

Market and Sales Trends for Zero-NOx Appliances

Bay Area Air Quality Management District

prepared by

Rincon Consultants, Inc.
66 Franklin Street, Suite 300
Oakland, California 94607

Sept 2024



RINCON CONSULTANTS, INC. SINCE 1994

Table of Contents

Executive Summary	1
1.1 Key Takeaways	2
1 Introduction	3
2 Current Zero-NOx Appliance Sales and Trends	5
2.1 Baseline Conditions for Zero-NOx Appliance Market Share	6
2.2 Heat Pump Market Trends	7
2.3 Current Bay Area Availability of Zero-NOx Technologies to Contractors & Distributors...	11
3 Predicted Policy Impacts on the Heat Pump Market	20
3.1 BAAQMD Impacts: Rules 9-6 and 9-4.....	20
3.2 State, National, Global Policy Drivers for Zero-NOx Appliances	22
3.3 Current Heat Pump Sales Projections	26
4 Can the Market Meet Demand?.....	29
4.1 Zero-NOx Appliance Supply Chain Overview	29
4.2 Manufacturer Progress Towards California’s 6 Million Heat Pump Goal	30
4.3 Supply Chain Readiness for Implementation of Rules 9-4 and 9-6.....	31
5 Conclusion	34

Tables

Table 1 Estimated Zero-NOx Appliances Required Due to Rules 9-6 and 9-4	21
---	----

Figures

Figure 1 2019 California Residential Appliance Saturation Survey Results – Combined Electric, Natural Gas, and Other Fuel	6
Figure 2 EnergyStar HPWH Shipments (2011-2022).....	8
Figure 3 Historic Sales Data: U.S. HP HVAC Sales Outpace Gas Starting in 2021	9
Figure 4 Annual Global Growth in Heat Pump Sales (%)	10
Figure 5 HPWH Distributors: Are Timelines for Acquiring HPWH Longer Than for Gas Versions?.....	12
Figure 6 HPWH Distributors: Would You Be Able To Stock More HPWH if Demand Increased?	12
Figure 7 HPWH Distributors: What Trends Have You Seen for HPWH Wait Times.....	12
Figure 8 Contractors: Union or Non-Union?.....	13
Figure 9 Contractors: What Specialty Do You Work In?	14
Figure 10 Contractor- Who Is Your Distributor for Standard HPWH Equipment	15
Figure 11 Contractors: Typical Wait Times for HPWH Equipment.....	16
Figure 12 Contractors: Have You Experienced Difficulty in Obtaining HPWH Equipment?.....	17
Figure 13 Contractors: What are the Timelines for Getting HPWH Equipment?	18

Figure 14	Are Timelines Different Between Procuring HPWH and NOx-Emitting Water Heaters?	19
Figure 15	Global Heat Pump Demand Forecast (Gigawatts (GW) of Capacity)	25
Figure 16	Projected Future HPWH Demand and Policy Interventions (New Buildings Institute)	27
Figure 17	U.S. Exports Heat Pump Technologies to Europe (U.S. Department of Energy)	29
Figure 18	HPWH Component Part Diagram	30
Figure 19	AHRI Projected Increase in Heat Pump Shipments [2022 Base Year]	31
Figure 20	Recently Announced Investments in Heat Pump Production by Selected Manufacturers in Europe	33

Appendices

Appendix A	Distributor and Contractor Survey Questions and Raw Results	
------------	---	--

Executive Summary

This whitepaper summarizes market and sales trends for zero-NOx space and water heating technologies. Electric water and space heating technologies are currently the only zero-NOx technologies available on the market that comply with the upcoming emissions standards of Rules 9-6 (zero-NOx water heating) and 9-4 (zero-NOx space heating) of the Bay Area Air Quality Management District (BAAQMD). While the rules allow for the installation of any zero-NOx technology, this analysis will focus on heat pump water heaters (HPWH) and heat pump space heaters (HP HVAC) due to their cost-effectiveness (i.e., available rebates, bill savings from energy efficiency, and lower voltage options which are less likely to trigger expensive home electrical upgrades).

Specifically, this whitepaper assesses whether there will be enough heat pumps available to meet future market demand for HPWH and HP HVAC driven by Rules 9-6 and 9-4. This analysis uses the best available economic, market, and sales data, as well as contractor interviews to evaluate the current state of the heat pump market, as well as future market trends. BAAQMD's zero-NOx space and water heating rules are projected to increase demand for HPWH and HP HVAC across the Bay Area. As gas water and space heating appliances are replaced at the end of their useful life across the Bay Area's 2.96 million housing units, the default replacement technology is expected to shift towards HPWH beginning in 2027 and HP HVAC in 2029.¹

Rules 9-6 and 9-4 are one example of the multiple regulations, policies, incentives and programs pushing the market towards an emission-free building stock. Although the BAAQMD rules are focused on reductions in air pollution (NOx), they will likely push a larger policy-driven market trend towards electric buildings. Additional policy-based market drivers include California's 6-million heat pump installation goal by 2030 and the California Air Resources Board (CARB)'s zero-emission water and space heating appliance standards currently in rulemaking, as well as many local government building ordinances and programs designed to encourage electrification. Nationally, federal investments in domestic heat pump manufacturing via the Defense Production Act and incentives reducing consumer costs for heat pump retrofits through the Inflation Reduction Act (IRA) are predicted to be instrumental in moving the United States (U.S.) market towards widespread heat pump adoption.

These policy market drivers will be critical in sending a strong signal to manufacturers to ramp up production of HPWH and HP HVAC. Knowing whether manufacturers can meet future demand will be critical as demand for heat pump technologies, especially water heaters, is expected to grow significantly due to upcoming regulations. In 2019, approximately 1 percent of California's existing water heating units were high-efficiency electric (11 percent of all appliances were electric), while HP HVAC accounted for 4 percent of California's space heating units. However, heat pump sales are growing rapidly in California and the U.S. HPWH overtook sales of gas water heaters in 2022, and shipments of U.S. air source equipment doubled between 2013 and 2021.²

¹ For housing estimates:

<https://data.census.gov/table/ACSDP5Y2022.DP04?g=050XX00US06001,06013,06041,06055,06075,06081,06085,06095,06097&d=ACS%20-Year%20Estimates%20Data%20Profiles> – based on summation of “Total Housing Units” across all counties – note that BAAQMD only governs southwestern Solano and southern Sonoma so this estimate may be higher than actual BAAQMD housing totals (see more on BAAQMD geographic range here: <https://www.baaqmd.gov/about-the-air-district#:~:text=The%20Air%20District%20is%20tasked,Solano%2C%20and%20southern%20Sonoma%20counties>)

² <https://ahrinet.org/resources/statistics/historical-data/central-air-conditioners-and-air-source-heat-pumps>

Looking ahead, original equipment manufacturers (OEM) are calling for consistent regulations and long-term incentives to increase supply chain resiliency as heat pumps are expected to become the preferred appliance for space and water heating in the Bay Area and beyond.

1.1 Key Takeaways

- Electric water heaters and furnaces are rapidly gaining market share in California. The total number of installed electric water heaters almost doubled between 2009 and 2019 (6 to 11 percent) and electric space heating increased from 5 to 20 percent of all homes during the same time. Many of these appliances were air source heat pumps.³
- Heat pump supply chains are characterized by a global manufacturing base reliant on commodities like steel, which is increasingly becoming consolidated. However, the U.S. manufacturing base is a leading global player in heat pump production, including key OEMs like A.O. Scott and Rheem. In fact, the U.S. has historically been a heat pump exporter to Europe.⁴
- Policies incentivizing heat pump technologies and regulating NOx-emission producing appliances have been named as a major driver in growth for both HPWH and HP HVAC.⁵
- HP HVAC have a higher rate of market penetration (20%) than HPWH (11%) and are also growing more quickly due to increased demand for air conditioning.⁶
- HPWH are only 10 years into being commercially available and are characterized by a small total market penetration (~1 percent market penetration) but increasing growth over the last 3 years. Meanwhile, sales of gas water heaters are declining. In fact, in December 2023, shipments of electric water heaters outpaced gas.⁷
- Generally, if California and other global entities implement their stated decarbonization goals, there will have to be a multi-fold increase in heat pump production.⁸
- Both policy “carrots” (e.g., subsidies, programming to aid hurdles, incentives) and “sticks” (e.g., regulations and requirements) are critical in sending a market signal to heat pump manufacturers.
 - Across the board, policymakers and OEMs recommend long-term consistent funding and technical support programs, regulations, and a uniform approach to ensure a clear market signal to ramp up production.⁹

³ California Heat Pump Residential Market Characterization and Baseline Study - <https://pda.energydataweb.com/#!/documents/2625/view>

⁴ https://www.energy.gov/sites/prod/files/2016/04/f30/30005_Mann_040716-1105.pdf

⁵ New Buildings Institute (HWP Market Transformation Scenarios): <https://newbuildings.org/heat-pump-water-heater-sales-in-2022-signal-a-decisive-shift-in-water-heating-trends/>; <https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf>

⁶ <https://www.technologyreview.com/2024/02/12/1087970/heat-pumps-hot/>; Building Decarb Coalition. https://buildingdecarb.org/wp-content/uploads/Heat-Pump-Shipment-Report-Spring-2023_V4.pdf

⁷ <https://newbuildings.org/heat-pump-water-heater-sales-in-2022-signal-a-decisive-shift-in-water-heating-trends/>;

<https://www.ahrinet.org/system/files/2024-02/December%202023%20Statistical%20Release.pdf>

⁸ <https://efiling.energy.ca.gov/GetDocument.aspx?tn=242595>

⁹

https://static1.squarespace.com/static/605d0aa46f4b6f47e0ab88af/t/63783d55d1731e04e36f4ca0/1668824407206/CarrotsAndSticksInHotWater_Gupta.pdf; Ibid. CPUC Heat Pump Market Study Report

1 Introduction

The Bay Area Air Quality Management District (BAAQMD) regulates stationary sources of air pollution in the nine counties that surround San Francisco Bay. The Board oversees policies and adopts regulations for the control of air pollution, such as nitrogen oxides (NOx) within the district. On March 15, 2023 the BAAQMD Board adopted amendments to Rule 9-4: Nitrogen Oxides from Fan Type Residential Central Furnaces and Rule 9-6: Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters. These rules govern point of sale emission standards for small, typically residential and commercial, water and space heating systems. Emissions of nitrogen oxides impact local and regional air quality and contribute to the formation of ozone and secondary particulate matter.

Rules 9-6 and 9-4 are expected to change market demand for water and space heating appliances in the Bay Area. NOx-emitting gas appliances are currently the default appliance option for heating and cooling space and water across California. As the updated Rules take effect, NOx emitting water heaters under 75,000 British Thermal Units (BTU)/hour manufactured after January 1, 2027 will no longer be available for purchase or installation in the Bay Area.¹⁰ NOx emitting furnaces under 175,000 BTU/hour, and combination heating/cooling units under 65,000 BTU/hour manufactured after January 1, 2029 will no longer be available for purchase or installation in the Bay Area.¹¹ As NOx-emitting gas water heaters and furnaces start to fail or “burnout,” the Rules mandate that they may only be replaced with zero-NOx appliances. Electric appliances are currently the only zero-NOx technologies available on the market. HPWH and HP HVAC are currently the most cost-effective appliance options of these electric options. Accordingly, HPWH and HP HVAC installations are expected to increase significantly across the Bay Area beginning in 2027 and 2029.

The purpose of this analysis is to determine the current ability of the market to provide zero-NOx space and water heating appliances in support of Rules 9-6 and 9-4, as well as the ability of the market to respond to the increased demand for these appliances generated by the upcoming rules.

To understand the market for zero-NOx appliances, this analysis first reviews current sales data through 2022 for zero-NOx appliances both locally and nationally. The report references best available data from California, including the California Energy Commission’s (CEC) 2019 Residential Appliance Saturation Survey (RASS) and the California Public Utilities Commission (CPUC) Heat Pump Market Study (2022), among others. While California-specific data is important to understand the current local market, this analysis also summarizes national market conditions and trends that provide a fuller picture of the market for zero-NOx appliances, as well as the market’s ability to absorb the additional demand created by the BAAQMD rules.

This analysis presents findings from interviews and surveys of Bay Area contractors and distributors in April of 2024. The interviews and surveys were used to understand current conditions in the Bay Area relating to acquiring zero-NOx appliances. This direct outreach also included questions to identify and expand on any remaining supply chain hurdles that were prevalent during the COVID-19 pandemic. These results supplement the literature review findings and paint a current picture of market availability of HPWH and HP HVAC. Survey questions are attached in Appendix A.

¹⁰ The Bay Area refers to all BAAQMD governed geographic regions across the Bay Area’s nine counties: San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Solano, Napa, Sonoma, and Marin County.

¹¹ Note that there will be an allowable “sell-through” period of these older units meeting the current requirements for 2024 ultra-low NOx requirements.

This analysis then estimates the potential increase in demand for HPWH and HP HVAC units within the Bay Area due to the BAAQMD rules and compares these forecasted changes to current market trends. While the BAAQMD rules are driving zero-NOx appliance demand locally, broader statewide and even national policy drivers are also occurring, resulting in a broader shift to zero-NOx technologies. This report summarizes these other market drivers to provide context to the local market and how manufacturers are preparing to meet these future demands.

Finally, this report summarizes the readiness of the zero-NOx appliance supply chain to meet future demand based on manufacturer signals, market drivers, and existing market trends.

2 Current Zero-NOx Appliance Sales and Trends

This section summarizes market trends in HPWH and HP HVAC to understand baseline conditions for zero-NOx appliances prior to the adoption of Rules 9-6 and 9-4.

The California Energy Commission (CEC) Residential Appliance Saturation Study (RASS) defines heat pump water heating as “High Efficiency” electric. These appliances currently represent approximately 1 percent of total appliances for water heating, and HP HVAC represent 4 percent of total appliances for space heating in California.¹² Despite this small market share, heat pump technologies have experienced rapid growth, outpacing shipments for gas appliances beginning in 2021. In some parts of the U.S., zero-NOx electric space and water heating is far more prevalent than gas appliances, demonstrating that there is precedent for an electric-dominated appliance market in the U.S.

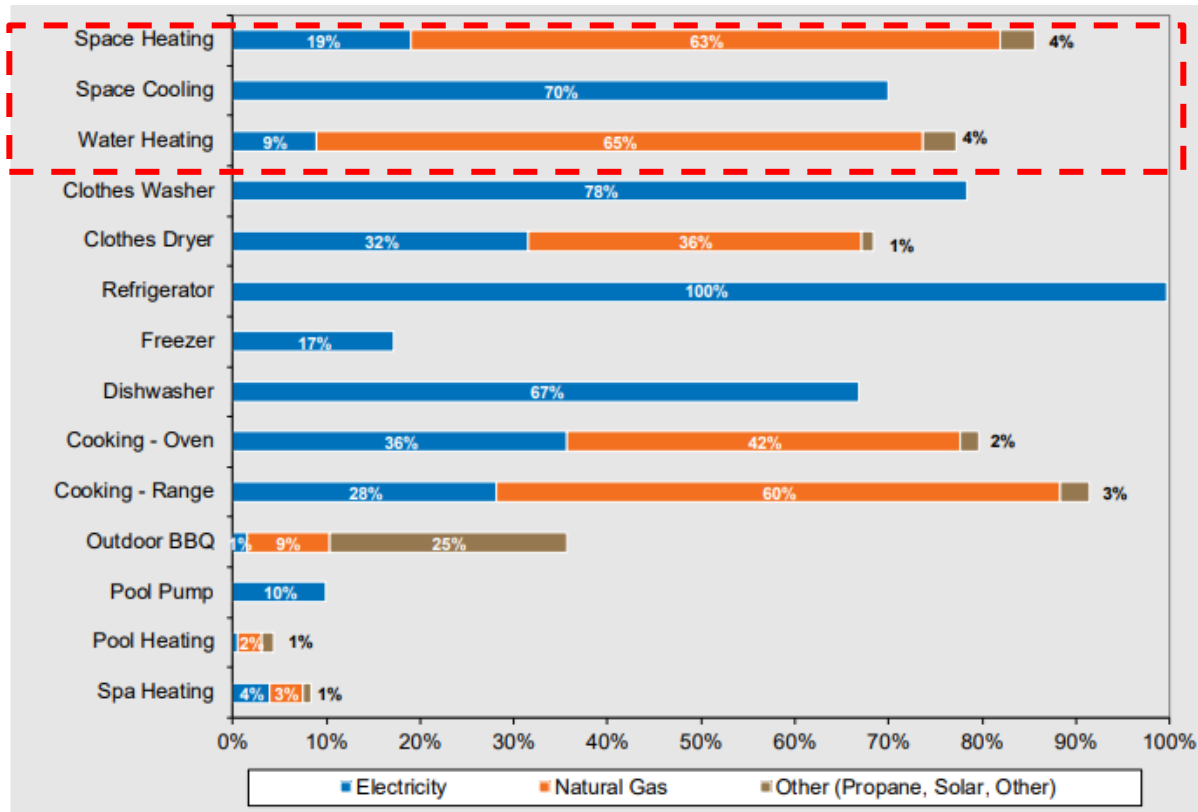
As described in Figure 1, according to the latest CEC RASS, 9 percent of installed statewide water heating was zero-NOx electric. It should be noted that as the original RASS did not differentiate between electric resistance or HPWH; the exact uptake of HPWH of this 9 percent total is unknown. As previously noted, the requirements of Rules 9-4 and 9-6 allow for the installation of any zero-NOx appliance. CPUC’s 2022 Heat Pump Market Availability Study that references the CEC RASS results produced a slightly different estimate of a total of 11 percent electric (likely combining the RASS ‘other’ category to include solar and other electric options) with 1 percent estimated to be “high-efficiency electric.”¹³ Seventy percent of space cooling, and 19 percent of statewide space heating was also zero-NOx electric, with 4 percent of homes using HP HVAC as their primary means of space heating.¹⁴

¹² 2019 California RASS Results <https://www.energy.ca.gov/sites/default/files/2021-08/CEC-200-2021-005-RSLTS.pdf>; <https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf>. HPWH share not split out for water heating.

¹³ 2022 Heat Pump Market Availability Study

¹⁴ 2019 RASS - <https://www.energy.ca.gov/sites/default/files/2021-08/CEC-200-2021-005-ES.pdf>; Figure 1 pulled from Figure Es-6

Figure 1 2019 California Residential Appliance Saturation Survey Results – Combined Electric, Natural Gas, and Other Fuel



2.1 Baseline Conditions for Zero-NOx Appliance Market Share

Electric Resistance Water Heating Adoption

In large areas of the U.S., most water heating appliances are electric. These appliances are likely electric resistance water heating appliances, as HPWH account for only 1 to 2 percent of units sold nationally each year.¹⁵ In 2020, electricity was the second largest fuel type used for water heating, with 57 million American households using electricity and 59.3 million American households using natural gas as the fuel for their main water heater. Electricity was also the most widely used water heating fuel for the Southern U.S. Census Regions, with 31.3 million households using electricity to heat water and 14.1 million households using gas.¹⁶ However, the exact proportion of electric resistance versus heat pump appliances as a part of this electric total is unknown, as the Energy Information Agency dataset only differentiates water heating by fuel type, not appliance.

Electric resistance water heaters can result in higher energy bills than HPWH, and cumulatively, more peak demand strain on the electric grid.¹⁷ Nonetheless, electric resistance water heaters are zero-NOx

¹⁵ <https://buildingdecarb.org/joint-vision>

¹⁶ 2020 Residential Energy Consumption Survey; Water Heating Tables by HC8.7/8.8: <https://www.eia.gov/consumption/residential/data/2020/#waterheating>

¹⁷ <https://www.energy.gov/energysaver/electric-resistance-heating>

compliant and are commonly used across the U.S. These appliances offer a rules-compliant technology option for water heating, in addition to HWP, especially over the short-term.

HPWH Adoption

HPWH appliance adoption was not specifically tracked by the 2019 RASS, the primary source for appliance saturation, so the proportion of heat pumps within this dataset is unknown.¹⁸ However, according to the California Heat Pump Residential Market Characterization and Baseline Study, 1 percent of California's 12.1 million water heating units installed in investor-owned-utility (IOU) territory residences were HPWH.¹⁹ This is equivalent to more than 146,000 high efficiency electric water heating appliances installed in residential units across the state, based on 2022 Census numbers.²⁰ As of October 2023, the market share for HPWH was 16 percent in new single-family homes, signifying a comparatively larger percentage of adoption in new housing units.²¹

It should be noted that at the national level, shipments of electric water heating appliances have now outpaced gas appliance shipments starting in December 2023.²²

HP HVAC Adoption

The 2019 RASS data shows that HP HVAC represent 4 percent of the 12.22 million space heating units across residences in California IOU territories. As of October 2023, the market share for HP HVAC was 55 percent in new single-family homes in California.²³ This indicates that there has been a comparatively larger saturation of HP HVAC in comparison to HPWH, but also that gas continues to be the dominant technology for space heating in California. It also indicates that there has been a significant paradigm shift towards HP HVAC in new buildings, with the majority of new construction installing HP HVAC instead of gas.

Across the U.S., 16 percent of homes use electric heat pumps for space heating.²⁴ However, in large areas of the U.S. electric appliances dominate space heating. In the South, 25.76 million housing units use electricity for space heating, as opposed to 15.54 million that use natural gas. Of this total, the largest proportion of space heating is provided by heat pumps (12.52 million), followed by electric central air warm furnaces (9.01 million).²⁵

2.2 Heat Pump Market Trends

This section describes HPWH and HP HVAC sales and market trends. As data included in this analysis is only through the end of 2022, it likely does not show the market impact of the BAAQMD rules, Inflation Reduction Act (IRA), and other consequential air quality and climate policies that are expected to lead to future increases in heat pump adoption.

¹⁸ 2019 California RASS Results <https://www.energy.ca.gov/sites/default/files/2021-08/CEC-200-2021-005-RSLTS.pdf>;

¹⁹ <https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf>

²⁰ Based on 1 percent of total housing units: <https://www.census.gov/quickfacts/fact/table/CA/RHI725222>

²¹ CEC; Top Global Building Appliance Manufacturers and Distributors Commit to Help California Achieve Six Million Heat Pump Goal.

<https://www.energy.ca.gov/news/2023-10/top-global-building-appliance-manufacturers-and-distributors-commit-help>

²² <https://www.ahrinet.org/system/files/2024-02/December%202023%20Statistical%20Release.pdf>

²³ Ibid. 2019 RASS

²⁴ Rewiring America Pace of Progress: November

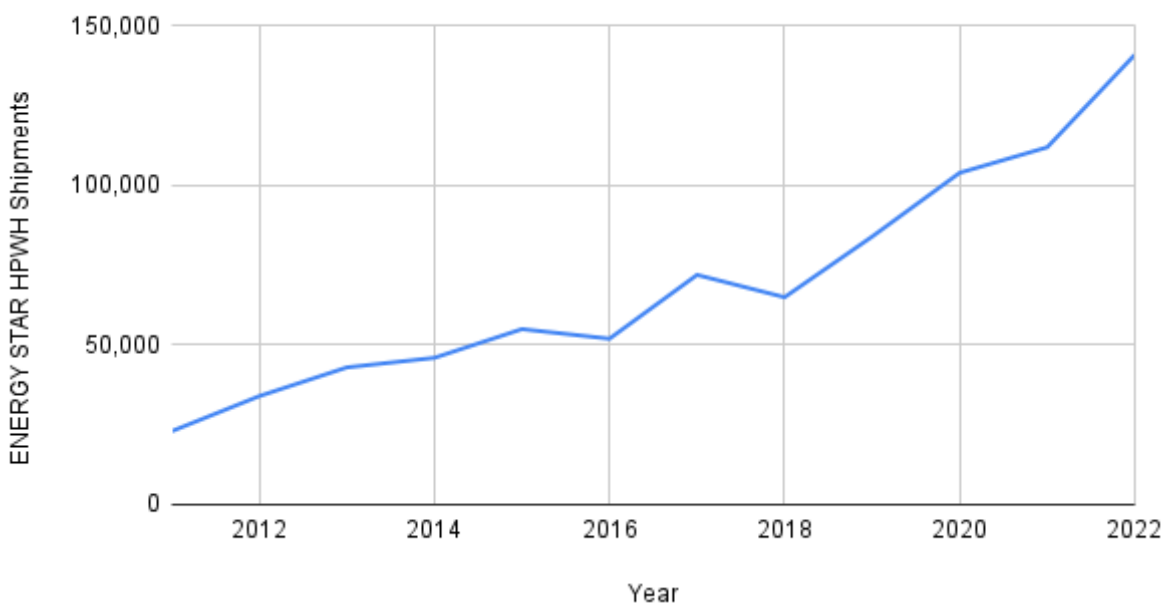
²⁵ EI Space Heating Data; South and West Regions (HC6.8); <https://www.eia.gov/consumption/residential/data/2020/#sh>

HPWH: Small but Fast-Growing Market Share

Sales of HPWH in the U.S. grew 26 percent in 2022 as sales of gas water heaters declined by 17 percent. Though HPWH still has a comparatively low market penetration rate (less than 3 percent) of the total U.S. market for water heating, data from EnergyStar shows a fast-paced growth in HPWH shipments per year over the last 11 years as shown in Figure 2.²⁶ Note that Figure 2 only shows shipments of EnergyStar heat pumps, which may leave out some HPWH options as many HPWH are not EnergyStar appliances²⁷. Total domestic sales of HPWH are also not tracked by any one organization, which is why they are not referenced here. Accordingly, using EnergyStar shipments of HPWH can show overall trends for HPWH demand, but are a conservative proxy for actual shipments and sales of HWP in the U.S.

Figure 2 EnergyStar HPWH Shipments (2011-2022)

ENERGY STAR HPWH Shipments vs. Year



Future Sales Projections: Rapid, Policy-Driven Growth

Analysis from the New Buildings Institute indicates that incentives in California and decarbonization policies were likely instrumental in the recent uptick in HPWH sales. These policies and programs are discussed further in State, National, Global Policy Drivers for Zero-NOx Appliances section below. This historic data likely does not include the market effects of the IRA, which passed in August of 2022 and began rolling out tax credits for customers in 2023 with additional funding for low and medium income households expected in 2024.

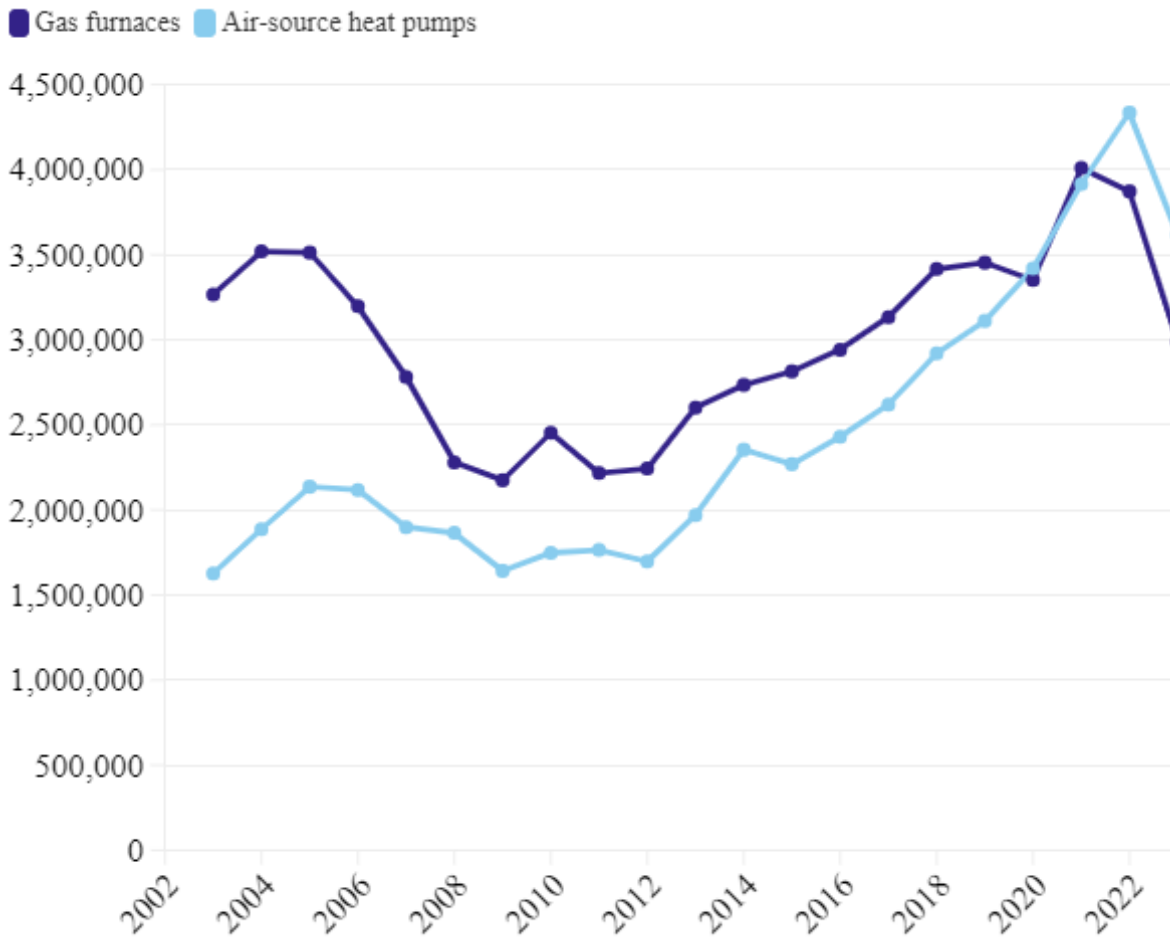
²⁶ New Buildings Institute, using EnergyStar Data: <https://newbuildings.org/heat-pump-water-heater-sales-in-2022-signal-a-decisive-shift-in-water-heating-trends/>; <https://www.energystar.gov/sites/default/files/2022%20Unit%20Shipment%20Data%20Summary%20Report.pdf>

²⁷ To receive the Energy Star rating, manufacturers are required to sign a formal agreement with EPA and products must be third-party certified against strict performance requirements. Therefore, not all heat pump manufacturers seek out Energy Star certification.

HP HVAC: Rapid Demand Increase Overtakes Gas Appliance Demand

Half of homeowners with natural gas or electric space heating have units that are over 14 years old. BAAQMD assumed a lifespan of 18 years for furnaces for the rule amendment development process, indicating that a large proportion of homeowners will need to replace their space heating appliance within the next decade.²⁸ Past HP HVAC trends in combination with zero-NOx requirements are expected to increase the rapid growth that has already been observed in HP HVAC appliances. As shown in Figure 3, starting in 2020 HP HVAC sales outpaced gas sales in the U. S. showing rapidly increasing HP HVAC demand and declining gas heating demand.²⁹

Figure 3 Historic Sales Data: U.S. HP HVAC Sales Outpace Gas Starting in 2021³⁰



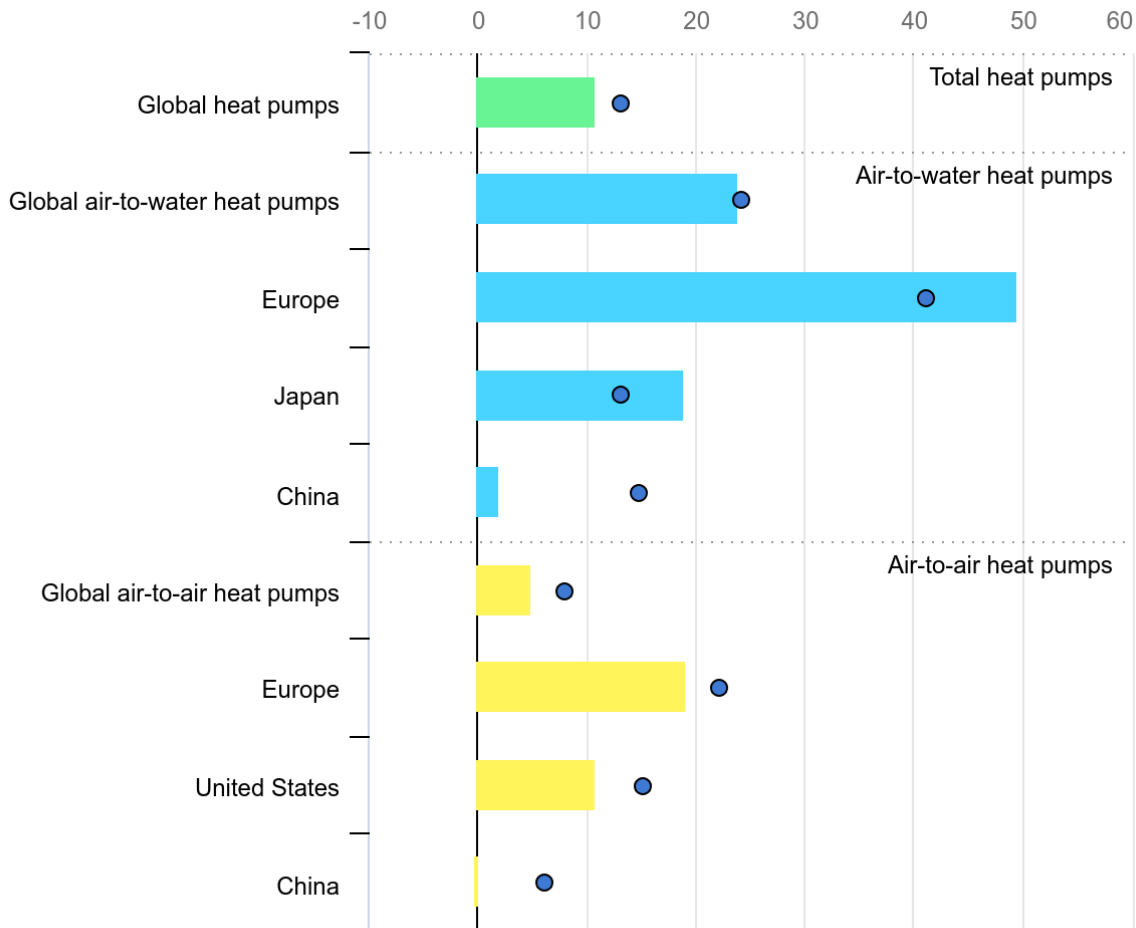
²⁸ Ibid. 2019 RASS

²⁹ <https://www.technologyreview.com/2024/02/12/1087970/heat-pumps-hot/>

³⁰ Source: Air-Conditioning, Heating and Refrigeration Institute. Chart by Casey Crownhart, MIT Technology Review

Globally, sales of heat pumps increased rapidly, experiencing double-digit growth in 2021 and 2022, as shown Figure 4.³¹ This is consequential as many parts of the heat pump market and manufacturing base is international, including Daikin Industries Ltd. (Japan) and Mitsubishi Electric (Japan). The U.S. also has a significant heat pump original equipment manufacturer (OEM) presence, which will be explored in later sections that summarize the current heat pump supply chain landscape.

Figure 4 Annual Global Growth in Heat Pump Sales (%)



³¹ <https://www.iea.org/energy-system/buildings/heat-pumps>

The sections below will expand on how Rules 9-6 and 9-4, as well as other state, national, and global policies will change these past patterns of demand for heat pump technologies.

2.3 Current Bay Area Availability of Zero-NOx Technologies to Contractors & Distributors

Sources detailing availability of HPWH and HP HVAC for the Bay Area at the distributor and wholesale level were virtually nonexistent at the time of research. To provide some insight into the current localized availability of heat pump technologies, tailored surveys were sent to contractors and distributors in the Bay Area.

Outreach Description

Survey links were shared with organizations/ companies including:

- BayREN Contractors;
- OEM distributors including Rheem, A.O. Smith, Johnson Controls, Bradford White, and AHRI;
- Unions that are part of BAAQMD’s Implementation Working Group (IWG)

In addition, desktop outreach identified HPWH distributors in the Bay Area, and all distributors were called to fill out the distributor survey over the phone. This outreach resulted in three respondents for the distributor survey and eleven respondents to the contractor survey as of April 26, 2024.

Distributor Survey Respondents

Three of the four identified Bay Area HPWH distributors completed the survey over the phone.³² Due to the small number of total distributors in the area, and feedback from contractors on the most common distributors, this sample set, although small, is likely representative of broader trends in the region.

Survey Respondents included:

- Pace Supply Company
- WHCI Plumbing Supply Company
- Heieck Supply company

Pace was named as the number one distributor by contractors who took the survey. WHCI and Heick were also named by Contractors as major distributors.

Distributor Survey Results

Distributors responded that timelines to acquire HPWH equipment were not slower than their gas appliance counterparts as shown in Figure 5. Distributors that answered “not sure” do not stock gas appliances.

³² Includes: <https://www.sfwarehouse.com/#>; <https://www.cal-steam.com/>; <https://whcisupply.com/products/#products>; <https://pacesupply.com/Locations>

Figure 5 HPWH Distributors: Are Timelines for Acquiring HPWH Longer Than for Gas Versions?



Created with Datawrapper

Across the board, distributors expressed confidence that they would be able to stock more HPWH if demand increased as shown in Figure 6.

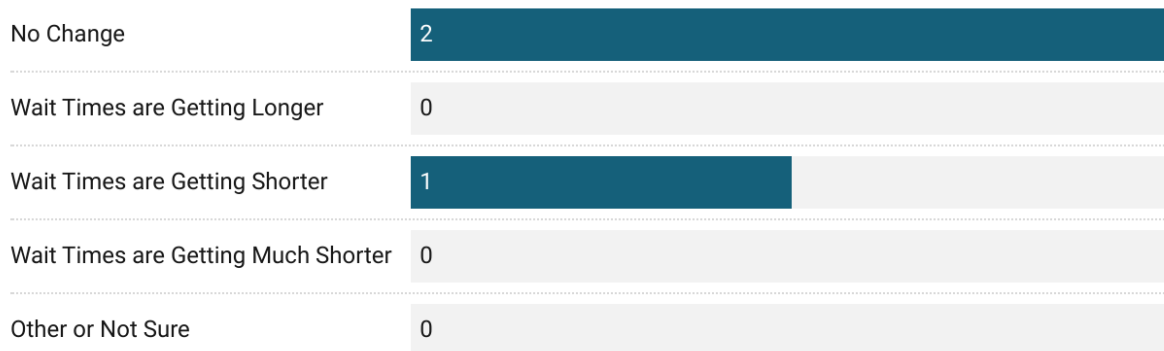
Figure 6 HPWH Distributors: Would You Be Able To Stock More HPWH if Demand Increased?



Created with Datawrapper

HPWH distributors have seen no change, or shorter wait times than before when stocking HPWH equipment as shown in Figure 7.

Figure 7 HPWH Distributors: What Trends Have You Seen for HPWH Wait Times



Created with Datawrapper

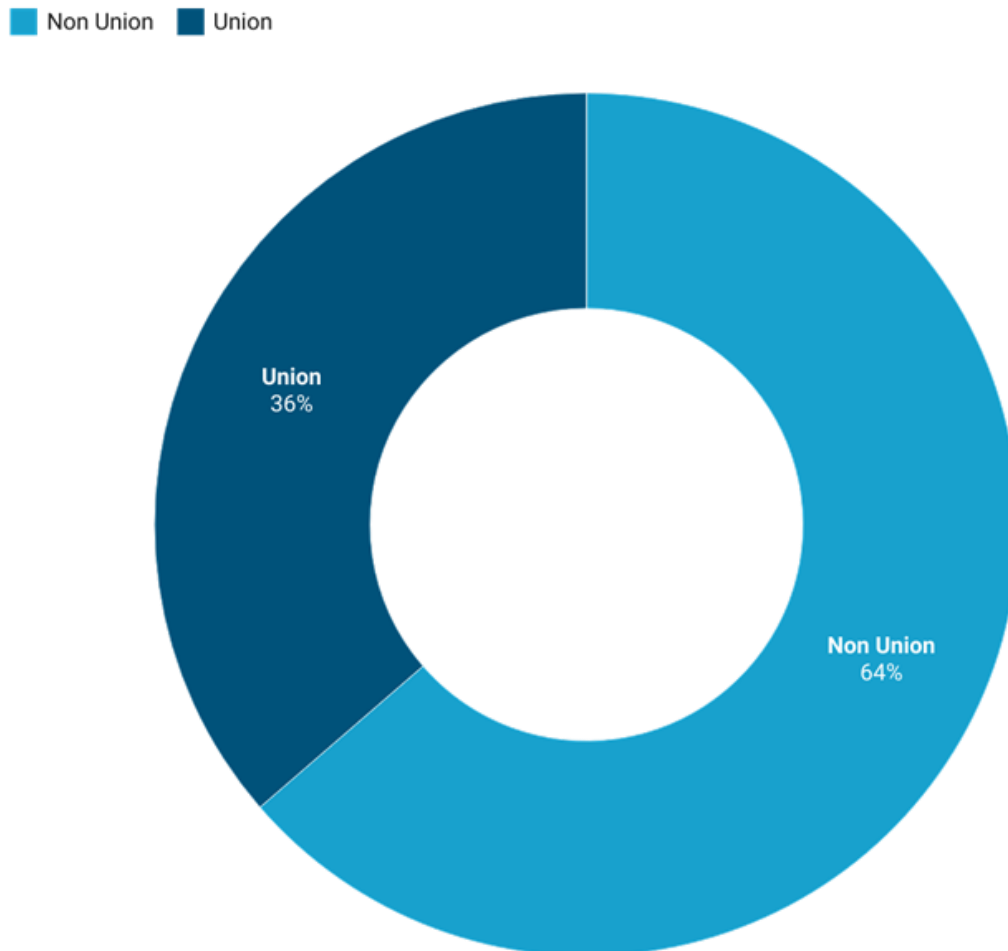
When asked “What has been the most challenging aspect of this overall market shift from gas appliances to heat pumps?”, distributors described a market landscape characterized by fast-paced growth, but also driven by subsidies that have been instrumental in establishing cost competitiveness for HPWH. Distributors also described 120v technologies as an important newer technology to overcome an observed barrier from switching from gas water heaters to tanked HPWH which was previously limited to requiring 240v circuits.

Contractor Survey Respondents

Eleven contractors who are currently installing HPWH and/or HP HVAC across the Bay Area responded to the survey. While most contractors served all areas of the Bay Area, some only served specific geographic regions within the Bay Area (e.g., Contra Costa County only; Alameda County Only).

As shown below in Figure 8, most respondents were non-union, while a minority represented unionized contractors.

Figure 8 Contractors: Union or Non-Union?

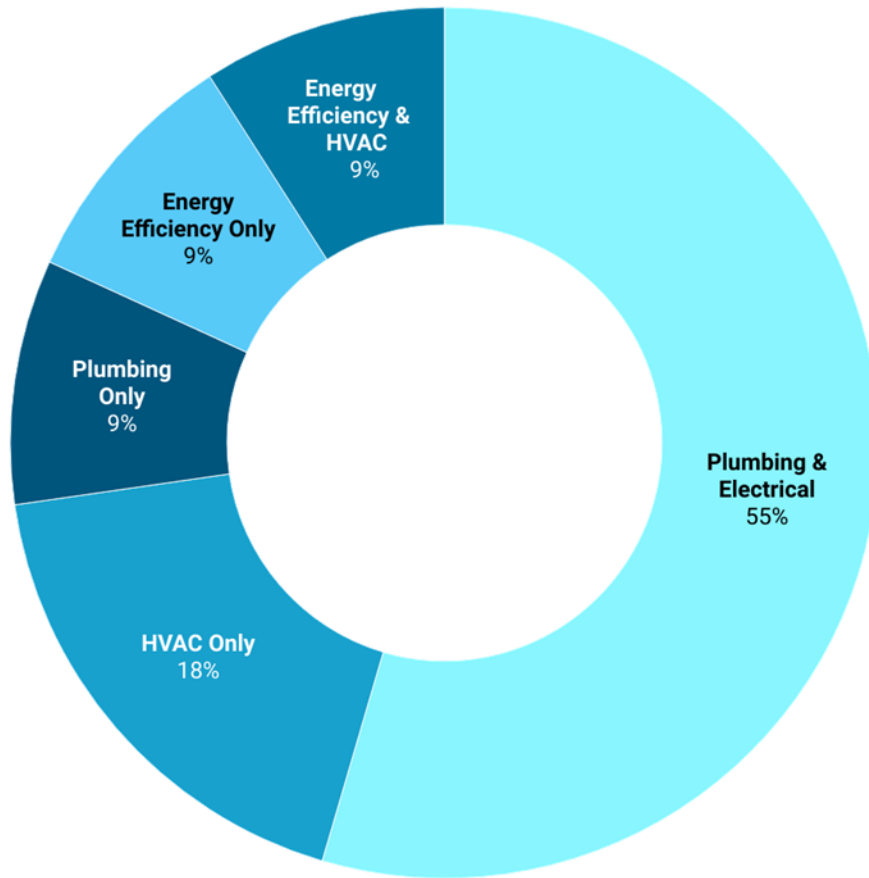


Created with Datawrapper

While there were a range of Contractor specialties, most installed both HPWH and HP HVAC. In addition, many contractors also had a focus on energy efficiency projects as shown below in Figure 9. The results of the survey show that the majority of contractors are able to conduct both electrical and plumbing work, which are both required for heat pump water heater installation. Having contractors with both skillsets should allow a more streamlined and efficient HPWH installation.

Figure 9 Contractors: What Specialty Do You Work In?

■ Plumbing & Electrical ■ HVAC Only ■ Plumbing Only ■ Energy Efficiency Only
■ Energy Efficiency & HVAC



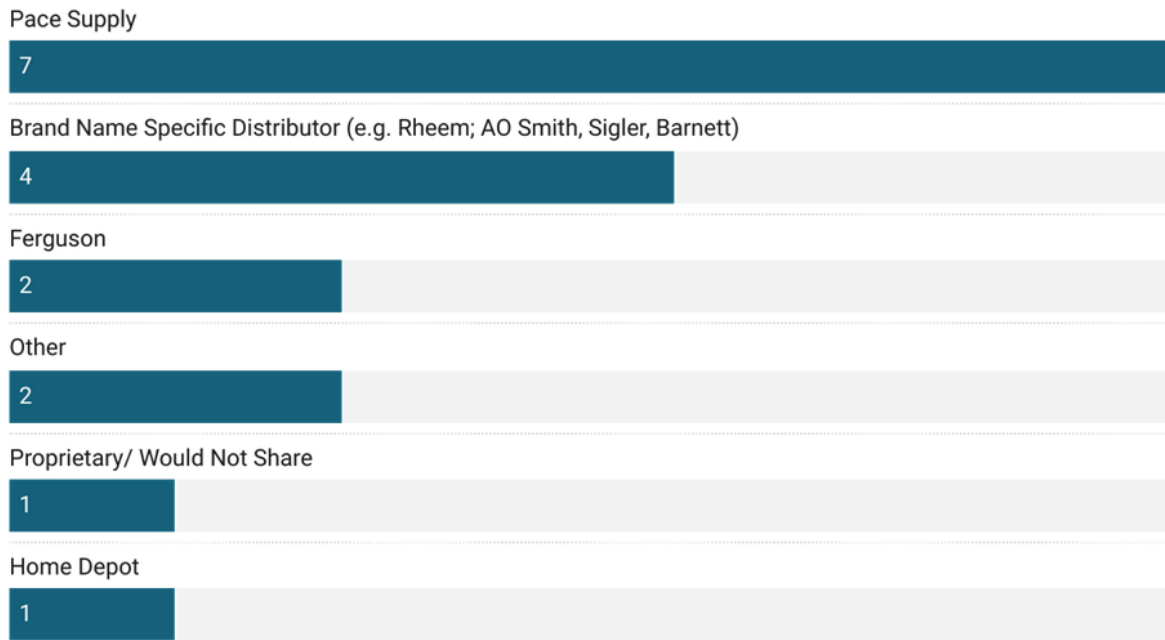
Created with Datawrapper

Contractor Survey Results

Contractors were surveyed both on HPWH equipment and HP HVAC. To focus this analysis on the most rapidly approaching rules, this section focuses on water heaters and includes results from contractors who install only water heaters or both HVAC and water heaters. HP HVAC results interpretation and data visualization are attached in addition to survey questions and raw results in Appendix A.

The first question of the survey asked who the primary distributor was for HPWH equipment. As noted above, Pace, WHCI, and Heick (the latter two are captured under ‘other’ in Figure 10 below) were surveyed as HPWH distributors. Distributor results displayed in Figure 10 are supported by the distributor interviews described in the section above. The survey results also allowed for multiple responses to this question. Most surveyed contractors had three separate distributors for HPWH equipment. One listed Home Depot as a backup as well.

Figure 10 Contractor- Who Is Your Distributor for Standard HPWH Equipment

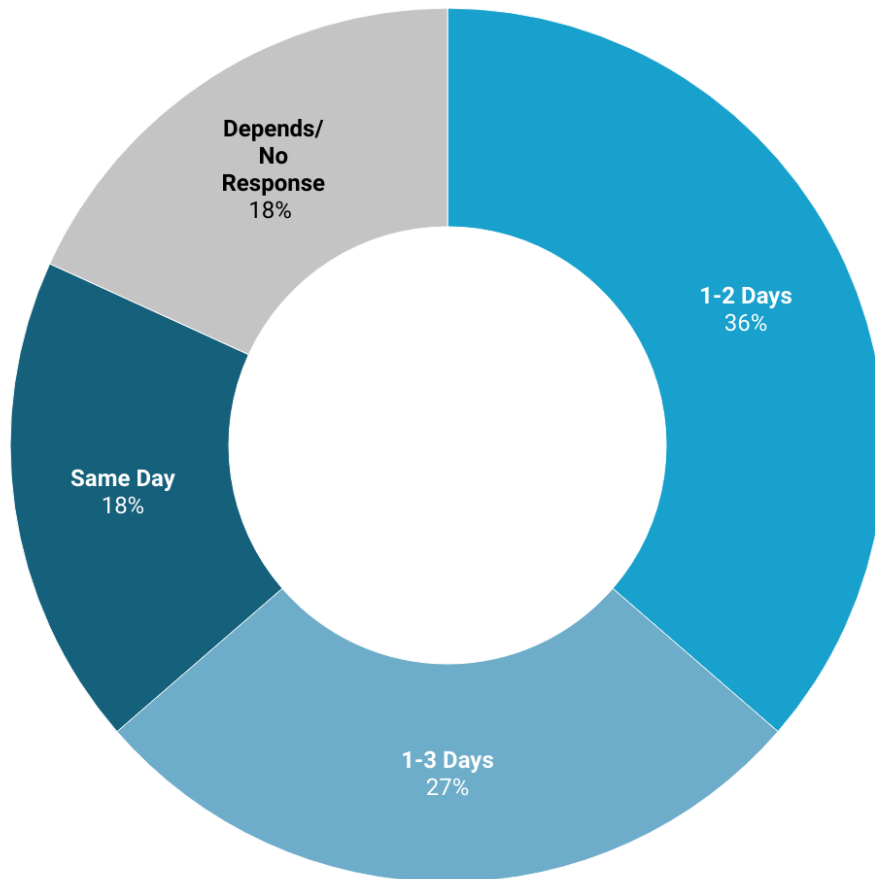


Created with Datawrapper

Timelines to acquire standard HPWH typically fall within the 1-3 day range, with six (54%) respondents reporting even faster delivery times of same day- next day. As shown in Figure 11, nine (81%) contractors surveyed receive HPWH within 3 days, with zero contractors reporting typical wait times longer than three days. The remaining two (18%) respondents did not install Zero NOx appliances at all and therefore, could not provide an answer.

Figure 11 Contractors: Typical Wait Times for HPWH Equipment

■ 1-2 Days ■ 1-3 Days ■ Same Day ■ Depends/ No Response

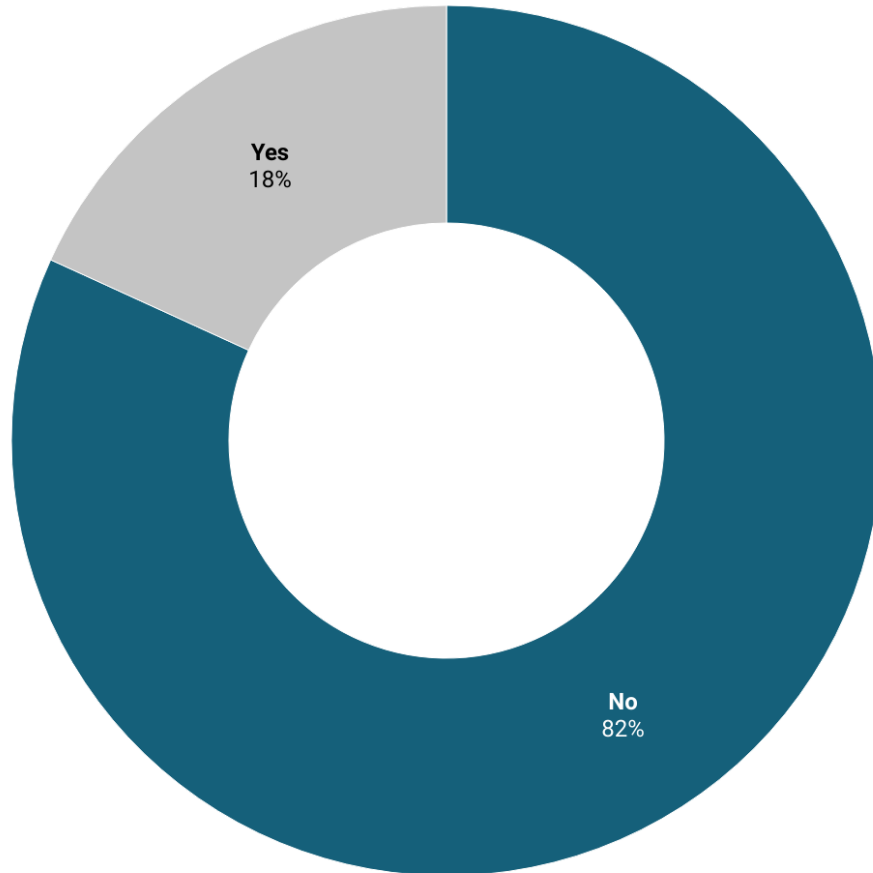


Created with Datawrapper

The majority of contractors surveyed (9) indicated that they had not experienced difficulties in obtaining HPWH, while two respondents (18%) reported difficulties in HPWH equipment procurement, as shown in Figure 12.

Figure 12 Contractors: Have You Experienced Difficulty in Obtaining HPWH Equipment?

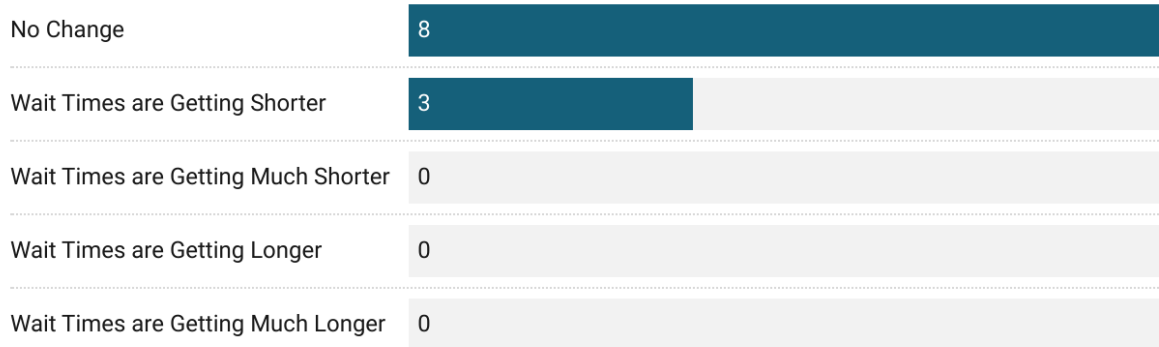
■ No ■ Yes



Created with Datawrapper

Contractors were also asked if they had experienced changing wait times for obtaining HPWH equipment as demand has increased over the past couple of years. Across the board, surveyed contractors reported that wait times were getting shorter or had not changed, as shown in Figure 13.

Figure 13 Contractors: What are the Timelines for Getting HPWH Equipment?

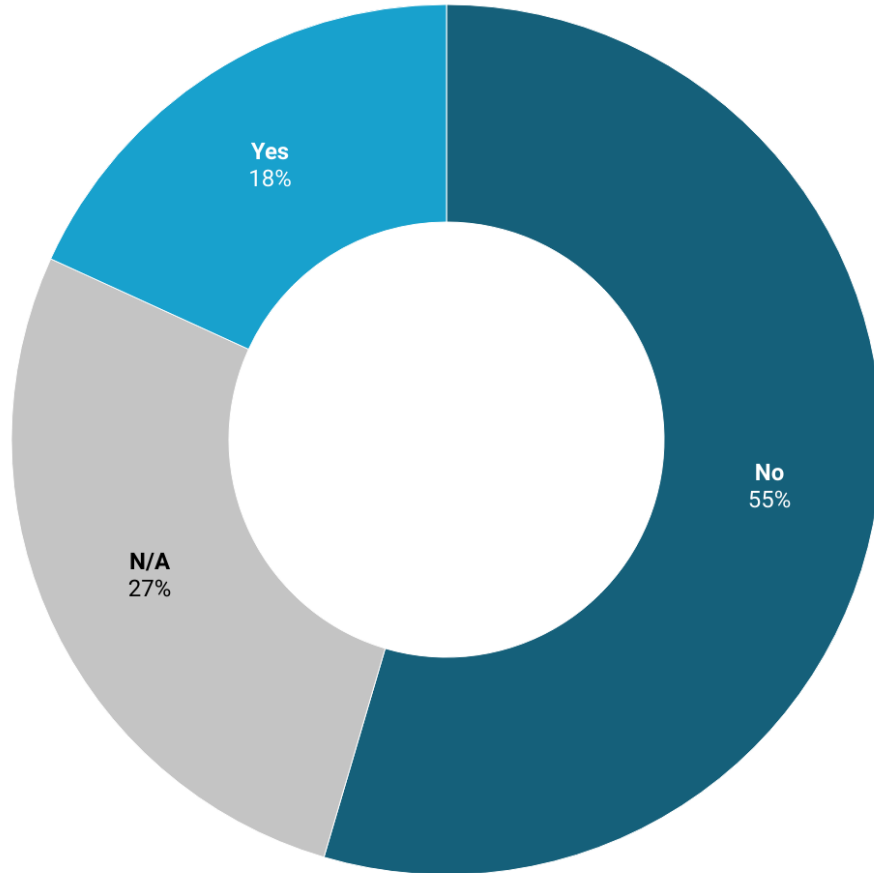


Created with Datawrapper

In addition, the survey also asked contractors if the wait times for HPWH were longer than for traditional natural gas fired NOx-emitting water heaters as shown in Figure 14. A majority of survey respondents (eight) found no difference in wait times between HPWH and NOx-emitting water heaters, three respondents said it took longer to get HPWH's, and three did not install NOx emitting appliances and therefore, could not answer. The results of this question are summarized in Appendix A.

Figure 14 Are Timelines Different Between Procuring HPWH and NOx-Emitting Water Heaters?

■ No ■ N/A ■ Yes



Created with Datawrapper

When asked about the most challenging aspect of this market shift so far, contractors had the following answers (which are summarized for clarity):

- Mismatch between OEM advertising and user experience for heat pumps;
- Workforce: lack of trained electricians paired with a need for higher hourly rates in the Bay Area;
- Customers assume a higher costs than gas appliance counterparts and higher cost on the utility bills side because of comparatively higher electric rates;
- Consumer and homeowner pushback due to perception or reality that heat pumps are more complicated to install than a 'like for like' gas replacement

These results are also described for HP HVAC technologies in addition to survey questions and raw answer results in Appendix A.

3 Predicted Policy Impacts on the Heat Pump Market

Rules 9-6 and 9-4 are one example of the multiple regulations, policies, incentives and programs pushing the market towards an emission-free building stock. Although the BAAQMD rules are focused on reductions in air pollution (NOx), they will likely push a larger policy-driven market trend towards electric buildings. This section explores the projected impacts of Rules 9-6 and 9-4 on the heat pump market in the Bay Area, as well as larger policy drivers at the state, national, and global level. These policy drivers are expected to shift the market trends described in the previous section towards a larger Bay Area, statewide, and even national adoption of HPWH and HP HVAC.

Modeling conducted by Rewiring America and ICF, on behalf of BAAQMD, predicts that heat pump adoption, and by proxy, supply chain evolution (which will be described in sections below) will follow an “S-curve” characterized by slow early adoption, rapid increase, and eventual market saturation. This S-curve, driven by policies and programs, could mirror California’s adoption curve for residential rooftop solar technologies.^{33,34} California’s solar market was also initially driven by policies, via a combination of Senate Bill 1 and Net Energy Metering (NEM); over 10 years, California’s distributed solar market experienced 200 percent growth.³⁵ Some researchers predict a similar trajectory for heat pump adoption across the state.³⁶

3.1 BAAQMD Impacts: Rules 9-6 and 9-4

According to most recent Census data (2022), the Bay Area’s nine counties have 2.96 million housing units.³⁷ BAAQMD modeling assumes a lifespan of 13 years for small water heating appliances covered under Rule 9-6 and a lifespan of 18 years for residential furnaces covered under Rule 9-6.

As the millions of space and water heating NOx-emitting gas appliances used throughout these housing units in the Bay Area reach the end of their useful life, they will eventually be replaced entirely by zero-NOx appliances. Table 1 shows a conservative estimate of the relative market impact of the BAAQMD rules assuming each household has their own water heater and furnace. The total number of appliances may differ due to households with more than one appliance and/or buildings with one large central unit. This analysis also does not include commercial appliances. However, it is useful in understanding the scale of the BAAQMD rules effort considering national installation trends.

³³ https://assets.ctfassets.net/v4qx5q5o44nj/3JhEcPyvkt0JKFpX1B16e7/19ff7c1575192401c804b778d4a595f4/Pace_of_Progress_2024.pdf;

³⁴ Ibid. ICF PCAP Projections

³⁵ https://newbuildings.org/wp-content/uploads/2022/09/9-0613_0868_000624_Gupta.pdf

³⁶ <https://www.nature.com/articles/s41560-022-01104-8>; <https://www.energy.ca.gov/event/workshop/2022-04/staff-workshop-heat-pump-goals-supply-chain-and-programs>

³⁷ For housing estimates:

<https://data.census.gov/table/ACSDP5Y2022.DP04?g=050XX00US06001,06013,06041,06055,06075,06081,06085,06095,06097&d=ACS%205-Year%20Estimates%20Data%20Profiles> – based on summation of “Total Housing Units” across all counties – note that BAAQMD only governs southwestern Solano and southern Sonoma so this estimate may be higher than actual BAAQMD housing totals (see more on BAAQMD geographic range here: https://www.baaqmd.gov/about-the-air-district#:~:text=The%20Air%20District%20is%20tasked,Solano%2C%20and%20southern%20Sonoma%20counties))

Table 1 Estimated Zero-NOx Appliances Required Due to Rules 9-6 and 9-4

Total Households: 2,962,784 (2022 American Community Survey)	
Bay Area Water Heaters Demand Estimate	
Estimated electric water heaters ¹	11%
Remaining gas water heaters [89% of total] ²	2,636,878
Water heater Lifespan [Years] ³	13
Heat pumps needed per year Bay Area [Total Gas #/Lifespan] ⁴	202,837
HPWH installed nationally ⁵	141,000
Percent of market ⁶	117%
Furnace Demand Estimate	
Estimated electric furnaces ⁷	20%
Remaining gas furnaces [80% of Total] ⁸	2,370,227
Furnace Lifespan [Years] ⁹	18
HP HVAC needed per year Bay Area [Total Gas #/Lifespan] ¹⁰	131,679
HP HVAC installed nationally ¹¹	3,616,632
Percent of market ¹²	3.6%
Sources/Method	
¹ 2022 CPUC Electric Water Heater Estimate. https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf	
² Ibid. CPUC	
³ BAAQMD Internal WH lifespan calculations	
⁴ Calculated: Total # gas appliance/Lifespan years	
⁵ EnergyStar heat pump install numbers	
⁶ Percent of national market share (2022) needed to meet projected Bay Area Demand	
⁷ 2022 CPUC Electric Water Heater Estimate. https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf	
⁸ Ibid. CPUC	
⁹ BAAQMD Internal Furnace lifespan calculations	
¹⁰ Calculated: Total # gas appliance/ Lifespan years	
¹¹ https://www.ahrinet.org/analytics/statistics/historical-data/central-air-conditioners-and-air-source-heat-pumps	
¹² Percent of national market share (2022) needed to meet projected Bay Area Demand	

As shown in Table 1, the number of heat pump water heaters required to meet the demand created by the upcoming rules is significant with the estimated average annual demand slightly exceeding the 2022 HPWH installation rates. However, HPWH installation rates have been increasing rapidly and are expected to have been much higher in 2023. For space heating, the expected demand is only a 3 percent increase compared to the national number and should be relatively easy for manufacturers to meet. While the BAAQMD rules are expected to greatly increase zero-NOx appliance demand, the market is already shifting towards zero-NOx and heat pump appliances due to the incentives and policy drivers occurring both within California and nationally.

3.2 State, National, Global Policy Drivers for Zero-NOx Appliances

California and the Bay Area specifically has led the way forward in policy and programmatic market drivers to increase market demand and smooth adoption hurdles for heat pumps. These policy developments, which include BAAQMD Rules 9-6 and 9-4, have been complemented by recent federal-level incentives and policies to shape the heat pump market which are described here.

Statewide Market Drivers for Heat Pumps

BAAQMD's requirements for zero-NOx space and water heating is supported by state level efforts to decrease GHG emissions in the building sector and develop the electric heat pump market. Space and water heating account for 89% of NOx emissions, but also a majority of GHG emissions in the building sector and switching these emissions sources from fossil fuel to renewable electricity (driven by Senate Bill 100) is critical in achieving the State's carbon neutrality targets.³⁸ To facilitate this transition California has begun to provide incentives for heat pump adoption and further regulate gas appliances to shift the market trajectory from gas to electric or zero-NOx technologies.

Technology and Equipment for Clean Housing Program Clean California (2018)

Technology and Equipment for Clean Housing Program (TECH) Clean California has a multi-year market transformation initiative aimed at accelerating heat pump adoption. TECH's approach drives down costs through incentives, finds new value streams, and scales successful approaches through market and policy changes. This approach is described as a "mid-stream" supply chain intervention to spur the adoption of heat pump technologies. TECH was created by 2018 California Senate Bill 1477 and initially leveraged \$120 million to kickstart California's market for heat pump space and water heating. TECH's theory of change hinges on the market signal effect of a long-term, simplified incentive structure to subsidize heat pumps. It also brings forward programs to boost industry best practices and workforce training (e.g., TECH QuickStart Grants) and clear and consistent market communication to increase customer and contractor awareness on heat pumps.³⁹

These TECH incentives and workforce training programs are also complimented by additional efforts by BayREN and community choice aggregators (CCA) across the Bay Area. These multiple incentive sources can be combined or 'stacked' to support the installation of HPWH and HP HVAC appliances. In 2023, the CPUC allocated \$50 million of additional funding to TECH.

California's 6 Million Heat Pump Goal (2022) and Manufacturer Pledge (2023)

In July 2022, Governor Gavin Newsom sent a letter to the Chair of the Air Resources Board (CARB) establishing a goal of deploying 6 million heat pumps statewide by 2030.⁴⁰ This letter was followed by a 2023 pledge signed by ten of the world's largest manufacturers of heating and cooling equipment to achieve California's 6 million heat pump installation goal by 2030, in collaboration with the CEC.

³⁸ <https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf>

³⁹ <https://energy-solution.com/wp-content/uploads/2023/02/Heat-Pump-Market-Transformation.pdf>

⁴⁰ <https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf>

The 6 million heat pump goal should be considered relative to the projected Bay Area demand for heat pumps outlined in Table 1. By 2030 approximately 610,000 HPWH are projected to be installed as a result of Rule 9-6 (roughly 10 percent of the State heat pump goal). 2030 is only one year into implementation of Rule 9-4, with an anticipated 131,679 HP HVAC installed between 2029 and 2030. Implementation of Rules 9-6 and 9-4 would require the installation of 740,190 HPWH and HP HVAC, accounting for ~12 percent of California’s 6 million heat pump goal.⁴¹ This indicates that heat pump demand as catalyzed by Rules 9-6 and 9-4 represents a not-insignificant proportion of the States’s overall heat pump procurement target, in line with the Bay Area’s significance as a major population center within California, accounting for approximately 16% of the State’s 13.3 million households.⁴²

OEM efforts to meet these State goals will be described in the section below which provides an overview of the state of the heat pump supply chain.⁴³

CARB Zero-Emission Space and Water Heaters by 2030

CARB is developing a proposal for a zero-emission space and water heaters requirement to their Board for consideration in 2025, aligning with the 2022 Scoping Plan goal to reduce greenhouse gas (GHG) emissions while also helping to meet State and federal air quality standards through NOx emission reductions. The proposed regulation would mean that all-new construction and replacements of space and water heating appliances in existing buildings would have to be zero-emission according to proposed implementation dates.

National Market Impacts for Heat Pumps

Recent federal-level incentives, investments, and regulations have also begun to push the market towards increased levels of heat pump adoption. These recent developments can be seen as a national-level market driver signaling manufacturers to upcoming demand for heat pump technologies.

Updated Congressionally Mandated Energy-Efficiency Standards

In April of 2024, the U.S. Department of Energy (DOE) finalized updated efficiency standards for water heaters which is expected to save Americans over \$7 Billion annually on household energy bills.⁴⁴ The new standards, which are the first updates to Federal energy efficiency standards since 2010, are expected to put electric water heater requirements on par with entry level heat pump water heater efficiencies. There was also a moderate increase in the requirements for gas water heaters as well. These changes are expected to increase demand for HPWH.

⁴¹ 202,837 HPWH assumed installed/year beginning in 2027 with implementation of Rule 9-6 through 2030 (3 years of implementation). One year of implementation is assumed referencing 131,679 HP HVAC needed per year in the Bay Area to replace burned out appliances, as displayed in Table 1.

⁴² https://datacommons.org/place/geold/06?utm_medium=explore&mprop=count&popt=Household&hl=en

⁴³ <https://www.energy.ca.gov/news/2023-10/top-global-building-appliance-manufacturers-and-distributors-commit-help>

⁴⁴ <https://www.energy.gov/articles/doe-finalizes-efficiency-standards-water-heaters-save-americans-over-7-billion-household>

The Inflation Reduction Act (IRA)

The passage of the IRA in 2022 introduced a host of federal incentives via tax credits and upfront rebates for heat pump retrofits of existing buildings. These additional contractor and consumer facing rebates significantly reduce heat pump installation costs and in some cases, make them more cost-effective than gas appliance installation.⁴⁵

Under the IRA, the High Efficiency Electric Home Rebate (HEEHRA) and Homeowner Managing Energy Savings (HOMES) programs allocated \$528 million to the State of California.⁴⁶ HOMES allocates rebates based on modeled energy savings. HOMES could be used to fund certain heat pump retrofit projects, but thresholds of financing would vary from building to building and are therefore, hard to quantify. HEEHRA offers homeowners upfront cash rebates for HPWH and HP HVAC. HEEHRA caps funding for HP HVAC at \$8,000/project, and \$1,750/project for HPWH.⁴⁷

These funds are already allocated to the State of California and will be distributed by the CEC. The funds are intended to support a 10-year rebate program that will run until there are no more funds, with a final fund sunset date of 2032.⁴⁸ This total amount of funding through HOMES and HEEHRA is consequential but can only cover the incremental cost of a limited number of heat pump installations throughout the state. For example, all available federal funding from both programs used through 2032 could only cover the incremental cost of between 37,000 and 49,000 HP HVAC upgrades throughout California depending on technology and complexity of installation.⁴⁹ However, in addition to these rebates and upfront incentives, the IRA also provides tax credits which do not have budget caps.

Defense Production Act Investment to Accelerate Heat Pump Production

In November of 2023, the Biden-Harris administration announced \$169 million for nine selected projects to accelerate heat pump manufacturing at 15 sites across the country.⁵⁰ This effort also leverages the Defense Production Act to increase the domestic production of five key energy technologies which include electric heat pumps. The Department of Energy also anticipates another round of investments via the Defense Production Act to secure domestic manufacturing supply chains. This investment will happen through the Office of Manufacturing and Energy Supply Chains which was established in February 2022 to launch a range of investments in America's energy manufacturing centers.⁵¹ This can be seen as a larger policy shift that has focused on investment in America's industrial base, particularly for green technologies like heat pumps.

⁴⁵ https://assets.ctfassets.net/v4qx5q5o44nj/4NjKtKlBctiwSuMXlumJUB/00d06479160c95dee43d3ec89f98df1a/Go_Electric_Guide_2023.pdf

⁴⁶ <https://www.energy.ca.gov/programs-and-topics/programs/inflation-reduction-act-residential-energy-rebate-programs-california#:~:text=More%20than%20%24582%20million%20is,program%20development%20in%20late%202023>

⁴⁷ <https://www.energy.ca.gov/programs-and-topics/programs/inflation-reduction-act-residential-energy-rebate-programs-california>

⁴⁸ Incentives reflect available incentives as of November/December of 2023.

⁴⁹ See BAAQMD Task 1. Referencing an incremental cost of \$14,101 for ducted HP HVAC.

⁵⁰ <https://www.energy.gov/articles/biden-harris-administration-announces-169-million-accelerate-electric-heat-pump>

⁵¹ <https://www.energy.gov/mesc/about-us>

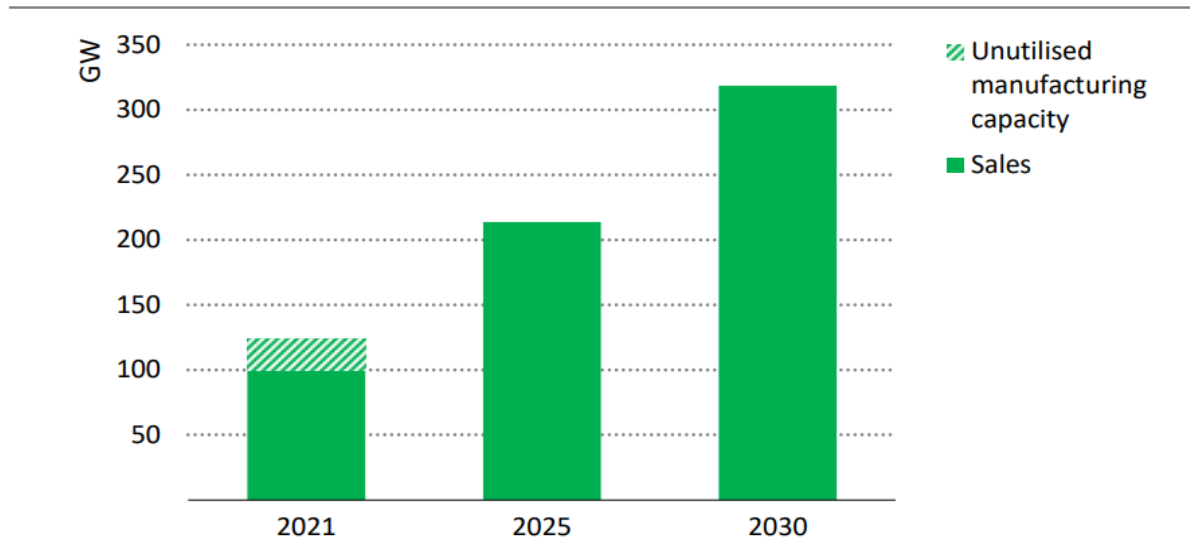
International Decarbonization Goals for Buildings

Recent analysis by the International Energy Agency modeled heat pump demand if governments across the globe implemented the building decarbonization strategies necessary to achieve their announced pledges to achieve carbon neutrality. Figure 15 shows that in 2021, global heat pump manufacturing was underutilized, meaning that the existing manufacturing infrastructure had room to meet additional demand (accounting for an additional 20% of global 2021 demand). This also suggests that increased demand in the Bay Area could be met with internationally manufactured heat pumps.

However, if governments started to implement their announced carbon neutrality targets (Announced Pledges Scenario or APS), heat pump sales would rapidly outpace manufacturing capacity. This is an important note as the heat pump manufacturing base is global, with significant manufacturing bases in China, Europe, Japan, and Korea.^{52,53}

Figure 15 Global Heat Pump Demand Forecast (Gigawatts (GW) of Capacity)

Figure 3.5 ▶ Current and projected heat pump sales in the APS and unutilised manufacturing capacity today



IEA. CC BY 4.0.

Unutilised heat pump manufacturing capacity, while equal to about 20% of total capacity, would not even be sufficient to meet the growth in sales in the APS for two years

Source: IEA analysis for 2021 based on data provided by Global Research View.

⁵² Section 3.4: Manufacturing Constraints: <https://iea.blob.core.windows.net/assets/4713780d-c0ae-4686-8c9b-29e782452695/TheFutureofHeatPumps.pdf>

⁵³ <https://iea.blob.core.windows.net/assets/4713780d-c0ae-4686-8c9b-29e782452695/TheFutureofHeatPumps.pdf>

The International Energy Agency notes that globally, heat pump sales growth rate is increasing substantially in the European Union (up to 65 percent growth), while heat pump sales in the U.S. grew 15 percent between 2020 and 2021.⁵⁴ The U.S. is also not alone in subsidizing heat pumps; over 30 countries around the world have incentive programs for heat pumps, with most featuring bonuses for low-income households.⁵⁵

While past market trends show that even before the passage or adoption of the policy drivers described here, HPWH and HP HVAC technology were both increasing rapidly as gas declines. As noted in the sections above, there are also large parts of the United States where zero-NOx water and space heating dominate the market. The combination of additional “carrots” (incentives, workforce training), and “sticks” (upcoming regulations) at the Bay Area and global levels has been instrumental in further shaping the global heating and cooling market and shifting supply chains from gas to electric heat pump technologies. The next section will explore the existing conditions of the heat pump supply chain in meeting this new policy driven demand.

3.3 Current Heat Pump Sales Projections

This section describes HPWH and HP HVAC growth projections. It also describes key predicted drivers of future demand, namely, the role of environmental policy in shaping the market. While the section above describes BAAQMD rules as a market driver, this section describes the cumulative impact of environmental policies at the state, national, and global level in shaping future demand and supply for zero-NOx appliances.

HPWH Future Sales Projections: Rapid, Policy-Driven Growth

Recent analysis indicates that business-as-usual growth based on 2021 consumer patterns for HPWH would lead to single-digit growth in the annual sales of HPWHs, whereas policy interventions, including energy and performance standards, building performance standards, and appliance emission standards, would shift appliance replacements to exclusively HPWH instead of gas, or electric resistance, as shown below in Figure 16.⁵⁶

⁵⁴ <https://www.iea.org/reports/the-future-of-heat-pumps/executive-summary>; <https://iea.blob.core.windows.net/assets/4713780d-c0ae-4686-8c9b-29e782452695/TheFutureofHeatPumps.pdf>

⁵⁵ https://www.technologyreview.com/2023/02/14/1068582/everything-you-need-to-know-about-heat-pumps/?gad_source=1&gclid=CjwKCAjw_LOwBhBFEiwAmSEQAadNn0dmOC6OVt1BVR-tLhvbMJCnstS6pLg0d2H3hisj6H6goTMKUBoChZIQAvD_BwE

⁵⁶

https://static1.squarespace.com/static/605d0aa46f4b6f47e0ab88af/t/63783d55d1731e04e36f4ca0/1668824407206/CarrotsAndSticksInHotWater_Gupta.pdf; original image source: New Buildings Institute

Figure 16 Projected Future HPWH Demand and Policy Interventions (New Buildings Institute)

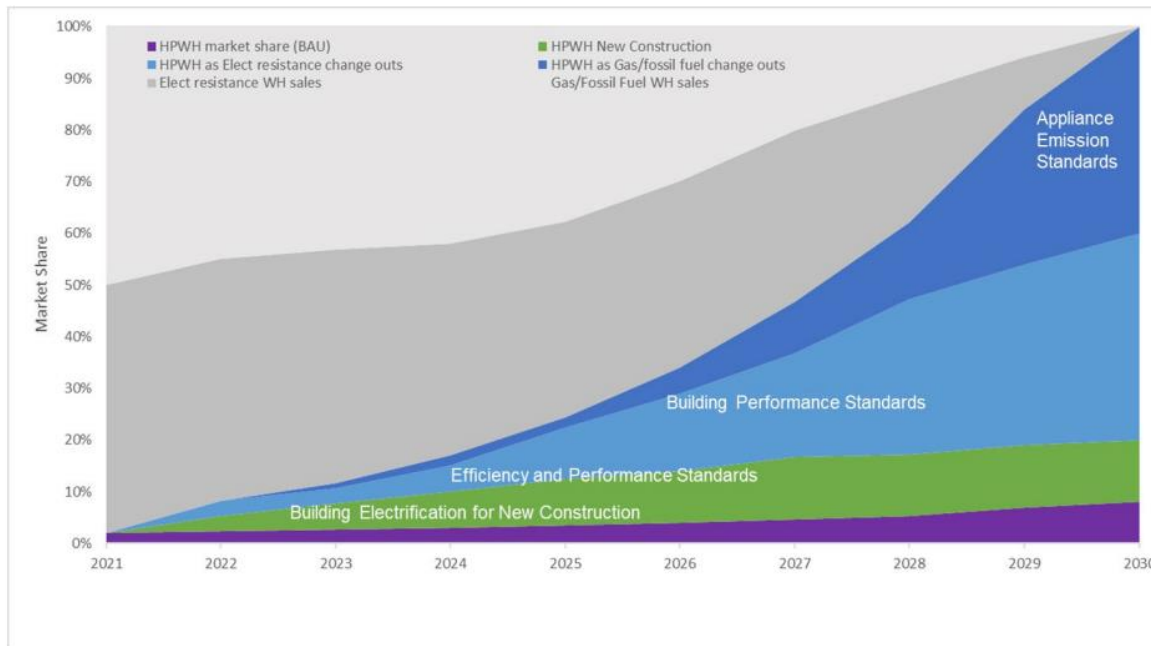


Figure 6: Illustrative market share projection with policy interventions for residential heat pump water heaters, Source: NBI 2021

This country-wide analysis is supported by California-specific research that interviewed contractors on projections for future market trends based on experience with HPWH installation. 2022 CPUC research with contractors indicate that 80 percent of contractors expect to see “some” or “a lot” of growth in the heat pump market for new buildings, both in HPWH and HP HVAC. Eighty-four percent of respondents saw local government reach codes as the main driver for heat pump installations (instead of “environmental progressiveness”).⁵⁷

Climate Change and Heat-Waves - HP HVAC Future Sales Projections

Rising demand for space cooling in response to increased instances of extreme heat events may influence future demand for air conditioning, which can be provided by a HP HVAC. Currently, consumers have two major technologies to choose between when cooling buildings: central air conditioning and HP HVAC (which adds a reversing valve to heat as well as cool). HP HVAC replaced the space heating and cooling functions regulated by Rule 9-4. However, Rule 9-4 does not impact the installation of central air conditioning appliances if they have no heating function. Nationwide, central air-conditioning (AC) sales have increased 15 percent over the past 10 years in comparison to the previous decade.⁵⁸ A Building Decarbonization Coalition analysis has found that if the sales of central AC units are converted to HP HVAC, 51 percent of California homes would have a heat pump that could provide both heating and cooling.⁵⁹ Drafts of the upcoming 2025 state building code from the

⁵⁷ <https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf>

⁵⁸ Natural Resources Defense Council, The Cool Way To Heat: CA Is Poised to Encourage “Smart” AC Units: <https://www.nrdc.org/bio/merrian-borgeson/cool-way-heat-ca-poised-encourage-smart-ac-units>

⁵⁹ Building Decarb Coalition. https://buildingdecarb.org/wp-content/uploads/Heat-Pump-Shipment-Report-Spring-2023_V4.pdf

CEC indicate pathways for installing HP HVAC (also known as “smart” ACs) in existing buildings instead of standard one-way AC units under Part 11. Though unrelated to the scope of Rule 9-4, this policy development could further shift the market towards HP HVAC in California as more buildings install space cooling to adapt to a changing climate.⁶⁰

⁶⁰ Ibid. NRDC.

4 Can the Market Meet Demand?

4.1 Zero-NOx Appliance Supply Chain Overview

Originally invented in the 1850's, heat pumps have been used in homes since the 1960's. In some countries heat pumps are the main appliance used to heat buildings, accounting for 60 percent of buildings in Norway, for example.⁶¹ As of the mid-2010s, most heat pumps were manufactured for export to Europe, with the U.S. being the dominant exporter as shown in Figure 17. Heat pumps use commodity components like copper, steel, and refrigerant, which are heavily connected to global commodity supply chains. In particular, steel dominates the cost of producing heat pumps. Heat pump manufacturing is also connected to the fast-growing global AC market.⁶²

Figure 17 U.S. Exports Heat Pump Technologies to Europe (U.S. Department of Energy)



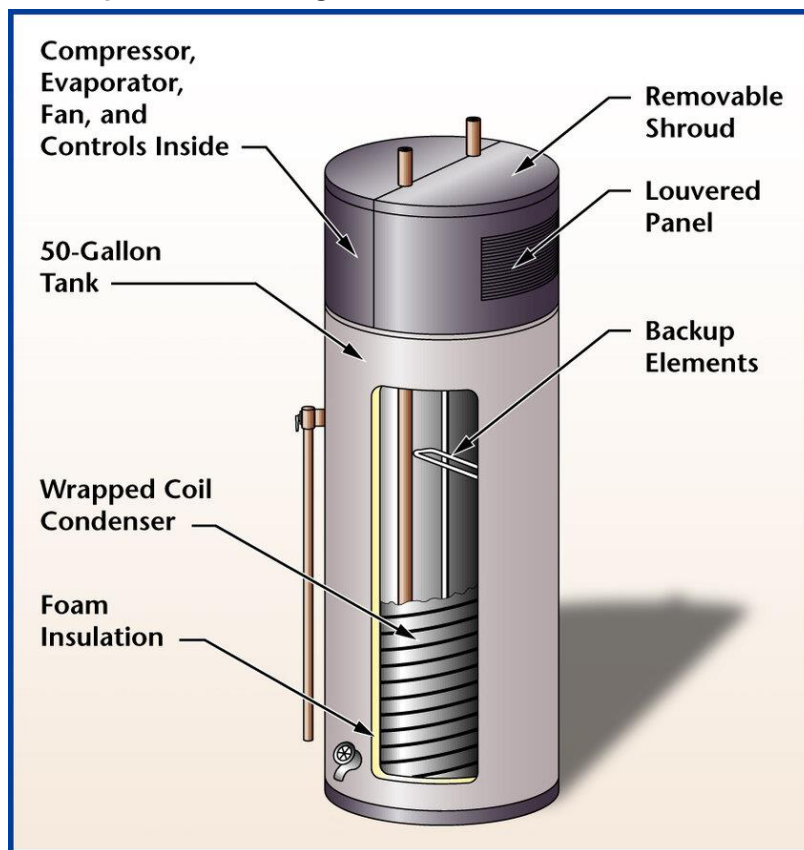
These supply chain characteristics show that the HPWH and HP HVAC supply chain is characterized by a robust global and domestic manufacturing base that uses commonly available materials and components to manufacture a long-established technology. This makes increasing production of HPWH and HP HVAC not analogous to the technology and supply chain fears for other green technologies, like the battery manufacturing supply chain bottlenecks for EV production, or challenges

⁶¹ https://www.technologyreview.com/2023/02/14/1068582/everything-you-need-to-know-about-heat-pumps/?gad_source=1&gclid=CjwKCAjw_LowBhBFiEiwAmSEQAadNn0dmOC6OVt1BVR-tLhvbMJCstS6pLgOd2H3hisj6H6goTMKUBoChZlQAvD_BwE

⁶² https://www.energy.gov/sites/prod/files/2016/04/f30/30005_Mann_040716-1105.pdf

in procuring the right mix of rare earth minerals for solar panels.⁶³ For clarity, a diagram of the core components of a HPWH is shown below in Figure 18.⁶⁴

Figure 18 HPWH Component Part Diagram



4.2 Manufacturer Progress Towards California's 6 Million Heat Pump Goal

Recent Air-Conditioning, Heating, and Refrigeration Institute (AHRI) analysis presented to the CEC indicates that California's 6 million heat pump goal by 2030 is ambitious compared to the current state of heat pump availability. While annual shipments of U.S. air source heat pump equipment doubled between 2013 and 2021, this rate of growth would need to continue through to 2030 to meet California's goal, as shown in Figure 19.⁶⁵

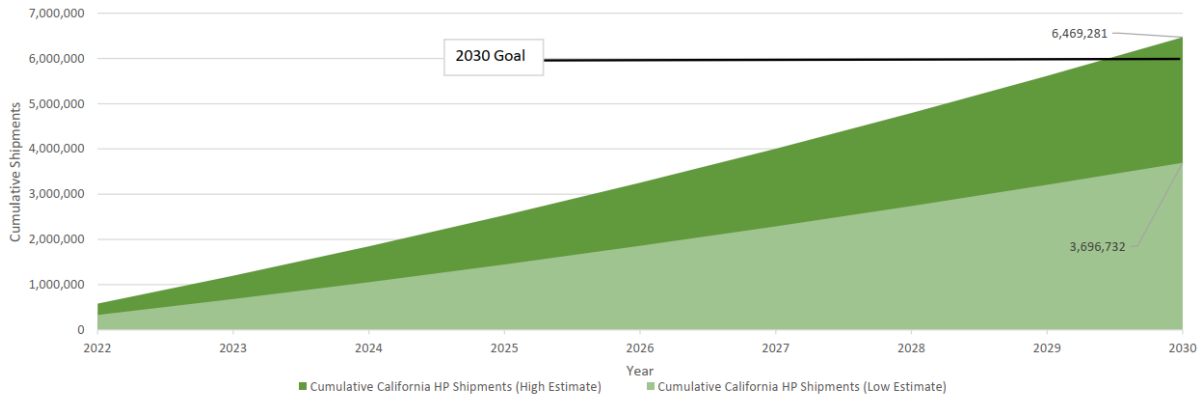
⁶³ <https://www.automotivelogistics.media/battery-supply-chain/battery-supply-chain-could-bottleneck-in-2025-says-analyst/44283.article>;
<https://www.iea.org/reports/solar-pv-global-supply-chains/executive-summary>

⁶⁴ https://www.researchgate.net/figure/Cutaway-schematic-view-of-the-integral-HPWH_fig4_267305058

⁶⁵ <https://efiling.energy.ca.gov/GetDocument.aspx?tn=242595>

Figure 19 AHRI Projected Increase in Heat Pump Shipments [2022 Base Year]

Projected Cumulative Shipments of Heat Pumps in California by 2030



Leading OEMs have also expressed public support through pledges to achieve California’s 6 million heat pump goal. In October of 2023, 10 of the world’s largest manufacturers of heating and cooling equipment signed a pledge to achieve California’s 6 million heat pump installation goal by 2030. Manufacturers including A.O. Smith Corporation, Carrier, Daikin, Fujitsu, Johnson Controls, Lennox International, and Rheem agreed to create the manufacturing capacity to achieve the State’s goal and collaborate with the CEC to develop a private-public partnership to facilitate policy and market support to bring heat pumps into the mainstream.⁶⁶

At the national level, the Building Decarbonization Coalition has led a similar initiative to increase OEM buy-in. A coalition of OEMs including A.O. Smith, Carrier, Dakin, Ferguson, Mitsubishi, and Rheem signed the Joint Vision pledging to work with state and federal government entities in achieving decarbonization goals. Manufacturers also made asks of state and federal government in aiding this market shift, including increases in consumer education campaigns, holistic energy transition planning at the public utility commission level, stable, well-funded incentive programs, and expanded workforce development.⁶⁷

4.3 Supply Chain Readiness for Implementation of Rules 9-4 and 9-6

As described in the sections above, HPWH and HP HVAC have both experienced rapid market growth in the last few years. Sales of HPWH in the U.S. grew 26 percent in 2022 as sales of gas water heaters declined by 17 percent.⁶⁸ HP HVAC has experienced even faster growth, fueled in part by increased consumer demand for air conditioning in combination with energy efficiency and decarbonization policies pushing the market towards HP HVAC adoption. In fact, in 2020, HP HVAC sales outpaced gas furnace sales in the U.S.⁶⁹

⁶⁶ <https://www.energy.ca.gov/news/2023-10/top-global-building-appliance-manufacturers-and-distributors-commit-help>

⁶⁷ <https://buildingdecarb.org/joint-vision>

⁶⁸ Ibid. New Buildings Institute, using EnergyStar Data: <https://newbuildings.org/heat-pump-water-heater-sales-in-2022-signal-a-decisive-shift-in-water-heating-trends/>;

⁶⁹ <https://www.technologyreview.com/2024/02/12/1087970/heat-pumps-hot/>

This recent market shift towards HPWH and HP HVAC has mainly been driven by incentives (e.g. TECH Clean California) and local regulations for all-electric new construction, decarbonization, and air quality. In addition, the data referenced in this report on heat pump market share increases does not yet reflect policies adopted and implemented in 2022 and 2023 which are expected to continue this trend. The implementation of these upcoming policies and federal investments (e.g. IRA consumer-side subsidies for HPWH and HP HVAC, direct investment in heat pump manufacturing through the Defense Production Act) and rules and requirements (e.g. Rules 9-6 and 9-4) will send an even stronger signal that the market is shifting from gas to zero-NOx technologies, and that OEMs should prepare to meet future policy-driven demand. Although these policies and incentive programs may not immediately appear to be a supply chain solution, they are instrumental in signaling to manufacturers that they should plan to ramp up manufacturing capacity. The OEM-signed pledge to meet California's 6-million heat pump target is an example of this relationship between environmental policy and supply chain readiness.⁷⁰

Like many other technologies (including high efficiency gas appliances) heat pumps use semiconductors to operate. During the COVID-19 pandemic, a lack of semiconductors (and other materials) caused supply chain bottlenecks worldwide. However, since the pandemic, many of these supply chains have improved, especially semiconductor production.⁷¹ Furthermore, the Biden Administration has implemented the CHIPS and Science Act which promotes expanding semiconductor manufacturing within the U.S.⁷² Accordingly, HPWH and HP HVAC manufacturing bases are likely in a strong position to increase production once policy-driven consumer demand goes into effect.

Furthermore, investment in heat pump production specifically is being made globally as identified in International Energy Agency World Energy Outlook Special Report.⁷³ As shown below in Figure 20, billions of dollars of funding has been allocated to heat pump manufacturing. Therefore, at present, there are no recognized supply chain risks that suggest meeting future market demand for HPWH and HP HVAC systems (as driven by Rules 9-6 and 9-4) will pose any challenges in effectively implementing the Rules across the Bay Area.

⁷⁰ <https://www.energy.ca.gov/news/2023-10/top-global-building-appliance-manufacturers-and-distributors-commit-help>

⁷¹ <https://www.jpmorgan.com/insights/global-research/supply-chain/chip-shortage#:~:text=Chip%20supply%20began%20to%20improve,began%20falling%20in%20March%202022.>

⁷² <https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/>

⁷³ The Future of Heat Pumps (iea.blob.core.windows.net)

Figure 20 Recently Announced Investments in Heat Pump Production by Selected Manufacturers in Europe

Company	Region/country	Investment allocation	Investment (EUR)	Date of completion
Vaillant	EU	Heat pumps and energy efficiency	130 million	2022-2023
Hoval	Liechtenstein, Slovakia	Heat pumps	60 million	2023-2024
Clivet (Midea Group)	Italy	Heat pumps	60 million	2024
Mitsubishi	Turkey, UK	Heat pumps and air conditioning	128 million	2024
Bosch	Europe	Heat pumps	300 million	2025
Daikin Europe	Belgium, Czech Republic, Germany, Poland	Heat pumps, digitalisation, R&D and service capacity	1.2 billion	2025
Stiebel Eltron	Germany	Heat pumps	600 million	2025
NIBE	Sweden	Heat pumps	460 million	2025
Viessmann	Poland	Heat pumps and other green solutions	1 billion	2025
Panasonic	Czech Republic	Heat pumps	145 million	2026

Note: Converted to EUR for Mitsubishi (USD 113 million plus GBP 15 million) and NIBE (SEK 5 billion [Swedish kronor]).

Sources: Vaillant Group (2022); Business Solutions (2021); Hoval (2022); Quanlin (2022); Mitsubishi (2022); Walker (2021); Bosch (2022); Daikin (2022); Klingauf (2022); NIBE (2022); Viessman Group (2022); Panasonic (2022).

These investments, along with other signals such as the 6 million heat pump commitment letter in California, signal a manufacturing sector that is responding to growing demand for heat pumps.

5 Conclusion

- Current market saturation is low for HPWH, which covers only 3 percent of water heaters in the United States. HP HVAC take up a comparatively larger, but still-minority share of appliance saturation, with about 16 percent of U.S. Households using a heat pump.
- Based on the survey responses from Bay Area Contractors, obtaining heat pump water heaters and HVAC equipment is not a challenge and wait times for receiving equipment is remaining constant or decreasing.
- Despite these currently low market penetration rates in California, HP HVAC and HPWH demand is increasing rapidly. Other parts of the U.S., namely the South, show that an electric-dominant water and space heating market is possible.
- Policy “carrots” and “sticks” like TECH incentives and BAAQMD Rules 9-6 and 9-4 have been instrumental in increasing market demand and availability for HPWH and HP HVAC.
 - Most market predictions model future heat pump demand based on a range of factors including statewide decarbonization targets and legislation, making it challenging to break-out the contribution that is driven by BAAQMD rules alone.
 - Rules 9-6 and 9-4 are one example of the multiple regulations, policies, incentives and programs pushing the market towards an emission-free building stock. When combined, these various policies and programs are creating clear market signals for increased demand of zero-emission appliances.
- Heat pump manufacturers are aware of the upcoming demand and are responding in material ways to help meet California’s 6 million heat pump installation goal by 2030.
- Heat pumps are an established technology with a robust OEM base both in the U.S. and abroad. Although demand for heat pump technologies is expected to increase rapidly, much in the same way that market demand has driven increased production of personal computers or cellular phones, existing OEM manufacturers are expected to meet demand if they invest in production capacity. There are several efforts underway to shift the market in this direction, such as recent supply-side investments via the Defense Production Act.

Appendix A

Distributor and Contractor Survey Questions and Raw Results