



# Room Heat Pumps

## Market Characterization Report

CalMTA is a program of the California Public Utilities Commission (CPUC)  
and is administered by Resource Innovations



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# Room Heat Pumps

## Market Characterization Report

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This report is also appended as Appendix D to the Market Transformation Initiative Plan for Room Heat Pumps.

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## List of Abbreviations

Abbreviation	Definition
AC	Air-Conditioning
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BMA	Baseline Market Adoption
CA	California
CalMTA	California Market Transformation Administrator
CCA	Community Choice Aggregators
CEC	California Energy Commission
CEE	Consortium for Energy Efficiency
CEER	Combined Energy Efficiency Ratio
CPUC	California Public Utilities Commission
DOE	Department of Energy
EPIC	Electric Program Investment Charge
ESA	Energy Savings Assistance
eTRM	Electronic Technical Resource Manual
GWP	Global Warming Potential
HEEHRA	High Efficiency Electric Homes Rebates Act
HFO	Hydrofluoroolefin
HP	Heat Pump
HVAC	Heating, Ventilation, and Air Conditioning
IOU	Investor-Owned Utility
IRA	Inflation Reduction Act
MTI	Market Transformation Initiative
NYCHA	New York City Housing Authority
NYSERDA	New York State Energy Research and Development Authority
PG&E	Pacific Gas and Electric
PHP	Portable Heat Pump
PM	Program Manager
REN	Regional Energy Network
RHP	Room Heat Pump
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SME	Subject Matter Expert
UL	Underwriters Laboratories

### Market Characterization Report for Room Heat Pump

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# 1 Executive summary

This Market Characterization Report is an output of the Phase II research for the Room Heat Pumps Advancement Plan, finalized in February 2024. The Advancement Plan outlined a high-level research approach focused on investigating the target market, barriers, and opportunities with the goal of supporting the development of the Room Heat Pump Market Transformation Initiative (MTI) Plan. The envisioned long-term market impacts of the MTI are that room heat pumps (RHPs) are widely adopted by single- and multifamily households as a readily available and cost-effective alternative to electric-resistance space heating and air conditioning (AC) cooling-only appliances. In addition, the MTI envisions that increased adoption will reduce reliance on natural gas used in centrally heated homes. This report characterizes the California market for room heat pumps, discusses key barriers and opportunities for achieving the envisioned impacts of the MTI from demand and supply side perspectives, and informs the development of a baseline market forecast for room heat pumps.

## 1.1 Product description

RHPs are self-contained products that provide efficient heating and cooling for small spaces (up to 1,000 ft<sup>2</sup>), such as single rooms, modest apartments, or small homes. They offer both heating and cooling, use efficient heat pump technology, and can be installed without a certified technician. These units are available in several different form factors, including window and portable forms, shown in Figure 1. Note that through-the-wall units are included in the traditional window unit form factor shown in Figure 1d.

Heating and cooling represent the largest energy consumption end-uses for homes in California, with more than 50% of households still using gas appliances for heating.<sup>1</sup> RHPs offer an affordable and highly efficient alternative by reducing natural gas usage, contributing to California's decarbonization goals.

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<sup>1</sup> U.S. Energy Information Administration. (2020). Highlights for appliances in U.S. homes by state, 2020. <https://www.eia.gov/consumption/residential/data/2020/state/pdf/State%20Appliances.pdf>

**Figure 1 . Room Heat Pump form factors**



a) Dual-duct portable heat pump (HP), b) Saddlebag window HP, c) U-shaped window HP, and d) Traditional window and through-the-wall HP.

## 1.2 Objectives and methods

CalMTA's research objectives were to:

- Characterize the supply-side RHP market
- Characterize the demand-side RHP market
- Characterize fitness/relevance of RHP under existing CA programs
- Identify technology opportunities, limitations, and use cases
- Characterize the baseline market conditions to inform a market baseline forecast

To address market characterization and assess the objectives, CalMTA conducted secondary research and primary research, as summarized in Table 1.

**Table 1. Summary of research activities**

<b>Audience or task</b>	<b>Research description</b>	<b>Number completed</b>
Secondary research and literature review	Secondary data review and analysis; literature review of evaluation and market reports; regulatory filings; product manufacturer and retailer websites and media	N/A



Audience or task	Research description	Number completed
CA stakeholders and subject matter experts (SME)	In-depth interviews	22
Manufacturers	In-depth interviews	2
Consumers	Focus groups	8 groups
	Quantitative survey	790
Property managers	In-depth interviews	15
	Quantitative survey	96
Secret shopping	Retail store visits	7
Delphi panel	A panel of seven SMEs forecasted baseline market adoption (BMA) through a Delphi process, based on market information provided and their market knowledge	1

### 1.3 Main findings

#### **Finding 1: The unavailability of room heat pumps, especially for cold climates, in brick-and-mortar stores and insufficient product differentiation in online storefronts has dampened product awareness and demand**

The research found several supply chain issues creating barriers to RHP adoption. First, inconsistent and unclear product labeling on the majority of models on the market makes it difficult for consumers to identify them as heat pumps. Further, of the models identified through a technical review by the CalMTA team, only about half were actually available to purchase online from major retailer websites such as Lowe's®, Home Depot®, Best Buy® and WalMart®. The CalMTA team did not find any models during in-person visits to seven brick-and-mortar locations. Additionally, the sales associates at the visited locations possessed little knowledge about the technology. In CalMTA-hosted focus groups, participants often cited that they wanted to see products in-person to look at them when making purchase decisions. These dynamics showcase a key barrier for increasing the awareness, and subsequent adoption, of RHP models by consumers.

On top of this challenge, manufacturers cited concerns about the size and weight of models made to perform in cool and cold climates and the ability to sell them through retail channels. One manufacturer acknowledged that it is not feasible for one person to lift and install their current model (which is not sold retail at this time), while another said they had not ventured into product development of these heavier units due to concerns that retailers won't want to carry them if they are too big. One of the manufacturers interviewed said they would like to work with retailers to explore installation and delivery services (such as those typically offered for larger appliances like washers, dryers, and refrigerators) to help ease the burden on the customer and overcome this barrier.



## **Finding 2: The operational costs of using room heat pumps in certain scenarios, such as switching from gas heat, is a large barrier to adoption.**

Surveys and focus groups confirmed an anticipated barrier to the adoption of RHPs: consumers are wary of electric bill increases, seek ways to reduce their electric bill, and look for efficient options when shopping. When asked which factors would prevent them from purchasing an RHP in the future, 30% of survey respondents cited concerns about electric bill impacts. Additionally, customers in the focus groups stated that this was a top consideration for them if shopping for a new portable heater or air conditioning (AC) unit.

Some focus group participants reported the need to forgo central cooling due to the cost of the electric bill, supporting the notion that RHPs could play a role in shifting central cooling to zonal and reducing customers' bills. Heat pumps can provide efficient heating and cooling, allowing customers to use a single heating, ventilation, and air conditioning (HVAC) appliance to reduce their central system usage year-round. Despite the efficiency benefit of RHPs, some consumers switching from gas to electric heating may still experience a bill increase due to the difference in electricity and gas rates. Any customer using electric resistance heat should expect to see significant savings through switching to an RHP.

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*"I go to see them physically in stores to see which one convinces me. I look at the energy consumption it will have and how many watts it will consume because we have to save a little. They consume a lot of energy. You must look for something that helps you save a little money."*

*-Focus Group participant on purchasing decisions for heaters and ACs*

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CalMTA's energy and bill impact modeling found that a 1,024-square-foot apartment with room AC and a gas wall furnace could see average annual utility bill increases between \$7 and \$24, depending on the investor-owned utility (IOU) territory, by switching to a room heat pump as the primary heating and cooling source.<sup>2</sup> Conversely, an apartment using electric resistance heat and window air conditioning would experience annual bill savings of \$136 to \$179. Portable heat pumps, which are less efficient, are expected to see significant bill increases when switching from zonal gas heat, with an average annual increase of \$64 to \$96, depending upon IOU.

As electric rates continue to rise it is likely that consumers will continue to be very cost-conscious of anything that adds electric load instead of displacing it.

## **Finding 3: Room heat pumps have a significant market opportunity and potential energy savings to replace space heaters and displace other heating modes, according to data on consumers' current space heater use.**

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<sup>2</sup> For further information please see Appendix C: Product Assessment Report for Room Heat Pumps.

Overall, 18% of total households stated that they owned a space heater (n=790), with 40% of space heater owners reporting daily use and 94% reporting that they typically turned down or turned off any other sources of heating while they used their space heater during the winter months. Additionally, according to the residential survey, 40% of households (n=731) are either *somewhat likely* or *very likely* to purchase a new space heater in the next five years, illustrating an opportunity for a heat pump purchase instead. Slightly fewer households (34%) are likely to purchase a new window or portable AC in the next five years, though these AC purchase decisions can also represent an opportunity for RHPs.

**Finding 4: Room heat pumps are highly applicable to small dwellings such as multifamily apartments, but property manager and renter concerns need to be addressed if there is to be widespread market adoption in this market segment.**

Given the applicability of RHPs for smaller homes, and the need to ensure this technology is accessible for low-income communities, multifamily renters and property managers are key target audiences the MTI needs to reach. The residential survey found homeowners were twice as likely as renters to state they would be likely to purchase an RHP for heating needs, and they also were more likely to state they would purchase one for cooling needs.<sup>3</sup> Cost barriers, both initial price of the unit and long-term operating costs (i.e., impact on bill), were more prevalent concerns for renters compared to owners, and renters were also more concerned about heating performance.

Interviewed property managers saw value in the products for the potential to increase tenant satisfaction and improve rentability, along with liking that they did not require professional installation, and they had the ability to mitigate health risks during severe weather events. The property manager survey revealed that about half of respondents said they would be either *somewhat* or *very likely* to install an RHP. However, they had questions about their heating and cooling performance and particularly whether they could rely on them for a primary heating source in their units, concerns about installing window units (aesthetics, improper installation causing safety risks, and condensate drainage), and questions about bill impacts and added electrical load. Additionally, 30% of property managers stated that window units were not allowed in their buildings, even if installed by building staff or maintenance staff, highlighting a key barrier and opportunity to educate and engage multifamily property managers on the benefits of window heat pumps and particularly the reduced risk of “saddlebag” types of units falling out of the windows.

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<sup>3</sup> 27% of homeowners (n=430) reported being *very likely* to purchase a portable or window heat pump for heating needs compared to 13% of renters (n=360); 33% of homeowners said they were *very likely* to purchase for cooling compared to 22% of renters; differences were statistically significant at the p<.01 and p<.05 levels, respectively.

**Finding 5: Product innovation is needed to serve the California market with a room heat pump that fits horizontal sliding and casement windows, as the currently compatible portable models are less efficient and less aesthetically desirable among consumers.**

Over half of California's homes have exclusively horizontal sliding or outward-opening casement windows, which will not physically accommodate existing window heat pump models. Although portable form types, which use one or two exhaust hoses to vent air through a window, may accommodate these windows with a kit,, there is more work to be done from a product innovation standpoint due to several drawbacks of portable form types.

For example, consumers in CalMTA-hosted focus groups, while largely unfamiliar with the technology, felt that the design of portable units were cumbersome that there was little value in the technology once they saw what they looked like and learned how they functioned; and that they may be unsafe (tipping, falling out of the window, or managing the hose was a concern).

Additionally, the heating performance test procedure embedded within the ENERGY STAR® specification – which SMEs expect to spur product innovation to suit a wider range of climates – is only applicable to window form types. (Currently, portable form types on the market lose some, if not all, functionality when outdoor temperatures drop below 40°F, making them poor candidates for primary heating equipment.) The lack of ENERGY STAR and the Consortium for Energy Efficiency (CEE) specifications will preclude portable form types from being eligible for Inflation Reduction Act (IRA) incentives and tax credits in the near-term, thereby creating larger cost barriers for lower-income households. Given the weight that manufacturers place on these federal and utility policy levers, the absence of the specifications for portable forms is likely to limit investment in product enhancements and innovation compared to window types. However, ENERGY STAR has indicated an openness to amending the RHP specification to include portable form types sometime in the future.

**Finding 6: Technology competitions and bulk purchase agreements have been effective at spurring product innovation.**

The New York Clean Heat for All Challenge<sup>4</sup> (spearheaded by state and local agencies) challenged manufacturers to develop a new window heat pump model for cold climates with a commitment to purchase 30,000 units resulted in the development of two new cold-climate (or all-weather) window heat pump models with innovative design features (saddlebag version). A comparable challenge may spark product development specific to the window styles and climate of California. In interviews, manufacturers reported potential interest in a

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<sup>4</sup> <https://www.nyserda.ny.gov/About/Newsroom/2023-Announcements/2023-09-20-Governor-Hochul-Announces-Installation-Of-Window-Heat-Pumps-For-New-York-City#:~:text=The%20Clean%20Heat%20for%20All%20Challenge%20directly%20supports%20the%20goals,buildings%20by%20the%20year%202030.>

similar tech challenge in California that came with bulk purchase agreements. One suggested purchase agreement in the range of 10,000 to 20,000 units could be enough to support the development of a new solution for horizontal sliding and casement windows.

## 2 Methodology

### 2.1 Secondary research and literature review

CalMTA completed a literature review of published research and analyzed available secondary data pertaining to RHPs. Specifically, the team utilized the Energy Information Agency's 2020 Residential Energy Consumption Survey,<sup>5</sup> the U.S. Census, and the most recent California Residential Appliance Saturation Study (2019 to 2020) to gain insights into appliance saturation levels, behaviors, and other insights relevant to single- and multifamily California households. The team also reviewed publicly available technical and market research documents, California regulatory filings, dockets, the CA Electronic Technical Resource Manual (eTRM), and conducted searches using tools including Google Scholar, Semantic Scholar, Science.Gov, and general internet research on RHP products. Lastly, the team analyzed pricing and product availability by reviewing manufacturer websites and online retailers.

#### Bill impact modeling review

The CalMTA team modeled bill impacts for the most common RHP use cases, using electricity and therm rates for residential customers from the three major IOUs, EnergyPlus (the open-source Department of Energy (DOE) software energy model), and the California Database of Energy Efficiency Resources' multifamily prototype. This report references findings on bill impacts from that study.<sup>6</sup>

### 2.2 CA stakeholders and subject matter expert interviews

The CalMTA team developed research questions to gather information from key stakeholders and SMEs to inform the market characterization of RHPs. The research team interviewed 22 key stakeholders and SMEs across multiple categories. These included administrators and implementers of California programs that promote efficient heating and cooling technology and/or serve the target audience for RHPs, organizations conducting research and development, standard setting, and pilot efforts supporting deployment of the technologies, and community organizations and/or recipients of pilot funding or other programming. The team also spoke with three SMEs working on RHP initiatives outside of California, and federal Environmental Protection Agency staff involved in standard setting and specification development. The interview guide is included in Attachment 3: Research Instruments.

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<sup>5</sup> <https://www.eia.gov/consumption/residential/>, 2023.

<sup>6</sup> For further information please see Appendix C: Product Assessment Report for Room Heat Pumps.

## 2.3 Manufacturer interviews

CalMTA constructed the sample frame of manufacturers of RHPs through secondary research and SME referrals. The research team identified six major manufacturers to target for an interview, which included both larger companies historically manufacturing room and portable air conditioners (ACs), those with new heat pump offerings, and startups.

CalMTA reached out to priority contacts at these organizations via email to describe the purpose of the interview and offered a research stipend. The response rate was low. Up to three follow-up emails were sent to each invitee, and the CalMTA team did rolling secondary research to identify new contacts (reviewing manufacturer comments on public documents, researching professional platforms such as LinkedIn, and other sources) and snowball sampling (requesting referrals for personal contacts) after initial contacts were not responsive. Most individuals did not respond. Some responded to decline an interview, citing internal policies that precluded them from sharing information. Of the six manufacturers that CalMTA contacted, two of the manufacturers agreed to be interviewed: one company was large, with an estimated 14% share of the room HVAC market, and the other was a newer market entrant. The interview guide is included in Attachment 3: Research Instruments.

## 2.4 Focus groups

The CalMTA team hired a California-based focus group facilitator who completed eight focus groups for RHPs, which were segmented by income and region as shown in Table 2. Low-income groups were hosted in counties with a large Latino presence, and groups were conducted in Spanish. The focus groups had an average of seven participants and included both renters and homeowners. Respondents were further screened into groups based on their ownership of a portable space heater or a portable or window air conditioner.

**Table 2. Focus group segmentation**

Region segment	Income segment	Number Of groups	Language
Coastal	Non-low-income	2	English
Coastal	Low-income	1	Spanish
Inland	Non-low-income	2	English
Inland	Low-income	2	Spanish
Mountains	Non-low-income	1	English
<b>Total</b>		<b>8</b>	

### Screeners criteria and discussion guide

Low income was defined as at or below 80% of the median area income.<sup>7</sup> Low-income segments were screened using customized income thresholds for each county, as defined by the California Department of Housing and Community. Other screening criteria for all segments were that the participants must be between the ages of 35-65 and a joint or primary decision maker in their household for large purchases and had to have a smart phone with ability to install an ethnographic data collection app for use prior to the focus group. The screener and discussion guide are included in Attachment 3: Research Instruments.

## 2.5 Residential consumer survey

The team surveyed a sample of California's general population of residential customers to establish baseline saturations of heating and cooling equipment and baseline trends such as consumer awareness and attitudes. The survey was offered in Spanish and English, and it explored consumers' willingness to consider RHPs in future purchases, factors that may potentially aid adoption, and barriers to adoption. Respondents included homeowners and renters in single- and multifamily homes.

### Sampling plan

The online panel was purchased through Qualtrics, a panel aggregator. CalMTA used a stratified random sampling approach, in which quotas were established for climate region, housing type, and income category to ensure a robust response from key segments and established a total target of 800 completed surveys. The team also tracked electric utility territory - Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas and Electric (SDG&E), and others - but did not use quotas. Upon data review, the team removed 10 responses due to poor response quality, resulting in a total of 790 completed surveys. After a one-week fielding period, quotas were relaxed to improve study efficiency and timeliness.

The sampling plan was designed to produce results with 90% confidence  $\pm 10\%$  precision at the stratum level. Table 3 contains the final sample disposition by key segments.

**Table 3. Achieved residential sample**

Strata	Single-family		Multifamily		Mobile		Total
	Low-income	Non-low-income	Low-income	Non-low-income	Low-income	Non-low-income	
Coastal: All	51	59	78	49	19	6	262
PG&E	31	19	32	18	13	1	114

<sup>7</sup> According to Assembly Bill 1550, low-income communities and households are defined as those who live in census tracts or households at or below 80% of the statewide median income or meeting the threshold designated as low-income by the California Department of Housing and Community Development's Revised 2021 State Income Limits.

Strata	Single-family		Multifamily		Mobile		Total
	Low-income	Non-low-income	Low-income	Non-low-income	Low-income	Non-low-income	
SCE	5	15	12	15	3	2	52
SDG&E	9	13	21	8	0	1	52
Other	6	12	13	8	3	2	44
Inland: All	111	189	131	55	41	10	528
PG&E	41	59	28	7	6	2	143
SCE	36	65	47	21	17	3	189
SDG&E	3	10	4	1	7	4	29
Other	31	46	52	26	11	1	167
<b>Total</b>	<b>162</b>	<b>239</b>	<b>209</b>	<b>104</b>	<b>60</b>	<b>16</b>	<b>790</b>

### Strata definitions

- Consistent with the focus groups, the low-income segment was defined as households at or below 80% of the median area income, where median area income aligned with income thresholds defined for county by the California Department of Housing and Community.
- Single-family was defined as single-family detached homes and attached homes with up to three units. Multifamily was defined as condominiums or apartment buildings with four or more units and mobile was defined as a mobile or home manufactured home.
- Coastal and inland were defined by assigning the respondent's zip code to the appropriate California Energy Commission (CEC) Building Climate. See Attachment 1: Weighting Methodology for more details.

### Weighting approach

CalMTA weighted the survey results to the population using statewide population statistics on household income, housing type, climate zone (mapped with zip codes), and IOU customer base. A detailed methodology on the approach is found in Attachment 1: Weighting Methodology.

## 2.6 Multifamily property manager interviews

CalMTA conducted 15 qualitative interviews with multifamily property owners to understand the considerations and challenges faced by multifamily building owners and property managers in adopting RHPs. (The interviews also explored topics pertaining to induction cooking). The interviews aimed to provide insight into the nuanced perspectives of building owners or managers within the multifamily sector.





CalMTA targeted property management companies managing buildings in coastal and inland regions and sought to include representation from those serving Priority Populations.<sup>8</sup> The team used the California Apartment Association directory, Zillow, and Apartments.com to build the sample frame, gather contact information, and hone recruitment efforts by region. Participants in the interviews were recruited via a mix of email and phone calls and were offered an incentive to complete an interview. Table 4 contains the number of completed interviews by region and priority population status. The interview guide is found in Attachment 3: Research Instruments.

**Table 4. Count of interviews by climate region and priority population status**

<b>Climate region</b>	<b>Coastal</b>	<b>Inland</b>	<b>Total</b>
Priority Population	5	6	<b>11</b>
Not Priority Population	4	0	<b>4</b>
<b>Total</b>	<b>9</b>	<b>6</b>	<b>15</b>

## 2.7 Property manager survey

The team surveyed a sample of California-based multifamily and single-family building owners and property managers who own or manage five or more units. The goal of the survey was to establish baseline saturations of heating and cooling equipment and baseline trends such as awareness of heat pumps and attitudes toward space conditioning units. The survey was offered in English and explored willingness to consider RHPs in future purchases, factors that may potentially aid adoption, and barriers to adoption.

An online panel was purchased through Qualtrics, a panel aggregator that sources participants from a variety of sample providers to supply a network of diverse, quality respondents for the study. CalMTA used a stratified random sampling approach, in which quotas were established for climate region, housing type, classes of properties in your portfolio, types of units (market rate or affordable housing), and utilities category to ensure a robust response from key segments and established a total target of 96 completed surveys. The team also tracked electric utility territory but did not use quotas. 100 surveys were completed.

The sampling plan was designed to produce results with 90% confidence  $\pm 10\%$  precision at the stratum level. Table 5 contains the final sample disposition by key utility.

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<sup>8</sup> Priority populations, as defined by the California Air Resources Board, are census tracts categorized as either low-income or disadvantaged communities (DACs). See map here: [Priority Populations 2023 \(ca.gov\)](https://www.ca.gov/priority-populations). DACs, designated by the California Environmental Protection Agency as per Senate Bill 535, are defined by CalEnviroScreen 4.0: <https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40>

According to Assembly Bill 1550, low-income communities and households are defined as those who live in census tracts or households at or below 80% of the statewide median income or meeting the threshold designated as low-income by the California Department of Housing and Community Development's Revised 2021 State Income Limits.

**Table 5 : Count of participants by IOU service area**

<b>Utility</b>	<b>Target (n) property managers</b>
PG&E	24
SDG&E	24
SCE	24
Other	24
<b>Total</b>	<b>96</b>

## 2.8 Retail store visits

CalMTA conducted seven in-person retail visits to big box stores in Northern and Southern California to assess available models of room air conditioners and heat pumps and to understand sales associates' awareness of these products. The objectives were to qualitatively determine stocking and promotional trends; store visits were not representative of the entire state. Secret shopping visits were at the following retail chain and locations:

- 2 Home Depots (Alameda County and L.A. County)

- 2 Best Buys (Alameda County and L.A. County)

- Lowes (L.A. County)

- Costco (Alameda County)

- Sam's Club (L.A. County)

The team collected model numbers of room ACs and portable ACs that provided heating and later worked with SMEs to verify if the units used heat pump technology. The shoppers also sought to understand store associates' awareness of RHPs, making it a point to speak with multiple associates to glean as much information as possible - seeking specialists or section managers who may have more expertise than general sales associates.

## 2.9 Delphi panel

CalMTA completed a Delphi Panel to inform the BMA. The Delphi process and findings and how they inform the BMA Forecast are presented in Appendix B Market Forecasting & CE Modeling Approach.

## 3 Program and policy landscape

### 3.1 Federal and state standards

The products covered by this initiative fall into two different categories according to federal appliance standards. “Portable” heat pumps (see Figure 1a above) fall under the federal product category of Portable Air Conditioners, which describes moveable products that are placed on the floor and connect to outdoor air via one or two ducts running to a window. “Window” heat pumps (Figure 1b, 1c, and 1d) fall under the federal product category of Room Air Conditioners with Reverse Cycle.<sup>9</sup>

Cooling efficiency standards are set through the Combined Energy Efficiency Ratio (CEER) which is the same term for room and portable AC product categories, but the values are calculated differently based upon a different test procedure. In 2026, there will be a major increase in efficiency standards that will apply to window heat pumps, when the current minimum CEER of 9.8 will increase to 14.4.<sup>10</sup> Meanwhile, CEERs between 7.83 and 8.85 for portable heat pumps (PHPs) – depending on capacity – will take effect in 2025. Federal heating efficiency standards do not currently exist but are under development.

California regulations prohibit room air conditioners (ACs), including window units, from using resistance heating as a supplemental heat source. As a result, consumers seeking both heating and cooling options must choose a heat pump. Portable air conditioners are exempt from this regulation and may utilize resistance heating.

#### ENERGY STAR specification and CEE developments

To-date, there is no ENERGY STAR specification or CEE tiers for RHPs. However, work is currently underway at both organizations to produce or update specifications that would apply to window forms only, expected in early 2025. In July 2024, ENERGY STAR released a final draft of its heating test procedure.<sup>11</sup>

Critically, these specifications will allow a pathway for window heat pump units to qualify for federal tax credits under the IRA and they will stack them with local utility consumer product rebates; they will also provide key guidance and certainty for manufacturers.

The new heating test procedure used in the forthcoming ENERGY STAR specification will classify RHPs into four different categories (Type 1 to Type 4) based on the operating temperature.

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<sup>9</sup> See Title 10 of the Code of Federal Regulations. <https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-430/subpart-C/section-430.32>

<sup>10</sup> <https://www.federalregister.gov/documents/2023/05/26/2023-10287/energy-conservation-program-energy-conservation-standards-for-room-air-conditioners>

<sup>11</sup> [Room Air Conditioner Final Test Method \(energystar.gov\)](https://energystar.gov/room-air-conditioner-final-test-method)

Two manufacturers recently released Type 4 window models, which are expected to operate at full capacity in temperatures less than 5°F. Timelines are uncertain for developing Type 2 and Type 3 units, which are suitable for temperatures down to 17°F and 5°F, respectively; these are also more appropriate for mild climates like California. CalMTA discussions with SMEs indicate that these specifications may spur the development of a wider variety of models that can operate in lower temperatures and more Type 2 and Type 3 models suitable for California climates. There is no known timeline for the expansion of these specifications to *portable* form types, but ENERGY STAR has indicated the possibility of inclusion of this form type as an amendment to the Room AC/Room HP specification sometime in the future.

### Inflation Reduction Act (IRA) pathways

Federal guidance for both the Home Efficiency Rebates and High Efficiency Electric Homes Rebates Act (HEEHRA) programs under the IRA<sup>12</sup> states that the path for an RHP to qualify for incentives involves the finalization of a new heating test method, the establishment of the new Heating Energy Efficiency Ratio, and an associated ENERGY STAR criteria.<sup>13</sup>

Once the criteria are established and manufacturers certify their products, it will then be possible for window heat pumps to be eligible for incentives through the IRA programs, and the 25C federal tax credit (which requires the CEE Tier). Again, at this time this eligibility does not apply to portable form types.

California expects to receive its \$290 million HEEHRA program allocation into its own program administered by the California Energy Commission, though plans for specific technology incentives have not yet been released.

## 3.2 California programs and pilots

At the time of this report, there are a small number of California entities that are incentivizing or promoting RHPs to California residents through their programming, though potential exists for them to expand RHP offerings.

- **Research and development programs and pilots:** The Electric Program Investment Charge (EPIC) program, administered by the CEC, along with CalNEXT and TECH Clean California have all invested research and development funds into RHPs. EPIC and TECH

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<sup>12</sup> INFLATION REDUCTION ACT HOME ENERGY REBATES: Program Requirements and Application Instructions. U.S. Department of Energy, State & Community Energy Programs (SCEP). Last revised Oct 13, 2023. [https://www.energy.gov/sites/default/files/2023-10/home-energy-rebate-programs-requirements-and-application-instructions\\_10-13-2023.pdf](https://www.energy.gov/sites/default/files/2023-10/home-energy-rebate-programs-requirements-and-application-instructions_10-13-2023.pdf).

<sup>13</sup> Ibid., Section 4.2.2.1.2: Electric heat pump for space heating & cooling. "Room heat pumps currently do not have a heating test procedure, metric, or ENERGY STAR criterion in heating mode allowing manufacturers to certify. Therefore, models on the ENERGY STAR Qualified Products List (QPL) for Room Air Conditioners are not eligible for rebates at this time. Once ENERGY STAR criterion for room heat pumps are established for efficient cooling and heating using the DOE test procedure and models are certified on the ENERGY STAR Room AC QPL for heating and cooling, then room heat pumps will be eligible."

have recently funded pilots to install RHPs: under the EPIC grant, administered by Redwood Energy and the Electric Power Research Institute, 100 Gradient saddlebag window heat pump units will be installed in multifamily property and single-family homes in Tracy and Fresno. Under the TECH Clean CA Quick Start program, Bay Area 350 received a grant to install 30 PHPs and air filters in limited-income households in the San Francisco region. In 2023, CalNEXT identified RHPs as a “high priority” technology research area, citing their ability to help meet California’s goal of six million heat pumps by 2030 due to their applications in smaller spaces, potential to replace electric heaters, and instances in which traditional ductless heat pumps are too costly or onerous to deploy.

- **Resource acquisition programs:** Resource acquisition programs administered by utilities, Regional Energy Networks (RENs), and Community Choice Aggregators (CCAs) such as the Golden State Rebate program that provides instant discounts for qualifying energy efficient products, rely on workpapers and guidance in the eTRM to determine product eligibility. The CalMTA team did not find such programs promoting or incentivizing RHPs at this time.
- **The eTRM workpaper SWAP007-03**, “Room Air Conditioner, Residential,” identifies qualified window heat pump specifications based on the ENERGY STAR Program Requirements Product Specification for Room Air Conditioners, Version 5.0, and allows Room Air Conditioners with Reverse Cycle (i.e., window heat pumps) to qualify so long as they meet the minimum CEER levels (no heating efficiency level is required). This workpaper has a status of “California Public Utilities Commission Approved.”<sup>14</sup>
- **The eTRM workpaper SWAP020-01**, “Portable Air Conditioner and Heat Pump, Residential,” identifies qualified PHPs that exceed Title 20 Code efficiency by at least 5% and use a Significant New Alternatives Policy listed refrigerant with a global warming potential (GWP) of 1,000 or less. As of July 2024 this workpaper has a status of “POU Ready” (Indicating the protocol is ready for publicly owned utilities (POUs) but not IOUs).<sup>15</sup> In CalMTA’s interviews, one CCA program administrator suggested that the existence of a “POU Ready” workpaper may be enough to allow their program to consider making PHPs eligible for incentives, but other administrators of EE ratepayer-funded programs stated that they would not be able to consider incentives or promotion of PHPs until the workpaper was confirmed for use by IOUs.
- **Energy Savings Assistance (ESA) programs:** ESA is a ratepayer funded program that provides free energy efficiency services and installation of energy efficiency measures to income-eligible households. ESA, its separate multifamily program (ESA-MFES), and a new

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<sup>14</sup> Measures Characterization, Room Air Conditioner, Residential. SWAP007-03, CPUC Approved. <https://www.caetrm.com/measure/SWAP007/03/>.

<sup>15</sup> Measure Characterization, Portable Air Conditioner and Heat Pump, Residential. SWAP020-01, POU READY. Nov 21, 2023. <https://www.caetrm.com/panels/core/measure/5178/export-pdf/>.

building electrification program (ESA-BE) all have the potential to install RHPs to qualifying participants as part of their energy efficiency and decarbonization efforts. CalMTA could not confirm whether the program was actually promoting them. In an interview, ESA-BE program staff suggested that including RHPs may be possible, but only after other higher-efficiency alternatives were explored and found infeasible. Interview respondents reported that ESA-funded projects may have flexibility in measure approval that energy efficiency-funded projects do not, and that there may be different ways to validate certain measures, such as through health comfort and safety (HCS) offerings – especially given the eTRM’s workpaper’s existence in draft form that could support the measure’s introduction.

- **CCA Programs and REN Programs:** Peninsula Clean Energy (a CCA operating in San Mateo County) is offering RHPs through its Home Energy Upgrade program. According to program materials, the Program installed between 20-30 PHPs and between 10-20 window-mounted heat pumps in 2022 and 2023.<sup>16</sup> RENs also have the ability to offer energy savings programs, but CalMTA did not identify any REN programs that include portable or window heat pumps at this time.

### 3.3 Technology competitions

Through the Clean Heat for All Challenge, the New York City Housing Authority (NYCHA) and the New York State Energy Research and Development Authority (NYSERDA), in partnership with the New York Power Authority (NYPA), challenged manufacturers to develop an all-weather, cold climate capable window heat pump in 2022. This industry competition encouraged manufacturers to develop a packaged cold climate heat pump that could be installed through an existing window opening to provide heating and cooling in multifamily buildings, with a commitment to purchase 30,000 units from the awarded vendors. Two manufacturers – Gradient and Midea – were selected through the NYPA solicitation and awarded seven-year contracts for the development and delivery of all-weather window heat pumps. Units were installed in NYCHA buildings in July and November of 2023, and data on their performance is currently being gathered.

## 4 Demand side characteristics

### 4.1 Target market and baseline market saturation

The target market for CalMTA’s Room Heat Pump MTI is single- and multifamily homes in all climates, with any non-efficient electric or fossil fuel heating and cooling systems. Homes using a window or portable heat pump will also require a proper window fit: window heat pumps on the market today are designed to fit into vertically hung windows and will not fit into casement or

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<sup>16</sup> “Peninsula Clean Energy Low Income Building Electrification Program.” Slide 8, Results and Metrics.  
<https://www.spur.org/sites/default/files/2023-09/PCE%20Digital%20Discourse%20-%202023.pdf>.

sliding window types, though most portable form types, which use a duct vented through the window to transfer heat, will fit these windows with the use of an appropriate window kit.<sup>17</sup>

### California housing type by income level

According to the U.S. Census, 22% of California households lived in a multifamily building in 2022 (multifamily being defined as two or more units). Most households (74%) live in a single-family detached or attached house, while a small proportion (3%) resided in a mobile home, as shown in Table 6. Low-income households, defined as those at or below 80% of the statewide median income, are more likely to live in a multifamily household compared to higher income earners (34% compared to 16%, respectively). However, 60% of low-income households resided in a single-family home.

**Table 6. California households by housing type**

Housing type	% HH with income at or below 80% statewide median income	% HH with income above 80% statewide median income	All HH
Single-family attached	7%	7%	7%
Single-family detached	53%	75%	67%
Multifamily: 2 apartments	3%	1%	2%
Multifamily: 3 or 4 apartments	7%	3%	4%
Multifamily: 5 to 9 apartments	7%	3%	4%
Multifamily: 10 or more apartments	18%	8%	12%
Mobile home or other type of housing	5%	2%	3%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: U.S. Census: The American Community Survey (ACS) Public Use Microdata Sample (PUMS) 2022 1-year estimates. Note: Percentages may add to above or below 100% due to rounding.

### Window types in California homes

According to CalMTA's consumer survey, a majority of single-family and multifamily homes have some or all windows that slide open horizontally (sliding) or outwardly (casement). A total of 75% of respondents reported having at least one horizontal sliding or casement window in their home, while 53% of households had these window types exclusively. Twenty-two percent (22%) reported having vertical hung windows exclusively. And 16% reported having a combination of vertically hung and other window types in their home. A small proportion of homes had a different type of window. See Table 7.

**Table 7. Window types in California homes**

Window type	Percent of CA households
Horizontal sliding only	49%

<sup>17</sup> Through the [CalMTA Portable/Window Heat Pump Self-Installation Pilot](#), research is underway on ease of installation and customer experience and findings will be available in early 2025.



Window type	Percent of CA households
Casement only	4%
Vertical hung only	22%
Something else (i.e., awning or tilt)	2%
Mix of casement or sliding + vertical hung	16%
Mix of other combinations	7%
<b>Total</b>	<b>100%</b>

Source: Quantitative Survey Q. L2, "Which types of windows do you have in your home? Select all that apply." (Respondents shown visual prompts) (n=790).

### Saturation of portable space heating and cooling units

Additionally, the survey assessed the saturations of portable AC (portable, window, or wall ACs) and space heaters by housing type and climate region, as shown in Table 8 and Table 9. The survey found that portable devices are much more prevalent in mobile homes and multifamily housing in comparison to single-family, with 61% of mobile homes and 50% of multifamily households owning at least one portable device, compared to 25% of single-family homes. Additionally, homes in inland regions of the state had more portable coolers and heaters. (See Attachment 3: Research Instruments for more information about how respondents were mapped to climate regions.)

**Table 8. Percentage of households in California in 2024 with portable AC or space heaters by housing type (CalMTA survey)**

	Single-family	Multifamily	Mobile	All segments
<b>Room/Portable AC unit (any type)</b>	<b>13%</b>	<b>25%</b>	<b>23%</b>	<b>17%</b>
Window AC	4%	9%	9%	6%
Wall AC	2%	9%	3%	4%
Portable AC	7%	5%	4%	6%
Combination of the above AC units	0%	2%	7%	1%
<b>Space heater</b>	<b>5%</b>	<b>17%</b>	<b>4%</b>	<b>9%</b>
<b>Room/Portable AC and space heater</b>	<b>7%</b>	<b>8%</b>	<b>34%</b>	<b>9%</b>
<b>No room/portable AC or space heater</b>	<b>75%</b>	<b>49%</b>	<b>40%</b>	<b>65%</b>
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: Residential Survey Question H1, "What type of system is used to heat your home? Select all that apply." And H10, "What type of air conditioning system do you use to cool your home, if any? Select all that apply, and please do not consider fans for the purpose of this question." (n=790). NOTE: Values may sum to above or below 100% due to rounding.

**Table 9. Percentage of households in California in 2024 with portable AC or space heaters by climate region (CalMTA survey)**

	<b>Coastal</b>	<b>Inland</b>	<b>All Regions</b>
<b>Room/Portable AC unit (any type)</b>	<b>12%</b>	<b>20%</b>	<b>17%</b>
Window AC	3%	7%	6%
Wall AC	4%	4%	4%
Portable AC	4%	7%	6%
Combination of the above AC units	1%	1%	1%
<b>Space heater</b>	<b>5%</b>	<b>11%</b>	<b>9%</b>
<b>Room/Portable AC and space heater</b>	<b>11%</b>	<b>7%</b>	<b>9%</b>
<b>No room/portable AC or space heater</b>	<b>72%</b>	<b>62%</b>	<b>65%</b>
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: Residential Survey Question H1, "What type of system is used to heat your home? Select all that apply." And H10, "What type of air conditioning system do you use to cool your home, if any? Select all that apply, and please do not consider fans for the purpose of this question." (n=790). NOTE: Values may sum to above or below 100% due to rounding. See Attachment 2: Zip Code and Climate Zone Mapping for more information about how respondents were mapped to climate regions.

## 4.2 Consumer barriers and opportunities

CalMTA conducted surveys and focus groups with California residents to gain an understanding of the current use of space heaters and portable and room air conditioners (ACs), motivating factors that drive purchase decisions of new space conditioning systems, general awareness of heat pump technology, likelihood or willingness to purchase an RHP, and barriers that prevent adoption of RHPs.

### Portable heater and cooler use

Overall, 18% of total households stated that they owned a space heater (n=790), with 40% of space heater owners reporting daily use in the winter, with 94% reporting that they typically turned down or turned off any other sources of heating while they used their space heater. Overall, 25% and 15% of respondents (n=731) stated that they were either *somewhat likely* or *very likely* to purchase a new space heater in the next five years, respectively.

For cooling, 26% of households use some type of portable or room air conditioning unit (either window AC, wall AC, or portable AC) (n=790), with 48% of those respondents using it daily and 71% stating that they turned down, or off, any other source of cooling (if they had it). For those that had a portable or window unit, most reported keeping their unit AC in one place (78%) rather than moving it from room to room. Overall, 20% and 14% of all respondents (n=790), stated that they were *somewhat likely* or *very likely* to purchase a new window or portable AC in the next five years, respectively.

### Important factors in new portable space conditioning purchases

Consumers consider upfront cost, energy efficiency, and electric bills to be the most important decision making factors when purchasing a new space heater (Figure 2) or portable or window AC unit (Figure 3), followed by ease of installation and durability. Factors such as brand reputation and aesthetics were among the least cited factors; concerns about the environment and climate change also were infrequently cited.

Decision-making factors for space heaters were similar across demographics. However, there were several statistically significant differences between respondents from low-income households and non-low-income households in decision-making factors for new AC units. Upfront cost of the unit and energy efficiency were more frequently cited by low-income households than non-low-income households. Although not highly cited overall, aesthetics, brand reputation, and dual capacity were more frequently cited as important factors for non-low-income households compared to low-income households.

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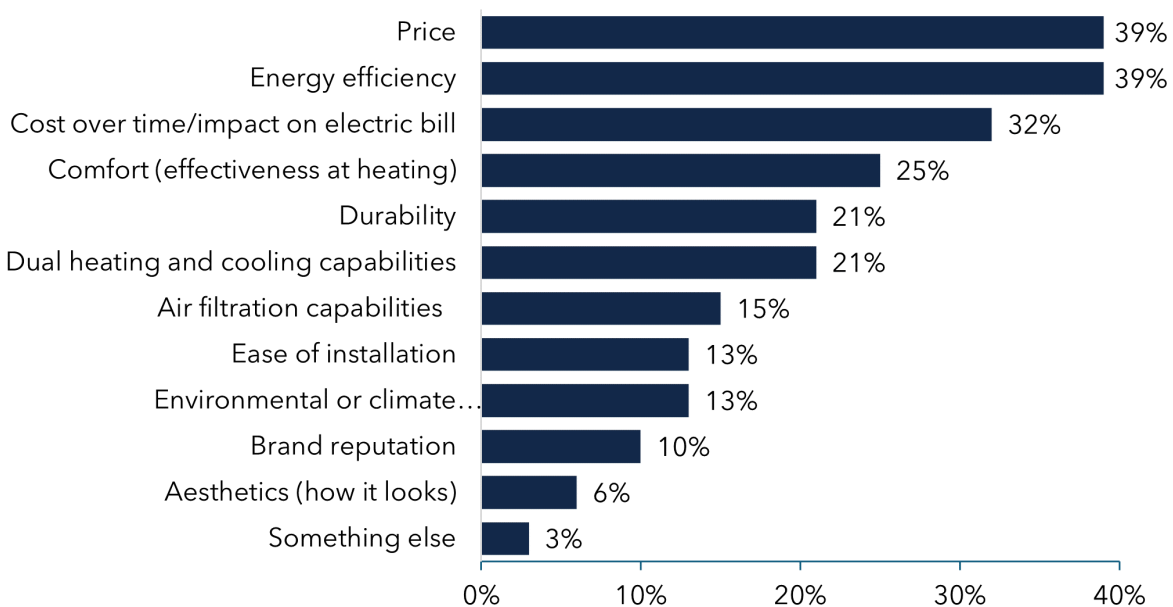
"I go to see them physically in stores to see which one convinces me. I look at the energy consumption it will have and how many watts it will consume because we have to save a little. They consume a lot of energy. You must look for something that helps you save a little money."

*-Focus Group participant on purchasing decisions for heaters and ACs*

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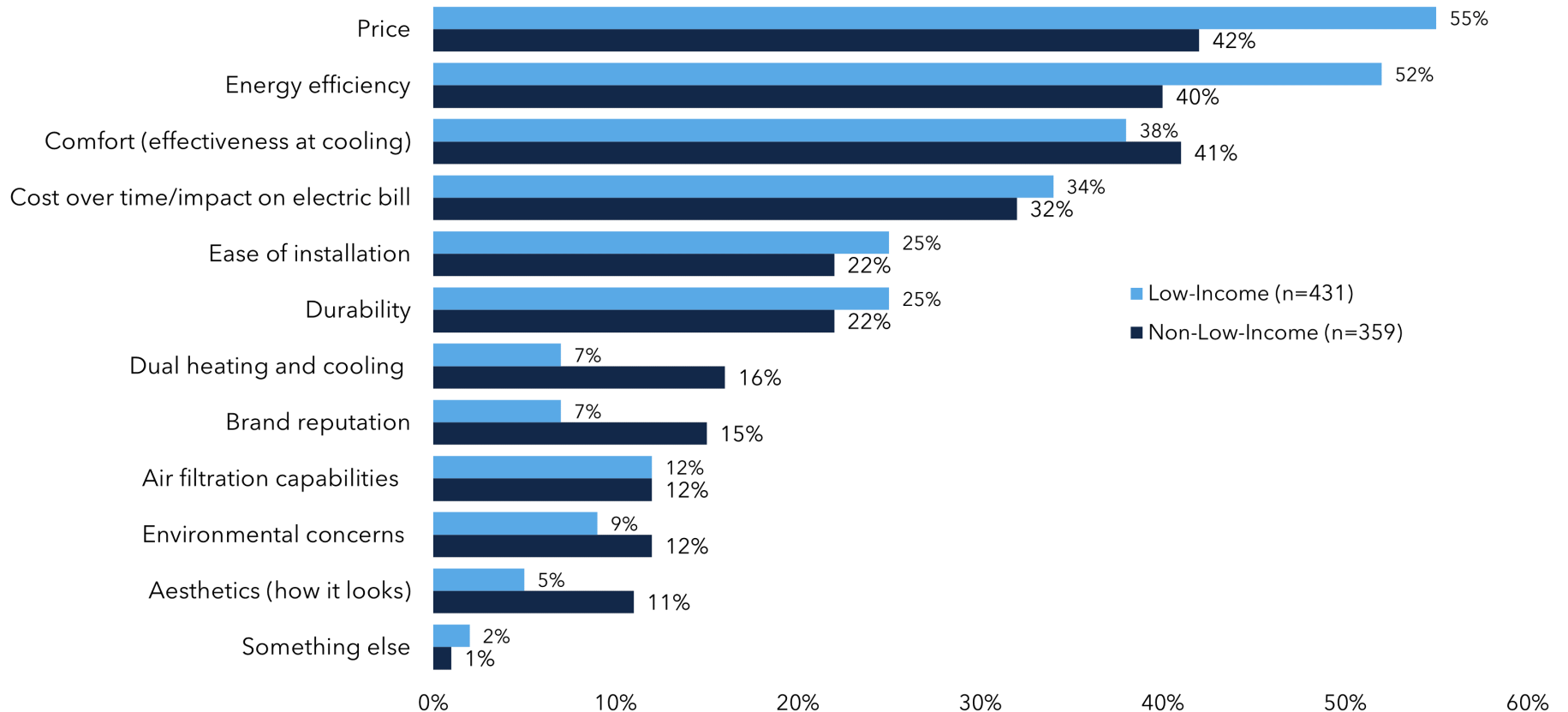
The focus group findings generally aligned with the quantitative survey on this topic, though focus group participants strongly emphasized efficiency in the context of their electric bills, stating that was one of their top factors if considering a new purchase. Focus group participants were asked to discuss their approach for researching and buying heating or cooling units, and a common theme across groups was that many participants wanted to go check out the products in brick-and-mortar stores. Some group participants mentioned specific places they like to shop for these types of appliance purchases, like Home Depot.

**Figure 2. Decision-making factors for purchasing a new space heater**



Source: Residential Survey Q. H9: "If you were to purchase a new space heater, what factors would be the most important to you? Please select up to three factors." (n =790) Multiple responses allowed; percentages add to over 100%.

**Figure 3. Decision-making factors for purchasing a new window or portable AC**



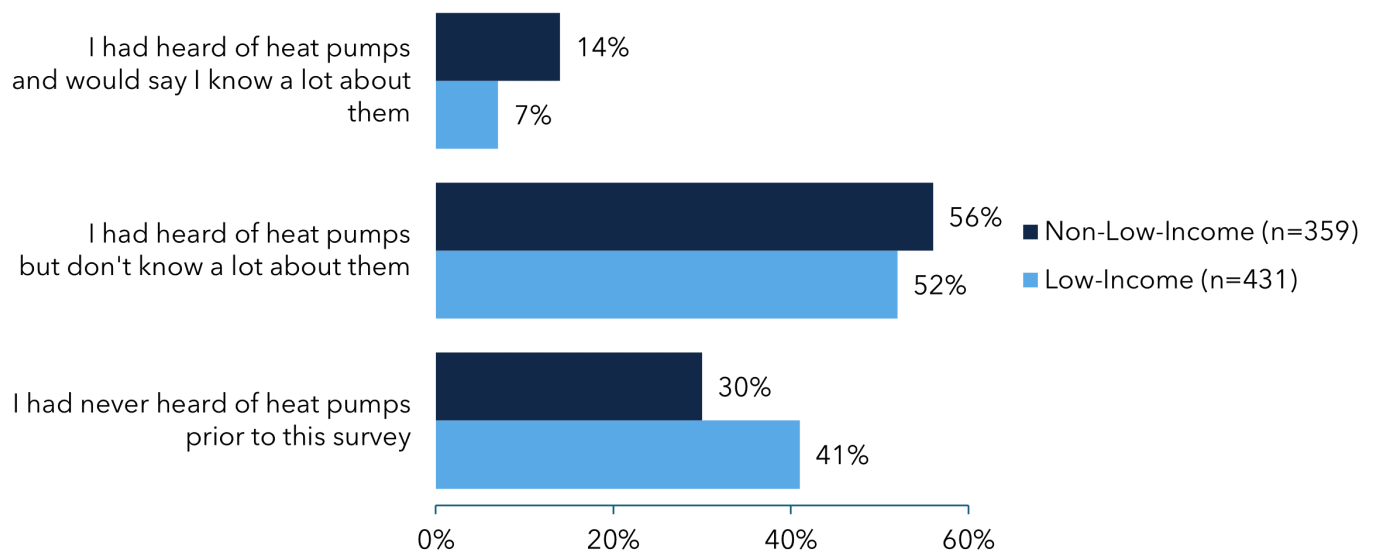
Source Residential Survey Q. I1: "If you were to purchase a room, window, or portable AC, what factors would be the most important to you? Please select up to three factors." (LI n=431; non-LI n=359). Multiple responses allowed; percentages add to over 100%. There was a statistically significant difference between low-income and non-low-income households regarding purchase decision making factors ( $p < .05$ ).

CalMTA's preliminary energy and bill impact modeling found that a 950-square-foot apartment with central AC and gas heat could see average monthly electric bill increases of \$84, depending on the climate zone, by switching to a window heat pump as the primary heating and cooling source and no longer using gas heat.<sup>18</sup> Conversely, an apartment using electric resistance heat and window air conditioning would experience bill savings in all climate zones. (The modeled impacts do not represent portable form types, which are less efficient than window types, so bill impacts would be larger in the first scenario with a portable heat pump).

### Awareness of heat pumps

Given that PHPs are a relatively new technology, the survey sought to gather a baseline awareness of heat pumps in general. Overall, 13% of households (n=790) reported knowing "a lot" about heat pumps, while 32% reported having "never heard of them" prior to the survey. There was statistically significantly lower awareness among low-income respondents compared to non-low-income respondents.<sup>19</sup> See Figure 4.

**Figure 4. Awareness of heat pumps among CA residents by income**



Source: Residential survey Q. J1: "Which statement best describes your awareness of heat pumps prior to this survey?" (LI n=431; non-LI n=359). There was statistically significant difference between low-income and non-low-income households in terms of awareness of heat pumps ( $p < .05$ ).

<sup>18</sup> For further information please see Appendix C: Product Assessment Report for Room Heat Pumps.

<sup>19</sup>  $p < .05$ .

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"It is a small heating unit for small spaces. I can't differentiate how it would be different from a heater."

- Focus group participant describing a portable or window heat pump when asked.

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For those that had heard of heat pumps, half of respondents were accurate in their assessment of heat pump functionality (i.e., a heat pump provides both heating and cooling). About one third believed that heat pumps were used only for heating (33%, n=525), with a lesser percentage believing they were only for cooling

(18%, n=525). This was consistent with what CalMTA heard from focus group participants, which was limited awareness of heat pumps, and some confusion about their function.

### Likelihood to purchase a portable or window heat pump

Respondents were asked to imagine a scenario in which they were to purchase a new space heater in the event that their heating system broke down or because they simply wanted to improve their comfort. Overall, 29% stated they were *somewhat likely* and 21% stated they were *very likely* to purchase an RHP in this scenario (n=790). There was a statistically significant difference in likelihood to purchase for heating needs between homeowners and renters, with 27% of homeowners (n=430) reporting they would be *very likely* to purchase an RHP compared to 13% of renters (n=360).<sup>20</sup>

For respondents that did not state that they were *very likely* to purchase a portable heat pump, the survey tested several scenarios to identify what might increase likelihood of adoption. Respondents were first asked whether the price of an RHP being the same or cheaper than other space heating alternatives would change their mind. The hypothetical price parity signaled a bigger jump in proportion among renters compared to homeowners, resulting in an additional 8% of homeowners stating they would be *very likely* to purchase an RHP for heating purposes, while an additional 17% of renters stated they would be *very likely* to do so.

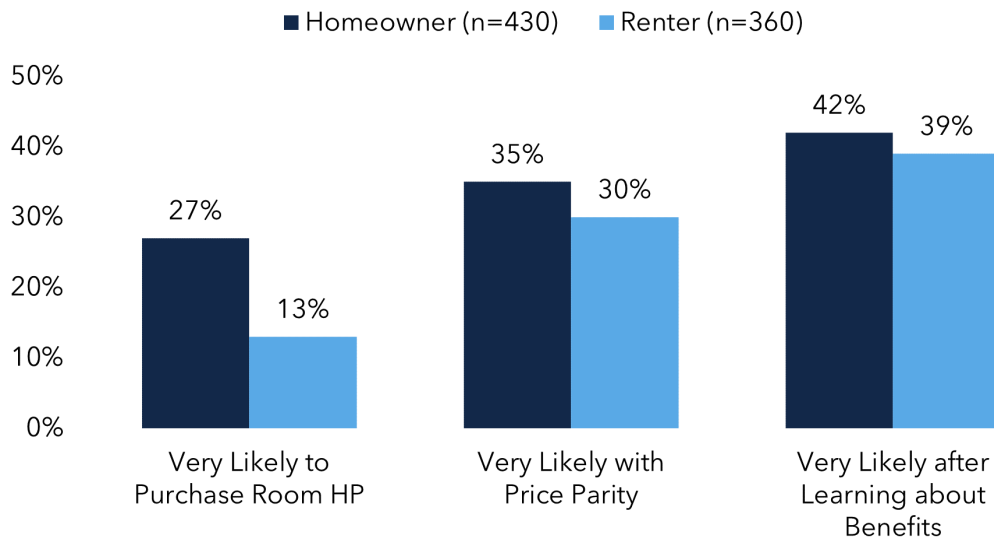
For those who did not change their response to *very likely* to purchase, a second hypothetical question asked if their likelihood to purchase would change with knowledge that PHPs are more efficient, better for the environment, and can potentially save on energy costs compared to space heaters. This resulted in increases of 7% among for homeowners and 9% among renters. Figure 5 shows the incremental increases based on the hypothetical scenarios presented, by homeownership status. After both hypothetical scenarios were posed, 42% of homeowners and 39% of renters stated that they would be *very likely* to purchase an RHP for heating purposes.

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<sup>20</sup> (p < 0.01).



**Figure 5. Likelihood to purchase room heat pump for heating purposes with interventions**



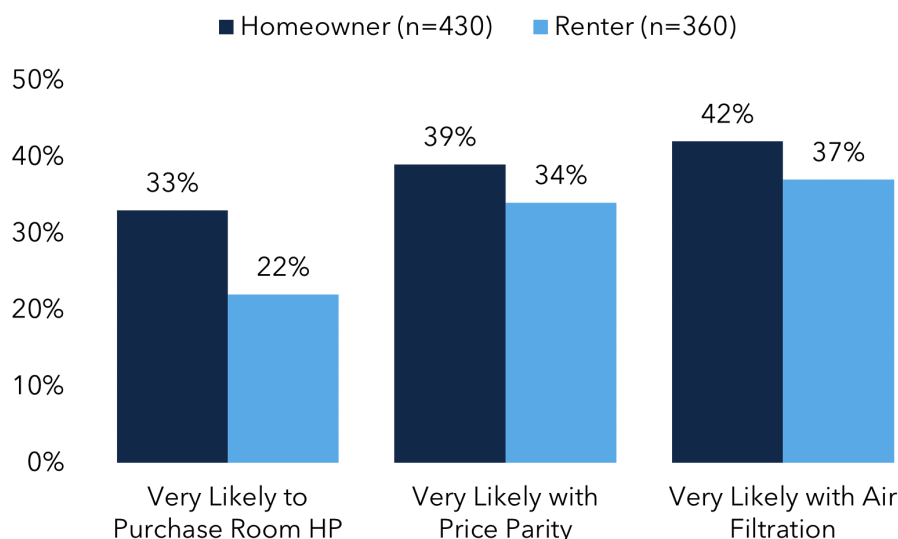
Source Q J6: "Imagine if you were to purchase a new space heater, whether that be because your heating system broke, or just simply to improve comfort. How likely would you be to purchase a portable heat pump similar to the ones shown above where 1 indicates not at all likely and 5 indicates very likely?"; Q J7: "What if the price of a new portable heat pump were the same or cheaper than other space heating alternatives, would that change your likelihood to purchase?"; Q J9: "Studies have shown that portable heat pumps are far more efficient, better for the environment, and have the potential to save energy costs when compared to space heaters. Does this information about increased energy efficiency change your likelihood to purchase? There was statistically significant difference between homeowners (n=430) and renters (n=360) and their likelihood to purchase a Room HP for heating purposes ( $p < .01$ ).

Respondents were asked a similar line of questioning for air conditioning. They were asked to imagine if they were to purchase a new window or portable AC, how likely would they be to purchase an RHP. Overall, 35% and 28% stated that they would be *somewhat likely* and *very likely*, respectively, to purchase a portable or window heat pump for cooling needs. Again, there was a statistically significant difference in likelihood to purchase based on homeownership status, with 33% of homeowners reporting being *very likely* to purchase a portable or window heat pump for cooling, compared to 22% of renters.

The price change hypothetical scenario was again posed to respondents, with an additional 6% of homeowners and 12% of renters stating they would be very likely to purchase a new RHP if the price was similar to a similar air conditioner. Again, price parity moved renters more than homeowners toward stating *very likely* to purchase. After price parity, a total of 38% of homeowners and 34% of renters reported being very likely to purchase a room or portable heat pump for cooling purposes.

A second hypothetical scenario asked respondents whether the inclusion of air filtration would change their likelihood to purchase a portable heat pump for cooling. Both homeowners and renters were moved toward *very likely* by 3% each.

**Figure 6. Likelihood to purchase room heat pump for cooling purposes with interventions**



Source Q J11: "Now imagine if you were to purchase a new window AC or portable AC, whether that be because your cooling system broke, or just simply to improve comfort. How likely would you be to purchase a portable heat pump similar to the ones shown earlier where 1 indicates not at all likely and 5 indicates very likely? Q J12: "What if the price of a new portable heat pump were the same or cheaper than other space heating air conditioners, would that change your likelihood to purchase (LI n=431; non-LI n=359). There was statistically significant difference between homeowners (n=430) and renters (n=360) and their likelihood to purchase a PWHP for cooling purposes ( $p < .05$ ).

### Barriers to adoption of portable heat pumps

Factors that would inhibit adoption of PHPs were similar to the factors that respondents cited as impacting purchasing decisions around heating or cooling units. Overall, the most frequently cited barriers to purchasing an RHP were associated with costs, specifically initial/upfront cost (35%, n=790) and the impact that the appliance would have on consumers' electric bills (30%). Another key barrier was the need for additional information (22%), which speaks to the low awareness levels of the technology reported by consumers.

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"I wouldn't like to have another piece of furniture in the house. I would prefer it to be something that could be installed in the wall because sometimes kids run around, or they might pull on this tube thing."

- Focus group participant reaction to the portable form type

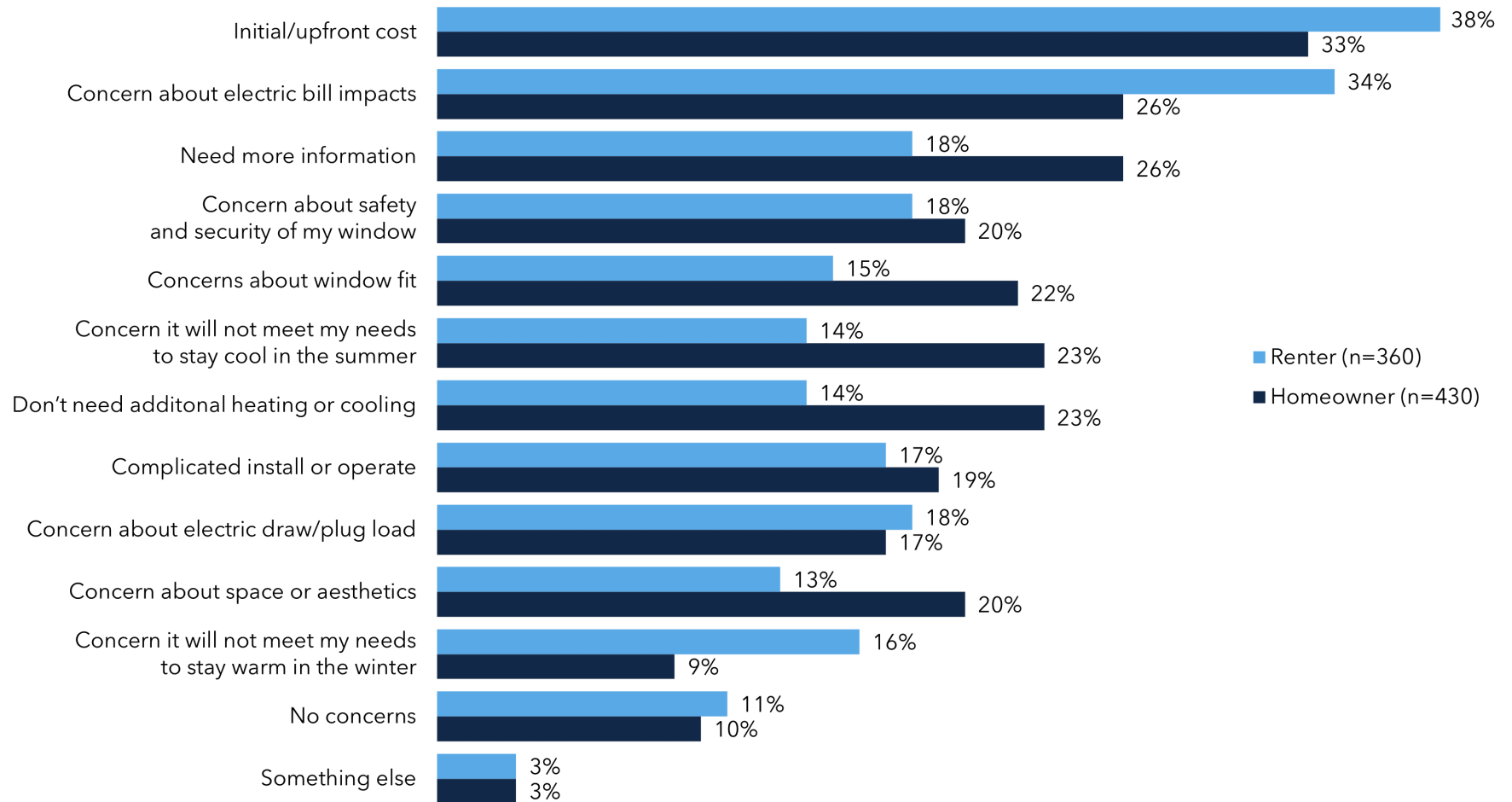
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While only 17% of survey respondents mentioned space or aesthetics based on the product images shown up above in Figure 1 of Section 1, focus group participants, who were shown images of products installed in a room, zeroed-in on this topic and discussed it widely in all of the groups. Many participants had negative reactions to the portable form type they were shown imagery of, citing concerns with bulkiness and a sharing an overall dislike of the hose attachment.

Among survey respondents, there were statistically significant differences in purchase barriers based on home ownership status (Figure 7). Renters were more likely to identify cost, both initial and long term (i.e., impact on bill) as a purchase barrier than homeowners. Owners cited the need for information, and space or aesthetics more frequently than renters. Owners also cited the concern that a portable heat pump won't meet their cooling needs in the summer more frequently than renters, whereas renters were more concerned about heating.



**Figure 7. Barriers to adoption of room heat pump by homeownership**



Source Q K1: "What factors would prevent you from purchasing a portable heat pump? Please select up to three challenges or concerns you have, if any." (Owner n=430; Renter n=360) Multiple responses allowed; percentages add to over 100%. There was statistically significant difference between homeowners (n=430) and renters (n=360) and their cited barriers to adopting a room HP ( $p < .05$ ).

## 4.3 Multifamily property manager barriers and opportunities

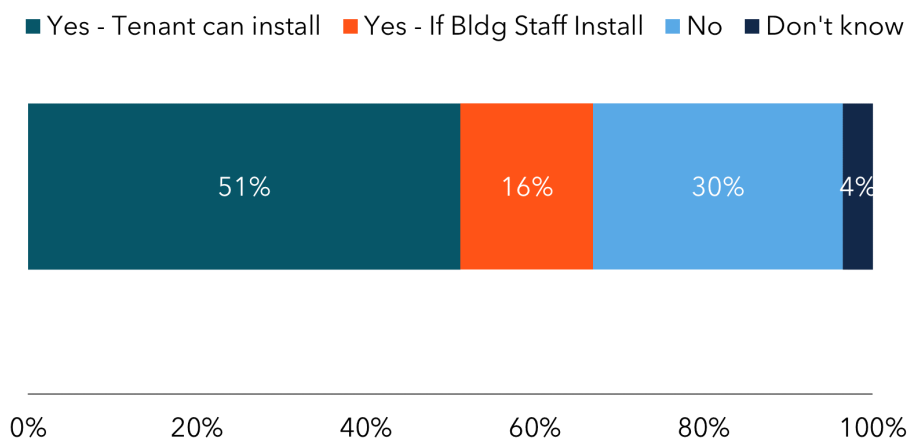
### Property characteristics

The team surveyed and interviewed two samples of California's property owners and managers to gain insights into the attitudes, preferences, and use of heating and cooling devices such as RHPs. The 100 survey respondents represented around 450 buildings located in both coastal and inland climate areas of California and represented a mix of affordable housing and market rate properties. The 15 interview respondents represented over 211 buildings with a wide range of portfolio sizes: building management varied from one to 105 buildings and between 14 and 4,300 units.

### Allowance of portable heating and cooling units in rental properties

During the in-depth interviews, some property managers raised concerns about the safety and aesthetics of window AC units (which also aligned with feedback received from California stakeholders). To follow up on this topic, the property manager survey asked respondents about policies relating to window AC units as well as space heaters, as space heaters are another equipment type often prohibited in rental units due to safety concerns. Responses were mixed. A little over half of survey respondents (58%, n=100) reported that they allow space heaters, and about half (51%) also reported that they allow window AC units to be installed by tenants. In a follow-up question for those who did not allow window AC units installed by tenants, the survey explored if a window AC was allowed if installed by the manager, building owner, or maintenance personnel. Still, of this group, most said no – an additional 16% reported that they would allow a window unit to be installed in that circumstance (Figure 8).

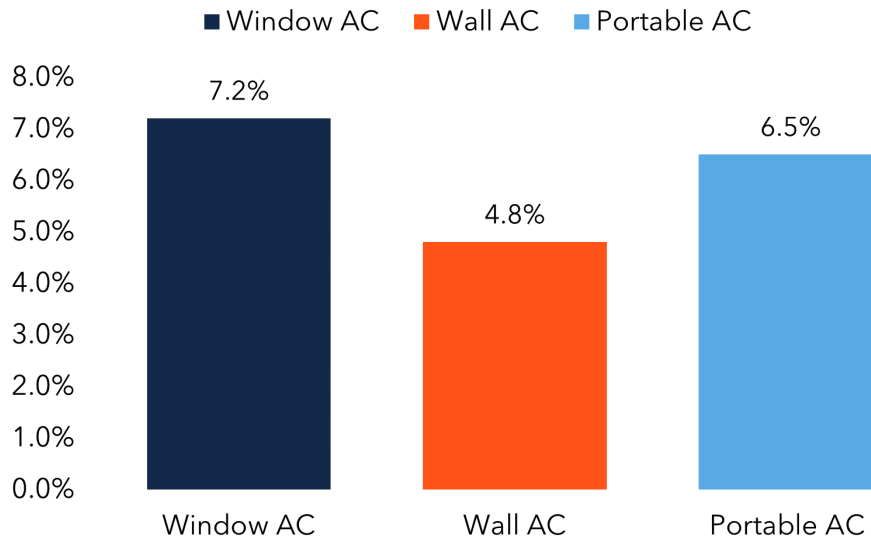
**Figure 8. Percent of property managers allowing window AC units**



Source: Property Manager Survey Question G5, "Do you allow tenants to install their own window AC unit?" (n=100) and G6, "Do you allow window AC units in your units if they are installed by the property manager, owner, or maintenance personnel?" (n=43).

The survey also found that 6.5% of rental units in California use portable AC units, 7.2% of rental units use window ACs, and 4.8% of rental units utilize wall AC units (Figure 9).

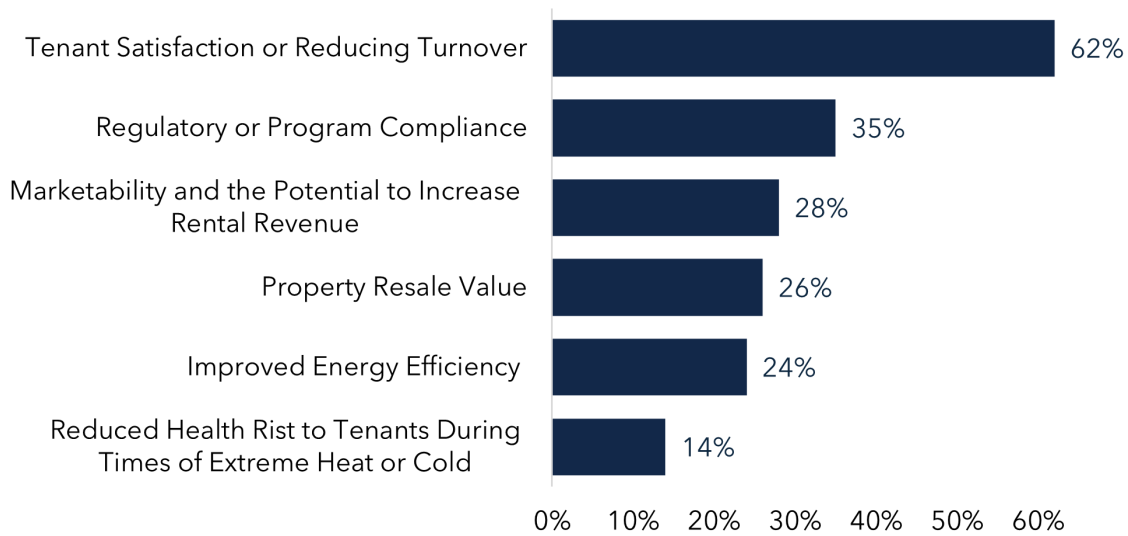
**Figure 9. Types of cooling systems used in units**



Source: Property Manager Survey Questions G2, "What type of systems are used to cool your properties, if any? Provide an estimate of the percentage of your units using each selected system. If a system is not used, leave it as 0%. The total percentage must sum to 100%. Please do not consider fans for the purpose of this question." n=91.

Of the 100 property managers surveyed, 38% reported that they had plans to add a cooling system, most of whom reported wanting to do so within the next year. When asked about the top reasons for wanting to add cooling, respondents reported they wanted to reduce turnover and increase tenant satisfaction, cited by 62%. Other reasons reported were to comply with regulations or programs, increase the marketability of their property, increase property resale value, or improve energy efficiency (Figure 10).

**Figure 10. Reasons for installing a cooling system (property managers)**



Source: Property Manager Survey Question G9, "What are the top two reasons that you plan to add cooling to your properties? Select up to two factors." (n=40) Multiple responses allowed, percentages sum to over 100%.

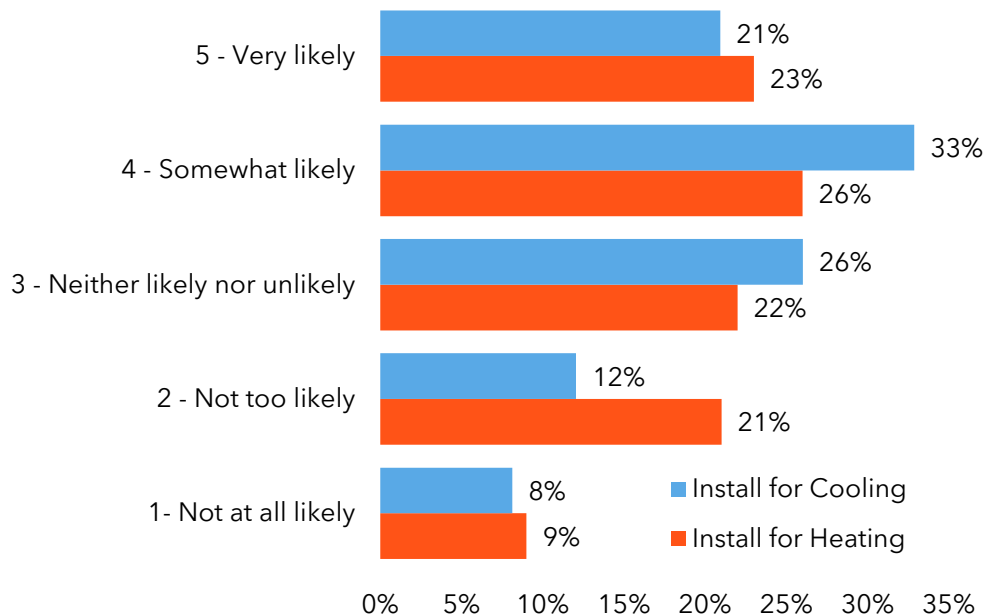
#### **Awareness and likelihood of room heat pump adoption**

Property managers had varying levels of heat pump awareness, with most having heard of heat pumps prior to the survey (respondents were asked about heat pumps broadly, not RHPs specifically). When asked follow-up questions to identify what they knew of heat pump function, 63% (n=75) properly identified that heat pumps provide both heating and cooling, while 33% thought that heat pumps only provide heating.

Similar to the residential customer survey, property managers were provided further information about heat pumps and imagery of RHP models, followed by questions about their willingness to purchase and install in their rented properties for heating and cooling purposes. Results for both uses were similar. When asked if property owners would consider purchasing an RHP for heating purposes, about half of respondents (49%, n=100) of respondents reported they would be *somewhat* or *very likely*. Similarly, 54% reported they would be *somewhat* or *very likely* to install an RHP if they were to add cooling (Figure 11).



**Figure 11. Property manager likelihood of installing a room heat pump**



Source: Property Manager Survey Questions H13, “Now imagine if you were to purchase a new window AC, or portable AC, whether that be because a cooling system broke or just simply to improve comfort. How likely would you be to purchase a portable heat pump similar to the ones shown earlier?” (n=100).

### Perceived benefits

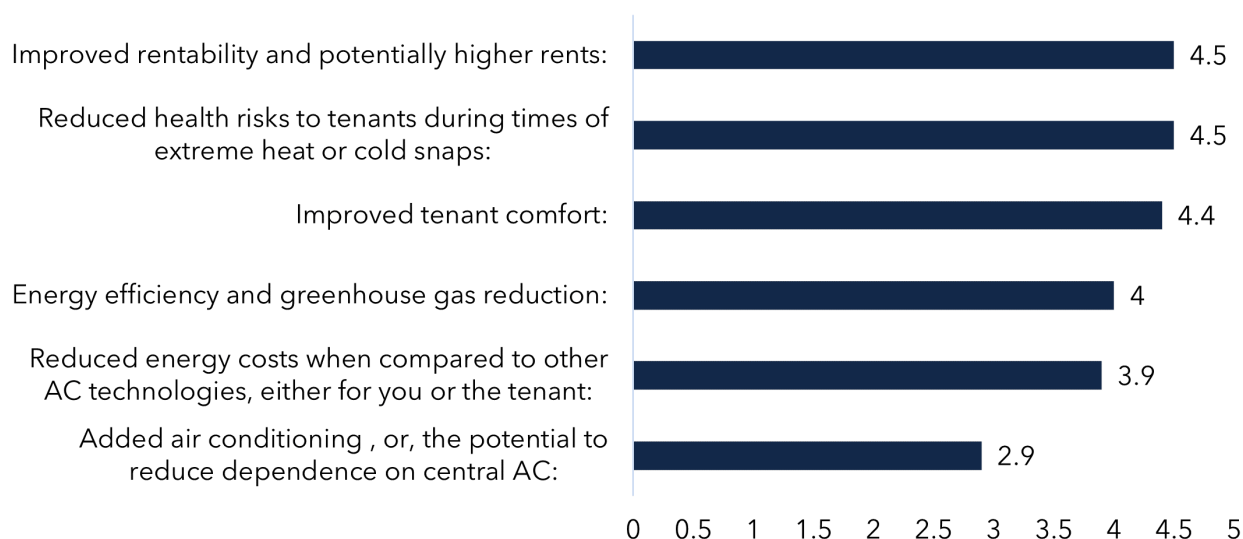
In in-depth interviews, the team asked respondents who said they would be willing to consider adopting room pumps what they saw as the primary benefits for doing so. Similar to the reasons for installing added cooling, property managers liked the fact that adding an RHP would improve tenant comfort and satisfaction, and they also saw particular value in the idea of installing RHPs as a temporary cooling solution. Respondents’ unprompted reasons for considering the adoption of RHPs (n=7) were as follows:

- Tenant comfort/convenience (2 respondents):** Two cited tenant comfort and portability of the heat pump as benefits. They saw PHPs as offering tenants more control over their indoor environment, as they perceived the portable units as being easily moved from room to room, allowing tenants to condition specific areas of their living space according to their needs. These respondents also liked that PHPs were easier to store when not in use, giving tenants the option to use them only when necessary, such as during particularly hot or cold periods. Overall, these respondents saw portability as a desirable feature that could enhance tenant satisfaction and overall experience.
- Rentability (2 respondents):** Two respondents thought that apartments equipped with PHPs would be easier to market and rent out; one stated, “It’s going to be much easier to rent apartments with that.” They emphasized the importance of providing a reliable heat source to ensure habitable living conditions and maintain rent collection.

- **Short-term, easy solution (3 respondents):** Three respondents said PHPs could be a short-term solution or temporary fix. One property manager said that when a heating system malfunctions in a unit, tenants require a portable heating solution. “If we're again waiting for a repair to their main source of heat or cooling, then this would be a great option.” While acknowledging the risks associated with traditional space heaters, such as fire hazards, the interviewee was more comfortable with PHPs due to their perceived lower risk. Another property manager said that PHPs could serve as a temporary solution during repair periods for main heating or cooling systems, emphasizing the value of easy installation and that they do not require professional installation. One property manager mentioned PHPs could be a viable option to provide comfort to tenants and comply with potential regulatory requirements, especially in older buildings where installation of new central systems pose unique challenges.

Separately, CalMTA also provided all in-depth interview respondents (n=15) with a list of potential benefits of RHPs and asked them to rate how important each benefit was to them on a scale of 1 to 5, where 1 one was *not important at all* and 5 was *very important*. Figure 12 shows that while added air conditioning and reduced energy costs were moderately important, factors like rentability and higher rents, tenant comfort, and health risks reduction were highly prioritized by property managers.

**Figure 12. Average importance rating of room heat pump benefits by property managers**



Source: In-Depth Property Manager Interview Guide Question H5. “I’m going to read a list of benefits associated with portable heat pumps. Please rate how important each one is to you, as a property manager on a 5-point scale, where 5 is very important and 1 is not important at all.” n=14.

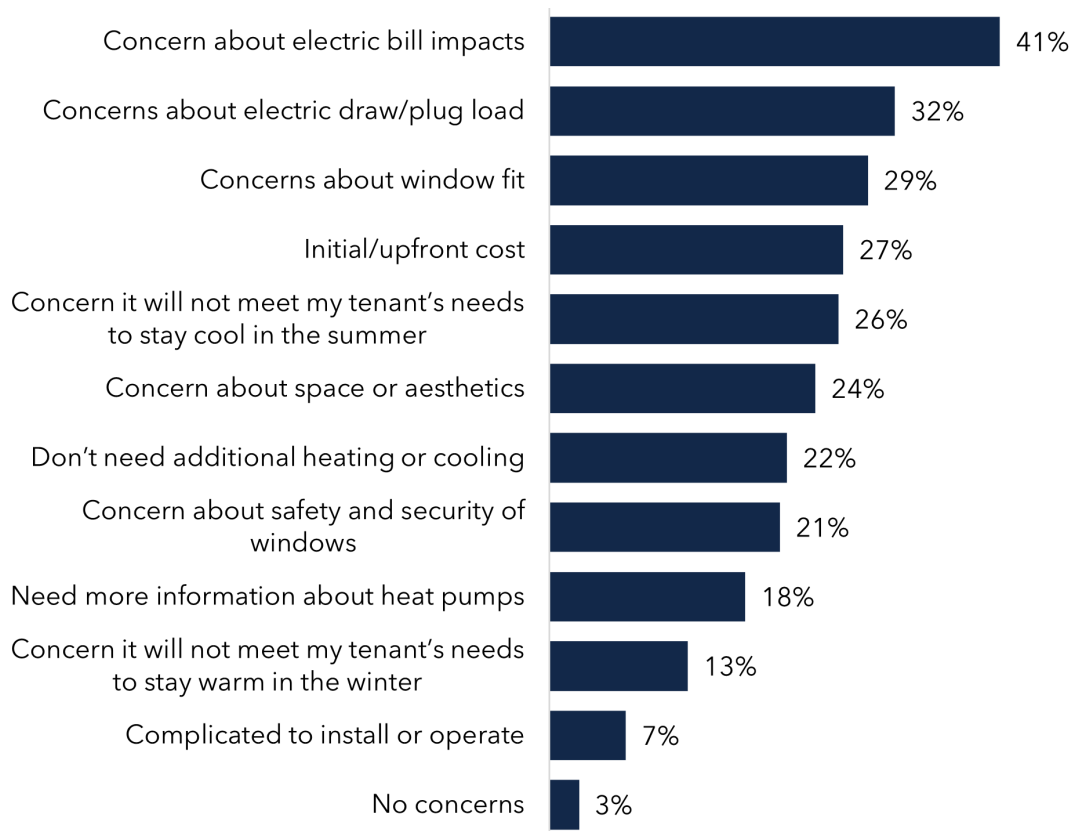
### Barriers

Survey and interview respondents were asked questions about the barriers to purchasing RHPs. The most common concern reported in the survey was increased electric bill impacts

(41%, n=100) followed by: electric draw or plug load, window fit, and cooling performance (meeting tenant needs to stay cool in the summer) – as shown in Figure 13.

Interview respondents were most concerned about the initial cost of RHPs, with 5 of 15 citing cost as their number one concern. The interview respondents also had concerns regarding safety of window units and window fit, and whether the heat pump would provide sufficient heating or cooling. As one respondent noted in response to being asked what the challenges were with installing RHPs: “The window aspect and then the aesthetics of it... just how big they are and then anything window-wise, the potential safety of them, like actually falling out of a window.”

**Figure 13. Barriers to room heat pump installation reported by property managers**



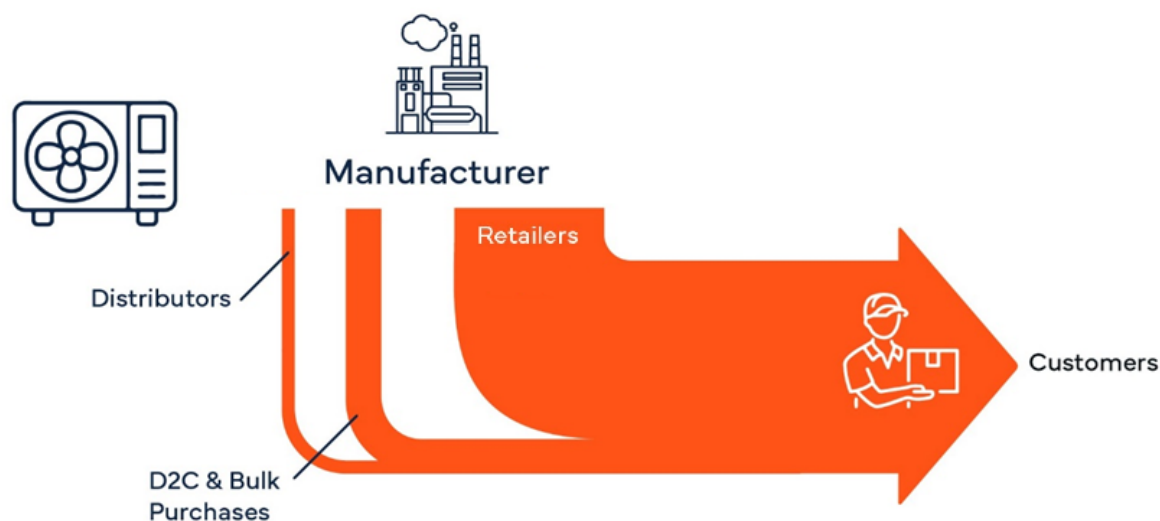
Source: Property Manager Survey Question I1, “What factors would prevent you from purchasing portable heat pumps? Please select up to three challenges or concerns you have.” (n=100) Multiple responses allowed, percentages sum to over 100%.

## 5 Supply side characteristics

### 5.1 Supply Chain Map

The two manufacturers interviewed identified the various sales channels they rely upon to sell their products, including sales to retailers, distributors, multifamily property managers, utility program managers, and direct to customer. Sales channels were dependent on company size and established presence in the market.

Figure 14. Manufacturer to consumer supply chains



- **Retailers.** One manufacturer of RHPs shared that the retailers that they engage with are primarily the larger big box retailers, including Walmart, Target, Home Depot, and Lowes, as well as major online retailers.
- **Distributors.** One manufacturer confirmed use of regional distributors and while they declined to discuss the share of their own sales, offered that across the industry, approximately 10% of sales of portable and room ACs occur through distributors.
- **Direct to consumer and bulk purchase customers.** Both manufacturers interviewed discussed engaging in some direct-to-consumer opportunities. One manufacturer communicated this as a smaller channel, while the other shared that all of their business, for the time being, has been moved to focus on selling direct to large customers purchasing in bulk for portfolios of buildings, such as multifamily property owners or managers, and utility program managers.

One manufacturer shared that while they use all three sales channels discussed above (direct to consumer, distributor, and retail), the channel is somewhat dependent on product type and size. They shared that a high percentage of their larger AC products (12,000 BTU, 18,000 BTU units) move through distributors, whereas retailers move most of the units under 12,000 BTU capacity and are therefore the main channel for smaller portable and window units. They noted that distributors are used for larger products that often require professional installation. While true for this manufacturer's supply chain, the CalMTA team did identify several models of RHPs available to purchase through online retailers with 12,000 BTU capacity.

## 5.2 Pricing and market competition

CalMTA conducted secondary research into retail pricing of room and PHPs. Findings of this research are summarized in Table 10. Portable and window heat pumps on the market currently have prices ranging from \$330 to \$3,800. Prices generally trended higher than stand-alone window AC units and space heaters but were closer to prices of portable ACs on the market. Depending on factors such as features, form type, capacity, and efficiency levels, consumers can encounter RHPs that cost more than economically priced space heating and AC units combined but may find economies of scale in some models.

**Table 10. Prices per unit, not including installation costs**

Use	Equipment type	Median price	Range
<b>WINDOW AND PORTABLE HPS</b>			
Space Heating & Cooling <sup>1</sup>	Window HP	\$510	\$330 - \$1550
	Portable HP	\$560	\$400 - \$660
Space Heating & Cooling <sup>2</sup>	Window HP (New Technology; Gradient and Midea)	N/A	\$3000 - \$3800
<b>Competing technologies</b>			
Space Cooling <sup>1</sup>	Window AC	\$390	\$350 - \$530
	Portable AC	\$550	\$450 - \$650
Space Heating <sup>1</sup>	Electric Baseboard Heater	\$170	\$110 - \$200
	Gas Wall Furnace	\$940	\$400 - \$1275
	Portable Space Heater	\$110	\$65 - \$180
Space Heating & Cooling <sup>3</sup>	Single-Zone Ductless Mini-Split Heat Pump	\$1500	\$700 - \$3000

Sources:

(1) CalMTA review of retailer websites, including Home Depot, Lowe's, Amazon.com® and WalMart® in the third and second quarters of 2024.

(2) Products under development by Gradient and Midea in partnership with the New York City Housing Authority Clean Heat for All Challenge. Retail purchases not available. Price range based on best available knowledge.

(3) Review of product listings on HVACdirect.com and SME interviews. Price range dependent on size, efficiency, and temperature performance. The pricing in the table for single zone ductless mini-split heat pump excludes installation costs.

The research also found that the prices of most units are substantially lower than installing a single-zone ductless mini-split (prices in Table 10 do not reflect installation costs), with the

exception of new cold-climate saddlebag window models being developed by Gradient and Midea in partnership with the New York City Housing Authority Clean Heat for All Challenge. These products cost more than incumbent RHPs because they employ a variety of technologies to achieve robust heating performance down to 0°F and they are a new form factor. This includes inverter-driven cold climate compressors, larger heat exchangers, active defrost control, and meltwater management.

Manufacturer perceptions of their products' competitive positioning varied. For example, one manufacturer felt that the price of RHPs was unlikely to fall below separate portable space heaters and room or portable air conditioning units. They saw this as a potential barrier to growing market adoption, considering the importance of first-cost to the consumer. Conversely, another manufacturer did not consider traditional portable ACs, room ACs, or space heaters as their competition in the marketplace, and therefore reported feeling confident in their product's price point within the niche category of heat pumps. With regards to their market positioning, this interviewee stated, "our customers choose our product because they want a heat pump. We are very clear that what we are selling is a heat pump."

Manufacturer interviewees also differed in price forecasting. One manufacturer estimated prices of their portable and window heat pump products were relatively stable, but unlikely to go down and likely to increase with inflation. A manufacturer reported that their product's price (currently in the higher end of the above price range) would likely be able to come down as the market matures and incentives gain traction, to that of approximately 1.5 times the retail unit price of a single-zone high-efficiency mini-split heat pump. This assumption was based on their estimate of growing economies of scale in the production process.

### 5.3 Retail availability and visibility

The stores that CalMTA shoppers visited did not stock any room or window heat pumps, and the sales associates did not know what these products were. Shoppers explored specific areas of interest, such as associates' preferred/recommended brands, their approach in discussing products with customers, and the features they recommended. Despite inquiries made to multiple associates at each store, none possessed any substantial information about heat pumps, and some did not know about AC products that offered dual heating and cooling at all. For example, when asked about a heat pump, one associate replied *"Oh, it heats and cools? I've never seen that. That sounds interesting."* The team did find two AC models that were labeled as having a cooling and heating mode, but after a technical review could not confirm whether the ACs were using reverse cycling (i.e., heat pump technology) or resistant heat.

#### Promotional messages for ACs

Promotional content and messaging that the team observed in stores was largely consistent across brands. Each brand emphasized the multifunctionality of their units, highlighting the 3-in-1 feature (AC, dehumidifier, and ventilation). (Two units offering a heating mode labeled

themselves as 4-in-1). Some units also advertised the units' efficiency, connectivity to smartphone apps, and quiet operation.

#### Availability of room heat pumps online

The CalMTA team also completed an online search for RHPs. A key finding from this research was that products are labeled inconsistently and do not contain standardized specifications to assist with comparison. The lack of clear product labeling makes it difficult for consumers to identify them for purchase. Despite variations in product names, specifications, webpage descriptions, and manuals, CalMTA identified 31 portable or window HP models through a technical review of product specifications online to verify the use of reverse-cycling. Of these 31 models, the Team found 16 available for purchase online on Big-Box retailer websites, such as Lowe's®, Home Depot®, Best Buy® and WalMart®, though they were not always labeled as heat pumps (other models were found on manufacturer websites). As shown in Table 11, certain brands manufacturing a large number of window and portable heat pump models were not well-represented in the brick-and-mortar locations, but occupy a larger presence online.

**Table 11. Room heat pump models available online**

<b>Brand (Manufacturer)</b>	<b>Number of models</b>	<b>Models available online at major retailer</b>	<b>Form</b>
Danby	5	4	Portable
Whynter	3	2	Portable
Arctic Wind	2	2	Portable
Soleus Air	2	1	Portable
Black & Decker	1	1	Portable
Freonic	1	1	Portable
Perfect Aire	1	1	Portable
Whirlpool	1	1	Portable
Della	1	1	Portable
Frigidaire	1	0	Portable
GE	1	0	Portable
Hisense	1	0	Portable
Honeywell	1	0	Portable
LG	1	0	Portable
Friedrich	3	1	Window and Portable
Midea	3	0	Window and Portable
Keystone	2	1	Window
Gradient	1	0	Window
<b>Total</b>	<b>31</b>	<b>17</b>	

### Product names and labels

Product names and labeling of RHPs were inconsistent, and most do not clearly identify whether they are heat pumps. Product names among PHPs models included “Portable AC,” and “Portable Air Conditioner with 9,500 Heating BTU,” and window heat pumps had product names including “Window AC” and “Room Air Conditioner and Heater.” In some cases, the product descriptions mentioned heat pumps, but not in all cases. Stakeholder interviews found that other program administrators who have a history of working with this technology also observed market barriers relating to unclear product labeling in their jurisdictions.

One manufacturer shared that they were not aware of clearly marketing their AC products that utilized heat pump technology as “heat pumps,” though expressed interest in the idea of this and thought it had potential value.

## 5.4 Supply side market barriers and opportunities

Manufacturers reported that slow product innovation due to supply chain challenges and an immature market, current form factors, uncertainty on refrigerant regulations, and retail price of the units all presented barriers to increased market adoption in California.

### Challenges to technical product improvements to fit CA needs

One manufacturer focusing on window heat pumps acknowledged the gap in the market for units designed for horizontal slider or casement windows in California. They noted that their product would require a full redesign in order to accommodate slider windows, but also mentioned that it is technically feasible (including for cold climates).

Under the new Heating Test Procedure released by ENERGY STAR, manufacturers are also having to make choices about the range of climate-capable products to manufacture, noting that all-weather models are larger/heavier, more complex, and therefore more costly to produce and ship. More information from manufacturers is needed regarding their perspectives on the specific costs for producing Type 2 and Type 3 models which are most relevant for California climate zones, as the specification was released after the interviews.

- **Scale.** One manufacturer noted that the supply side costs of producing multiple products for various climates is a barrier to product innovation, reporting that it would be consolidating its offering of RHPs to all-weather products only by the end of the year (products will be marketed as “all climate”). This respondent said the overhead costs of producing multiple products are too high based on their current factory partners and limited manufacturing capacity.
- **Product size.** Another manufacturer stated that they saw issues with moving larger products, so they have been hesitant to invest in R&D for cooler climate products without clear demand signals. They reported that efficient all-weather function would require products to have larger chassis, which would in turn make the product perceived as less desirable by consumers and make retailers less interested in stocking them. This



respondent noted the current supply chain dynamic is one which smaller HVAC appliances are sold through retail which is better for their margins, and larger products rely more on the use of distributors, which is more expensive. Both manufacturers aligned on the fact that product size was a barrier in terms of marketing and moving product. One spoke to the challenge of balancing the need for a self-install product with the reality that better performing units are heavy and require multiple people to install. They noted they would like to see larger products be carried by big box retailers who could offer at-home delivery services as they do currently for other large appliances to help overcome this barrier. This would be a shift from how portable and window AC products are currently sold.

- **Heating efficiency standards.** One manufacturer noted the absence of standards to date has also reduced the availability of products to suit cooler climates. They shared it was much more straightforward and affordable to make a mild climate heat pump product that emphasized cooling over heating performance, and that without federal heating efficiency standards to guide their product design and promotion, they have not invested in this technology improvement.

#### Uncertainty on supported refrigerants

As of January 2023, new room and portable/wall air-conditioning equipment using refrigerants with a GWP of 750 or greater are prohibited in California,<sup>21</sup> and additional restrictions are anticipated to be set in the future. Multiple stakeholders and manufacturers emphasized the need for clarity around refrigerant and GWP requirements to support efficient development and production of RHPs.

One manufacturer shared they would like to start making an RHP product using R290 (propane) but are currently barred from doing so due to Underwriters Laboratories (UL) and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 15 standards,<sup>22</sup> despite the review of R290's potential use currently underway in UL and ASHRAE committees (which are advocating for its use). They shared their perspective that the two options for meeting new standards are use of hydrofluoroolefins (HFOs) or R290, and they do not currently want to pursue use of HFOs due to the uncertainty around HFO creation of synthetic chemical compounds, and other potential health and safety concerns. The interviewee emphasized that the uncertainty added complication to product development.

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<sup>21</sup> See California Code Regs. Tit. 17, § 95374 <https://www.law.cornell.edu/regulations/california/17-CCR-95376> and "Air-conditioning Equipment," California Air Resources Board website, <https://ww2.arb.ca.gov/our-work/programs/california-significant-new-alternatives-policy-snap/air-conditioning-equipment>.

<sup>22</sup> "The UL484 limitation of 114 grams for A3 refrigerants in room ACs (UL, 2017) effectively precludes the use of propane in all but the smallest window AC (such as Shen and Fricke 2019) and PTAC/PTHP units." See *Benefits and Challenges in Using Low GWP A3 Refrigerants in Residential Air Conditioning Equipment*, California Energy Commission May 2024. <https://www.energy.ca.gov/sites/default/files/2024-05/CEC-500-2024-043.pdf>. See also ASHRAE Standard 15 Safety Standards for Refrigeration Systems.

One manufacturer also pointed out that there is potentially a case to be made for allowing higher GWP refrigerants in certain types of products with lower potential for refrigerant leakage. The manufacturer mentioned that since their product is charged at the factory and hermetically sealed, with no charging in the field (the charging of the unit matches the lifetime of the unit), there is much less concern for leakages, in comparison to ductless mini-split systems.

### Retail cost

Both manufacturer interviewees acknowledged that retail costs are a barrier. One reported, “Window ACs and portable ACs are among the most price-sensitive segments we sell into, when you consider the limited range of models produced in this segment. [In contrast,] for kitchen appliances, we have our “hot plate” brand, all the way up to [luxury brand]. [Luxury]... customers don’t exist in this segment.” This respondent noted that they are pursuing heat pump products largely due to policies directing investment and promising incentives, stating that they don’t believe consumers will pay the incremental cost of a heat pump product above a room or portable AC.

### Opportunities for market growth

- **Technology competitions and bulk purchasing.** One manufacturer shared that they did not participate in NYSERDA’s Clean Heat for All challenge, but could be interested in a challenge in California, in part due to the milder climate. One manufacturer suggested that a commitment to a bulk purchase (the manufacturer estimated in the range of 10,000 to 20,000) could support the development of a new solution for horizontal slider or casement windows, and that better data on the prevalence of different window types would also be a useful market signal.
- **Upcoming standards and federal tax incentives, and state, local and utility programs.** Manufacturers identified policy and voluntary programs as major drivers in the acceleration of technology development and market demand, due to the strong signals they send to manufacturers. Specifically, one manufacturer shared that increased heat pump interest due to IRA funding had spurred them to develop new heat pump-equipped products. Another stated the opportunity for federal incentives was what motivated them to bring RHPs to market at all (versus products with electric resistance heating).

Manufacturers recognize that the finalization of a new RHP ENERGY STAR heating test procedure and subsequent specification through the CEE expected in early 2025 will unlock qualification of RHPs under IRA program paths. Because utilities and other program administrators often look to CEE as a guide in their incentive program eligibility criteria, manufacturers anticipate that this will qualify their RHPs for additional voluntary incentive programs around the country, noting they have already seen an increased interest in RHPs from various program administrators in the Northeast and the Northwest. Grants for R&D and partnerships with national labs were also cited as critical for product innovation to-date.



Although the upcoming CEE specification for IRA qualification was seen as a very large opportunity by manufacturers, one noted some concerns with the direction of these discussions. They stated that some efforts to push the efficiency threshold for what qualifies for tax credits will create delays in market growth, given that manufacturers had made their plans based on the previous efficiency requirements. They guarded against anything that would cause a lack of IRA-qualifying equipment in the market, which they predicted would slow heat pump adoption for the next 1-2 years as manufacturers “caught up.”



# Attachment 1: Weighting Methodology

Weighting is a statistical technique used as a means of adjusting the representativeness of the sample to reflect the actual population of interest. The goal of applying weights is to extrapolate results from the sample to the population. CalMTA applied weights to the residential survey and the property manager survey, based each survey's respective target population and sample target variables. For the residential survey, the goal was to ensure that the survey was representative of all households in California. For the property manager survey, the goal was to ensure that the survey was representative of all rented households in California.

## Weighting variables

### Residential survey

The team selected six target variables to use for weighting for the residential survey, based on available data. The population used for the residential survey was 13,550,586 households, which is the total number of households in California.<sup>23</sup>

**Table A1. Population proportions for variables used in weighting for residential survey**

Variable	Stratum	Population proportion	Source
Homeownership rate	Owner	55.8%	<a href="#">ACS DP04 - Selected Housing Characteristics</a>
	Renter	44.2%	
Climate region	Coastal	34.7%	<a href="#">CA Energy Commission</a>
	Inland	61.0%	
	Desert	4.3%	
Electric utility	SDG&E	9%	<a href="#">EIA: Annual Electric Power Industry Report</a>
	PG&E	36%	
	SCE	33%	
	SMUD	4%	
	LADWP	10%	
	Other	7%	
Single-family vs. multifamily	Single-family	64.6%	<a href="#">ACS DP04 - Selected Housing Characteristics</a>
	Multifamily	31.8%	
	Mobile homes and other	3.6%	
Income status - granular	Less than \$25,000	13.6%	<a href="#">ACS S1901 - Income in the past 12 months</a>
	\$25,000 to \$49,999	14.4%	
	\$50,000 to \$74,999	13.8%	
	\$75,000 to \$99,999	12.0%	
	\$100,000 to \$149,999	17.6%	
	\$150,000 to \$199,999	10.6%	

<sup>23</sup> [U.S. Census Bureau: California Total Households by Occupancy Status](#)

Variable	Stratum	Population proportion	Source
	\$200,000 or more	18.0%	
Income status - broad	Low Income	12.2%	<a href="#">ACS S1901 - Income in the past 12 months</a>
	Not-Low Income	87.8%	

### Property manager survey

The team used two variables to weight the property manager survey. The population used for the property manager survey was 5,777,597, which is the total number of rental dwellings in the state (CalMTA used rental dwellings as the population for property managers because each respondent represents units that they manage).<sup>24</sup>

**Table A1. Population proportions for variables used in weighting for property manager survey**

Variable	Stratum	Population proportion	Source
Electric utility	SDG&E	9%	<a href="#">EIA: Annual Electric Power Industry Report</a>
	PG&E	36%	
	SCE	33%	
	SMUD	4%	
	LADWP	10%	
	Other	7%	
Single-family vs. multifamily	Single Family	35%	<a href="#">ACS DP04 - Selected Housing Characteristics</a>
	Multifamily	65%	

### Weighting methodology

To apply the weights, CalMTA used a method called raking, or iterative proportional fitting. Like the tool working the soil in alternate directions till it's smooth, the raking method adjusts weights over several iterations to get the distribution of the weighted survey sample to align with the distribution of the population, based on the selected characteristic variables. Raking is relatively simple to implement, only requiring the population and sampling distributions for each variable chosen for the weighting scheme. According to the Pew Research Center, raking is the standard weighting method that they and many other public pollsters use.<sup>25</sup>

The team utilized R to generate the survey weights, specifically the *rake* function from the "survey" package. The function takes in the sample distribution (counts) for the target variables along with the population distribution (counts) of the same target variables to generate the final weights. The number of iterations required to generate the weights depends on the number of target variables. Since six target variables were chosen, the team set the maximum iterations to 20 to ensure convergence to weights that most balance out the survey data.

<sup>24</sup> [U.S. Census Bureau: 2022 1-Year American Community Survey PUMS file - csv\\_hca.zip](#)

<sup>25</sup> Mercer, et al. (2018). *How Different Weighting Methods Work*. Pew Research Center. Retrieved from <https://www.pewresearch.org/methods/2018/01/26/how-different-weighting-methods-work/>.

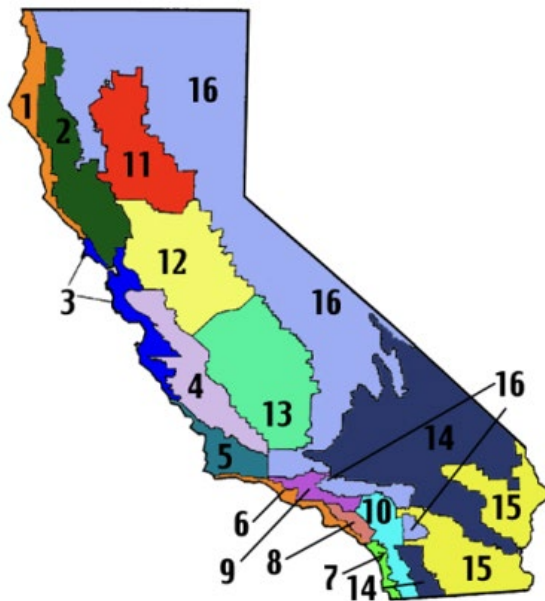
# Attachment 2: Zip Code and Climate Zone Mapping

CalMTA characterized the residential customer and property manager survey samples by key characteristic variables such as climate zones and regions. To identify the climate zone for the survey sample, we applied the California Energy Commission (CEC) mapping of zip code to California Building Climate Zones.<sup>26</sup>

CalMTA then developed broader definitions of climate regions for the survey sample by mapping the CEC climate zones to regions, as identified by the CPUC *Impact Evaluation of Water Heating Measures* report.<sup>27</sup> These climate regions are:

1. **Coastal/Mild Climate Region:** Includes CEC climate zones 1, 2, 3, 4, 5, 6, 7, and 16. These areas have moderate temperatures (see Figure B1).
2. **Inland Climate Region:** Covers climate zones 8, 9, 10, 11, 12, and 13, where residents experience hotter summers and colder winters.
3. **Desert Climate Region:** Includes climate zones 14 and 15.

Figure B1. CEC Climate Zones<sup>28</sup>



<sup>26</sup> <https://www.energy.ca.gov/media/3560>

<sup>27</sup> DNV. (2019). *Impact Evaluation of Water Heating Measures*. Retrieved from [https://www.calmac.org/publications/CPUC\\_Group\\_A\\_Report\\_Water\\_Heating\\_PY\\_2019\\_Final\\_CALMAC.pdf](https://www.calmac.org/publications/CPUC_Group_A_Report_Water_Heating_PY_2019_Final_CALMAC.pdf)

<sup>28</sup> California Energy Commission. (n.d.). Building Climate Zones by Zip Code. <https://www.energy.ca.gov/media/3560>

# Attachment 3: Research Instruments

[Find the research instruments used here.](#)

## About CalMTA

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations. We work to deliver cost-effective energy efficiency and decarbonization benefits to Californians through a unique approach called market transformation. Market transformation is the strategic process of intervening in a market to create lasting change by removing market barriers or exploiting opportunities, accelerating the adoption of identified technologies or practices. CalMTA-developed market transformation initiatives also aim to advance state goals on demand flexibility, workforce development and equity. Learn more at [www.calmta.org](http://www.calmta.org).



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