring ways to partner with solar installation companies for promotion of HPWHs.

Conclusion: High purchase prices associated with HPWHs continue to undermine perceptions of value. Customers are sensitive to equipment prices and increased electricity rates. High prices may limit the appeal of HPWHs for the general public and hamper their widespread adoption.

Recommendation: Current TECH Clean California customer households are wealthier than average, and lower income Californians who may be struggling with high energy burden need efficient equipment. This underscores the need for TECH Clean California to continue offering incentives to income-qualified customers and to explore additional programmatic activities tailored to the needs of disadvantaged communities. Consultation with experts and representatives from DACs should be part of such exploration.

Conclusion: Customers are generally pleased with their HVAC heat pumps. Whether ducted or ductless, for heating or cooling, more than 80% of customers rated their heat pumps as at least highly effective. Perceptions of value increased with the length of time customers had their HVAC heat pump; repeat respondents were significantly more likely to rate their equipment as "a great value" at the time of wave 2 survey than when they took the wave 1 survey.

Recommendation: TECH Clean California should consider publicizing these findings to further boost the appeal of HVAC heat pumps and support confidence in their performance.

Conclusion: Ductless heat pump users require more support for their thermostats to enhance system efficiency. Ductless heat pump users in particular were troubled by their thermostats, with about one-third of customers finding their ductless thermostat harder to use than their prior thermostat. A minority of ductless heat pump customers (39%) felt comfortable using their thermostat right away. New TECH Clean California respondents more frequently reported these struggles than repeat respondents. Ductless heat pump customers also reported adjusting their thermostats more frequently than ducted heat pump customers, which is a less efficient way of operating the equipment.

Recommendation: There is a need for additional customer education and support regarding the use of ductless heat pump thermostats. TECH Clean California could collaborate with manufacturers to improve customer resources, such as hotlines and troubleshooting guides. Some difficulties may arise from Wi-Fi connectivity issues, which HVAC contractors may not be knowledgeable about, and these will need to be addressed by the customers themselves. Therefore, it is important to enhance end-user guides and manuals to empower customers to troubleshoot issues as effectively as possible.

Conclusion: As with HPWHs, more than half of HVAC heat pump customers have solar PV systems. Solar is a driver for HVAC heat pump adoption and satisfaction.

Recommendation: TECH Clean California should investigate options to conduct targeted marketing for HVAC heat pumps to customers who already have solar PV. They may also consider exploring ways to partner with solar installation companies for promotion of HVAC heat pumps.

Conclusion: Despite generally positive ratings, 30% of ducted and ductless customers needed troubleshooting, repair, or replacement on their HVAC heat pump system, including a small number of repeat respondents reporting the same persistent issues in two waves of the survey. The most commonly reported issues included those related to maintaining the home's temperature.

Recommendation: TECH Clean California should consider re-instating the contractor bonus incentives that offered additional money for completing Manual J calculations and performing duct sealing. The added financial reward should encourage greater adherence to quality installation practices, thus reducing these system issues.

Conclusion: Despite representing a minority of customers, high prices for HVAC heat pumps and high utility bills are the top two reasons for perceiving their HVAC heat pump as not a good value, followed by insufficient heating or cooling. The high upfront cost of the system was still an issue, even for those who rated their equipment as "a good value."

Recommendation: High purchase price will inhibit equitable adoption. These findings point to the need for TECH Clean California to maintain financial incentives as a core program offering and offer enhanced incentives to income-qualified customers if TECH Clean California is to achieve more widespread heat pump penetration. TECH Clean California should explore additional incentive designs in consultation with DAC community members and HVAC experts.

APPENDIX A. SURVEY INSTRUMENT

Please click on the icon below to view the TECH Clean California Customer Experience Survey instrument.

TECH Customer Experience Survey_F

APPENDIX B. CLIMATE ZONE DISTRIBUTION

Table 17 shows our survey sample by their heat pump type and climate zone compared to the population of TECH Clean California customers at the time the survey sample frame was developed in July of 2024.[17] Please note that the population of TECH Clean California customers includes a portion of customers who had their heat pump fewer than six months and were ineligible for the survey. We developed the sample frame from TECH Clean California's database of approved incentive applications, also known as the "application data."

Table 17. Climate Zone Distribution by Equipment Type

Climate Zone	Equipment Type	Number of Respondents	Number of Customers in Application Data
1	HVAC heat pump	5	72
	HPWH	1	
2	HVAC heat pump	50	1,382
	HPWH	12	
3	HVAC heat pump	117	3,332
	HPWH	46	
4	HVAC heat pump	38	1,569
	HPWH	25	
5	HVAC heat pump	2	53
	HPWH	0	
6	HVAC heat pump	40	1,454
	HPWH	6	
7	HVAC heat pump	50	2,231
	HPWH	5	
8	HVAC heat pump	21	1,772
	HPWH	8	
9	HVAC heat pump	31	2,065
	HPWH	7	
10	HVAC heat pump	35	3,050
	HPWH	8	
11	HVAC heat pump	27	1,110

[17] TECH Clean California population counts are based on application data through July 11, 2024, that was used to develop the survey sample frame.

	HPWH	2	
12	HVAC heat pump	133	11,504
	HPWH	177	
13	HVAC heat pump	35	1,762
	HPWH	0	
14	HVAC heat pump	1	595
	HPWH	0	
15	HVAC heat pump	43	2,485
	HPWH	0	
16	HVAC heat pump	6	143
	HPWH	3	
Not available	HVAC heat pump	0	66
	HPWH	1	
Total		**935**	**34,645**

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