Market Study—Residential Multifunction Heat Pump

Final Report

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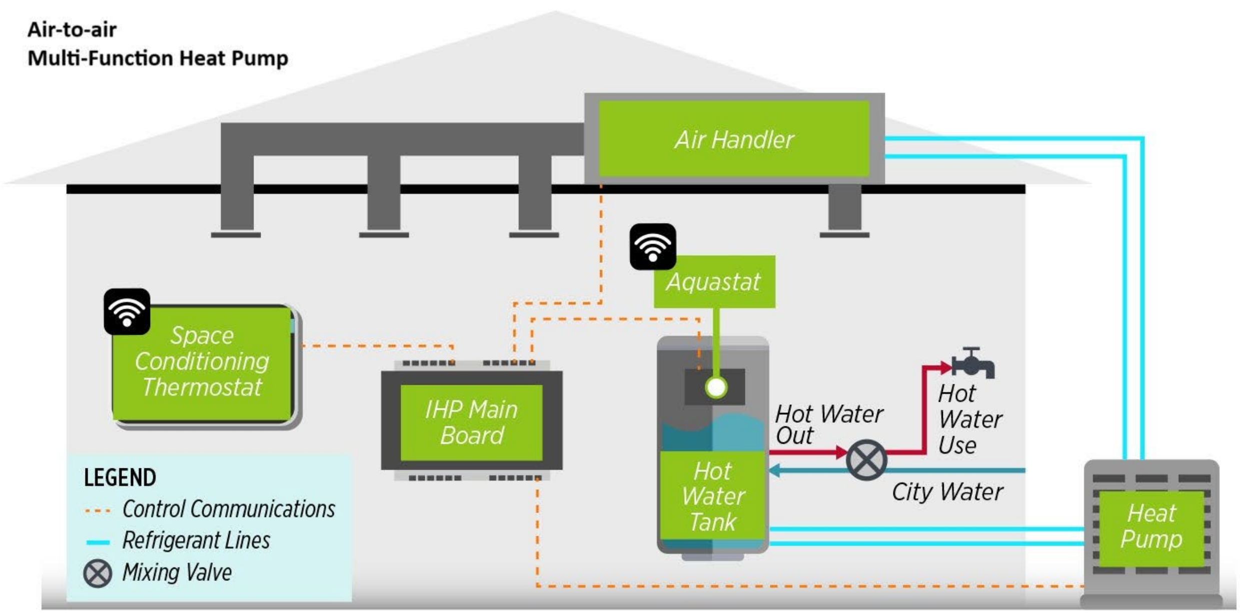

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Disclaimer

Executive Summary

This market study investigates the adoption potential of residential air-to-air multifunction heat pumps (MFHPs) in California as a pathway to achieving the state's building decarbonization goals. By combining space heating, cooling, and water heating into a single system, MFHPs offer unique advantages, such as reduced electrical load, greater operational efficiency, and enhanced load flexibility, which may be particularly valuable in homes with constrained electrical capacity. The findings from this study are intended to inform the design of energy efficiency programs, policies, and market interventions that enable broad and equitable access to emerging technologies, especially among underserved communities.

To address current gaps in understanding and support equitable market growth, this study employs a mix of methods to explore the market potential of residential air-to-air MFHPs in California. The research integrates primary and secondary data through three complementary components.

- First, a landscape analysis synthesized technical and policy literature, regulatory frameworks, housing stock and climate suitability data, manufacturer specifications, and expert consultation to characterize MFHP technology, market conditions, and adoption barriers.
- Second, stakeholder interviews were conducted between August and October 2025 with 49 participants from 41 organizations—spanning affordable housing developers, program managers, energy organizations, consultants, manufacturers, installers, utilities, and service providers—to capture diverse perspectives on MFHP deployment.
- Third, residential customer surveys were completed by a demographically representative sample of Californians (N= 961) through Qualtrics panels, ensuring diversity in socioeconomic status, race and ethnicity, and geography, to assess awareness, perceptions, and potential adoption drivers among energy customers.

Together, these methods provide a comprehensive platform for understanding MFHP performance characteristics, market readiness, and the economic, technical, and policy factors shaping their deployment. The findings aim to inform the design of energy efficiency programs, incentive structures, workforce training initiatives, and policy strategies that can accelerate equitable and scalable MFHP adoption in California.

Findings and Insights

Residential air-to-air MFHPs represent a nascent technology pathway for building decarbonization. These systems integrate space heating, cooling, and water heating within a single platform, recovering waste heat during simultaneous operation to achieve efficiencies beyond those reflected in current ratings designed for standalone heat pumps. However, the absence of a formal DOE product class and standardized performance metrics constrains the ability to evaluate MFHPs' cost-effectiveness, readiness, and applicability across program portfolios.

Despite limited product availability and field data, MFHPs offer several potential advantages relative to separate space-conditioning and water-heating systems. By relying on a single compressor and eliminating electric resistance backup heating, MFHPs can operate at amperages well below typical dual-system installations—helping avoid costly electrical panel upgrades during electrification retrofits. For example, a 3-ton capacity MFHP requires approximately 25 to 35 amps in comparison to the 85 to 150 amps of separate systems. Their flexible installation options, compatible with existing outdoor condenser and water heater locations, enhance retrofit feasibility. Emerging research also suggests that advanced control strategies could further enhance efficiency and load flexibility, positioning MFHPs as a potentially valuable resource for grid-responsive, low-carbon operation.

Customer survey findings echo these technical advantages while highlighting how households weigh the tradeoffs of heat pump technology more broadly. Respondents identified long-term energy efficiency, lower utility bills, environmental benefits, and the convenience of having heating, cooling, and hot water integrated into one system as key reasons to consider MFHPs and related heat pump solutions. At the same time, they noted major practical barriers: high upfront installation costs, the prospect of electrical panel upgrades, and a strong reluctance to retire equipment that is still working. Equipment-specific issues, particularly noise and the cooling effect associated with heat pump water heaters, also featured prominently in customers' concerns.

External context further shapes consumer perceptions. Many respondents reported that upcoming 2030 California rules restricting new gas appliances, coupled with sizeable but potentially time-limited incentives, make electrification more urgent and attractive than it might otherwise be. Within this policy and incentive landscape, decision-making remains highly personal: some customers base their choices on detailed cost–benefit analyses and a desire to "future-proof" their homes, while others rely heavily on installer or program recommendations.

Nonetheless, significant barriers remain to achieve MFHP market viability. From an equipment standpoint, MFHPs must overcome several technical hurdles—including limited product availability, lack of standardized performance ratings, and, like all HPs, the need to transition toward ultra-low-GWP refrigerants. Stakeholders consistently cited a weak value proposition, characterized by high upfront costs, uncertain energy savings, and unproven long-term reliability. Perceived risks such as dependence on a single integrated system, limited reliability data, and potential service or parts discontinuity further dampen market confidence. These concerns are amplified by the technology's reliance on digital controls and the limited number of trained contractors capable of commissioning and servicing MFHPs. As one participant admitted, "I've struggled with trying to figure [the value proposition] out. Saving breaker space and a few other random benefits are outweighed by drawbacks." Overall, stakeholders agreed that—outside of a few niche applications—there may not be enough demonstrated value yet to justify these challenges.

To realize MFHPs' potential benefits, stakeholders emphasized the need for rigorous field demonstrations, expanded workforce training, and manufacturer commitments to service continuity and firmware support. Over time, increased field experience, standardized installation guidance, and cross-trade coordination could reduce costs, shorten learning curves, and improve system reliability.

Ultimately, the technology's success will depend on demonstrating clear, measurable value to consumers, installers, and utility programs. In near-term applications, particularly in homes constrained by electrical panel capacity, MFHPs could provide an efficient, low-power and lower-cost electrification pathway that mitigates grid impacts and avoids infrastructure upgrades. Targeted demonstration projects and incentive structures that reflect these benefits would accelerate market readiness.

While technical potential is evident—spanning space savings, integrated efficiency, and load flexibility—MFHPs must progress from an emerging product type to a proven solution. Achieving that transition will require improved controls, robust field validation, standardized commissioning, and coordinated efforts among manufacturers, utilities, and program administrators to define optimal use cases, quantify benefits, and ensure equitable market access. With sustained collaboration and investment, MFHPs could evolve into a practical, adaptable technology serving diverse residential segments across California and beyond.

Critical Recommendations

- **Establish a product classification and performance standard for MFHPs.**
  Current rating systems (e.g., UEF, HSPF2, SEER2), misrepresent MFHP performance and exclude heat-recovery and simultaneous operation. A DOE rating pathway and ENERGY STAR® certification are essential for broad market legitimacy, incentives, and code compliance.

- **Align US certification and testing with international protocols.**
  Accept European standards (e.g., EN 14825, EN 16147), as provisional benchmarks to reduce duplicative testing and speed market entry, while developing harmonized US procedures through DOE/ENERGY STAR.

- **Improve controls and interoperability to optimize performance and user experience.**
  Advance MFHP control logic to communicate with demand-response and load-flexibility protocols, enable real-time optimization for energy efficiency, and provide intuitive, user-friendly interfaces for both installers and occupants.

- **Build long-term reliability evidence and parts-support commitments.**
  Fund large-scale demonstrations with multi-year monitoring and public reporting on failure rates, service outcomes, and effective maintenance practices. Tie incentive eligibility to minimum warranty and parts-availability periods to prevent stranded assets.

- **Support data transparency and field validation.**
  Establish centralized databases of field and lab performance results to validate efficiency claims, guide program design, and support consumer and utility trust.

- **Address cost and risk barriers to early adoption.**
  Design rebates and financing programs that close the incremental cost gap relative to separate HP systems and provide risk-sharing mechanisms to support early adopters and contractors.

- **Incorporate MFHP grid and emissions benefits into planning and incentives.**
  Recognize avoided panel upgrades, reduced transformer loads, and load-shifting potential in cost-effectiveness tests and incentive valuations to reflect MFHPs' broader system benefits.

- **Develop a trained, cross-trade workforce.**
  Integrate MFHP-specific modules into HVAC, plumbing, and electrical training programs, focusing on installation, refrigerant safety, and commissioning to reduce failure rates and build market confidence.

- **Facilitate the transition to ultra-low-GWP refrigerants while maintaining safety and performance.**
  Support R&D on designs that reduce total refrigerant charge, employ secondary loops, and enable factory-sealed or quick-connect configurations. Expand installer training on safe A2L handling and update fire and building codes to reflect new refrigerants (for MFHPs and other HPs).

Stakeholder Feedback and Technology Transfer

Stakeholder engagement is at the core of this research study. Interviews were conducted with over 49 individuals from a range of stakeholder groups including affordable housing developers, utility program managers and implementers, energy experts, consultants and researchers, MFHP manufacturers, installers, utility providers, and policy experts. As findings emerged, they were incorporated into the interviews to gauge stakeholder response. Feedback from CalNEXT and SCE on the preliminary results and draft report have been incorporated into the final draft.

Both formal and informal channels are in use for technology transfer. Ongoing stakeholder engagement has ensured the research yields relevant findings and actionable program guidance. Insights from the research will be disseminated through final reports, briefings, and targeted outreach to support knowledge transfer and effective program implementation. In addition, findings will inform future MFHP R&D by the Western Cooling Efficiency Center (WCEC) engineers.

Abbreviations and Acronyms

Acronym	Meaning
AB	Assembly Bill
ACEEE	American Council for an Energy-Efficient Economy
AEA	Association for Energy Affordability
AHU	Air handling unit
AHR	Air-conditioning, heating, refrigerating
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
ASHP	Air-source heat pump
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
AWHP	Air-to-water heat pump
BPS	Building performance standards
BUILD	Building Initiative for Low-Emissions Development
CAHPP	California Heat Pump Partnership
CARB	California Air Resources Board
CCA	Community choice aggregator
CEC	California Energy Commission
CPUC	California Public Utilities Commission
DHW	Domestic hot water
EPA	US Environmental Protection Agency
ESA	Energy Savings Assistance
EUL	Effective useful life

Acronym	Meaning
EV	Electric vehicle
GHG	Greenhouse gas
GWP	Global warming potential
HEEHRA	High-Efficiency Electric Home Rebate Act
HFC	Hydrofluorocarbon
HFO	Hydrofluoroolefins
HPWH	Heat pump water heater
HSPF	Heating seasonal performance factor
HVAC	Heating, ventilation, and air conditioning
IEPR	Integrated Energy Policy Reports (CEC)
IOU	Investor-owned utility
IRA	Inflation Reduction Act
MAEDbS	Modernized Appliance Efficiency Database System
MFHP	Multifunction heat pump
NRDC	Natural Resources Defense Council
NRECA	National Rural Electric Cooperative Association
ODU	Outdoor unit
POU	Publicly owned utility
PV	Photovoltaic
RMI	Rocky Mountain Institute
SB	Senate Bill
SEER	Seasonal energy efficiency ratio

Acronym	Meaning
SGIP	Self-Generation Incentive Program
TOU	Time-of-use
TPM	Technology Priority Map (CalNEXT)
TSB	Total system benefit
UEF	Uniform energy factor
VEIC	Vermont Energy Investment Corporation
WCEC	Western Cooling Efficiency Center (UC Davis)

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Introduction

California has set ambitious climate and energy targets, including the installation of six million heat pumps (HP) by 2030 and the phasing out of gas-powered heating equipment.[1] The CEC's 2022 Integrated Energy Policy Report (IEPR) highlighted heat pumps' potential to contribute to building decarbonization, energy efficiency, refrigerant leakage reduction, and demand flexibility.[2] Despite currently having about 1.9 million heat pumps installed statewide, California is projected to fall short of this target unless adoption rates dramatically increase.[3] To achieve the goal, heat pump installations will need to nearly quadruple, supported by a comprehensive portfolio of policies, incentive programs, workforce training, and consumer engagement, as well as alternative system configurations that address existing technical barriers to heat pump adoption.

Multifunction heat pumps (MFHPs), prioritized in CalNEXT's 2024 Technology Prioritization Map, represent an emerging technology that integrates space heating, cooling, and domestic hot water (DHW) into a single, highly efficient system. By replacing separate HVAC and water heating equipment, these systems reduce electrical panel requirements, minimize installation footprints, improve energy and cost savings (especially during simultaneous operation), and provide enhanced load flexibility to support grid resilience.[4]

This study investigates the barriers and opportunities for residential air-to-air MFHPs in the California market, drawing on market research and stakeholder interviews. The report characterizes currently available and near-market MFHP products in the California market; identifies market barriers, customer readiness factors, and stakeholder perspectives; and explores challenges and opportunities related to MFHP adoption in underserved communities and equity-focused electrification. The findings are intended to inform the development of energy efficiency programs, incentive design, workforce planning, and policy implementation strategies that can support equitable and scalable MFHP deployment.

Methodology and Approach

This study uses a mixed-methods approach that integrates both primary and secondary research to comprehensively explore the market potential of residential air-to-air MFHPs in California. By combining qualitative and quantitative methods, the approach captures both depth and breadth. Secondary research through landscape analysis synthesizes diverse technical, policy, and market data to frame the broader environment affecting MFHP adoption. Qualitative interviews provide rich, contextual insights into stakeholder perspectives, while surveys offer generalizable evidence of

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[1] Building Decarbonization Coalition (2022): https://buildingdecarb.org/california-governor-gavin-newsom-sets-a-target-of-3-million-climate-ready-homes-and-6-million-heat-pumps-by-2030

[2] California Energy Commission. (2022). *2022 Integrated Energy Policy Report Update*. Sacramento, CA. Retrieved from https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2022-integrated-energy-policy-report-update

[3] California Heat Pump Partnership. (2025). *Scaling California's heat pump market: The path to six million.* https://heatpumppartnership.org/wp-content/uploads/2025/03/CAHPP_Blueprint_2025.pdf

[4] Green, C., Chakraborty, S., & Vernon, D. (2024). *Load Flexibility of a Residential Multi-Function Heat Pump Using Dynamic Pricing*. UC Davis. https://escholarship.org/uc/item/4q9952hb

consumer awareness and preferences. This integration enables triangulation of findings, where data from each method complement and validate one another. Such a strategy is particularly valuable for addressing the complex technical, economic, and behavioral factors influencing MFHP deployment and for informing strategic program design. The following sections describe in detail the distinct but interconnected research components: landscape analysis, stakeholder interviews, and residential customer surveys.

Landscape Analysis

The landscape analysis employed a comprehensive research design incorporating five strategies.

- First, a thorough **technology and policy review synthesized technical literature**, **regulatory frameworks**, and **market research reports** from authoritative sources such as the California Energy Commission, California Public Utilities Commission, US Environmental Protection Agency, and the WCEC, while also integrating insights from CalNEXT's 2024 HVAC and Water Heating Technology Prioritization Maps to identify MFHP opportunities and barriers.
- Second, a **target market analysis** incorporated data from a recent CalFlexHub study projecting MFHP sales in California, alongside an examination of housing stock characteristics, solar photovoltaic alignment, and climate zone suitability; **preliminary technical input** from WCEC engineers further informed assumptions concerning electrical panel capacity, system types, and retrofit feasibility.
- Third, the **barrier and opportunity assessment** analyzed a wide range of factors shaping MFHP adoption—including technical, economic, policy-related, customer-centric, and workforce considerations—drawing on academic research, program evaluations, incentive data, and consultations with subject matter experts.
- Fourth, the **product landscape characterization** built upon an earlier CalNEXT product search to update and expand the inventory of available and soon-to-be-available MFHP models in California, detailing technical specifications, refrigerant compliance, and system integration features through vetting of manufacturer documentation, online sources, and expert interviews.
- Lastly, **ongoing expert consultation and validation with WCEC specialists** ensured that assumptions remained grounded in practical deployment experience and that findings reflected current real-world conditions.

Together, these interrelated strategies provided a robust platform for understanding the current MFHP market landscape and informing strategic program design. The findings of the landscape analysis were the focus of the preliminary findings report.

Stakeholder Interviews

We conducted a series of qualitative, in-depth interviews to explore stakeholder perspectives on MFHPs between August and October 2025. In total, 40 interviews were completed with 49 participants representing 41 distinct organizations and companies. Participants were purposefully recruited using a targeted recruitment strategy designed to capture a broad and representative range of stakeholders engaged in manufacturing, program implementation, and energy-related work.

The final interview participant pool reflected a diverse set of roles and organizational affiliations, as shown in Table 1.

Table 1. Overview of stakeholders interviewed

Stakeholder Category	Interviews	Orgs	Individuals
Affordable Housing Developers	5	5	8
Program Managers and Implementers	4	4	5
Energy Organizations	7	8	7
Consultants and Researchers	7	7	7
MFHP Manufacturers	7	7	7
Installers and Service Companies*[5]	5	5	5
Utilities and Energy Providers	5	5	10
Total	**40**	**41**	**49**

Interviews lasted approximately 60 minutes and were conducted virtually via Zoom to accommodate participants and ensure geographic representation. Semi-structured interview guides were used to ensure consistency across conversations while allowing for flexibility to probe into participant experiences and perspectives. The discussion protocol covered topics relevant to stakeholder roles with prompts tailored as appropriate to each stakeholder group. The interviews also addressed the potential benefits MFHPs could offer underserved communities, how MFHPs may meet their specific needs, and the unique challenges these customers face in adopting the technology. More information, including interview questions, is included in Appendix A. The findings presented in this report are derived from the stakeholder interviews unless otherwise stated.

At the conclusion of the interviews, the stakeholders were offered the opportunity to fill out two online assessments tools. The Technology Characteristics and Adoptability Assessment tool (based on a framework published in Outcault et al., 2022b) is essentially a structured scorecard for how “adoptable” a technology is across 14 specific characteristics. It asks users to rate a technology such as an MFHP on simple scales such as high/medium/low for each characteristic, grouped into four categories: economic, technical, informational, and externalities.

Economic items cover upfront costs, ongoing operating costs, return on investment (ROI), and how easy it is to find the product and support. Technical items cover how well it fits existing infrastructure and conditions, how well it performs and lasts, and how complex installation, everyday use, and maintenance are, plus the level of expected energy savings. Informational items cover how visible

[5] One interviewee, an installer, due to scheduling issues completed the interview in writing – answering questions in the protocol and returning via email.

the technology and its results are, and how easy it is to trial on a limited basis. Externalities cover environmental and non-energy impacts on the home, like health, noise, or convenience.

By filling out this assessment, interviewees produce a visual snapshot (the “morphological box”) that shows which characteristics are strong (help adoption) and which are weak (hinder adoption), providing a quick, comparable picture of the technology’s overall adoptability profile. The results were compiled and are reported in relevant sections throughout the report, as well as in Appendix B, to provide perspectives on the extent to which stakeholders view given technology characteristics as a barrier to adoption.

Next, the Non-Energy Impacts (NEI) Assessment tool translates the Occupant NEI Identification Framework (ONEII Framework) (published in Outcault et al., 2022a) into a practical virtual worksheet that walks users through key building performance areas (spatial, thermal, acoustic, visual, and building integrity) and asks them to note the NEI--physiological, psychological, economic, practical, and social effects--for each. By crossing those performance areas with the five NEI types, the tool guides participants to think about up to 30 specific impact pathways, rather than only focusing on energy savings or comfort in general terms. This structured approach makes it easier to compare technologies, uncover hidden benefits or drawbacks, and discuss NEIs using neutral language so responses are not biased toward only positive or negative outcomes.

The two assessments were filled out by 14-15 of the stakeholder interviewees. Overall, the group who filled out the assessment was heavily weighted toward research and analysis perspectives, with a smaller but diverse set of market-facing roles involved in implementation, design, manufacturing, installation, and property ownership. The results are reported as part of a discussion on the *Positive Externalities* of MFHPs.

Residential Customer Surveys

To obtain a demographically representative sample of homeowners in California, we recruited participants through Qualtrics survey panels. Qualtrics provides access to a diverse pool of individuals who agreed to participate in online surveys, enabling efficient recruitment based on defined demographic and geographic criteria. Panel management tools within the Qualtrics platform allowed us to set precise selection criteria to screen for participant eligibility. Quotas were applied to ensure diversity across sociodemographic variables, including socioeconomic status, race and ethnicity, and geographic location. The survey was limited to homeowners in California. The survey was administered online through the Qualtrics platform from October to November 2025.

The survey was completed by 961 California homeowners who reflect a diverse cross-section of California homeowners across race, ethnicity, age, and gender. Eighty-seven percent live in a single-family home, while 13% live in a multi-family apartment, condo, or townhome. Seventy-three percent identified as White, 16% as Asian or Pacific Islander, 8% as Black or African American, and 2% as American Indian or Alaska Native, with an additional small share selecting “other” or declining to state. About 41% of respondents identified as Hispanic or Latino. Gender representation was evenly balanced between males and females. Respondents spanned a wide age range; roughly 7% were ages 18–24, 20% were 25–34, 17% were 35–44, 18% were 45–54, 17% were 55–64, 12% were 65–74, and 10% were age 75 or older. Income diversity was present in the sample with one-fifth of respondents reporting annual household income under $50,000, 39% $50,000 to $99,999, 22% $100,000 to $149,999, 11% $150,000 to $199,999, and 5% $200,000 or more.

The survey employed an interactive "choose your own adventure" design to immerse participants in a realistic decision-making scenario regarding residential space conditioning and water heating equipment replacement. Participants were presented with a hypothetical situation in which their current space cooling or water heating system fails, prompting the need for replacement. They were told that a trusted contractor had recommended an MFHP and were then provided detailed information outlining the benefits and drawbacks of MFHPs.

Respondents navigated through the survey by choosing among options to accept the MFHP recommendation, upgrade to separate heat pump systems (if they did not already have heat pumps), or replace existing equipment with like-for-like conventional gas or electric systems. At multiple junctures, participants assessed trade-offs, expressed their priorities for new household equipment (such as cost, efficiency, comfort, environmental impact), and identified dealbreakers affecting their willingness to adopt MFHPs.

The survey further elicited qualitative data by inviting respondents to describe their thought processes behind their ultimate hypothetical equipment replacement decisions. This design captured realistic consumer considerations in a dynamic, stepwise manner, offering rich insights into adoption drivers, barriers, and the relative appeal of integrated versus separate heat pump systems.

This adaptive, scenario-based methodology reflects emerging best practices where branching logic and immersive storytelling provide deeper behavioral insights beyond standard surveys, while replicating the complexity and nuance of real-world household technology decisions.

The following section synthesizes findings from the landscape analysis, stakeholder interviews, and residential customer surveys to provide a comprehensive view of the factors shaping MFHP market development in California. We begin with a market landscape characterization to set context, then examine design and installation considerations, performance and reliability outcomes, workforce readiness, and cost drivers. We also assess policy dynamics and customer considerations including adoption drivers and barriers, linking each to implications for near-term deployment and program design.

Findings

Market Landscape

HPs are widely acknowledged as a cornerstone technology for achieving climate mitigation and building decarbonization targets, especially in the residential sector where space and water heating consume about half of global heat energy. Electrically powered HPs offer a sustainable alternative to fossil fuel heating by transferring heat rather than generating it through combustion, providing energy efficiencies typically three to five times higher than conventional gas furnaces. This shift not only improves energy efficiency but also substantially lowers lifetime greenhouse gas (GHG) emissions. For example, using heat pump water heaters (HPWHs) instead of traditional gas water heaters can reduce emissions by 50 to 70 percent[6], saving an estimated 12 tons of CO_2 over the

[6] Delforge, P. (2020, September 24). *The methane math for gas tankless water heaters*. Natural Resources Defense Council. https://www.nrdc.org/bio/pierre-delforge/methane-math-gas-tankless-water-heaters

equipment's lifespan.[7] Similarly for space heating, installing space HPs over gas furnaces can reduce emissions in California by over 70 percent now, with increasing reductions as the grid gets cleaner and HPs transition to low-GWP refrigerants.[8] These qualities make HPs a critical component in climate policies worldwide, including those in the United States and the European Union.

United States vs. International Markets

HP adoption, including MFHPs, has evolved differently in the US compared to other regions, profoundly shaping the current product landscape. In many international markets, elevated fuel prices for gas, oil, or propane, along with a reliance on less efficient electric resistance systems, have accelerated demand for advanced technologies like MFHPs. By contrast, the US has experienced slower uptake of both conventional and multifunction HPs, influenced by historically low gas prices, skepticism about HP performance in cold climates, and a "centrally ducted, set-it-and-forget-it" mindset that discourages attention to energy use. As one expert summarized, "If gas is cheap, why would someone switch to a [HP], even if it's 300 percent efficient compared to a 95 percent furnace? Ultimately, adoption depends on understanding [HP] performance, savings, and the gas-electric price balance."

Market Maturity and Product Availability

Internationally, the market for MFHPs, including air-to-air and air-to-water systems (for coupling with hydronic loops) is relatively mature in Europe and Asia, where high fuel costs have driven adoption of these advanced systems. Europe witnessed record sales growth of 49 percent in air-to-water HPs in 2022.[9] However, product availability in California and throughout the broader US remains limited, which CalNEXT identifies as a major barrier to MFHP adoption in the US. In addition, the MFHP product landscape is highly dynamic, characterized by frequent market entries and exits.

As of October 2025, three manufacturers—Samsung, LG, and HiSense—offer residential air-to-air MFHPs in California, while Panasonic, Mitsubishi, and Daikin market comparable products internationally but have yet to introduce them domestically. Notably, Villara, once an important US player, has exited the MFHP market, though its experience remains relevant for understanding market evolution.

Concerns around product availability represent a persistent barrier to MFHP adoption. While some of these challenges are shared with conventional HPs, they are often more acute for MFHPs, which remain an early-stage technology. On the Technology Characteristic Assessment, the overwhelming consensus was that market availability is "Low," indicating significant difficulty in accessing MFHP equipment, support, and information (see Table 3 and Table 4 in Appendix B for rating across all characteristics). Although several MFHP models have been "listed" or shown in presentations but are not meaningfully present in the US market. One manufacturer recalled a 2024 presentation

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[7] Wachunas, J. (2023, April 14). *This Earth Day invest in a Heat Pump Water Heater and do the equivalent of planting a tree (or a forest)*. New Buildings Institute. https://newbuildings.org/this-earth-day-invest-in-a-heat-pump-water-heater-and-do-the-equivalent-of-planting-a-tree-or-a-forest

[8] Pistochini, T., Dichter, M., Chakraborty, S., Dichter, N., & Aboud, A. (2022). *Greenhouse gas emission forecasts for electrification of space heating in residential homes in the US. Energy Policy*, 163, 112813. https://doi.org/10.1016/j.enpol.2022.112813

[9] Energy Sufficiency. (2023, April 3). *IEA: Heat pump sales reached record highs in 2022, with Europe leading the way*. https://www.energysufficiency.org/news/news/iea-heat-pump-sales-reached-record-highs-in-2022-with-europe-leading-the-way/

showcasing "about all the [MFHPs] on the market," estimating a dozen or more models, but noting that "not many of them are actually being actively sold."

Commercial availability that translates to a "practical sales presence" requires more than just marketing. In California, legality to sell or offer to sell these products hinges on Title 20 certification in Modernized Appliance Efficiency Database System (MAEDbS). Product availability is also hampered by manufacturing and supply chain constraints, as well as limited training and support needed to bring new systems into the market. Consumers echo this concern in online forums, reporting delays tied to supply chain constraints and limited product familiarity among installers.[10] These factors led one manufacturer to state: "I don't think there's a manufacturer that's actually launched a fully vetted and proven product in the US market… The technology essentially doesn't exist on a mass scale." Moreover, the US product landscape for HPs—particularly MFHPs—is in flux, shaped by tightening refrigerant regulations and the gradual phaseout of incentives. These forces create both pressure and opportunity: some manufacturers are withdrawing from the market while others consider entry. Frequent shifts in which products are available and which companies remain committed make it difficult for contractors and consumers to develop the confidence and long-term trust needed to support MFHP adoption.

OVERVIEW OF AVAILABLE PRODUCTS

Taken together, these dynamics highlight a narrow and unsettled product landscape in California. Table 2 below provides a snapshot of current residential air-to-air MFHP offerings available in or relevant to the California market.

Table 2. Air-to-air MFHP market availability summary, as of December 2025[11]

Manufacturer[12]	Model	Availability	Sizes Offered	Hot Water Tank Included[13]
Samsung[14]	DVM S Eco Heat Recovery	CA	3-ton, 4-ton, 4.5-ton, and 5-ton	No (recommends American Wheatley)

[10] [Egan_Fan]. (2022). *Which heat pump installers…* [HomeImprovement]. Reddit. https://www.reddit.com/r/HomeImprovement/comments/10wy9rc/which_heatpump_installers_are_full_of_crap_and/

[11] Manufacturers do not consistently list MFHPs on their primary websites or in standard product catalogs; technical details and purchasing pathways are often obtained through direct outreach to manufacturers or distributors, special-order arrangements, or other channels such as researcher engagement at conferences.

[12] Vernon, D. (2022). *Residential Multifunction Heat Pumps: Product Search.* CalNext. https://calnext.com/wp-content/uploads/2023/02/ET22SWE0021_Residential-Multifunction-Heat-Pumps-Product-Search_Final-Report.pdf

[13] Practical and performance implications of integrating MFHPs with existing, 3rd party, versus OEM hot water tanks is the subject of ongoing research. For more information, see Louie E., M. Evren & A. Selvacanabady (2024); Vernon (2024); Vernon & Chakraborty (2024); Wang J., X. Lu, E. Louie & V.A. Adetola (2024).

[14] https://www.samsunghvac.com/commercial/hydro; https://www.samsunghvac.com/DVM-S-Eco/Eco-HR

Manufacturer[12]	Model	Availability	Sizes Offered	Hot Water Tank Included[13]
LG[15]	Multi V S Heat Recovery + Hydro Kit	CA	2-ton, 3-ton, 4-ton, and 5-ton	No (requires separate compatible tank)
HiSense[16] [17]	HiComfort Series	CA	3-ton, 4-ton, and 5-ton	Yes (55-gallon tank)
Panasonic[18] [19]	Aquarea EcoFleX	Europe, no US launch date announced	1-ton to 8-ton	Yes (integrated)
Mitsubishi[20]	SlimPlus	Discontinued	2.5 ton	Yes (integrated)
Villara[21] [22] [23]	AquaThermAire	Discontinued	4 ton	Yes (60-gallon tank)
Daikin[24]	Altherma	Discontinued air-to-air	Unknown specifications	Unknown specifications

Sources: As referenced in table above.

Samsung's MFHP model, the DVM S Eco Heat Recovery, debuted in February 2023 at the ASHRAE Winter Conference's AHR Expo and was showcased again in February 2024. The unit became commercially available in California in fall 2024. The research team is not aware of any publicly

[15] https://www.lg.com/global/business/hvac/commercial-solutions/vrf-system/outdoor-unit/multi-v-s/
[16] https://www.hisensecomfort.com/professionals/product-common/index.aspx?nodeid=377
[17] HiSense. (2025). *HiComfort Product Specifications.*
[18] Vernon, D. & Chakraborty, S. (2024). *Residential Multi-Function Heat Pump Laboratory Testing.* CalNext. https://ucdavis.box.com/s/nl1m3rtfjea6qy1sqbe1tbb1cfp5zgho
[19] https://www.aircon.panasonic.eu/IE_en/happening/aquarea-ecoflex/
[20] Chally, S. & Haile, J. (2024). *Field Assessment of Residential Three Function Heat Pump Performance*. Frontier Energy. https://www.etcc-ca.com/reports/field-assessment-residential-three-function-heat-pump-performance
[21] Vernon, D. & Chakraborty, S. (2024). *Residential Multifunction Heat Pump Laboratory Testing.* https://ucdavis.box.com/s/nl1m3rtfjea6qy1sqbe1tbb1cfp5zgho
[22] Vernon, D. (2022). *Residential Multifunction Heat Pumps: Product Search.* CalNext. https://calnext.com/wp-content/uploads/2023/02/ET22SWE0021_Residential-Multifunction-Heat-Pumps-Product-Search_Final-Report.pdf
[23] Chally, S. & Haile, J. (2024). *Field Assessment of Residential Three Function Heat Pump Performance.* Frontier Energy. https://www.etcc-ca.com/reports/field-assessment-residential-three-function-heat-pump-performance
[22] Daikin. (n.d.) Daikin Altherma 4 unveiled [Press release]. https://www.daikin.eu/en_us/press-releases/daikin-altherma-4-unveiled.html

available performance data for the unit. Notably, the system does not include an integrated hot water tank; instead, Samsung recommends pairing the MFHP with a potable water tank manufactured by American Wheatley.[25] A researcher we spoke with reported that Samsung's MFHP exists, but the exact water tank is still being determined.

LG introduced its Multi V S Heat Recovery + Hydro Kit air-to-air MFHP at the February 2024 AHR Expo, following its initial announcement one year earlier. The system is now commercially available in the US.[26] Similar to Samsung's offering, LG's MFHP does not include a hot water tank, requiring customers to source a compatible tank separately to enable the water heating function.[27] As of this writing, one researcher reported that LG's MFHP exists and is available in California, but the exact water tank is still being determined. HiSense unveiled its MFHP model at the AHR Expo in February 2025, with stakeholders indicating its California market launch in March 2025.[28] The HiComfort series is available in three sizes: 3-ton, 4-ton, and 5-ton. Distinct from some other manufacturers, HiSense includes its own 55-gallon hot water tank as part of the system offering.[29] As of this writing, WCEC researchers confirm that the HiSense MFHP is available on the California market, but they are not aware of any installations to date.

Panasonic currently offers the Aquarea EcoFleX MFHP in the European market.[30] While the company has expressed interest in entering the California market, it has not yet announced a timeline for the commercial launch of the EcoFleX in the US.[31] As one stakeholder noted, however, the system would need to be redesigned and adapted for the US market. Several stakeholders reported that Panasonic's MFHP is available in other parts of the world. "They haven't designed it and adapted it for the U.S," as one observed, "but if they do, the product will be for customers [for whom] price is no object."

Mitsubishi has an MFHP system on the market in Europe (Slim Plus).[32] Despite its technical potential, the system was never launched in the US due to challenges with finding a manufacturer for the water tank, creating a critical barrier to commercialization. However, stakeholders foresee Mitsubishi's entry into the MFHP market in the US in the future. Stakeholders reported that Mitsubishi is rumored to be coming to the US market but, as one researcher noted, "I don't think they're available commercially yet. They're still getting ready to launch them."

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[25] Information obtained from the manufacturer at the 2024 AHR Expo and relayed by WCEC researcher.
[26] Vernon, D. & Chakraborty, S. (2024). *Multifunction Heat Pump Laboratory Testing Final Report.* https://ucdavis.box.com/s/nl1m3rtfjea6qy1sqbe1tbb1cfp5zgho
[27] Vernon, D. & Chakraborty, S. (2024). *Residential Multifunction Heat Pump Laboratory Testing Final Report.* https://ucdavis.box.com/s/nl1m3rtfjea6qy1sqbe1tbb1cfp5zgho
[28] Information obtained from the manufacturer at the 2024 AHR Expo and relayed by WCEC researcher.
[29] HiSense. (2025). *HiComfort Product Specifications.*
[30] Vernon, D. & Chakraborty, S. (2024). *Residential Multi-Function Heat Pump Laboratory Testing*. CalNext. https://ucdavis.box.com/s/nl1m3rtfjea6qy1sqbe1tbb1cfp5zgho
[31] Researcher. (Personal communication, December 5, 2024).
[32] In the *Preliminary Findings Report*, we reported "Mitsubishi's system combines its standard outdoor units (such as the MXZ series) with indoor units (like the PEAD) in a multi-split zoning configuration. The domestic hot water (DHW) component, known as the "HydroBox with integrated storage tank," functions as a dedicated heating-only zone within the system." Since that report, we have learned that the configuration does not provide simultaneous cooling and domestic hot water making it different than the other MFHP systems discussed in this report.

Until early 2025, Villara's AquaThermAire system represented the only fully integrated residential air-to-air MFHP commercially available in California.[33] In February 2025, the company announced it would exit the MFHP market and cease further development of the AquaThermAire. The system included a single-speed outdoor unit and air handler, both adapted from Carrier equipment, along with a custom hot water tank and proprietary control board.[34]

Daikin offered an air-to-air MFHP, called Altherma, in the US until approximately four years ago when they pulled it from the market. Stakeholders report that Daikin plans to re-enter the US market with an air-to-water MFHP system, also called Altherma, which they currently sell in Europe and Asia. While the company does not have a public date, stakeholders report that Daikin is planning to reenter the US market in quarter 1 of 2026.[35]

Market Size, Growth, and Drivers

The global residential HP market is poised for substantial growth, from USD 50.2 billion in 2025 to USD 184.5 billion by 2035,[36] driven by rising demand for energy-efficient heating and cooling solutions, government incentives, and tightening building codes. Globally, HP adoption is strongest in the single-family residential segment, driven by rebate programs and supportive regulations. In the US, if everyone adopted HPs, it could reduce national GHG emissions by up to 9 percent.[37] With environmental benefits as the driver, California has set aggressive targets such as installing six million HPs by 2030 and achieving carbon neutrality by 2045. In a recent CalFlexHub report, drawing from a variety of data sources,[38] the WCEC estimated that California's sales of MFHPs, for new and existing construction in single-family and multifamily buildings, could reach 36,000 units by 2035, rising to over 65,000 with favorable policy interventions.[39]

Evolving federal and state refrigerant policies are reshaping the market and raising costs of entry, as discussed in later sections of the report. Compliance requirements can be especially burdensome for smaller firms with limited resources, raising the risk of additional market exits from the MFHP space.

At the same time, California's aggressive decarbonization policies and HP incentives may attract new entrants. Several international manufacturers already sell low-GWP MFHPs in Europe and Asia, and the California market presents a compelling opportunity to adapt and launch these products in the US. In this way, while stricter rules may drive out less competitive firms, they also create space for global leaders and innovators to introduce next-generation MFHPs to California.

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[33] Vernon, D. & Chakraborty, S. (2024). *Residential Multi-Function Heat Pump Laboratory Testing Final Report*. https://ucdavis.box.com/s/nl1m3rtfjea6qy1sqbe1tbb1cfp5zgho

[34] Vernon, D. (2022). *Residential Multi-Function Heat Pumps: Product Search.* CalNext. https://calnext.com/wp-content/uploads/2023/02/ET22SWE0021_Residential-Multi-Function-Heat-Pumps-Product-Search_Final-Report.pdf

[35] Daikin approved this information to be shared publicly in this report.

[36] Kaitwade, N. (2025, September 15). *Residential Heat Pump Market: Size and Share Forecast Outlook 2025 to 2035*. Future Market Insights. https://www.futuremarketinsights.com/reports/residential-heat-pump-market

[37] Simon, M. (2024, May 6). The one thing that's holding back the heat pump. WIRED. https://www.wired.com/story/heat-pump-worker-shortage/

[38] This report presented an S-curve adoption model drawing data for assumptions from a variety of sources including US Census data, US EIA's 2020 RECS (California microdata), a CPUC EUL study, and a recent electrical panel study.

[39] Outcault, S., Alston-Stepnitz, E., & Searl, E. (2025). *Market assessment of selected load-flexible technologies: Year 3* (Report for CalNEXT). CalNEXT.

Design and Installation

This section describes the strengths and weaknesses of current MFHP system configurations, equipment designs, and installation approaches, and identifies potential strategies to improve them and accelerate MFHP deployment in California.

Equipment and System Design

MFHPs are designed to provide a cohesive mechanical system, offering a combined solution for DHW and space heating and cooling with one outdoor unit. The integration of all three functions into a single system fundamentally reduces the complexity and quantity of hardware required, resulting in fewer components and materials. One researcher explained, “MFHPs decrease the number of [heat exchangers] and number of compressors that the system totally needs in order to achieve both DHW and space conditioning." They elaborated that this means homeowners are "using just one [HP] instead of two.”

Using a single compressor and no electric resistance backup for either space conditioning or water heating also means that MFHPs draw significantly less power than two separate HPs for the same two end uses. This lower demand often enables low-power electrification[40] without requiring an electrical panel or service upgrade, one of the most common cost and timeline barriers to HP adoption. Panel and service upgrades in California cost $5,000 on average, though actual costs can range from $2,000 to more than $30,000, depending on trenching, permits, conduit work, and transformer replacements. Customers are often required to cover expenses beyond the utility’s allowance based on meter location, distance to distribution infrastructure, or pole and transformer configuration.[41] An energy expert recounts an experience that highlights the variability of both cost and time with electrical service upgrades. “I had to upgrade to a 200 amp service… The request went through in three weeks, they came and did the [line] drop the next week. They didn't have to update the transformer; it was just a new wire size they had to drop from the pole. So, my particular neighborhood had electrical capacity. Across town, they determined that the existing block and transformer had to be upgraded. That added a six-month delay and a cost, to that particular homeowner, of $15,000.” A manufacturer echoed this, explaining, “it's just much more complex and cumbersome to have to upgrade a panel. It adds a lot of friction in the process. If you can remove that friction, then you make the job easier and faster. For contractors, it's all about ‘how many jobs can I do?’”

The survey findings confirmed that electrical service upgrade requirements are a major barrier to electrification. Among 434 survey respondents presented with scenarios requiring electrical panel upgrades for heat pump installation, 51% viewed the upgrade as a significant barrier—with 27% calling it an outright "dealbreaker" that would prevent adoption entirely. This was particularly true for homeowners with older homes. Respondents in homes built between 1960 and 1977 showed the

[40] Low-power electrification refers to the deployment of electric technologies that aim to operate within a home’s existing electrical service capacity (i.e., without requiring panel upgrades, new circuits, or major wiring changes). There is no prescribed wattage or amperage threshold for this approach; the emphasis is on enabling electrification within existing constraints rather than defining a fixed cutoff.

[41] Pena, S., Smith, C., Butsko, G., Gardner, R., Armstrong, S., Higbee, E., Anderson, D., and R. Hueckel. (2022). *Service Upgrades for Electrification Retrofits Study Final Report*. PGE. https://www.redwoodenergy.net/research/service-upgrades-for-electrification-retrofits-study-final-report-2.

highest barrier rates at nearly 60%, likely reflecting that older electrical systems are both more likely to require upgrades and more expensive to retrofit.

Given the potential cost and hassle of a panel or electrical service upgrade, stakeholders consistently emphasized that MFHPs' lower load is one of their most compelling advantages. "If you have a consumer that is power constrained, this is one of those products I would bring in. It's a huge advantage," explained an energy expert. MFHPs provide a practical way to electrify without triggering costly and time-consuming utility upgrades. One manufacturer confirms this, reporting that in all their MFHP installs, "not a single customer has had to upgrade their panel." About one-third of the survey sample lived in pre-1978 homes—a substantial market segment where MFHPs' panel-friendly design could provide a pathway to electrification.

Stakeholders caution that the appeal of panel upgrade avoidance may be limited. Households that have or are considering EVs, induction cooking, or solar will require upgraded panels regardless. "The benefit of avoiding a new panel upgrade is a real small little segment," according to one manufacturer. Our survey findings offer a different perspective. Just 7.6% of respondents indicated they were planning to add EV chargers or other electrical equipment that would require upgraded panels anyway. This challenges stakeholders' assertion that panel avoidance would have limited appeal as a temporary electrification workaround. Additionally, as one utility employee warned, any new electrical load—however small—requires a safety assessment of the existing panel. Older panels, in particular, may warrant replacement due to fire or reliability risks, regardless of whether the added load exceeds their capacity.

Lower load requirements undoubtedly benefit utilities, enabling low-power electrification while minimizing grid strain and deferring costly upgrades to aging infrastructure. MFHPs are "really useful from an energy usage and power draw standpoint. When you're thinking about California's grid and its electricity rate structure, that becomes very powerful. From a cost and GHG emissions reduction standpoint, you don't have these energy-intensive elements that will turn on in the evening when people are using water." Thus, by using fewer compressors and avoiding electric resistance, MFHPs may help advance the goal of electrification with less impact on peak demand growth relative to separate HP systems.

In homes with limited electrical capacity, some stakeholders believe that MFHPs may represent a relatively affordable and streamlined pathway to low-power electrification—one of MFHPs' most compelling selling points. By reducing both household upgrade costs and broader grid impacts, MFHPs could offer a tangible near-term advantage over separate HP systems. Stakeholders agreed that further research is needed to quantify the benefits of low-load electrification through MFHPs and assess their true potential impact.

Caution should be taken not to overstate the panel-related benefits—often cited as a core MFHP advantage—as they may not be relevant in all cases. Stakeholders stressed that MFHPs are one way to address constrained electrical capacity, but "not the only way." Smart panels and smart circuits are part of an emerging market that also aims to help avoid panel upgrades. Additionally, in some homes, safety considerations may necessitate a panel upgrade regardless: "Breaker panels do not last forever… if it's a 40 to 50-year-old panel, how long are we expecting that to function properly and safely?" a utility expert asked, emphasizing that any added load should trigger a safety review.

Another utility expert noted that whenever “you are increasing the electrical load, you are increasing the risk,” even if the added electrical load is relatively low.

Design Enhancement Opportunities

While MFHPs provide an “elegant solution,” equipment design remains a critical area of development, as current configurations present several challenges that limit broader market adoption. As one expert observed, MFHPs “take what’s already kind of a complicated problem and make it more complicated.” Stakeholders highlight the need for design improvements that address controls, water tank design, modularity, and additional functionality.

CONTROLS

Stakeholders repeatedly underscored the importance of the user interface. As one energy expert observes, “you can have great efficiency, you can have reliable installation and operation. But if the controls are just a pain to understand and interact with… it’s not gonna run well.” Several noted that the HVAC industry has historically “done a pretty poor job at user interfaces,” which has driven demand for aftermarket smart thermostats. Similarly, one researcher explains that “controls can be a problem. The manufacturer thermostats [are] not very intuitive or providing the features that people want.” MFHP controls are no exception. “The controls are really where it is confusing.” To operate effectively, end users need to understand the system and may, at times, need to manually adjust priorities (e.g., hot water vs. space conditioning). Poorly designed dashboards exacerbate this challenge, one that manufacturers are not necessarily well-equipped to address, as the following quote indicates: “It’s big. It's a whole new line of oversight and business [manufacturers] have to take on.” Even when controls include programmable features, they are often underused. As one program implementer puts it, “HPs have programmable capability, but often installers shrug [their] shoulders about how to work with controls.” Another researcher adds that installers frequently skip changing settings, leaving systems at default configurations as long as they appear to function. Depending on the default settings, this may compromise MFHP performance.

Experts also highlighted the shortcomings of current water heating controls, describing them as “rudimentary, basic” and lacking the sophistication needed to optimize performance. As one researcher observed, “there is room for efficiency improvements if the control logic [were] a little bit more outdoor temperature aware, maybe even water temperature aware, to understand when to begin heating water or not.” More adaptive strategies could, for example, allow the tank to cool further in mild weather to extend compressor run times and avoid cycling losses, while narrowing the hysteresis band in colder conditions to match system performance. These insights underscore that existing controls miss important opportunities to boost efficiency through relatively simple refinements in how heating is timed and managed. Such refinements could benefit both traditional HP technologies and MFHPs alike.

One researcher reports that their field demonstration revealed “a potential…HVAC tuning issue, where the tuning…had to be optimized for…different seasons, because it was either… favoring heating or favoring cooling.” They noted uncertainty about whether this challenge is unique to MFHPs or also present in conventional HP systems, suggesting that it may not be visible without “very granular energy monitoring.”

WATER TANKS

Thermal stratification creates significant design and performance challenges for MFHP water tanks. As one researcher explains, “in almost all real-world conditions, the tank is hot at the top, and the water is quite a bit colder at the bottom ... The temperature's not uniform across your heat exchanger.” Additional research is needed to improve heat exchanger design in tanks, reduce the effects of stratification, and ensure consistent performance across operating conditions. In the meantime, stratified water tanks require more complex or alternative thermodynamic models or, as the researcher suggests, a return to “real-world testing” to determine the best design approach.

Current MFHP designs typically rely on a single DHW tank, but one researcher suggested that adding a secondary “preheat tank” could improve performance by serving as a heat dump during cooling operation. In this configuration, the main DHW tank would be maintained at end-use temperature (e.g., ~125°F), while the preheat tank could be charged opportunistically to 60–90°F during cooling. As the researcher put it, “If you are able to have…a preheat tank and use that as…your heat dump…that usually ends up being maintained anywhere between 60 and 90 degrees.”

Future work is needed to improve water-tank heat exchanger design to address challenges such as thermal stratification. There may also be value in considering the potential role of a second tank, balancing possible performance gains against added cost and footprint.

MODULAR INSTALLATION

Stakeholders consistently pointed to early retirement of functioning equipment, likely water heaters, as a major obstacle to MFHP retrofit adoption. One manufacturer explained the problem from the customer’s viewpoint, “The barrier is… ‘My HVAC's broken right now. Why should I replace my water heater?’ No one wants to spend money if they don't have to.” One strategy to avoid this issue could be to develop a modular or staged approach to MFHP installation whereby the water tank is only installed once the existing water heater fails. Among survey respondents presented with options for replacing HVAC and water heating equipment, 45% preferred a staged approach—replacing broken cooling equipment now while planning to upgrade the water heater "in the future, or when the current one fails." Only 39% preferred simultaneous replacement, suggesting meaningful consumer demand for modular installation pathways.

Two air-to-water MFHP manufacturers reported that their products already support such modular installation, and one air-to-air manufacturer stated they are exploring a staged installation option for a product they have under development. Temporarily separating the hot water function from the integrated system is technically complex because the systems are engineered to work as combined units, requiring changes to refrigerant circuits, controls, and tank integration, making staged installation a significant engineering challenge. As one manufacturer confirmed, “It is challenging, but we're trying to see what we can do to overcome that barrier.”

There are several downsides to the modular approach that should be considered. Owners would not receive the full benefits of an integrated system—particularly the efficiency gains from simultaneous mode—and the equipment may be oversized when not serving all three end uses. In addition, “piecemeal” installation would add cost, require an additional site visit, and remove the “single transaction benefit” that MFHPs are intended to provide. Staged installation would also create mismatched replacement timelines between the tank and the rest of the system, a disadvantage found with traditional systems.

Several stakeholders suggested an alternative approach: installing the MFHP water tank as an intermittent backup, supplementing the primary water heater when it cannot meet demand and later becoming the sole hot water tank once the primary unit fails. While technically feasible, one researcher cautions that this approach would be highly customized and require significant additional work. Research could also explore the feasibility of staged installation approaches for MFHPs, including whether installing the water tank as a backup until the primary water heater fails offers a practical pathway for adoption.

ADDITIONAL FUNCTIONALITY

While MFHPs offer enhanced energy savings and load flexibility relative to other HP technologies, several stakeholders suggested that adding functions might be critical to stimulating demand. For instance, one housing developer suggested designing MFHPs to provide ventilation would make them much more attractive. While MFHPs do exist in Europe that combine ventilation with space conditioning and water heating in a single system,[42] research and testing have shown that these systems would need further development to provide minimum required efficiency in the US.[43]

Similarly, as concerns about power outages and resilience grow in California, several stakeholders suggested adding a backup power option to MFHPs and noted in their interviews that Carrier recently announced trials of battery backup for its space conditioning HPs.[44] MFHPs' relatively low electrical load could make adding battery backup relatively affordable compared to separate HP systems. While some researchers argue that whole-home backup may be more useful than device-level backup, others noted that in panel-constrained homes, backup for the MFHP system alone could be advantageous. As one researcher explains, "It depends on whether you have that extra circuit breaker slot available…to install an AC-coupled battery…. Because if your circuit breaker panel is fully packed to the gills, or you don't have any extra slots, maybe the place to put the battery is on that outdoor [compressor]." Although adding functions such as ventilation or battery backup would increase costs, stakeholders emphasized that these features could strengthen the overall value proposition of MFHPs making them significantly more attractive to consumers.

The potential for incorporating additional functions, such as integrated ventilation, while maintaining high efficiency, could be explored as a way to expand MFHP utility and market appeal. Similarly, adding battery backup may offer value for resilience, though the benefits would need to be weighed against potential cost impacts.

Installation

This section examines challenges and opportunities related to MFHP installation, including equipment sizing and commissioning, configuration, and space considerations.

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[42] SystemAir: *Combi Unit Genius.* https://shop.systemair.com/upload/assets/END_CONSUMER_BROCHURE_20190426_183628364.PDF

[43] Chakraborty, S., Mcmurry, R., & Harrington, C. (2022). *Concurrent Space Cooling and Hot water Heating through Compact Heat Pumps for All-electric Residential Buildings.* UC Davis. Retrieved from https://escholarship.org/uc/item/9565g85

[44] Carrier Global Corporation. (2025, September 17). Carrier powering the future of energy. PR Newswire. https://www.prnewswire.com/news-releases/carrier-powering-the-future-of-energy-302558126.html

Equipment Sizing and Commissioning

Sizing and commissioning present significant challenges for MFHPs. Contractors face limited guidance, constrained equipment options, and complex system requirements—factors that directly affect system performance and customer confidence.

SYSTEM SIZING

Correct sizing is a challenging aspect of successful MFHP deployment. The complexity of MFHPs compounds these risks, as the equipment must serve three different loads: heating, space cooling, and water heating. A researcher explained: "you've got one... system serving... multiple loads that are very different... Your space conditioning load is one thing. There are already challenges of sizing between the heating and the cooling load because one is usually larger than the other.... if you are sizing it for heating... in a heating-dominated climate, then you're going to be oversized for cooling... So there's already those kinds of challenges there. But now you're throwing in this third obstacle of the DHW." To address sizing, one manufacturer recommends that installers run a typical load calculation on the house to determine space cooling and heating loads, then add "about 2,000 BTUs more [HP] capacity" for the water heating "because over the 24-hour time frame, I need a couple of thousand BTUs per hour, because the hot water heater is intermittent demand." This recommendation, however, may result in undersizing in mild climates. One researcher noted that "a very low-load region... with a large house with a lot of DHW load" may struggle to meet demand without resistance backup, if the compressor is sized for the space conditioning load.

The complexity of sizing a multifunction system occurs in an industry where oversizing, which reduces efficiency and causes short cycling, is a recurring problem. Experts warn that the same trend is likely with MFHPs. One researcher explained, "contractors are...always gonna edge towards the upper limit... They want to give you the bigger thing, because they don't want to...[have]...a complaint...[that] it's not able to meet the [load]." Although Manual J calculations are the accepted standard for determining loads, most contractors avoid them, according to stakeholders interviewed. An energy expert reported that HVAC contractors "are resistant to doing Manual J calculations because it's really like using sophisticated software. ...You have to have a full-blown model... And so ... they just won't." Instead, many simply oversize by one ton, in part because "commission-based sales encourage bigger units." Absent clear standards, experts caution that MFHPs will face the same oversizing risks. As one manufacturer acknowledged, "[MFHP] manufacturers are giving some recommendations... But the question about what is best for a home, that all depends on the contractor who is going to do the sizing."

Providing clear resources to guide contractors on equipment sizing is critical, as MFHP sizing is more complex than for conventional systems. Standardized tools and training are necessary to ensure proper sizing, deliver optimal performance, and maximize energy efficiency. However, to date there is no consistent approach to MFHP sizing. Without widely adopted standards, contractors face perverse incentives to oversize, while the challenge of balancing three distinct loads heightens the risk of inefficiency and underperformance.

Sizing an MFHP water tank is a bit more straightforward. Many stakeholders recommend selecting a unit equal to or one size larger than a typical gas water heater or, if replacing a HPWH, at least one size larger. One manufacturer offers only a 60-gallon tank, which has "enough capacity for a typical home, even a relatively large home." Meanwhile, other manufacturers are developing new tank sizes to meet emerging needs.

INSTALLING AND COMMISSIONING

High-quality installation and proper commissioning are critical to HP performance. As one researcher emphasized, “so much of this kind of stuff depends more on the installation quality, and the design of the system, than it does on… the actual technology…. much of equipment performance matters more [than] the installation quality.” One researcher described proper installation and commissioning as the single most significant challenge facing MFHPs. Among stakeholders who completed the Technology Characteristic Assessment, complexity of installation was rated as a major barrier (i.e., “High”) by 9 out of the 15 respondents.

Working in its favor, however, the streamlined electrical wiring makes installation of MFHPs easier than separate HPs. MFHP design avoids the complexity and expense of "running multiple electrical circuits to a HP, water heater, and [an air handler]." This aspect of the installation process is one of “the best features for these new products,” according to one manufacturer.

On the other hand, other aspects of MFHP installation are hampered by a lack of established practices. For traditional HP systems, “manufacturers have established… guidance and…provide charts for this size line set, for this outdoor unit, for this indoor unit. You'll have a whole bunch of tables for different conditions… that will tell you what your refrigerant charge should be, and…give you the ability to verify [it].” No such clarity exists for MFHPs, leading to confusion, particularly around refrigerants. In recalling a field assessment of one unit, stakeholders highlighted the difficulty of determining the proper refrigerant charge: “you have…the DHW tank, you have a very large heat exchanger. You also have a long line set. And then you have a whole bunch of these solenoids and switching valves…. There are multiple paths that the refrigerant can take…different modes that may have different conditions…. You'll have to find the best refrigerant charge level for each of those different operating conditions… that works well enough for each one.” In practice, contractors “struggled…to figure out the… proper refrigerant charge. …Through a bunch of experimentation, they had…to recharge it a few times. And each time, they put in a different charge.”

Some manufacturers express a different point of view. One claims that experienced contractors already know how to handle such systems: “It's not an issue for us and our contractors, because…it's just the same as our multi-zone products today…. We have a chart that tells you how much refrigerant you need to charge.” Nevertheless, experts agree that determining appropriate refrigerant charges initially will be challenging for MFHPs.

Space and Installation Considerations

FORM FACTOR

Stakeholders emphasized that MFHPs’ form-factor adaptability could accelerate adoption across multiple building types. According to one researcher, “One driver for what will allow [MFHP] systems to flourish is really honing in on the form factor and getting the form factor right.” In the California Energy Commission’s EPIC-funded field studies, researchers found that MFHP configurations resembling traditional split systems was an attractive feature. “People are used to thinking of these systems separately.” MFHPs were more compatible with multifamily applications, since they “mimic a form factor of equipment that already exists in residential buildings allowing flexibility of install and familiarity for contractors and maintenance staff. They combine those mechanical end uses, but in a system that isn't physically combined in one box.”

This similarity with traditional layouts mitigates concerns about system layout complexity and enables various types of applications. In contrast, certain air-to-water MFHPs systems may be less suitable for multifamily buildings and small single-family homes due to their size. As one researcher explained, "Some classes of MFHP equipment do not lend themselves very well to multifamily, but they can work for larger single-family homes or new construction where there is space—like a basement or a garage—for these larger, refrigerator-sized units." While air-to-air MFHPs are not a "blanket solution," their multiple form factors and space-saving design offer pathways for both retrofit and new construction applications.

EQUIPMENT AND FOOTPRINT

One of the most tangible advantages of MFHPs is the ability to consolidate multiple pieces of mechanical equipment, thereby significantly reducing space requirements. In a typical single-family California home, the air-conditioning condenser is located outdoors, connected to an indoor gas furnace that serves as the air handler for space heating and cooling, while a separate gas-fired storage water heater—often situated in the garage or a utility closet—provides DHW independently of the HVAC system.[45] In comparison, as one energy expert observed, with MFHPs "you have the advantages of only having to put one exterior component, one pad and one electrical connection." The gas furnace is eliminated and the MFHP's hot water tank can be installed where the water heater was previously. This advantage, according to one program implementer, enhances site design flexibility and supports broader adoption in space-constrained retrofit applications.

WATER TANK SITING

MFHP water tanks offer significantly greater flexibility in placement compared to unitary HPWHs. As one energy expert recounted, "A lot of people struggle with the siting of the standalone HPWH. It often involves some compromise—In some cases it involves a lot of disappointment." Unlike unitary HPWHs, stakeholders pointed out, MFHP water tanks do not contain an integrated compressor on top or require ventilation, condensate drainage, or additional electrical circuits. As one installer noted, for HPWHs, "We need a minimum, depending on the manufacturer, of about 700 square feet for that water heater to be installed to get the ample ambient air in the room." Instead, MFHPs' compact configuration allows larger tanks to fit within the same footprint as gas water heaters. Another energy expert explained, "The [MFHP] tank does not need space on top to store the evaporator or compressor, so the same space where you would be able to fit a 50-gallon HPWH, you could probably fit a 65-gallon [MFHP] tank." This added storage capacity provides more hot water without expanding closet space—an especially beneficial feature for multifamily buildings or small single-family homes. These tanks can also be installed in existing closets that currently house gas water heaters, avoiding structural modifications or additional cost. As one program implementer said, "That's appealing. Lots of old houses have their water heaters in a kitchen [closet] or a closet in a hallway inside the house."

MFHPs also avoid several comfort and acoustic issues that limit HPWH acceptance. Because HPWHs cool the surrounding air during operation, depending on their location, they can cause discomfort or

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45 California Energy Commission (CEC). (2022). *California Residential Appliance Saturation Study (RASS): End Use Equipment Characteristics and Housing Stock Summary*. Sacramento, CA.; Pacific Gas and Electric Company (PG&E). (2021). *Residential Gas Appliance and HVAC System Market Characterization Study.* San Francisco, CA.; US Department of Energy (DOE). (2020). *Residential Building Stock Assessment: Characteristics and Energy Use of Single-Family Homes.* Washington, DC.

increase heating loads in winter, particularly in efficient or well-insulated buildings. As one manufacturer explained, "If you're in a high-performance home, that's changing the load of the home significantly." In contrast, MFHPs transfer heat from refrigerant rather than indoor air, eliminating the cooling effect and not thermal comfort. Similarly, HPWHs generate indoor compressor noise that can be disruptive in small spaces. "If you are in a thousand-square-foot or less [home] or multifamily, where do you hide the noise?" one researcher asked. Because the MFHPs water-heating function does not include a compressor on the tank, it operates quietly. "It definitely has the advantage of taking the noise out of the dwelling space," an energy expert observed.

By eliminating the need for ducting, venting or noise mitigation, MFHPs expand the potential locations for installation, including conditioned spaces and small closets that could not accommodate HPWHs. As one manufacturer summarized, "You don't have as many constraints in terms of where you install it than an integrated [HPWH] or even a gas water heater for that matter. It's just simpler." From a space-savings standpoint, one researcher explained, "That means you can build a smaller closet or put the water heater in a bedroom or some other place where it would be really challenging with a different type of equipment."

Performance

This section examines MFHP performance, including thermal comfort, energy efficiency, and positive externalities; system reliability; and serviceability and maintenance. The section also explores how installation quality, contractor experience, and control strategies influence real-world performance and customer satisfaction.

Thermal Comfort and Water Heating Performance

Initial field testing indicates that MFHPs satisfy consumer needs in terms of thermal comfort, hot water volume, and water temperature. Stakeholders agreed that MFHPs' space conditioning performance provides equal or better thermal comfort than a space conditioning HP. In particular, some stakeholders noted that unlike space conditioning HPs, MFHPs have a virtually invisible defrost cycle for the customer—using heat from the hot water tank to avoid the unpleasant "cold blow" of many single speed HPs. As one energy expert explained, "you don't have to cool down your heat exchanger on the air handler side and you can defrost probably in a third or a quarter of the time that it would take to do an air handler or air conditioning mode type defrost." They added that this also "increases the number of minutes out of the hour that the system is blowing warm air."

MFHPs can deliver faster, higher-capacity water heating than HPWHs. While HPWHs rely on a small, dedicated compressor drawing heat from ambient air, MFHPs use the larger shared compressor that also serves the space-conditioning function. This results in substantially greater heating capacity. As one researcher noted, "The typical [HPWH] is like 4 kW [per gallon] per hour, whereas the MFHP compressor system is on the order of 24 plus kW [per gallon] per hour—a much larger capacity that is able to heat the water much faster."

Faster recovery, coupled with potentially larger tank size in the same footprint (as described above) allows MFHPs to more closely match the hot-water availability and responsiveness of conventional gas systems. MFHPs have the potential to overcome one of the most common consumer concerns: hot-water availability. One installer recounted, "I have found that people are glued to their gas water heater. They have concerns about [HPWHs]—will they be able to keep up?" As one expert noted, an

MFHP “is going to be attractive to a lot of people because they will be able to have the same amount of hot water as they are currently used to” with gas systems.

While initial field testing indicates that customer needs are met by MFHPs, performance and reliability are central concerns, as the technology has not yet been widely validated in real-world conditions at scale. It should be noted, however, that among stakeholder assessments, compatibility with home infrastructure was viewed favorably, with most ratings being Medium (n=9) or High (n=4). Performance was also considered a strength, with a majority rating it as High (n=6) or Medium (n=8). Still, in interviews, stakeholders emphasized the need for additional testing and refinement to confirm whether MFHPs can consistently deliver expected benefits across different applications and climates.

Integrated Operation and Efficiency

MFHPs are designed to achieve higher overall efficiency than separate HPs by combining multiple thermal loads—namely space heating, space cooling, and water heating. Multiple interviewees, including a manufacturer and a developer, consistently highlighted the core benefit of consolidation. The combined system creates "obvious efficiency opportunities" by "using just one [HP] instead of two," avoiding backup electric resistance heating, simultaneous operation, using advanced controls strategies, energy savings, and offering load flexibility. These lead to "synergies in terms of performance benefits, savings, and comfort,” as described below.

NO ELECTRICAL RESISTANCE BACKUP

MFHPs use a shared refrigerant circuit and compressor to handle all heating functions by transferring or recovering heat among loads without relying on electric elements for supplemental capacity. By eliminating resistance heat strips (COP ≈ 1.0), MFHPs avoid the sharp efficiency drop and peak-demand spike that occur when HPs rely on electric backup. As one researcher explained, “At low ambient conditions, typical [HPWHs] don’t perform very well. So, if the ambient temperature gets very low, normally what’s happening is the electric heat element is turning on. Because most people set their system in hybrid mode, they don’t even know that the electric heat is turning on, and that’s not efficient.” MFHPs circumvent these limitations. They operate effectively across a wider temperature range and do not rely on electric resistance backup to meet demand. Avoiding strip heat eliminates a well-documented efficiency penalty, and MFHPs are designed to remove that penalty; however, the magnitude of the benefit still needs to be studied.

Initial indications show promising performance of MFHPs in cold weather without electric resistance backup heating. A researcher further explained that traditional HPWHs often “cut off around 40°F” because they typically “don't have a reversing valve for defrost.” In contrast, MFHPs, by using higher pressure refrigerants, can operate at much lower temperatures, with cut-offs advertised as low as -3 to -30°F according to one researcher, which would make them more robust in cold conditions. Thus, while “all [HP]s eventually need defrost,” MFHPs offer “a superior method compared to traditional options that either blow cold air or use inefficient electric resistance.”

While first signs are favorable, cold weather performance needs to be verified in a rigorous manner. Stakeholders stressed the importance of contractor and customer confidence, warning that “if contractors don't know that [an MFHP] these can operate [during] cold snaps, then they're not going to be promoting it because they don't want to have a cold house complaint.” Additionally, a manufacturer observed that in the heating season, "pulling heat from inside the house to put it in the hot water tank" can create "a little bit of a tug-of-war." Additional testing will be needed to understand how MFHPs perform with competing heating loads.

Verified cold-climate capability would support broader adoption of MFHPs beyond mild climates. As one program implementer says: "I would highly recommend [making] these cold-climate capable so that you're not slapping in a huge resistance element [… and] forgoing all the grid benefits in the winter." There is some evidence of the industry's shift in this direction. One manufacturer reports they are releasing a new unit with a broader temperature range than their current unit offers. Overall, stakeholders suggest a need for continued technological improvements, field testing, and communication to validate MFHP performance in cold-climate applications and support broader market opportunities.

SIMULTANEOUS OPERATION

Some preliminary evidence shows that simultaneous or heat recovery mode is 36 percent more efficient than running space cooling and water heating separately.[46] This synergistic efficiency is achieved by recovering waste heat from space cooling to supply DHW. One manufacturer explained that in summer "the hot gas piping will recover the condensing heat," effectively providing "free hot water." Because California is a cooling dominant climate, "capturing that heat waste is huge." Others agreed, calling it "dramatically more efficient," a "no-brainer" for efficiency, a "really great opportunity," "most unique," and "a really big selling point and opportunity."

However, given the relative infrequency of this mode naturally occurring, it is unclear how this simultaneous mode operation would actually translate to overall energy efficiency and bill savings. As one researcher explained, simultaneous mode "happened about 5 percent of the time" in a study, adding that such a low percentage was "a real barrier to realizing that value." Another researcher found that "the cooling operation and water heating demand were very rarely coincident, and so you didn't really see that benefit very often" in field demonstrations. Thus, to understand the efficiency and bill savings this can pose, "there's still more testing to be done to see how often that simultaneous mode runs." Researchers are investigating advanced controls to increase the frequency and duration of the simultaneous operation, which can improve efficiency and reduce customer energy costs.[47]

CONTROL STRATEGIES AND DEMAND RESPONSE PROTOCOLS

To realize MFHPs' efficiency gains, controls are critical. As one stakeholder put it, "controls become a big issue." This complex equipment must be managed appropriately to achieve peak performance; as a manufacturer noted, "without significant investment in controls, you don't get the maximum benefit out of the equipment."

MFHPs' efficiency gains occur when space cooling and water heating demands overlap, but in practice, these demands rarely align naturally. As one researcher concluded, "the system can operate in this very efficient mode, but it's not useful if it doesn't," or doesn't do so often. However, that "doesn't mean the value isn't there. It just means that there's more opportunity for proactively

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[46] Chally, S. & Haile, J. (2024). *Field Assessment of Residential Three Function Heat Pump Performance.* Frontier Energy. https://www.etcc-ca.com/reports/field-assessment-residential-three-function-heat-pump-performance

[47] Kalantar-Neyestanaki, H., Chakraborty, S., dela Rosa, L., & Ellis, M. J. (2024). *Optimal mode selection of multi-functional heat pumps with simultaneous water heating and space cooling mode.* Proceedings of the American Control Conference, 5330–5335.

controlling these systems and being able to take advantage of that value stream." They emphasize that "there's a lot more opportunity… to control the equipment differently so that it can both meet the load profile needs and also take advantage of its configuration efficiencies."

Currently, different demand response protocols govern water heaters and space conditioning loads. As one manufacturer explained, "the water heaters require CTA 2045… yet… space [conditioning] uses a different protocol… They don't have an MFHP demand protocol." Thus, to comply with demand response protocol requirements, MFHPs will either need the capability to communicate with both space conditioning and water heating protocols or a new MFHP protocol will be needed. Further, to realize improved energy efficiency and cost savings, MFHPs will likely need to incorporate demand response protocols. Preliminary simulations suggest that adopting advanced control strategies—such as economic model predictive control—can preheat, precool, and schedule water-heating to low-cost, low-carbon hours while maintaining comfort constraints by accounting for forecasted prices, weather, and load. By coordinating simultaneous loads, avoiding peak hours, and reducing compressor cycling, these strategies could significantly enhance energy efficiency and cost savings (especially for time-varying price signals) over current MFHP controls strategies.[48]

Implementing two-way communication protocols, such as those enabled by a CTA 2045 communications port, may be challenging to incorporate into MFHPs without compromising performance. One manufacturer explained that some MFHP manufacturers have resisted adding CTA 2045 ports due to "concerns about occupant comfort and the complex coordination required between space conditioning and water heating operations." They further explained that their company decided against including these ports because "it was conflicting with the controls." Moreover, enabling load management functionality would require significant manufacturer investment, which is difficult to justify satisfying a "California-centric … request". Stakeholders suggested global MFHP OEMs may be more responsive if the value proposition for load flexibility extends across multiple international markets.

ENERGY SAVINGS

Although stakeholders frequently highlighted MFHPs' energy savings potential, most acknowledged it remains largely theoretical, supported only by limited preliminary testing. Several field studies have shown promise, but the scale was too small to fully vet the technology or assess performance against separate HP systems. Stakeholders consistently highlighted the need for rigorous, real-world testing to determine MFHPs' true potential relative to two separate HP systems. As one manufacturer stated, "We've got simulations, but… simulation versus reality is different. Real-world usage needs to be done in an apples-to-apples comparison."

The need for testing MFHPs at a larger scale is underscored by the few stakeholders who cast doubt on MFHPs' energy saving potential relative to separate HPs for space conditioning and water heating. One researcher asserted that "a purpose-built device is always going to be better at that one purpose than a multifunction device," noting, "that's just the way that it is." In particular, another researcher noted that a "MFHP's compressor is oversized for water heating so may not be very efficient in water heating-only mode—particularly during swing season or months where cooling load isn't that high." Moreover, another researcher pointed out that the longer refrigerant lines are

[48] Green, C., Chakraborty, S., & Vernon, D. (2024). *Load Flexibility of a Residential Multi-Function Heat Pump Using Dynamic Pricing.* ASHRAE 2024 Winter Conference. https://escholarship.org/uc/item/4q9952hb

between components, the, “greater [the] efficiency losses.” Stakeholders agreed that more research is needed to demonstrate MFHP performance. As an energy expert notes, “more field studies on [MFHPs]—their power demands, their operations, the maintenance on it—is key.” Until such comprehensive studies and pilot projects are conducted, the energy savings attributed to MFHPs will remain speculative.

Positive Externalities

Beyond direct household energy savings, MFHPs offer system-level benefits that extend across the electric grid and the broader environment. These “positive externalities” arise when the aggregated effects of many installations reduce grid stress, improve capacity utilization, and lower marginal emissions—benefits that may not be captured in standard cost-effectiveness metrics. From a utility perspective, MFHPs are an opportunity for low-power electrification that can support both decarbonization and grid reliability goals when deployed strategically.

LOAD FLEXIBILITY

California has made load flexibility a central policy priority—positioning HPs at the focal point, with programs and rate designs that encourage shifting operation and integrating smoothly with the grid, including programs like SGIP that incentivize shifting energy use to off-peak hours. MFHPs have the potential to contribute to the state’s load flexibility goals by allowing systems to preheat water during off-peak hours when electricity rates are lower. This strategy reduces utility bills and alleviates strain on the electrical grid. One utility expert emphasized that this flexibility actively supports “California’s grid resiliency and reduces reliance on fossil fuels”. Two other utility experts agreed that homes equipped with solar PV systems are “particularly well-suited for MFHPs,” as their consolidated load “can better align with onsite solar generation and help maximize onsite energy use through load flexibility.” As one explained, “charge it when the sun's up, and it's hot outside… and then use it at night,” which absorbs excess solar production and reduces evening peaks.

While all HPs can provide load shifting, some stakeholders stated that MFHPs have the advantage of being able to prioritize demands during peak grid times to mitigate occupant impacts during load flexibility events. One manufacturer explained, “We have one compressor doing both—ramping up or down” for space conditioning or water heating. “With one system, you have the flexibility to decide what the priority is and to control the amount of output to maintain [thermal] comfort or hot water.” While this may involve sacrificing some HVAC output at times, one energy expert noted that it "appears to be performance-wise, pretty well-managed.”

Other stakeholders disagree. One manufacturer commented that MFHP’s load flexibility is “probably not much different than what you can do with a standard HP and a standard [HPWH].” In fact, one researcher asserted that unitary HPWHs may even offer more load flexibility since they can achieve 140°F storage temperatures and extend load shed periods, whereas “the [MFHP]…can’t really do the 140 degree charge-up.” Furthermore, the dramatic reduction in peak demand achieved by HPWHs, including MFHPs, compared to electric resistance models—roughly 4,500 watts versus 500–1,000 watts—led one researcher to wonder whether further load reduction was even needed, quipping, “maybe who cares about load flexibility?”

Additionally, one utility expert noted the difference in typical demands of the load profiles for space conditioning and water heating are mismatched. “When you look at the load profile of water heating you need a lot of hot water, usually in the mornings—when people are waking up, getting ready to go to work, and taking a shower— and then towards the evenings. Whereas, the HVAC load you don't see any during the beginning of the day, and then, you have the peak when it's hottest outside, and then, past 4:00 p.m. when people are getting home from work." They added that, "because the different load profiles of those different end uses differ to that extent, it would be harder to do some of that precooling and prewarming." This led the stakeholder to conclude that "it might be a little bit less flexible to have one system versus two dedicated HP systems for those different end uses."

ADDRESSING GRID CONSTRAINTS

From a utility viewpoint, MFHPs can be a useful lever for managed electrification. With lower amperage, MFHPs can reduce node-level grid stress and defer service and transformer upgrades in capacity-constrained areas. As one manufacturer stated, utilities can manage when "one house at a time" electrifies, "but not [an] entire neighborhood," where avoiding transformer replacements becomes a concrete benefit. A program implementer emphasized that MFHPs could "really help" in districts with very old infrastructure. Moreover, promoting MFHPs as a "stay within existing service" option can keep projects moving and reduce near-term utility field work. As one manufacturer put it, panel work is "complex and cumbersome… it adds a lot of friction," and removing that friction makes jobs "easier, faster" for contractors.

The benefit of electrification through MFHPs becomes very apparent when the cumulative effect is considered, given the cascading upgrade dynamic along the distribution chain. As one utility expert explained: when enough homes complete service upgrades, the shared transformer often must be replaced; replace the transformer and you may also need a new pole; upgrade enough transformers and the feeder and even the substation can become the next constraint. The challenge is timing—these triggers rarely happen all at once, so it's hard to see the full cascade in real time. "We don't have a clear threshold for 'how many customers tips it," they noted. "You just know when it happens—there's a 'last customer' effect: the last one pushes the system over the edge and draws the attention and sometimes the bill." One utility representative said that from their perspective, these systems offer the potential to delay the need for expensive "transformer upgrades" in communities experiencing increased demand due to electrification. As such, they considered this a significant benefit, with the potential to avoid "billions of dollars" in infrastructure costs through a "smart way with load shifting, with controllable devices." Another utility expert elaborated, "As a utility, we may be looking at end uses or electrification approaches that require less stress on the grid and that could be done in a number of different ways- including [MFHPs]- to reduce the connected load." While MFHPs can't indefinitely postpone the need for infrastructure upgrades, additional time to plan for it may be valuable.

Peak demand is another externality—utilities "want more electrification," which spreads fixed grid costs over more kWh, but "not at the cost of high peaks" or large, intermittent loads. MFHPs can mitigate peak risk by avoiding electric-resistance backup and enabling load flexibility—preheating water midday, shedding evening HVAC load, and using heat-recovery from cooling. Done well, that improves capacity utilization and reduces peak contributions; done poorly—without interoperable controls or enrollment—MFHPs risk exacerbating evening peaks. As one utility expert summarized: "Electrification is good… but you have to be really careful where that additional load is being applied on the grid."

ENVIRONMENTAL BENEFITS

MFHPs may reduce marginal emissions by using less electricity for the same thermal services and by mitigating peak load growth—shifting water-heating and some space-conditioning demand away from the evening peak when generation is costlier and more carbon-intensive. By consolidating loads in a single system and enabling heat recovery (capturing waste heat from cooling to produce DHW), MFHPs avoid the low-COP operation and peak-hour fossil generation that drive higher incremental emissions from separate HP systems.

Stakeholders emphasized that these benefits are strongest in hotter climate zones with persistent cooling loads. "If you're in a climate where during the summer season ambient temperatures are on average 95–100 degrees or more, you are always going to have a cooling load. And depending on your DHW usage, you're always going to be in heat recovery mode… In that sense, you are saving a lot of energy, because you're getting free hot water heating." Another energy expert put it simply: "We're always gonna get more benefit from the air-conditioning side in the hotter climate zones, like in the Central Valley or the inland areas."

While most market assessments focus on direct customer costs and savings, the true value of MFHPs extends further. By easing grid constraints, reducing peak demand, and lowering marginal emissions, MFHPs can provide measurable system benefits that align with California's decarbonization and grid modernization objectives. Recognizing and quantifying these positive externalities—both in utility planning and in cost-effectiveness frameworks—will be essential to fully capturing MFHPs' societal value and accelerating their deployment at scale.

NON-ENERGY IMPACTS

Based on the NEI Assessments completed by over one-third of stakeholders interviewed, MFHPs were perceived as delivering a wide range of positive non-energy benefits, particularly in terms of improving the direct living environment. Respondents most frequently emphasized practical benefits, followed by psychological and physiological benefits. Spatial quality emerged as the most comprehensively endorsed functional outcome, especially within the practical and psychological domains, highlighting efficient use of home space and equipment consolidation. Acoustic quality also received strong positive ratings across physiological, psychological, and sociological domains. Thermal quality was viewed positively, with the strongest endorsement in the physiological domain for enhanced health and comfort, complemented by practical perceptions of system effectiveness. Air quality benefits, although cited less frequently, were noted primarily for their physiological and psychological impacts. Building integrity was generally viewed favorably for its practical and economic contributions to home durability and cost-effectiveness.

Negative non-energy impacts were mentioned far less often and were dominated by practical and economic concerns. High technology costs were consistently perceived as the primary drawback, shaping perceptions of spatial, thermal, and acoustic quality. Practical drawbacks were particularly associated with spatial quality, likely related to equipment footprint, as well as with thermal quality. Acoustic quality concerns, split between physiological and psychological impacts, suggested some noise-related issues. Potential adverse physiological and psychological impacts were relatively rare, as were sociological concerns across the functional outcomes.

On balance, MFHPs rate well on NEIs relative to separate heat pumps. Most stakeholders who completed the Technology Characteristics Assessment rated MFHPs' NEIs as "High" relative to ASHPs (8 out of 15) and HPWHs (8 out of 14) as shown in Table 5 in Appendix B.

Reliability

The effective useful life (EUL) of MFHPs remains unknown due to the newness of the technology. There is currently limited field data to validate how long these systems will operate under real-world conditions. While typical space-conditioning HPs have an approximate 15-year EUL,[49] it is reasonable to hypothesize that the compressor in an MFHP system may have a shorter lifespan than a standalone HVAC HP, given its additional operating load for domestic water heating. One utility expert discussed the unknown EUL, "If we're running the compressor more frequently, because now it's heating and cooling and water heating, does that affect the longevity of the compressor unit of that system? Is this a 7–10 year product, or is this a 15–20 year product?" They added that the importance of understanding the EUL of this equipment is so that customer expectations can be adjusted accordingly. In the absence of empirical data or manufacturer-provided durability testing, no official EUL has been established.

"Reliability is still a big unknown—[MFHPs] are probably not where they need to be in terms of maturity" to attract broad interest. With limited field data and no proven track record, contractors are hesitant to recommend MFHPs as it is unclear whether they will "live up to manufacturers' claims." Stakeholders emphasized that while reliability issues may fade as the technology matures, as with most new technologies, the absence of large-scale demonstrations and long-term service history is a significant barrier to adoption today.

RELIANCE ON A SINGLE SYSTEM

A major concern repeatedly raised by stakeholders is the "all eggs in one basket" issue: if one element of an MFHP fails, the household loses all three end uses—space heating, space cooling, and water heating—at once. A researcher describes failures with cascading consequences: "when you have one system that does more things, the consequence is higher if that one system goes down. We definitely saw [that] in our demonstrations. And those were pilot demonstrations, so that's gonna happen, but…there were always these…fire drills because the tenant's now out of hot water [too]."

Several stakeholders emphasized that customers may not fully appreciate this risk. As one energy expert notes, "I could easily see contractors being like, 'Whoa, over-dependence…you're gonna lose your shower when your AC breaks.' For your average consumer, I don't know if they would really think about it." Others highlighted that while the risk is significant, its importance varies by climate: in temperate California, outages may be inconvenient but tolerable, whereas in more extreme climates, the consequences of simultaneous loss of space conditioning and hot water could be much more severe. Overall, stakeholders agreed that customer acceptance hinges on how these risks are communicated and mitigated through installation quality, contractor support, and redundancy strategies.

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[49] DNV. (2024). *Residential HVAC and DHW measure effective useful life (EUL) study: Executive summary.* California Public Utilities Commission. https://www.calmac.org/publications/CPUC_Group_A_2023_Res_HVAC_and_DHW_EUL_Study_Final_ReportES.pdf

These concerns are magnified in multifamily contexts, where property management teams and subcontractors may lack the specialized knowledge to service MFHPs. "Do we know anyone who knows how to repair them?" one developer asked. "Do we have the right mechanical team on the property that can service them?". Hot water reliability is particularly important because there may be regulatory requirements tied to timely service calls. As one housing developer explained, "if this one system fails, the resident is going to have to be relocated, because they don't have any heating or cooling, and they don't have hot water. [We would want to know] 'How long does it take to fix that? Do we have contractors in the area who can fix those?'". Moreover, as one installer noted, there are timing and notifications considerations within the affordable housing space related to installation and maintenance. "I can't disturb the residents for this period of time, because if they send a [complaint] over to HUD or Section 8, then then it brings a whole bag of problems to the property. You have to be super sensitive to these things." Within the affordable housing market, it may be particularly difficult to gain traction because property owners are very hesitant to install technology without a proven record of reliable performance.

MANUFACTURER SUPPORT

Reliability concerns are compounded by market risks. Stakeholders repeated concerns about "stranded assets," where manufacturers leave owners without replacement parts or service options when they exit the market. As a researcher said: "I'm worried about the stranded assets issue. All these new players [that] are going to enter [the market] are going to have the trust issue. The challenge is assurance and trust. Are people going to be able to trust these new manufacturers coming in?". One energy expert framed the issue bluntly: "there's no guarantee that they're in business for another 15 years. What if you don't have service or warranty? That would be my bigger concern."

These concerns are not hypothetical nor are they limited to small or emerging players. In the product's short tenure, the HVAC industry has already experienced the disruption caused by market exits. As one manufacturer recounted, when one of the world's largest HVAC manufacturers "pulled out of the [MFHP] marketplace, they stopped supporting the equipment. It made life miserable for everybody. They just decided they weren't going to do it anymore." Ultimately, as one energy expert explained, "The root fear is I buy [an MFHP] and five years from now, I need a replacement part, and [the company or product] doesn't exist anymore. Now I have to replace my system again."

Another concern is the commercial staying power of controls vendors: experts noted the fragmented and sometimes fragile nature of proprietary and third-party control systems. One installer explained that while major brands provide long-term support, "a lot of these companies, especially on the lower end, don't have proprietary controls. What happens if that third party changes anything, or are they doing patches for it over time? There is some risk with those control systems that the HVAC will last longer than the controls." Others echoed that outsourcing controls to smaller firms could leave them unsupported if those companies exit the market. Stakeholders further noted that electronics and software evolve more rapidly than mechanical systems, creating long-term reliability risks. While this is not unique to MFHPs, their greater reliance on controls to optimize performance across three end uses heightens this concern. It should be noted, however, that several stakeholders pointed out that many controls eventually "settle down" and remain reliable over years of operation.

These experiences underscore that long-term manufacturer commitment—and clarity around parts and controls compatibility—will be essential for customer and contractor confidence. A housing developer echoed these concerns, explaining that the mix of brands and controllers tradespeople support can make long-term service unpredictable: “We have contractors and subcontractors who maintain only some of the systems. [Getting] replacement parts over time, that’s really challenging.” They noted that, especially when chasing the lowest cost solution, “the bottom of the market changes.” Unlike higher-end major manufacturers that are “not going anywhere,” they explain, “if you just use the cheapest HP and a third-party controller, it can be a nightmare” to service this equipment over time.

Even so, some stakeholders expressed cautious optimism that established domestic brands could help alleviate these concerns. One researcher observed, “I do hear that traditional HP manufacturers are starting to think about multifunction. The word is getting out. It's slow, but I think once the traditional American manufacturers start playing in this field—start to understand the benefits of this and make products— then you have a lot more trust.” They added that, besides avoiding potential tariffs, “if American manufacturers come out with [MFHPs] it will be a lot better because you will have that trust,” eliminating one of the challenges for MFHP adoption. Alternatively, another energy expert explained that “some sort of installer guarantee,” particularly if a smaller company was acquired by a larger one, would “put my mind at ease.”

Serviceability and Maintenance

Stakeholders consistently identified that serviceability—the ease of maintaining, repairing, and supporting MFHPs over time—as pivotal to adoption. Maintenance complexity was generally rated as “Medium” in the Technology Characteristic Assessment. In interviews, opinions diverged on whether MFHPs will simplify service by consolidating equipment or complicate it by concentrating risk and specialized configurations; however, there was broad agreement that reliable performance and clear maintenance pathways are needed for market uptake.

By consolidating space conditioning and water heating into a single system, some stakeholders argued that MFHPs simplify ongoing maintenance and service needs. With only one compressor and refrigerant circuit to maintain, the number of mechanical components and service touchpoints is reduced, streamlining troubleshooting and coordination. As one researcher explained, “you have only got one piece of equipment to service,” and maintenance requirements are “similar to regular HVAC maintenance—getting the equipment tuned by a contractor every so often and changing air filters at the return grill.”

In contrast, other stakeholders contended that MFHPs’ design complexity increases service complexity. While they operate from a single compressor, each system contains numerous critical components—heat exchangers, fan coils, and refrigerant loops—any of which can cause system failure. A manufacturer explained the complexity of troubleshooting a malfunctioning MFHP, “It could be at the compressor or the outdoor unit. It could also be a leak in the indoor air handler, the hot water heater component, the hot water heat exchanger, the fan coil. Any one of those can drive me to no hot water and it can be a real delay in getting it back up and running.” Moreover, because repairs involve multiple subsystems, contractors must stock a broader range of parts to ensure effective and timely service. One contractor compared this to the requirements for servicing HPWHs. “Those are sealed units. If it is down, you just replace the whole unit. Everybody knows that, and they plan for that. You just have to stock extra units. But for multifunction systems, I've got to have more components ready to replace very quickly—and it just drives up the cost of service.” Moreover, one utility expert noted how limited availability of parts can lead to delays in service. “I’ve heard stories where it’s 100 degrees outside, the AC stops working, and the technician says, ‘I’ve got the part for a standard AC.’ But for a heat pump, it becomes, ‘I don’t have that part on my truck—it’ll take two weeks.’ That could be an issue and might scare people off. Readily available parts—especially for emergency calls—are a barrier.”

Additionally, DHW represents a uniquely time-critical service for contractors. One manufacturer noted that, “A hot water heater is an essential appliance. You have no cushion for downtime. You have to fix it [the] same day.” An energy expert added that MFHPs would introduce this heightened urgency to HVAC contractors. “There would be a higher sense of urgency from the customer, and therefore a higher sense of urgency for the contractor… that may slow down adoption rates [of MFHPs] from the contractor if they think they're gonna be on the hook for repairs.” Given the expectations—and in some cases, especially rental properties, legal requirements for timely restoration of hot-water service—many HVAC contractors are hesitant to take on a technology that merges high-risk functions under one warranty or service call.

MFHPs have lower maintenance demands than HPWHs. The MFHP’s water-heating function eliminates components such as electric resistance elements and anode rods—both potential failure points in HPWHs. As one researcher noted, “You do not have the electric resistance backup, so you don't have any anode corrosion issues to think about—which you would want to be thinking about every five years or so.” Additionally, “the maintenance is less with this system than a package tank-type HPWH—those systems have a filter on the compressor-condenser unit and these [MFHP water tanks] don’t. That's one less thing to think about.”

As manufacturers continue refining MFHP designs, many are emphasizing serviceability—including improved component access, detailed documentation, and intuitive product design. Stakeholders highlighted the need for a responsive network of qualified contractors with timely service and maintenance protocols and diagnostic checklists to support real system troubleshooting.

Costs

This section examines the cost dynamics influencing MFHP adoption, including upfront equipment and installation costs, operating costs, and overall cost-effectiveness. The section also explores strategies such as leasing models, incentive alignment, and rate reform to address affordability challenges and improve MFHPs’ economic competitiveness over time.

Upfront costs

In theory, MFHPs have the “potential to reduce overall first cost” by using a single compressor, compared to using separate HPs for space conditioning and water heating. At present, this cost savings has not yet materialized in the US market. The available data (albeit limited) on the price of MFHP systems suggests that they typically cost more than heat pump separate systems. There was strong consensus among stakeholders who completed the Technology Characteristic Assessment that the initial investment for MFHPs is high compared to ASHPs, with twelve of fifteen respondents rating it as “high.” Stakeholders interviewed estimated MFHPs cost $20,000 to $40,000 to install and one installer reported a retrofit quote of $30,000. In comparison, depending on the exact configuration of separate systems and whether a panel and service upgrade is required, the price difference could be as much as double the cost of separate HP systems. Or, if a costly electrical panel and service upgrade is required for separate HP systems, the cost of an MFHP could be roughly comparable or less.[50]

The high upfront cost limits the ROI, with stakeholders rating the latter "Low" (n=7) or "Medium" (n=7) on the Technology Characteristic Assessment relative to ASHPs. As one manufacturer conceded, "[An MFHP] is going to be an expensive product. It's not a mass market adoption type product, but it's an important niche product."

Several factors contribute to the high upfront cost of MFHPs. Equipment costs are elevated due to low production volumes, limited competition, and early market status. Installation costs are also higher. As one energy expert explained, "The most time intensive and expensive aspect of these installs are the refrigerant lines. They need to be installed correctly and make sure they are adequately charged." While some experts anticipate costs would decline with market maturity and competition, others speculate that MFHPs may always carry a premium because they are "a more robust technology," with greater complexity.

Given today's pricing relative to alternatives, incentives are essential for MFHP adoption. Stakeholders emphasized that rebate programs must target the incremental cost difference to "level the playing field or give the more competitive system that economic advantage." With a full stack of incentives—including TECH, Energy Smart Home rebates, and the 30 percent federal tax credit—some MFHPs may be able to approach cost parity with separate systems, landing in the $15,000–$20,000 range. Without such support, however, stakeholders agreed that adoption will remain limited. "Really, at the end of the day, it is a financial decision. Whichever one is the lowest cost solution that meets needs will be chosen."

Cost uncertainty also hampers MFHP uptake. At present, there is very limited data available on MFHP costs. The nature of MFHP system design may exacerbate variability; stakeholders noted that the lack of standard package pricing is even more exaggerated for MFHPs than other HP systems. One researcher explained, "a lot depends on the state of the house [and] how many subcontractors you need." They emphasized that "large, varied estimates" undermine trust and create adoption barriers.

MFHPs remain in an early stage of commercialization, with a gap between marketing visibility and true product availability. Additionally, stakeholders emphasized that noted customers weigh equipment reliability, manufacturer stability, and serviceability, in addition to upfront costs and efficiency claims.

LEASING AS AN ALTERNATIVE BUSINESS MODEL

Stakeholders identified leasing as a promising strategy to overcome the high upfront costs of HP adoption. Several noted that the leasing model was pivotal to the growth of rooftop solar, enabling customers to access clean technology without large capital investments. As one manufacturer

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[50] Current data regarding MFHP pricing is scarce. There is a wide price range for the installation cost of space conditioning HPs and HPWHs. For example, according to the 2022 Opinion Dynamics study, the median cost statewide for two separate systems is $13,700. In contrast, the median cost for installing these separate technologies through the TECH program is $24,832 combined.

explained, “The reason why rooftop solar has grown is because [providers] could offer to lease panels… the leasing model took care of all the incentives and tax credits.”

However, current policy and incentive structures often exclude third-party ownership, limiting access to rebates for leased systems. Another manufacturer cautioned, “There may be barriers to being able to get the HP incentives if you’re leasing the technology. Until we can do that for HPs, it’s going to be very slow.” Stakeholders emphasized that allowing incentives to flow to leasing models would be essential for market transformation.

This concept extends naturally into “equipment-as-a-service” approach, in which customers pay an all-inclusive monthly service fee covering both equipment and maintenance. An energy expert described this vision: “It’s a dream that we get to a place where we don’t ask consumers or property owners to take on the burden of ownership. I would pay a flat fee—say $100 a month—for hot water and air conditioning, just like I pay for electricity. If something goes wrong, I don’t have to worry about it… that’s all just priced into it.”

Leasing and service-based models could reduce upfront costs and transfer maintenance responsibilities to providers, aligning incentives for reliable performance. As one energy expert observed, the model remains “unproven but [has] great potential… because somebody else would be in charge of maintenance.” These approaches could remove cost and maintenance barriers and help drive a shift toward service-based clean energy delivery, echoing successful models in the solar and EV sectors.

Operating Costs

Uncertainty around operating costs was reported as a major challenge for MFHP (and other HP) adoption. California’s spark gap—the price difference between electricity and gas--makes HPs generally more expensive to operate than gas furnaces and water heaters. As one energy expert summarized, “operating costs will be higher” for many customers, especially in IOU territories where rates are high. Another added, “not having that ability to [tout] significant bill savings is going to be a huge headwind” stifling MFHP adoption. Stakeholders who completed the Technology Characteristic Assessment were slightly more optimistic, rating the operating costs of MFHPs compared to space conditioning heat pumps as “Medium” (n=9) or “Low” (n=6).

Energy efficiency is critical to contain HPs’ operating costs. With electricity roughly three times more expensive per unit of energy than gas, HPs, including MFHPs, must consistently achieve a COP of 3 or more to deliver bill savings. While MFHPs have demonstrated up to 36 percent higher efficiency when operating in simultaneous mode (providing space cooling and water heating concurrently) than when performing these functions separately, it is not yet clear whether these gains would bear out on a larger scale.[51] Stakeholders emphasized that claims of “synergistic operation” are promising in theory but largely untested in real-world settings, making it difficult to quantify energy or bill savings with confidence. Performance—and in turn operating costs—depends heavily on climate, load shape,

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[51] Chally, S. & Haile, J. (2024). *Field Assessment of Residential Three Function Heat Pump Performance.* Frontier Energy. https://www.etcc-ca.com/reports/field-assessment-residential-three-function-heat-pump-performance

and occupant behavior. CalNEXT has identified operating cost verification as a top research priority.[52]

Eligibility for discounted electricity rates will strongly influence MFHP operating costs. Many IOUs (e.g., PG&E, SCE, and SDG&E) currently offer reduced electricity rates for HP customers.[53] The low electricity rates within SMUD's territory—which includes most of Sacramento County and small portions of Placer and Yolo Counties[54]—already make full electrification through MFHPs or separate HPs more attractive. Load-shifting capability could also be critical. One manufacturer explains, "a system that is electric, but load shifting and arbitraging on time-of-use (TOU) rate is the best hedge for rising electric prices…that resonates with people." However, absent a designated rate for MFHPs, it is unclear exactly which of these discounted rate structures would apply to MFHPs.

Other challenges related to operating costs include variability and consumer perceptions. Unlike gas rates, which are generally flat aside from occasional seasonal adjustments, electricity rates are dynamic and vary by TOU. This creates both risks of higher bills during peak hours and opportunities for savings through load shifting. But the counterfactual is hard for consumers to understand. Many people are unaware that gas rates are rising quickly as are electricity rates. "So much of demand is based on perception," one energy expert explains. "People's misunderstanding of gas and electric rates, and actual usage and efficiency" creates persistent uncertainty.

Ultimately, not only do fluctuating electricity and gas rates complicate financial analysis and payback calculations for homeowners-the lack of energy usage studies further challenges the ability to make operating cost estimates. As one energy expert put it, "the bill impacts and savings are so uncertain." A program implementer added, "utility cost escalation after the project is done…is probably one of the biggest barriers right now." Without transparent data, many consumers and developers will default to gas systems, which are perceived as simpler and cheaper to run—even though rising gas prices may erode that advantage over time.

RATE REFORM

Stakeholders emphasized that reducing operating costs is essential for electrification including expanding MFHP adoption, and that policy reform must address the spark gap—the persistent price disparity between natural gas and electricity. As one program manager noted, bridging this gap is critical to making electric technologies more cost-competitive with gas alternatives.

Several experts recommended innovative rate structures to lower long-term electricity costs and provide customers with stability. They proposed offering opportunities to lock in electric rates or avoid future increases, citing successful precedents in net metering for solar and electric vehicle (EV) rate schedules. One expert explained, "Rates are a key intervention. If you think about the EV rate

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[52] CalNext. (2024) *2024 HVAC TPM.* https://calnext.com/wp-content/uploads/2024/09/2024-HVAC-TPM-September-1-2024.pdf

[53] PG&E. (n.d). *Electric Home Rate Plan (E-ELEC): The rate plan for an electric-powered home.* https://www.pge.com/en_US/residential/rate-plans/rate-plan-options/electric-home-rate-plan.page; Southern California Edison (SCE). (n.d.) *Energy Savings Assistance (ESA) Program: Heat Pumps- Frequently Asked Questions.* https://www.sce.com/factsheet/energy-savings-assistance-program; SDG&E. (n.d). *Electrify Your Home: Pricing Plans for Electrified Homes*. https://www.sdge.com/residential/savings-center/tips/home-electrification#pricing

[54] SMUD. (n.d.). *SMUD's territory map.* https://www.smud.org/Corporate/About-us/SMUDs-Territory-Map

schedule that PG&E launched 15 years ago, that was a wonderful incentive and intervention to encourage EV adoption. We need rate intervention along with programmatic intervention."

Stakeholders also called for rate reform to strengthen TOU signals and better reward load flexibility provided by technologies like MFHPs. Currently, the TOU differential in parts of California is only about eight cents per kilowatt-hour, providing limited incentive for demand shifting. As one expert observed, "If that were to change, or you had a really good demand rate or discount for this type of system, that'd be a real deep advantage."

Cost-Effectiveness

MFHPs' projected energy savings, and resulting cost-effectiveness, remain speculative. Without large-scale field demonstrations or recognized performance ratings, their efficiency gains are primarily modeled rather than verified.

Thus, lifecycle cost-effectiveness remains uncertain and hampered by poor data availability.[55] Stakeholders questioned whether MFHPs can outperform separate systems once equipment costs, labor, infrastructure upgrades, EUL, maintenance, and energy consumption are considered. In particular, as one program implementer noted, the expected useful life of MFHPs remains uncertain. However, it is reasonable to hypothesize that the compressor may have a shorter EUL when configured as a multifunction system than as a standalone HVAC HP, given its additional operating load for water heating.

Based on current information, a program implementer explained, it is not possible to show that MFHPs are cost-effective or in consumers' "long-term economic best interest." Thus, "people are probably going to stick with natural gas and their standard air conditioning, because you can't tell people in good faith that they're going to save money with this [technology]."

Workforce

This section examines industry acceptance and workforce readiness factors influencing MFHP adoption, which shape both near-term adoption potential and the long-term scalability of MFHP deployment in California.

Industry Acceptance

A fundamental barrier to MFHP adoption is that many contractors and distributors are not even aware of the technology. Without a widely available commercial product, local contractors may have never encountered an MFHP in the field, making it unlikely they would recommend or attempt to install one. As one manufacturer put it: "Nobody really knows about it." This lack of familiarity reinforces a cycle of limited adoption: if contractors do not know about the product, they cannot sell it, and without sales, they do not gain the experience needed to become comfortable offering it.

Contractors are still hesitant about HPs in general, and MFHP adoption faces an even greater barrier due to reluctance to embrace new technologies. Numerous stakeholders emphasized that the vast majority of contractors avoid unfamiliar systems, opting instead for "like-for-like" replacements.

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[55] The research team had planned to conduct a lifecycle cost comparison of MFHP to gas-fired equipment and separate heat pump systems. However, the cost-related data necessary to make such a comparative analysis is not yet available for MFHPs.

Another recalled a program evaluation where, “We interviewed probably 40 different contractors. And of those 40, there were probably two that were heavy on the adoption of new technologies and new systems. The other 38 had their product set that they were comfortable with and would do like-for-like replacements. Anything outside of that was a challenge. So, calling one of those 38 contractors and saying, ‘I want a [MFHP].’ The answer would be no. We don’t do that.” Stakeholders cited a variety of reasons for this wariness, including fear of callbacks, unsatisfied customers, and even lawsuits.

Learning a new technology requires contractors and designers to slow down and retrain, which reduces profitability. Plumbers showed similar resistance when HPWHs were first introduced: “If they can just pump out all these designs and do it quickly, learning a new technology means that they lose margin, so there was resistance there. And then they didn’t want to get blamed when a new technology goes wrong on a building….It’s easier to just go with the things you know.” When considering adding technology to a contractors’ regular portfolio of offerings, another energy expert explained, “you have to install 100 of them before you feel comfortable and experience minimal callbacks. The math that they’re doing is how many times is this customer going to complain about this and I’m going to have to roll a truck and deal with it. It’s fear of the unknown. Incorporating new products into [contractors’] standard offerings and then being comfortable making the sale and doing the installation—that’s a whole system-wide issue.”

Contractors perceive significant risks in deviating from established practice and are hesitant to adopt new technology until they know it will reliably pay off. Given small margins, “contractors are hesitant to promote anything that would overcomplicate the sales process.” Moreover, as a utility representative explained, MFHPs’ added complexity will impact sales and commission timing. “Sales guys think, ‘I can sell this gas equipment today, install it this week, and get paid on Friday.’ Or I could offer an MFHP, try to sell the customer on electrification and doing both HVAC and water heating—maybe make the same amount of money, but four to six weeks later because new circuits might be needed, infrastructure has to be assessed, and the equipment may not be available. There’s a lot happening behind the scenes working against [change].” Instead, they “tend to stick to established business models due to the inherent financial risks of new technologies.” Contractors are reluctant to abandon established system types that align with existing business models, permitting practices, and supply chains. As one expert explained, “Asking them to adopt something new means more risk—with no clear benefit. In many cases, they may even make less money and be less competitive compared to sticking with standard systems.” For the MFHP market to evolve, we need to know “How do we get [MFHPs] on our contractors' trucks? How do we teach our contractors to sell these things?” as one utility expert asserted.

Installation and Workforce Readiness

Installation and workforce challenges represent significant near-term barriers to MFHP adoption. While the technology does not necessarily require radically new installation practices, it introduces greater system complexity, cross-trade coordination, and precision during setup than most conventional HPs. Because MFHPs integrate space conditioning, water heating, and electrical functions, installation often spans multiple licensed trades and demands close collaboration among HVAC, plumbing, and electrical professionals—groups that typically operate independently. Stakeholders provided different views: some argued that MFHP installation steps are comparable to existing multi-zone systems, while others cautioned that additional components, control wiring, and refrigerant routing create more potential failure points and a steeper learning curve. Across interviews, stakeholders highlighted three main challenges: (1) overlapping licensing and trade coordination requirements, (2) higher labor intensity and slower installation times for early projects, and (3) a broader workforce and training gap that may limit the ability to scale up the technology's deployment.

LICENSING AND COORDINATION

Installation of MFHPs involves work spanning trades—HVAC, plumbing, and electrical—each governed by distinct licensing requirements. Because MFHPs include refrigerant lines, they must be installed by an HVAC contractor, whose license authorizes work involving refrigerant handling and associated mechanical systems. Some stakeholders suggest that a California HVAC license may be adequate for most MFHP installations. As one HVAC installer explained, "Our license covers gas, electrical, and mechanical work, but plumbing licenses are strictly plumbing. We kind of cross over into all three."

However, stakeholders highlighted that the barrier may not be the licensing rules themselves and more about contractors' perception of what those rules allow. The same installer noted that many HVAC companies refuse to perform any work with water lines. "You might run into [installers who say], 'Oh, I'm not gonna touch the water heater—I don't want that responsibility.'" Another expert described how licensing boundaries create gaps in responsibility: "If I replace my water heater, I get a plumber to come. If I replace my HVAC, I get an HVAC technician to come. But they don't work on each other's stuff." Even when licensing may technically allow certain work, perceptions of liability or scope could discourage contractors from taking on MFHPs.

Because MFHPs combine end uses, they introduce additional coordination, scheduling and accountability challenges. They present an especially acute workforce hurdle by requiring collaboration across HVAC, plumbing, and electrical trades—all of which already face shortages of qualified technicians and typically operate as single-trade contractors. One manufacturer summarized: "Trades are often siloed, with small businesses typically focused on a single trade, making real-time coordination a significant challenge on job sites."

While cross-trade coordination is not new or unique to MFHPs, without a lead contractor responsible for all components—or a multi-trade (e.g., plumbing and electrical) installer—MFHP installations could likely become inefficient and error prone. Contractors that consolidate these trades under one roof—or clearly delineate responsibilities with subcontractors—tend to achieve better outcomes, though this remains uncommon. Some stakeholders advocated for more multi-trade contractors, but others acknowledged that the required investment in training and certification can deter smaller firms. "Certification is a big [hurdle]," one energy expert explained. "If you're running a company that wants to start offering these products, what's the investment to get people trained up in the trade they haven't been working in for ten years? Or do you have to have more people on-site to make the installation?"

Ultimately, whether due to formal licensing limits or perceived restrictions, few individual firms would be able to complete an MFHP installation independently. Projects are likely to require coordinated efforts across HVAC, plumbing, and electrical trades—under tight schedules and with unclear lines of responsibility. Stakeholders cautioned that dependency can increase costs, delay timelines, and heighten the risk of errors or callbacks. As one energy expert summarized, licensing rules "double the installation barrier" by making collaboration across trades a necessity rather than an option.

Several stakeholders pointed to the need for clearer and more flexible licensing frameworks to avoid confusion and inefficiency when straddling multiple trades. Stakeholders suggested cross-certifying trades or adopting license categories that allow qualified professionals to perform limited plumbing and electrical work associated with HP installations. One expert cited Oregon's "water heating installer license" as a model, which allows contractors to complete any work within six feet of a water heater replacement, including minor electrical and plumbing tasks. "That simplified that particular trade," the expert explained. "HVAC installers should be able to do minor plumbing… That shouldn't be a barrier for installation." Aligning California's licensing approach with such models could reduce coordination bottlenecks and lower soft costs associated with installation.

Collectively, these recommendations underscore a clear strategy for workforce development: simplify training and testing, prioritize experiential learning, formalize contractor qualifications, focus geographically where conditions are ripe, and modernize licensing frameworks to match the technology. Taken together, these actions would help build a skilled, confident, and scalable contractor base capable of supporting widespread MFHP deployment across the state.

LABOR INTENSITY AND LEARNING CURVE

Even when properly staffed, most stakeholders—apart from the manufacturers interviewed—argued that MFHP installations are more complex and labor-intensive than standard HPs. As one researcher explained, "The [MFHP] installations are more complex and complicated. So, in that sense, it would probably require more labor compared to just a HP." Stakeholders agreed that the refrigerant line installation is the most time-intensive and expensive aspect of MFHP installs. Contractors emphasized that each additional component—control wiring, refrigerant piping, water connections—introduces opportunities for error in installation. One energy expert captured the challenge succinctly: "There's a lot that the contractor has to know about effectively implementing that system. The complexity is a real thing. It's not insurmountable, but it takes experience and discipline."

Stakeholders repeatedly stressed that "the devil is in the details." MFHPs require precise installation, configuration, and control tuning to function as intended. One energy expert noted that these systems "demand a high level of specificity—training, commissioning, and setup all matter." Another explained, "How do you set up the control board? There are so many mistakes you can make with that. How good is the vendor support? Sometimes it comes down to personal relationships—it's not just a 1-800 number." Without thorough, hands-on training and strong manufacturer support, small errors during setup—such as incorrect refrigerant charging or control sequencing—can undermine performance and reliability.

Decreasing installation time with experience is tempered, somewhat, by the variability of retrofit scenarios. Retrofit applications present additional variability: installation complexity depends heavily on site conditions—such as the distance between the water tank and outdoor unit or the location of the electrical panel. Some older buildings may require "creative installation" to overcome space and routing constraints. Stakeholders also noted that each retrofit tends to be somewhat "bespoke," requiring case-by-case design adjustments until consistent best practices emerge.

Given the novelty of MFHP installations, most stakeholders emphasized that installers will require repeated experience before achieving efficiency and confidence, as with any new HVAC equipment. As one manufacturer explained, "When [the installers] get experience, they're actually much faster. Our most experienced installers have roughly half the installation time of someone doing their first one." Early installations tend to involve a "fumbling process" as contractors learn how to deliver the product reliably and cost-effectively. One manufacturer stated, "It is going to be a big lift in terms of training. It's not an insurmountable task, but it is going to take a little while for that specialty to emerge."

Several experts recommended developing a certified vendor or preferred-contractor program modeled after Massachusetts' MassSave initiative. Through such a program, contractors who demonstrate proficiency with high-efficiency systems could be listed in a public directory. This approach would address both contractor motivation and consumer confidence. As one expert explained, "If a handful [of contractors] go all-in, it creates a competitive pull—others see a growing business and move to follow." Another added, "If that same model were applied to [MFHPs]… and you had some authority saying, 'Yes, this set of 10 contractors, they're the ones to get it', that would address the customer confidence issue." Developers likewise emphasized that pre-qualification is critical to ensure quality outcomes: "Pre-approval is really important—we don't have time to chase insurance or fix lousy workmanship. [The challenge is] not that there aren't contractors; it's making sure the ones on the job are qualified."

Stakeholders recommended also targeting early workforce development and market transformation efforts in select metropolitan areas with favorable policy conditions and contractor readiness. Concentrating training resources in these regions could create self-reinforcing "centers of excellence" that support replication elsewhere. As one energy expert put it, "Start in certain geographic areas… that have good incentive programs, the right kind of policies, and the right kind of attitude… then work with the right set of contractors to understand their needs, and design the program based on that feedback."

Workforce and training gap. The challenges noted above are playing out amidst a broader set of workforce-related challenges facing the HVAC labor force. According to the CAHPP, the state faces a shortfall of trained HVAC technicians, electricians, and plumbers[56]—an estimated 27,000 additional workers, or about a 25 percent increase by 2030,[57] will be needed to meet growing demand and replace retiring workers.

Ensuring the workforce has the required skills to install and service MFHPs is yet another challenge. Most plumbers, electricians, and HVAC installers currently lack hands-on experience or training with HPs, and even fewer have had exposure to the added complexity of multifunction systems. Stakeholders noted that high turnover among installers further compounds this challenge, emphasizing the need for consistent, practical training. One installer explained the learning curve: "Getting twelve technicians to understand a new idea—how it works, how we want to install it, and make it work right for the customer—that's the biggest concern." It is difficult "venturing into something new—that hasn't been around or something we've done for the last 53 years." An energy expert emphasized the importance of experiential learning, suggesting that installers should ideally "have hands-on experience—install it in their own homes."

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[56] California Heat Pump Partnership. (2025). *Scaling California's Heat Pump Market: The Path to Six Million.* https://heatpumppartnership.org/wp-content/uploads/2025/03/CAHPP_Blueprint_2025.pdf

[57] California Open Data. (2022). *Long-Term Industry Employment Projections.* https://data.ca.gov/dataset/long-term-industry-employment-projections

Stakeholders also highlighted that HVAC installation is a continuing education industry by nature, requiring ongoing adaptation as technologies and refrigerants evolve. As one contractor put it, “We have to train our people all the time on new technologies; for example, we just went through a new refrigerant change.” Building a workforce capable of handling MFHPs will therefore depend not only on recruitment but also on sustained investment in specialized, cross-trade training and experiential learning opportunities. As mentioned above, however, HVAC companies may be reluctant to make such investments.

Stakeholders consistently emphasized the importance of making MFHP training more intuitive and accessible. One manufacturer urged programs to “continue to make training easier, facilitate simpler installations, and [provide] more straightforward explanations of testing.” Several experts also recommended expanding the use of digital instructional tools—such as three-dimensional video demonstrations—to help contractors visualize how MFHP systems function and integrate each end use.

Many stakeholders emphasized that traditional classroom or webinar formats are insufficient for developing confidence with this new technology. Instead, they recommended more experiential approaches such as showrooms, demonstration sites, and in-field manufacturer training. One contractor reflected, “I always love a good showroom example… The more you can share of an existing install, and check in with the contractor and say, how’s it going?… Those are the more powerful ways to change contractor minds.” Another added that manufacturers who bring fully equipped training trucks “with all the components on their truck” provide “invaluable knowledge” for installers. As one energy expert noted, “If [installers] understand what the problem is, they can solve it. Allow them to use their skills, unleash their creativity about how to solve it.” These perspectives highlight the value of interactive, problem-based learning rather than solely prescriptive instruction. Such hands-on exposure helps demystify installation procedures, fosters peer-to-peer exchange, and normalizes the technology among contractors.

Policy

This section presents findings on policy and regulatory frameworks that influence MFHP commercialization, including performance ratings, testing standards, product classification, refrigerant regulations, and broader building decarbonization policies. Future analysis will incorporate updates from ongoing DOE rulemakings, refrigerant transitions, and related CEC or utility proceedings for inclusion in the Final Report.

Performance Ratings

CURRENT TESTING STANDARDS

MFHPs are currently evaluated under several separate rating standards merged under the ASHRAE 206 test standard. These include AHRI 210/240 for space conditioning, which measures heating and cooling capacity and efficiency under controlled indoor and outdoor conditions, yielding HSPF2 and SEER2 ratings[58]; the DOE Uniform Test Method for Water Heaters (Appendix E), which assesses water-heating performance through a controlled tank cycle test to determine the Uniform Energy

[58] Even for conventional space-conditioning HPs, SEER2 and HSPF2 ratings are not reliable indicators of actual energy consumption in real-world buildings—particularly for variable-speed equipment. Thus, even if federal performance metrics were established for MFHPs, estimating cost-effectiveness may remain challenging.

Factor (UEF) and first-hour rating. ASHRAE testing Standard 206-2024 also specifically addresses simultaneous space-conditioning and water-heating operation.

Because both AHRI and DOE procedures assess single-function performance, they fail to capture MFHP's synergistic efficiency— the ability to heat water while cooling air using the same refrigerant loop. As one expert explained, "when people are only looking at HSPF and UEF numbers, they may not see the efficiency of [MFHP] show up there at all." In simultaneous operation, these systems can deliver up to 36 percent more efficiency than performing these two functions separately, yet these gains remain invisible within current single-function test standards.

ASHRAE: REPRESENTATIVE BUT UNRATED

To address this gap, ASHRAE developed Standard 206-2024 as a system-level test method to evaluate combined space-conditioning and water-heating performance. The standard measures total system COP across multiple operating modes—including simultaneous or heat recovery modes—and determines an annualized performance factor intended to reflect real-world operation. However, because ASHRAE 206-2024 is a voluntary engineering protocol, not a certification or market-facing rating, its results are not recognized by AHRI or DOE (and therefore not usable for ENERGY STAR® certification.) As a result, even if a manufacturer demonstrates integrated efficiency under ASHRAE 206, that data cannot be used for code compliance, labeling, or rebate qualification. Until DOE creates a new product class or AHRI adopts an integrated rating protocol, MFHPs will remain technically testable—but not fully ratable—for their system-level performance.

APPLYING STANDALONE RATINGS

In the absence of MFHP-specific ratings, manufacturers must rely on standalone HVAC and water heater metrics on specification sheets. However, these ratings, designed for measuring single functions, will not accurately depict the performance of MFHPs that are configured to perform multiple functions. One manufacturer noted that this approach effectively penalizes MFHPs for space conditioning: "you're using a large compressor and putting it in a test standard where a smaller system could do the same thing more efficiently. Of course it's going to perform less efficiently than the standalone system." On the water-heating side, the problem is even worse: MFHPs with larger outdoor units are compared against small, dedicated HPWHs, making it "impossible to hit a UEF of 4 or 3.5… the electrical draw is just going to be higher." These misapplied efficiency ratings obscure real performance advantages and leave MFHPs undervalued in efficiency rankings.

IMPLICATIONS FOR INCENTIVES AND CODE COMPLIANCE

Although MFHPs may technically qualify for incentives and code compliance credit using their HVAC or water heating ratings, these single-function metrics fail to reflect true system efficiency. As one manufacturer summarized, "Trying to meet a testing standard that just doesn't apply to that technology segment is fundamentally unfair." As one who exited the market explained, "Performance standards were a problem for us; we couldn't get credit for heating water and cooling the space at the same time."

The lack of recognized ratings also limits access to financial incentives and code compliance credits. One researcher observed that, absent clear metrics, regulators often assume new technologies are equivalent to the minimum efficient baseline. In California, compliance software defaults to treating MFHPs as minimum-efficiency HVAC or water-heating equipment, erasing real-world benefits and limiting design flexibility in compliance trade-offs. "Because of that you're not getting any compliance credit for having a more efficient system—that makes it difficult. A lot of the stuff in code compliance is trade-offs between different things. One of the ways that you can put in a larger south-facing window is by putting in a more efficient space conditioning system or doing other things." Without full recognition of the energy efficiency of MFHPs, developers and homeowners may be less inclined to select them.

The lack of federally recognized metrics has downstream effects on incentive eligibility and code compliance. Because incentive administrators depend on standardized ratings, without them, utilities "will not promote [MFHPs] with incentives." As one manufacturer explained, field data alone is rarely sufficient for rebate eligibility: "we can prove the system is performing well and better than the standard after the fact, but before the fact, it's harder without a standard," one manufacturer explained. Thus, "as a designer, you're effectively limiting your options if you go with this system. That's how not having an efficiency metric ends up impacting [MFHP adoption]. Compliance and incentive programs are kind of off the table."

NO DOE PRODUCT CLASS

The DOE has not yet defined a product class for MFHPs, which means it cannot establish a unified test procedure or efficiency rating that reflects combined space-conditioning and water-heating operation. Without a DOE-defined product class and corresponding test method, ENERGY STAR likewise cannot establish criteria for MFHPs, since ENERGY STAR certification must be based on DOE test procedures. Experts estimated it could take at least six years to establish a new product class, with three years remaining under current regulations and an additional three for the rulemaking process. In the interim, manufacturers must test MFHP components separately under HVAC and water-heating protocols, an approach that fails to capture their integrated performance.

COSTLY AND SLOW CERTIFICATION

This regulatory gap forces manufacturers to pursue multiple certifications, significantly increasing both cost and time to market. As one energy expert observed, "The entire planet's population has one set of standards, and then the US, which is 5 percent of the global population, wants to have their own." To sell HPs in California, manufacturers must complete UL safety certification, AHRI performance testing, Title 20 appliance efficiency compliance, and Department of Building review. These overlapping processes involve long timelines, expensive equipment shipping, and significant laboratory testing, making market entry both costly and time-consuming.

Stakeholders emphasized that these burdens discourage investment in the US MFHP deployment. "It is like half a million to a million dollars [to come to market]. We're not going to spend that money on your speculative California market." With a DOE dedicated product class at least six years away, many manufacturers remain hesitant to commit resources to US certification or product launches.

INTERNATIONAL COMPARISON AND PATHWAYS FORWARD

In contrast, Europe has already established standards for MFHPs, allowing manufacturers to publish verified performance data and demonstrate comparative efficiency. Several manufacturers have tested their systems to these European protocols to support marketing and performance documentation. One program implementer noted that adopting a similar framework in the US could "encourage manufacturers to push the envelope and bring more of these types of systems to the market, because they're all over Europe and Asia."

Without formal recognition from US agencies, however, MFHPs remain excluded from the most advantageous programs—including federal ENERGY STAR labeling and many state or utility incentive structures. Future progress will depend on collaboration among manufacturers, testing organizations, and federal agencies to align existing HVAC and water-heating protocols. Interim steps—such as recognizing combined-system performance under existing standards or aligning with European test procedures—could help accelerate MFHP market entry while maintaining regulatory integrity. In the meantime, field demonstrations and case studies can help fill the evidence gap and build confidence in MFHP performance until formal standards are established.

Stakeholders identified a gap in compliance and modeling tools. One expert observed that "the Energy Commission has no benefit analysis for [MFHPs] within their compliance tools," leading to a lack of recognition in Title 24 modeling and energy consultant workflows. They recommended new research to demonstrate MFHP efficiency benefits and integrate those results into compliance software to "give [the technology] an advantage—with designers and energy consultants, even before you get to a contractor."

Stakeholders consistently emphasized the need to shift from technology-centric policies toward performance-based frameworks that reward outcomes rather than prescribe specific technologies. Existing performance metrics for HPs were seen as poorly aligned with real-world conditions and unavailable for MFHPs. As one developer noted, "I think this goes wider than MFHPs, but [there should be] a real credit for sustainability in tax credit scoring." Others criticized policies like Title 24 for "picking winners," observing that "anytime Title 24 picks a certain winner, a certain group backs it—HVAC doesn't back insulation and vice versa."

Another developer urged policymakers to "stop caring about how we get there and [just] get the job done," arguing that policies should focus on results rather than the means: "If you got a huge advantage for doing net-zero, everyone would do it. We shouldn't care about the technology—we should just care about the results." This reflects a broader call for outcome-driven policies that reward verified performance, efficiency, and emissions reductions rather than compliance with prescriptive measures. This approach would evaluate MFHPs' system-wide field performance—such as measured load flexibility, integrated thermal efficiency, and avoided electrical infrastructure upgrades—rather than relying solely on standardized equipment ratings or prescribed design criteria.

Stakeholders also underscored the importance of understanding the total resource cost of MFHPs compared with other technologies. A program manager suggested starting with "new construction with a resiliency component" through a pilot incentive program designed to "better understand the economics, the total resource cost, [and] what incentives would be needed to encourage market adoption."

Several experts advocated for a "forcing function" to accelerate market transformation toward higher-efficiency equipment. One explained, "If you don't have any kind of a policy forcing function, people will tend toward the cheapest option. They will not be looking for either efficiencies of system design or efficiencies of the actual equipment." Others argued "you are going to have to have rich incentives, or require people through policy, or have a combination of the two."

Refrigerant

Refrigerant safety emerged as a common concern with MFHPs. The recent shift to low-GWP refrigerants in HPs has created a new risk—flammability. As noted in the Technical Overview section above, MFHP systems installed from January 1, 2025, onward must use refrigerants with a Global

Warming Potential (GWP) less than 700[59] in accordance with federal regulations. New alternatives—including R-32 (GWP 675) and R-454B (GWP 466) used in HPs, including MFHPs—are mildly flammable A2L refrigerants. “For the refrigerant lines in current code,” as one manufacturer stated, “you have to treat [A2L refrigerant] as if it’s propane.” Because of flammability, “manufacturers [must] take various steps with control to make things safe in case there are leaks,” as one researcher explained. Further, this transition requires updated building and fire codes, technician training, and charge-size limits under UL 60335-2-40 and ASHRAE 15-2022.[60]

While manufacturers are currently grappling with meeting the new requirements related to low-GWP refrigerants, research is looking ahead to ultra-low GWP options. As one researcher said, “there are various regulatory goals and just a general desire to get refrigerants down to a much lower global warming potential. Ideally as close to zero as possible. Unfortunately, the closer you get to zero, the more flammable and toxic the refrigerants are.”

While all HPs must adjust to meeting the new refrigerant regulations and ensuring occupant safety, the safety risks for MFHPs are compounded. As one researcher explained, “your lines are longer, so there’s higher potential for refrigerant leak” evidenced by the fact that the MFHP systems evaluated in recent field tests used nearly twice as much refrigerant as traditional HP systems. However, another researcher explains, “…the GWP issue [is] going to be a challenge… It's going to be very difficult to achieve [ultra-low GWP] safely with direct expansion systems… I’m very skeptical that [MFHPs] would be able to survive [the refrigerant transition],” given the large volume of refrigerant they require relative to traditional HP systems. Stakeholders also flagged breakage risks during transportation and installation. One contractor cautioned, “I still think [lines] are risky for handling and breakage in the field. Breakage of a pre-charged pipe is probably pretty easy to do in a truck.” Furthermore, performance impacts to date are mixed: some studies suggest efficiency gains with ultra-low GWP options like R-290 (GWP 3), though trade-offs exist, and CARB is still evaluating the environmental effects of hydrofluoroolefins (HFOs) such as HFO-1234yf. The California Energy Commission recently reinforced this direction with a solicitation (GFO 24-305) for MFHP development and lab testing to explore the potential trade-offs between performance, safety, and environmental impacts of using ultra-low GWP refrigerants.[61]

Building Electrification

Several policy mechanisms have converged in recent years to accelerate California’s adoption of heat pumps for space conditioning and water heating, directly supporting the state’s target of installing six million heat pumps by 2030. The 2022 Building Energy Code (Title 24) included “prescriptive requirements for the use of heat pump technology in single-family homes, multifamily

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[59] US Environmental Protection Agency. (n.d.). *Regulatory actions for technology transitions.* https://www.epa.gov/climate-hfcs-reduction/regulatory-actions-technology-transitions

[60] Cadmus. (2024). *Low-global warming potential refrigerants study.* https://pda.energydataweb.com/api/downloads/3924/MCE_Low-GWP%20Refrigerants%20Study_011724_FINAL.pdf

[61] California Energy Commission. (2025, March 12). *GFO-24-305: Developing next generation, all electric heat pumps using low global warming potential refrigerants.* https://www.energy.ca.gov/solicitations/2025-03/gfo-24-305-developing-next-generation-all-electric-heat-pumps-using-low-global-warming-potential-refrigerants

buildings, and select commercial buildings."[62] It also required new homes to have electric panel capacity and electrical circuits to accommodate future heat pump installations.

The 2025 Energy Code goes further, requiring heat pumps for space conditioning and water heating for single-family homes in all climate zones. Provisions of the 2025 Code establish mandatory sizing and equipment selection standards for heat pump systems to ensure they meet design heating loads without depending on supplemental electric resistance or gas heat.[63] Approved by the California Building Standards Commission in December 2024,[64] these standards take effect on January 1, 2026,[65] and are expected to drive large-scale market growth and infrastructure readiness necessary to meet the six-million-unit goal.

At the same time, the California Air Resources Board (CARB) has been taking steps to effectively require heat pumps. In 2022, CARB established a policy goal prohibiting the sale of new natural gas-powered water and space heaters by 2030.[66] The agency clarifies that while existing gas appliances would still be able to be used and repaired, no new gas heaters for space or water heating would be allowed for sale beginning in 2030, mandating a shift to zero-emission alternatives like heat pumps. Following this, state agencies were tasked with drafting specific regulations to enforce this ban, with a final vote on the detailed implementation rules expected in 2025.[67] As of late 2025, the final vote on the detailed implementation rules has not yet occurred but is expected soon, with CARB actively drafting the proposal and engaging the public.[68]

Meanwhile, local jurisdictions are taking steps to accelerate building electrification through additional measures. The Bay Area Air Quality Management District, for instance, passed a ruling in 2023 mandating zero-NO_X HPWHs starting in 2027 and ASHPs starting in 2029.[69] The South Coast

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62 California Energy Commission. (2022). *Building Energy Efficiency Standards*, § 150.2. https://www.energy.ca.gov/sites/default/files/2022-08/CEC-400-2022-010_CMF.pdf

63 California Energy Commission. (2024, September 11). *Energy Commission adopts updated building standards expanding requirements for heat pumps and electric-ready buildings*. https : //www.energy.ca.gov/news/2024-09/energy-commission-adopts-updated-building-standards-expanding-requirements-heat

64 California Building Standards Commission. (2024, December 17–19). *Meeting minutes of the California Building Standards Commission, December 17–19, 2024* [PDF]. https://www.dgs.ca.gov/-/media/Divisions/BSC/03-Rulemaking/2024-Triennial-Cycle/Commission-Meetings/2024-12-17/Dec-17-2024-MM-FINAL.pdf

65 California Energy Commission. (2024, September 11). *Energy Commission adopts updated building standards expanding requirements for heat pumps and electric-ready buildings*. Retrieved from https://www.energy.ca.gov/news/2024-09/energy-commission-adopts-updated-building-standards-expanding-requirements-heat

66 Roth, S. (2022, September 23). *California moves to ban natural gas furnaces and heaters by 2030.* Los Angeles Times. https://www.latimes.com/business/story/2022-09-23/california-moves-to-ban-natural-gas-furnaces-and-heaters-by-2030

67 California Air Resources Board. (2023, May 30). *Zero-emission space and water heater standards: Frequently asked questions (FAQs).* Retrieved from https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/zero-emission-space-and-water-heater-standards/faq

68 According to the CARB website: "Notice: Following the California Air Resources Board's (CARB) August 2025 workshop, CARB staff have made available public resources to solicit feedback from stakeholders, including a Climate-Related Financial Risk Report Checklist (09/02/25), a preliminary list of regulated entities and voluntary stakeholder survey tool (09/24/25), and a draft reporting template for Scope 1 and Scope 2 GHG Emissions (10/10/25). Given the large volume of public comments staff have received, and given ongoing input related to identifying the range of covered entities, CARB is proposing an updated timeline for bringing the initial rulemaking (including the fee-related provisions) to the board in Q1 2026." Retrieved from: https://ww2.arb.ca.gov/our-work/programs/corporate-ghg-reporting/resources

69 Greenaway, T. (2024, November 19). *California cities planned to shut off gas in new buildings, but a lawsuit turned it back on. Now what?* Local News Matters. Retrieved from https://localnewsmatters.org/2024/11/19/california-cities-planned-to-shut-off-gas-in-new-buildings-but-a-lawsuit-turned-it-back-on-now-what/#:~:text=When%20Berkeley's%20ban%20took%20effect,outside%20the%20state%20followed%20suit.

Air Quality Management District proposed a ban on gas-powered water heaters,[70] but narrowly rejected it in mid-2025 due to concerns over costs, legal challenges, and grid readiness, postponing the decision, but leaving open the possibility of future action.[71]

Starting January 1, 2026, the 2025 California Energy Code requires that all new construction permits for homes and some commercial buildings install heat pumps for space and water heating. This code does not mandate replacing existing gas appliances but ensures that all new space conditioning and water heating equipment installed in California homes will be heat pumps by 2030.

In parallel with these regulatory measures, a suite of federal and state incentive programs is helping make heat pump adoption financially viable, thereby bridging the gap between policy ambition and on-the-ground implementation (see Appendix C for more information on incentives). The Inflation Reduction Act (IRA) provides rebates and tax credits for energy efficiency and electrification, allocating more than $582 million to California through the HOMES and HEEHRA programs.[72] These funds, alongside tax incentives under the Energy Efficient Home Improvement Credit (25C) and builder incentives under §45L, are intended to reduce first-cost barriers for homeowners and developers. At the state level, programs such as TECH Clean California,[73] the BUILD program,[74] and the Self-Generation Incentive Program (SGIP)[75] complement Energy Code requirements by funding installations, contractor training, and midstream rebates.

To further facilitate this transition, California has allocated significant funds to support the transition to heat pumps among existing homes, with a particular emphasis on California's disadvantaged and hard-to-reach communities. A majority of the $922 million in 2022–23 Equitable Building Decarbonization program funding was directed to the Statewide Direct Install Program, supporting the replacement of fossil fuel appliances with electric equipment, including heat pumps, in low-income households.[76] This funding stream complements code requirements and market transformation initiatives, collectively supporting the state to achieve its six-million-heat-pump goal on schedule.

Customer Considerations

This section presents findings related to customer perspectives, including awareness and knowledge, willingness to pay, and attitudes about early retirement of equipment and the all-in-one design. We discuss the outlook for market segments along with equity considerations. The content

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[70] South Coast Air Quality Management District. (2024). *Water heaters*. Retrieved December 2, 2024, from https://www.aqmd.gov/home/research/pubs-docs-reports/newsletters/aug-sep-2024/water-heaters

[71] South Coast Air Quality Management District. (2025). *Meeting notes.* Retrieved from https://www.aqmd.gov/home/rules-compliance/rules/scaqmd-rule-book/proposed-rules/rule-1111-and-rule-1121

[72] Inflation Reduction Act Guidebook | Clean Energy. (n.d.). The White House. Retrieved on March 7, 2024, from https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/

[73] TECH Clean California. https://techcleanca.com/

[74] BUILD. https://www.energy.ca.gov/programs-and-topics/programs/building-initiative-low-emissions-development-program-build/build

[75] SGIP. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/self-generation-incentive-program

[76] Equitable Building Decarbonization Program. (2023). *Equitable Building Decarbonization Direct Install Program Guidelines (Adopted).* Retrieved from: https://www.energy.ca.gov/sites/default/files/2024-04/11_GFO-23-404_EBD_DI_Att_11_EBD_Direct_Install_Program_Guidelines_ada.pdf

reflects market research and stakeholder interview findings, as well as results from the consumer survey.

Awareness and Knowledge

Consumer awareness and interest are critical precursors to technology adoption, both of which pose challenges for MFHPs. As one energy expert summarized: “I don't see the market uptake potential rising a lot without that awareness and education piece, frankly, regardless of how well we tackle the economic barriers. There is such a big social aspect to decision-making and innovation generally. You need to hear about how things work, how well they work, and how well people like what they're using. Education plays a huge role.”

Recent studies suggest the knowledge gap is large.[77] A 2024 homeowner survey found that only 58 percent were familiar with space conditioning HPs.[78] By extension, awareness of the more novel MFHP technology is essentially non-existent. The California Heat Pump Partnership (CAHPP) has recognized this gap. Its Blueprint outlines a statewide, multi-channel marketing strategy targeting both consumers and contractors. Plans include a high-visibility, week-long statewide educational campaign scheduled for 2026.[79] It is unclear, however, whether MFHPs will be explicitly featured in this campaign. Efforts to educate consumers may be complicated by disinterest. “I don't think people really care how they get heat or hot water or air conditioning. As long as they get it when they need it.” Thus, some noted challenges in educating homeowners about HPs and their benefits. Another energy expert put it bluntly: “People don't want to think about it. People just want to get their hot water back, they just want to get their air conditioning back, they don't want to have to have a whole conversation about technology, refrigerants, and COPs.”

It is unclear how motivating electrification, and by extension decarbonization—one of the big arguments for MFHPs—are for MFHP adoption. Some stakeholders noted a shift in interest and awareness of electrification and HPs. One stakeholder noted significant interest in HPs—with roughly 50 percent of all calls coming into an energy efficiency call center being related to HPs. An installer observed, “it's been pretty steady over the last two years of people wanting HPs. Recently, when I go on the bid, people are saying, ‘I want to get the bid and get this in before the end of the year because of the tax credits.’” In part of the installer’s service area, eight out of every ten bids are for HPs. One energy expert noted, “We just finished our third straight year of HPs outselling furnaces across the country—the US is now the number one market for HPs in the world. The vibes have totally changed.”

On the other hand, some stakeholders reported that “decarbonization” and “electrification” are meaningless terms in the field. As one program manager stated, “There is a huge information gap—people don’t have an understanding of the options they have. Consumer education is first and foremost. Californians have never been faced with more choices when faced with decarbonization.” Some stakeholders are optimistic that educating consumers on the benefits of MFHPs may be effective. For example, some stakeholders reported that electrification of space and water heating

[77] California Heat Pump Partnership. (2025). *Scaling California’s heat pump market: The path to six million.* https://heatpumppartnership.org/wp-content/uploads/2025/03/CAHPP_Blueprint_2025.pdf

[78] Opinion Dynamics. (2024). *Tech Clean California: Time 1 market assessment final report.* https://opiniondynamics.com/wp-content/uploads/2024/12/TECH_Time_1_Market_Assessment_Final_Report_4.22.24.pdf

[79] California Heat Pump Partnership. (2025). *Scaling California’s heat pump market: The path to six million.* https://heatpumppartnership.org/wp-content/uploads/2025/03/CAHPP_Blueprint_2025.pdf

may gain traction by promoting the health and safety benefits of eliminating gas combustion. As one program manager reported, "We have to get folks to understand that the combustion appliance off-gases, a bunch of stuff that just isn't good for you." Or as an energy expert stated, "It's four cars worth of muffler exhaust to boil water [on a gas stove]."

Some consumers are aware and interested in MFHPs but are hesitant to adopt them because of concerns about being able to service them. Stakeholders and potential customers frequently questioned whether qualified technicians would be available to service MFHPs if something goes wrong. Given that many local contractors and distributors have little or no familiarity with MFHPs, their concern appears well-founded. In online forums, individuals recounted having difficulties finding trustworthy technicians even for standard HPs, reinforcing perceptions that new systems could be riskier or harder to maintain.[80]

Willingness to Pay

Although MFHPs offer numerous advantages relative to gas-fired equipment and separate HP systems (e.g., energy efficiency, zero direct emissions, compact design), stakeholders assert that few buyers are willing to pay a price premium for these benefits. "Energy savings takes a back seat to the first cost," one energy expert explained. As a result, "the biggest challenge people would have to get over is gonna be the price," according to an installer.

The disconnect between perceived and actual costs may further undermine willingness to pay for MFHPs. According to stakeholders, many customers and installers will have the expectation that a system combining functions should cost less—not more—than two separate HPs. As one energy expert observed, "I think intuitively, most consumers like to think if this is a combined system, there's some economy of scale here by having [fewer] pieces of equipment. So this should cost less. Why would this cost more?"

This expectation creates a disconnect between perceived and actual costs. When MFHPs are priced higher than separate systems, customers struggle to see the value proposition. As another energy expert noted, "If you can get the same system cheaper by doing two different technologies, a HPWH and a forced air or mini-split HP for air conditioning purposes, [you] would probably do that." Developers and contractors echoed this sentiment, emphasizing that MFHPs are only likely to gain traction "if the price is the same or less" than separate systems. "I don't know if the value is there," one housing developer concluded.

Ultimately, the price differential, particularly in retrofits, remains one of the most significant customer barriers to MFHP adoption. Because both consumers and installers equate fewer visible components with lower cost, the challenge for manufacturers and program designers will be to clearly articulate the system's added value and demonstrate cost parity—or cost savings—over conventional installations.

Equipment Replacement Norms

MFHP for retrofit applications is likely to be constrained by typical consumer behavior around equipment replacement. According to the American Council for an Energy-Efficient Economy (ACEEE),

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[80] [Hypothetical_avocado]. (2023). *Reliable ways of finding heat pump installers… [Heatpumps*]. Reddit. https://www.reddit.com/r/heatpumps/comments/15527lo/reliable_ways_of_finding_heat_pump_installers_who/

approximately 90 percent of water heaters are replaced on an emergency basis, usually after failure.[81] Similar patterns exist with HVAC systems, as noted in a recent paper on electrification readiness strategies for low-income multifamily buildings.[82] This reactive replacement cycle makes it particularly difficult for integrated systems like MFHPs—which replace both HVAC and water heating equipment simultaneously—to gain traction.[83] As noted in previous section, adoption often requires the early retirement of at least one functional system, increasing costs and likely homeowner resistance. As one manufacturer explains, "the barrier [to] homeowners [is], only my HVAC's broken right now. Why should I replace my water heater? And no one wants to spend money if they don't have to."

Among survey respondents who were asked to consider scenarios that would require replacing working equipment alongside broken equipment, more than half (57%) expressed negative reactions. Twenty-five percent called it a "dealbreaker" that would make them unwilling to adopt MFHPs, while an additional 32% reported "serious concerns" but might still consider it. Only 16% viewed simultaneous replacement as beneficial (finding it "simpler" to replace everything together). MFHP acceptance varied dramatically based on attitudes toward replacing working equipment: only 26% of those who viewed early retirement as a dealbreaker accepted the MFHP recommendation, compared to 83% of those who viewed it positively. Among those with "serious concerns," 48% ultimately reported they would choose the MFHP. This gradient suggests that addressing the early retirement issue through modular installation, or other strategies, could substantially increase adoption.

Several stakeholders described early retirement as the single biggest barrier facing MFHPs. One emphasized, "it's absolutely a huge barrier [for MFHPs] and the only way… we're gonna get beyond that is by paying people. You're gonna have to have rich incentives or require people through policy. Or a combination of the two." Another interviewee shared their own experience, "my water heater is near the end of its life… I considered an MFHP, but my AC still has a lot of life left. For me, that was the barrier—it really complicates the financial analysis, even when I ran the numbers carefully. I couldn't move forward." Others echoed that most customers are unwilling to replace equipment that is still functioning, even when incentives are available—citing the adage "waste not, want not."

The mismatch in replacement cycles—HVAC and water heaters failing on entirely different timelines—creates structural barriers. As one researcher observes, "it's not even that they don't fail at the same time—they may be on completely different schedules. One fails and the other is almost new." This means MFHP adoption in retrofits often depends on the failure of the more expensive space-conditioning system, which is more likely to prompt consideration of a bundled replacement. As one program manager observed, "having to convince people to get rid of working equipment is an obstacle—a hard sell for a contractor." Otherwise, consumers default to replacing "like with like,"

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[81] Consumer Reports. (2019, January 25). *Tankless water heaters vs. storage-tank water heaters.* Retrieved October 3, 2025, from https://www.consumerreports.org/appliances/water-heaters/tankless-water-heaters-vs-storage-tank-water-heaters-a5291982593/

[82] Dryden, A., & Schaaf, B. (2024). *Avoiding locking in emission through electrification readiness.* ACEEE Summer Study on Energy Efficiency in Buildings. https://www.aceee.org/sites/default/files/proceedings/ssb24/pdfs/Avoiding%20Locking%20in%20Emission%20through%20Electrification%20Readiness.pdf

[83] Outcault, S., Alston-Stepnitz, E., & Searl, E. (2025). *Market assessment of selected load-flexible technologies: Year 3* (Report for CalNEXT). CalNEXT.

especially under emergency conditions. As one energy expert puts it, “nobody wants to think about maintenance, or repair, or replacement. And so it’s… a huge barrier.” Nearly one-third (32%) of surveyed households have water heaters less than 5 years old, and 62% have water heaters under 10 years old—meaning the majority would face the early retirement dilemma if they considered installing an MFHP upon failure of their HVAC equipment. Approximately 13% of households have aging HVAC systems (15+ years) paired with relatively new water heaters (<10 years), representing a substantial segment where HVAC replacement with an MFHP could directly trigger the early retirement problem.

Emergency replacements also preclude thoughtful decision-making, with customers prioritizing speed and convenience over efficiency. Load calculations and assessments of long-term savings are often skipped during urgent installations, in favor of standard products that are readily available.[84] As one installer explains, “people don’t generally budget for the unexpected water heater… so when it happens, you don’t want to hit them with the $30,000 system if you can hit them with a $20,000 system—especially if it achieves the same efficiency.” In these moments of “replace on burnout,” consumers almost always choose readily available standard products, further undermining potential MFHP uptake.

The implications are clear: unless one system is already at or near the end of its life, MFHPs require premature retirement of functioning equipment, an unattractive proposition for most households and building owners. As one energy expert summarizes, “in a moment of replace[ment] on failure, you have some real friction with the consumer.” Absent strong incentives, staged adoption pathways, or policies designed to align replacement cycles, MFHP adoption in retrofits will struggle.

All-in-One Design

The multifunction nature of MFHPs simplifies the installation process for customers, relative to two HP systems. It is "simpler to procure that service once opposed to having multiple different projects," thereby reducing "the transactional cost of getting it installed." Stakeholders mentioned that this is appealing to customers because homeowners often “don't want to have to deal with two separate appliances and two separate contractors," according to one manufacturer. A researcher added that homeowners "would rather install climate control systems all in one go."

Moreover, MFHPs’ simplified service requirements can be particularly advantageous for property managers and affordable housing owners responsible for multiple units with limited maintenance staff. As one installer observed, “consolidated and coordinated maintenance would be appealing for landlords.” Similarly, homeowners may benefit from a single point of contact for service and reduced service costs—”you have one person coming out to service it instead of two.”

Our customer survey data strongly confirms the consumer appeal of simplified service. Among homeowners surveyed, 89% viewed the single service call feature as beneficial, with 45% rating it a "major benefit" and 36% a "moderate benefit." Only 4% said they would prefer separate service calls. This widespread appreciation for consolidated maintenance supports stakeholder observations that homeowners value the simplicity of dealing with one contractor and one point of contact. Survey

[84] US Department of Energy. (2018). *Residential HVAC installation practices: A review of research findings.* Washington, DC: US Department of Energy. https://www.energy.gov/sites/default/files/2018/06/f53/bto-ResidentialHVACLitReview-06-2018.pdf

respondents who viewed single service as a "major benefit" accepted the MFHP recommendation 67% of the time, compared to just 14–19% among those who saw it as "not a benefit" or preferred separate service. This suggests the all-in-one convenience is not merely a nice-to-have but a meaningful driver of adoption decisions.

At the same time, because MFHPs are all-in-one, a fault in one component can compromise all functions, heightening perceived risk. A commonly expressed worry is this interdependence on a single piece of equipment— amplifying both contractor hesitation and consumer anxiety. As a prospective MFHP customer commented in an online forum, "One disadvantage is the idea of putting all your eggs in one basket. If the HP goes down, you also [lose] your hot water."[85]

While complete system failures may be uncommon, the possibility of losing multiple essential services at once may heighten customer hesitation. This concern may be amplified in California, where power outages are increasingly familiar. As one resident of an all-electric building described in a related WCEC study, "If the [hot] water goes out, your heat goes out… or if your AC goes out your [hot] water goes."[86]

When asked about the prospect of losing heating, cooling, and hot water simultaneously, if one MFHP component fails, 64% of respondents expressed significant concern: 27% called it a "dealbreaker" that would make them unwilling to adopt MFHPs, while 37% described it as a "major drawback" representing a serious concern (though they might still consider the system). Only 5% said this interdependence would not concern them at all.

MFHP acceptance varied dramatically based on how consumers perceived this risk: only 34% of those who viewed interdependence as a dealbreaker accepted the MFHP recommendation, compared to 70% of those with minor or no concerns. Even among those with "major" but not disqualifying concerns, acceptance dropped to 50%.

The survey reveals a striking tension: 89% appreciate the single service advantage, yet 64% harbor significant concerns about system interdependence. Notably, among those who most value single service (rating it a "major benefit"), 63% also expressed major concerns about interdependence (rising to the level of a "dealbreaker" for some). This suggests that the very integration consumers find appealing also generates anxiety—the all-in-one design is both MFHPs' core selling point and a significant psychological barrier.

Market Segments

Some stakeholders believe that MFHPs are promising across all housing types—single-family, multifamily, new construction, and retrofit. Several stakeholders stated that all housing types could benefit from these systems. A manufacturer pointed out that the value proposition and market positioning of MFHPs may vary depending on housing segment— "the main challenge with [MFHPs] is that you need to replace heating, cooling, and hot water at the same time, and that's a bigger cash outlay. But on the other hand, you get better value by doing it all at once. With the right business model and policy support, if that upfront cost and barrier is reduced or addressed, then all segments

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[85] https://www.eng-tips.com/threads/multi-function-heat-pump-mfhp.144103/, Retrieved on October 29, 2024.

[86] DePew, A. N., Outcault, S., Sanguinetti, A., Alston-Stepnitz, E., & Magaña, C. (2022). *Affordable Multi-family Housing Occupant Experience: All-electric & Zero-net Energy Communities.* Energy and Efficiency Institute, University of California, Davis. https://www.researchgate.net/publication/365964761

could equally benefit." Ultimately, stakeholders found that MFHPs offer features that are attractive across all housing types—better performance than HPWHs, space saving, energy efficiency, load flexibility, and low electrical panel requirements.

Survey findings demonstrate that home age is a stronger predictor of MFHP acceptance than home type. Acceptance rates showed a clear gradient by construction era: 65% in homes built 2014–2025, declining to 60% (1990–2013), 53% (1978–1989), and just 41% in homes built before 1978. This 24-percentage-point gap between newest and oldest homes suggests that retrofit applications face meaningfully different adoption dynamics than newer construction. Older homes face compounding barriers. Respondents in pre-1978 homes reported higher panel upgrade concerns (50–56% viewing it as a barrier) compared to those in homes built after 2014 (38%). Combined with lower baseline MFHP acceptance, this suggests the retrofit segment will require more targeted interventions—whether through MFHPs' lower electrical load advantage, enhanced incentives, or technical assistance.

While many MFHP features are attractive across all building types, stakeholders noted the importance of matching the right equipment to the right building type to receive the benefits of the system. As one researcher stated, "certain types of equipment will lend themselves better to different sectors. New construction and retrofit for both single and multifamily residential can benefit from MFHP systems, as long as it's the right system for that building. The building type is going to drive what system would be advantageous and would really deliver on the benefits that combined mechanical systems offer." Because the form factor and system configuration will strongly influence suitability, stakeholders anticipate that manufacturers will release multiple MFHP formats optimized for different segments—multifamily and single-family as well as new and retrofits.

Among survey respondents, 54% of single-family and 56% of multifamily homeowners accepted the MFHP recommendation when presented with the scenario. This similarity supports stakeholder observations that MFHPs can appeal across housing types—the core value proposition resonates similarly regardless of housing sector.[87]

MFHPs show promise across single-family and multifamily, in both new construction and retrofit, but each segment brings distinct opportunities and challenges. To move beyond technical potential—space savings, load flexibility, and lower panel needs—programs must validate performance and serviceability through robust field testing and standardized commissioning, while addressing known hurdles: cost, controls, reliability, and maintenance pathways.

MULTIFAMILY

Stakeholders agreed that multifamily technology adoption is more policy- and incentive-driven than single-family homeowner adoption. Multifamily property owners may be encouraged by local electrification mandates (e.g., Bay Area AQMD 2027–2029, CARB 2030), building performance standards (BPS) that phase out gas, and their company's own sustainability goals. Property owners are seizing the time-limited opportunity to "stack" incentives to overcome capital constraints. As one property owner stated, "Multifamily property owners are saying, 'I need to figure out a compliance path and start experimenting and piloting different options.'"

[87] It is important to note that the survey sample is heavily weighted toward single-family homes (87%), with limited multifamily representation (8%), so findings for multifamily should be interpreted cautiously.

Opportunities. Multifamily properties present several opportunities for MFHP adoption. Survey findings also indicated that multifamily residents already have a higher heat pump familiarity which could pave the way for MFHP adoption. Among multifamily respondents, 24% currently have heat pump heating systems, compared to only 13% of single-family homeowners.

Because many units share common layouts, contractors can gain economies of scale—streamlining design, installation, and commissioning processes—ultimately lowering installation costs. Consolidated and coordinated maintenance is also more efficient: on-site staff can learn the new technology once and apply that knowledge across multiple units.

Space and electrical constraints are important considerations in these types of buildings. Most multifamily units have small electrical panels—typically 100 amps or less—making it difficult to install separate HP systems. MFHPs offer a practical pathway to partial electrification by replacing both gas HVAC and water-heating systems without triggering costly electrical upgrades. Their smaller footprint further enhances their appeal, particularly in space-constrained buildings, and they allow water-heating tanks to be placed within livable areas without creating noise or thermal comfort impacts. As one researcher explained, in apartments, "multifunction inputs are easier to integrate. When it comes to closet spaces inside a home, MFHPs, hands down, will make a lot more sense than putting in a HPWH—which requires air connections, electrical outlets, etc." Similarly, a housing developer noted that, "When we think about unitary retrofits, they can be pretty scalable. We have a closet that had a water heater in it. We need to figure out where the outdoor unit goes."

Numerous stakeholders highlighted that California's "garden style" low-rise multifamily buildings are especially strong candidates for MFHPs. While estimates vary, the majority of California's multifamily housing stock statewide consists of low-rise buildings with three or fewer habitable stories, typically built during the 1960s and 1970s.[88] These properties often rely on unitary HVAC and water-heating systems and have relatively small electrical panels—characteristics that align well with the advantages of MFHPs.

Data from the US Energy Information Administration's 2020 Residential Energy Consumption Survey (RECS) support this: approximately 79.7 percent of California multifamily housing units use unitary water heaters,[89] 83 percent use unitary space heating systems, and 86 percent use unitary cooling systems.[90] Overall, unitary, or in-unit, space conditioning and water heating is common in multifamily buildings in California. The prevalence of in-unit systems indicates a strong alignment between MFHP capabilities and common existing multifamily building styles. Additionally, California's water submetering requirements may also create an opening for MFHP adoption in the multifamily sector. Under California's Water Code § 537.1, all new multifamily properties applying for water service after January 1, 2018 must install submeters that measure each unit's water use. This requirement adds cost and design complexity to centralized water-heating systems due to the need for additional

[88] California Energy Commission. (2019). *Multifamily building modeling: Multifamily prototypes report (SCE-MFModeling).* Title 24 Stakeholders. https://title24stakeholders.com/wp-content/uploads/2019/06/SCE-MFModeling_MultifamilyPrototypesReport_2019-06-07_clean.pdf

[89] US Energy Information Administration. (2022). *Residential Energy Consumption Survey (RECS) 2020 microdata: California subset.* Washington, DC: US Department of Energy. https://www.eia.gov/consumption/residential/data/2020/

[90] US Energy Information Administration. (2022). *Residential Energy Consumption Survey (RECS) 2020 microdata: California subset.* Washington, DC: US Department of Energy. https://www.eia.gov/consumption/residential/data/2020/

metering infrastructure and data management. As a result, developers seeking to avoid submetering compliance burdens may find MFHPs attractive.

One researcher noted, “budget-conscious customers, space-conscious customers are going to move more towards [MFHPs]. Budget limitations and space limitations—that is where MFHPs will shine.” In multifamily housing, both of these constraints are at play.

Challenges. Despite the opportunities MFHPs offer for the market segment, multifamily properties may be a slower, more cost-constrained market. As one energy expert observed, “it's very hard to reach and encourage multifamily property owners to do any energy upgrades. Unless they have to, they are not going to do this. It's a very difficult demographic to work with.” Projects often face tighter financing limits, complex ownership and regulatory structures, and longer approval processes, all of which tend to make technology adoption more conservative.

Property owners face split incentives—they bear the upfront costs of energy-efficient upgrades, while tenants reap the operating savings. In affordable housing, owners are often restricted from raising the rent to recover costs. As one developer explained, “You can't raise rent after you do this, but ultimately it has to be worth their while financially.” Thus, property owners are heavily reliant on rebates and incentives to make capital improvements pencil out. Most affordable housing developers will not adopt new technology unless it is cost neutral or positive.

MFHPs may not be appropriate for all multifamily building types—particularly those with centralized mechanical systems or limited access to outdoor space. As one housing developer stated, “As a unitary technology, MFHPs rule out more than half of the properties that we have in our portfolio.” Installation feasibility can also be site-specific. Buildings without balconies or nearby outdoor space may require rooftop- or garage-mounted outdoor units, which increases cost due to coordination with structural requirements.

Within the multifamily sector, especially among projects pursuing energy efficiency, there is a shift towards centralized systems that can be master-metered and managed holistically. As one property owner explained, “We are moving away from unitary systems and towards centralized systems with master metering. For 100 units, for example, we are looking at four big condensers that serve all of the apartments instead of 100 little ones.”

Based on current standards and compliance pathways, developers may struggle to justify MFHPs’ incremental costs. “We are looking at the building code in California: what are they dictating and how can we get there?” one housing developer asked. “It's hard for the developers to justify additional costs for systems—they are looking for their engineers to help them to get to that low cost.” Because MFHPs do not currently receive performance credit for combined efficiencies, “[owners] are not getting any compliance credit with MFHPs for having a more efficient system,” and may view the trade-off as not worthwhile.

High staff turnover further complicates maintenance readiness, creating additional risk for building owners considering adoption. Others noted that, in multifamily projects, simplicity is prized. One energy expert noted, “in multifamily, they love things simple. A contractor in the multifamily applications would probably balk at [installing MFHPs] until they got familiar enough to do it regularly.”

Stakeholders emphasized property owners' desire to avoid performance complaints or service disruptions to residents. As one developer captured the challenges with installing new technology, "ideally you are coordinating the changeover of HVAC equipment with other work during vacancies. Otherwise, you have to manage resident expectations. It has to be a quick install—ideally same day. Then performance has to work—the first time they go shower and it's not exactly what they want, you'll get 100 calls. Then the same thing for the first bill they get after install, it better be the same or lower than it used to be."

SINGLE-FAMILY

Single-family homes are driven by homeowner decisions—often triggered by emergency replacement needs rather than planned upgrades. While homeowners are driven by installed costs, they are also motivated by performance considerations such as hot-water delivery, reliability, and noise.

Opportunities. Stakeholders generally viewed single-family homes as a potentially promising early market for MFHPs. Decision-making in single-family contexts is typically streamlined—there are fewer ownership complexities or approval layers—so projects can move from consideration to purchase more quickly. The shorter cycle reduces sales friction and enables quicker pilots, early successes, and word-of-mouth adoption.

Site suitability further strengthens the case. Most single-family homes have adequate outdoor space for HVAC units, easing siting compared with mid-rise or high-rise multifamily buildings. Additionally, all single-family homes have unitary mechanical systems making them suitable for MFHPs unlike multifamily buildings with centralized systems.

Performance priorities—especially noise, hot-water delivery, and thermal comfort—are top of mind for homeowners, and MFHPs address these. Because the tank does not carry an integrated compressor, MFHPs can operate quietly in living areas, and properly sized systems can meet peak hot water demand. Moreover, the thermal discomfort issues associated with HPWHs are avoided as well as the "cold blow" of some space conditioning HPs. Positioning these attributes as headline benefits, supported by clear specifications and installer commissioning guidance, aligns the technology with what homeowners value day to day.

Finally, early adoption is most likely in affluent neighborhoods and higher-end homes, where owners have the ability to pay, trust incentives, and value non-energy attributes such as comfort, resilience, and lower emissions. As one energy expert noted, "people with higher income would probably go for this… not for cost savings, but for more environmental benefits that these provide." Aligning offerings with rebates, low-APR financing, and premium comfort features can accelerate uptake in these segments and establish visible proof points for broader market diffusion.

Challenges. In the single-family market, replacement decisions are frequently made on an emergency basis following equipment failure rather than through planned upgrades. This urgency compresses decision windows and pushes homeowners toward familiar, like-for-like replacements, limiting consideration of MFHPs even when lifecycle performance may be favorable.

Controls complexity is another barrier. MFHPs introduce additional logic and user interfaces that can be confusing without careful commissioning and intuitive defaults. As one energy expert noted, "While it seems a little bit more simple, having the combination of controls is going to be unique." A researcher similarly cautioned, "The complexity of these systems are going to be a challenge for homeowners" unlike multifamily property owners who have dedicated maintenance staff.

Homeowner preferences for redundancy also weigh against adoption. Unlike multifamily properties with standardized equipment packages, single-family owners can select any configuration they prefer and likely value having separate systems so that a failure in one does not compromise the other. As one researcher explained, "Single-family homeowners have the ability to put in whatever equipment. They want to have redundancy and they can spend a little more for separate systems."

Some stakeholders claim that current MFHP designs are likely not environmentally friendly enough for highly eco-conscious consumers. According to one researcher, "That kind of market—the environmentally-oriented client—wants you to be using [refrigerant with] a GWP of one to four. When people are making those environmental choices, refrigerant is kind of a big deal." While environmentally-motivated consumers may welcome a transition to ultra-low GWP refrigerants, "becoming more green [means] becoming more volatile" and some consumer groups question the safety of bringing larger volumes of combustible or toxic refrigerants indoors. One manufacturer cautioned, "There's a big movement against putting refrigerant in people's homes."

Together, these factors—emergency replacement dynamics, control complexity, and a bias toward redundant configurations—create a high bar for MFHP adoption in single-family homes. Overcoming them will require rapid-replacement pathways, simplified control strategies with clear "auto" modes, and compelling value propositions that address reliability and homeowner peace of mind alongside energy performance. Moreover, manufacturers will need to continue improving system designs to enhance environmental performance and communicate those benefits with greater credibility and transparency.

RETROFIT

Opportunities. The retrofit is where stakeholders felt MFHPs can deliver the largest impact. The existing housing stock dwarfs new construction, and most HVAC and water-heating purchases occur as replacements in occupied homes. MFHPs align with that reality by enabling partial electrification without panel upgrades, preserving performance on hot water delivery and thermal comfort while avoiding the friction that stalls many projects.

A primary advantage in the retrofit market is that MFHPs consolidate loads and draw fewer amps than two separate heat-pump systems, helping homeowners avoid both panel space constraints and expensive service upgrades. As one utility expert stated, "MFHP technology helps address some concerns that we have in the area of decarbonizing customer homes. It allows us to reduce the number of slots that are used on a panel, which is a known constraint that we're facing in electrifying customers." A manufacturer explained the practical stakes: panel work is "complex and cumbersome. It adds a lot of friction in the process; if you remove that friction, you make the job easier and faster."

Avoiding a full electrical service upgrade also trims cost, delay, and coordination with the utility—common pain points in retrofits. An energy expert underscored the customer perspective: "If you have a consumer that is power-constrained, this is one of those products to bring in to potentially solve that service upgrade." MFHPs let households move meaningfully away from gas now and defer the panel decision until later. This staged approach resonates with customers who want to electrify in phases. As one energy expert said, MFHPs could be good "for people who are trying to start electrifying, but probably not going to do it all at once. [MFHPs] allow people to kick down the road the issue of a panel upgrade and allow for tinkering with technology." Meanwhile, people can still get high performance for space heating and cooling and reliable hot water with MFHPs versus other lower draw alternatives. For example, 120-volt HPWHs may not provide adequate hot-water delivery. Similarly, it is possible to install separate HPs and avoid panel upgrades by using smart panels or smart breakers, but one researcher warned that "higher power equipment, like separate HPs, without an electrical panel upgrade, are going to compromise on comfort."

A staged approach to electrification fits a current trend. As one expert framed it, "In the end, you're future-proofing your house. [MFHPs] might convince some people to go [electric]. It might even motivate them to swap out that water heater now instead of waiting [because] you'll qualify for rebates." Manufacturers echo that this is the largest part of today's market, given the sheer volume of replacements and homeowners' desire to avoid big electrical work while upgrading comfort and efficiency.

The compact, flexible form factor of MFHPs may make them appealing for retrofit applications. If the system fits well "it reuses existing spaces well, and existing distribution infrastructure, like plumbing, HVAC distribution, and possibly electrical. It could be very advantageous compared to separate HP systems." In particular, homes with indoor hot water closets can often reuse this space for the MFHP water tank.

In short, MFHPs remove panel-related barriers, maintain performance on the end uses people care about, and reduce project friction for both homeowners and contractors.

Challenges. Nevertheless, MFHPs face many challenges as retrofit options. Retrofit adoption of MFHPs is constrained first by emergency replacement dynamics. In single-family homes, most HVAC and water-heater replacements occur on failure, shortening decision windows and pushing contractors and homeowners toward like-for-like swaps to restore service quickly. As one energy expert put it, this urgency "leads you to be quick in, quick out—replace like-for-like, rather than going with the HP," which can face delays from structural work, trade coordination, or permitting. While MFHPs may avoid panel upgrades, they are more involved than a one-for-one changeout, which raises the bar in emergency contexts.

Another barrier is the mismatched timing of equipment failures, which makes MFHP adoption, without early replacement, unlikely without preplanning. A developer estimated that in a given year "10 percent of water heaters fail and 10 percent of HVAC systems fail, but maybe 1 percent have both failing at once." As they added, "Have [homeowners] done the preplanning to do that replacement of the new [MFHP]? Probably not." Early retirement of still functional equipment is widely viewed by stakeholders as financially unattractive, and several noted that finding a property willing to replace both systems at once is "more capital intensive" and typically requires additional incentives.

Beyond timing, retrofit scope and site variability can drive complexity and cost. "Retrofit applications are often 'bespoke,'" a program manager noted. Another added: "It is a huge undertaking… [which will] likely involve displacing people for several days… [it's] more complex than a one-to-one retrofit." When existing layouts place the water-heater tank far from the compressor location, long refrigerant or plumbing runs, drywall removal, and discovery of underlying issues can add time, cost, and disruption.

While MFHPs can, in some cases, avoid the need for costly panel upgrades, interest in MFHPs often coincides with broader electrification plans—solar, cooking, and EV charging in particular—that can force panel upgrades and erode the “no-upgrade” value proposition. As one manufacturer observed, “The cooking and EVs—those are the massive load factors. Then… solar—even if they don’t electrify, often they need a new panel for solar production.” One high-volume installer reported that 60–70 percent of prospective heat-pump customers already have solar, suggesting many have already additional panel capacity. In other cases, MFHPs may only delay a panel upgrade: “Is this the last thing being electrified… or is there gonna be another end use later? If so, then you still have to do an upgrade, and now it’s even less cost-effective.” Delaying can also mean missing time-limited incentives, reducing net benefits.

In our customer survey, while pre-1990 homes show lower MFHP acceptance (41–53%) and higher panel concerns, the data suggests these are not insurmountable. About half of respondents in older homes still accepted MFHPs despite concerns, and MFHPs' panel-friendly design directly addresses one of the retrofit segment's key pain points.

NEW CONSTRUCTION

Opportunities. New construction offers a clear pathway for MFHPs because it avoids early retirement of functioning equipment and out-of-cycle replacements. As one energy expert put it, “In new construction, there's not the question of, ‘Well, if my water heater is broken, why do I need to replace multiple things?’”, which removes a major source of sales friction.

Beyond early retirement, retrofits often pose unknown site conditions. As one utility expert noted, “You don't always know [what you have] until you get there.” Those unknowns drive variable installation cost and timelines. “In a retrofit situation, you are stuck with the existing layout of the home and the physical location of the appliances [that] are in that home. Is the water heater tank physically located anywhere near where this compressor is gonna be? Is there actual savings or are you now running a pipe through the walls of the entire house with a circuit that now increases the cost and complexity and intrusiveness of the project from what it otherwise would be?”

By contrast, with walls open in new builds, the home can be laid out for maximum efficiency. As one utility expert noted, contractors “centrally locat[e] both the air handlers and the water heater” to shorten runs to registers and faucets and “reduce waste,” and at neighborhood scale “the efficiency impacts add up.” New construction also allows builders to right-size mechanical space and distribution from the outset, plan for one outdoor unit and one indoor tank, and avoid duplicate electrical circuits and gas roughins. MFHPs align naturally with all-electric design—avoiding gas trenching and meter set costs while reducing on-site emissions—and they pair well with PV and storage for load shaping and code pathways.

On cost, stakeholders reported the incremental cost gap between an MFHP and separate HPs in new construction is relatively small, roughly $1,000. As one energy expert put it, “The incremental costs associated with somebody who’s willing to build a new home are relatively negligible compared to somebody who says, ‘I need a new heating system, or a water heating system.’” Total installed cost can also be lower because builders avoid multiple electrical circuits and gas lines as well as repeat the same plan set across many lots or buildings. As one installer noted, “Installation costs should be less by utilizing an MFHP." Looking ahead, scale should improve economics: "Better uptake of MFHPs [will occur] because, at scale, the equipment should be at a lower cost and the installation should be at a lower cost at scale," a researcher summarized, though others are skeptical, as noted earlier.

Survey findings identified greater interest among owners of newer homes. Homes built between 2014 and 2025 showed the highest MFHP acceptance (65%) and highest rates of existing heat pump adoption (21%). These homeowners were also more likely to identify as early technology adopters (50% compared to 15–29% in older homes). At the same time, it's important to note that this segment faces fewer of the key barriers, namely no need for panel upgrades.

Challenges. While new construction removes many retrofit barriers, several factors limit the relative appeal of MFHPs for builders. First, the reduced electrical-panel requirement—one of MFHPs' hallmark advantages—matters less in new builds. California code now requires larger service panels in new homes, making the panel upgrade avoidance benefit largely moot. Design freedom also weakens MFHPs' siting advantage: because builders can plan from the outset, they can readily accommodate separate HPs—allocating mechanical space, ventilation, condensate management, and dedicated circuits within standard workflows.

Another barrier is perceived technology risk and lack of redundancy. Builders worry that a single compressor serving space heating, space cooling, and DHW concentrates risk; a failure could affect multiple end uses and trigger callbacks, reputational harm, or even liability exposure. Some stakeholders have the sense that homeowners—and by extension the builders who serve them—may prefer separate systems so that one outage does not compromise the whole home.

Price sensitivity remains an obstacle. Even if the marginal cost of MFHPs in new construction is nominal, profit-driven builders working with tight budgets may resist any price premium without clear consumer demand. As one developer noted, MFHPs are more likely to gain traction "if the price is the same or less" than separate systems; another added, "I don't know if the value is there." Compounding this, builders are less motivated by operating-cost savings; future utility bills accrue to the buyer, not the builder, so lifecycle economics alone seldom justify a higher upfront price.

For adoption in the new construction market, the value proposition must be explicit and verifiable. To be viable with developers, MFHP offerings need to demonstrate cost parity or better at scale, reliability with clear service commitments, and program support (e.g., incentives, financing, and straightforward compliance paths). Without that combination—plus strong messaging to address redundancy concerns and callbacks—the practical advantages of "designing from scratch" in new construction tend to favor familiar, separate heat-pump systems over a combined MFHP.

Equity Considerations

BENEFITS FOR UNDERSERVED COMMUNITIES

Stakeholders expressed mixed views about whether MFHPs would deliver distinct benefits to underserved communities. Some argued that potential advantages—such as efficiency and space savings—would apply broadly across all market segments. As one energy expert observed, "It is difficult to point to [MFHP] benefits that would be unique to underserved communities in particular versus the market at large." Others, however, argued that while "the barriers would be higher… the comfort or benefits might be enhanced—especially non-energy benefits."

Electrical infrastructure and affordability. For underserved households, MFHPs may offer a practical pathway to partial electrification without triggering costly electrical panel and service upgrades. As one energy expert explained, many homes in these communities have limited panel capacity—"40 to 50 amp panels up to 60"–almost always 100 amps or less— restricting the addition of new electric loads. Installing separate HPs for space conditioning and water heating would likely necessitate a panel and service upgrade, which can be cost prohibitive. Overall, 59% of survey respondents with incomes less than $50,000 viewed panel upgrades as a barrier, compared to 42% of higher-income respondents. MFHPs' lower electrical load could help address this disparity.

One installer explained that upgrading capacity can be a major capital expenditure, estimating that in the case of multifamily housing, it could be as much as "$15,000 per apartment," which he further noted "is a big number that most cannot manage, especially nonprofit organizations that are trying to provide low-income housing." Stakeholders agreed that MFHPs could enable affordable housing developers and underserved households to electrify end uses more affordably and incrementally, supporting a more equitable transition to building electrification.

Energy and cost savings potential. MFHPs may offer energy cost savings to underserved households, at least in the long run. As one program implementer pointed out, electrification sooner rather than later is in households' economic best interest long-term. "You don't want to get stranded on the gas line, because the utility has a commitment to serve everyone. If you get stranded, you're going to end up paying way more for the natural gas as everyone else leaves." As such, MFHPs' potential higher efficiency could lead to greater potential operating cost savings for underserved customers assuming households qualify for favorable electric rates. One researcher stated that, "I think there is definitely potential for operational cost savings. If the controls can be implemented in a way that allows the system to take advantage of the efficiency opportunities with simultaneous space cooling and water heating, that can definitely deliver savings."

In addition, survey findings showed that lower-income households also value the all-in-one benefit. Among those earning under $50,000, 74% viewed the single service call as a major or moderate benefit—lower than higher-income groups (89%) but still a substantial majority. This suggests that MFHPs' simplified maintenance could have genuine appeal in underserved communities if cost and reliability barriers are addressed.

Air quality and health benefits. MFHPs, like all HPs, also offer air-quality and health co-benefits that are particularly significant in underserved communities because of their higher baseline exposure to pollutants, making the relative gains from electrification more pronounced.[91] These communities are often located closer to major roadways, industrial areas, and other pollution sources, resulting in higher initial exposure to outdoor air pollutants.[92] In many older, smaller homes common in these communities, limited kitchen ventilation and gas use can concentrate indoor pollutants,[93] while

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[91] Ferguson, L., Taylor, J., Shrubsole, C., Davies, M., & Dimitroulopoulou, S. (2021). *Systemic inequalities in indoor air pollution exposure: A review of evidence and drivers in low-income communities. Buildings & Cities*, *2*(1), Article bc.100. https://doi.org/10.5334/bc.100

[92] Su, J. G., Jerrett, M., & Ito, K. (2024). *Examining air pollution exposure dynamics in advantaged and disadvantaged communities. Environmental Research Letters.* https://doi.org/10.1088/1748-9326/acd8f1

[93] Ferguson, L., Taylor, J., Shrubsole, C., Davies, M., & Dimitroulopoulou, S. (2021). *Systemic inequalities in indoor air pollution exposure: A review of evidence and drivers in low-income communities. Buildings & Cities*, *2*(1), Article bc.100. https://doi.org/10.5334/bc.100

leaky building envelopes simultaneously allow more outdoor pollution to infiltrate—compounding overall exposure. By replacing two gas appliances with one electric system, MFHPs provide greater incremental improvements on air quality than in the broader housing stock. These improvements are amplified for vulnerable populations, such as children and seniors, who are more sensitive to pollution exposure. California's equity frameworks—including SB 535[94] and AB 617[95]—recognize that these communities often face higher exposure and thus stand to gain more per unit of emissions reduction.

Among survey respondents earning under $50,000, 57% have both gas heating and water heating equipment compared to 48% of those earning $100,000+. This means the households with the greatest potential indoor air quality benefits from electrification are disproportionately concentrated in lower-income segments. Lower-income households also live in older housing stock with older gas infrastructure. Over half (53%) of respondents earning under $50,000 live in pre-1978 homes, where older gas appliances may pose greater combustion safety risks. This compounding of older homes, older appliances, and gas dependence suggests lower-income households face elevated—but largely unacknowledged—health risks and may reap the most benefits from switching to MFHPs.

Space, noise, and comfort advantages. Underserved communities may experience improved thermal comfort and other quality of life benefits with MFHPs. Overall, underserved customers are likely to experience greater thermal comfort because of the lower starting baseline in many underserved households, one expert explained. Additionally, because homes in underserved communities are less likely to have air conditioning, installing MFHPs, or indeed space conditioning HPs alone, would add air conditioning to many homes that previously did not have it. "Heat stress is a big issue" that MFHPs would address, as one energy expert highlighted.

MFHPs may offer a variety of other non-energy benefits to underserved communities as well—ranging from better health to space savings to noise avoidance. Long-term quality of life improvements could be possible for underserved communities with MFHPs through improved air quality. With wildfires, "there have been these days where you just can't open your windows. And having something like this could be really positive."

Homes in underserved communities are typically smaller than average, making MFHPs' smaller footprint, compared to separate HPs, an advantage. One researcher observed, "Usable space is at an utmost premium, especially in affordable housing." Additionally, MFHPs provide water heating without the noise created by HPWHs. While this benefit is not unique in underserved communities, the smaller living spaces typical in underserved communities may make the impact of indoor noise pollution more pronounced. While MFHPs are unlikely to eliminate structural inequities in housing or energy access, they may serve as an enabling technology for equitable electrification—particularly when paired with targeted incentives and workforce development in underserved communities.

CHALLENGES FOR UNDERSERVED COMMUNITIES

Adoption of MFHPs within underserved communities faces intertwined financial, informational, and trust barriers. Stakeholders emphasized that for MFHPs to succeed in these markets, "the value

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[94] OEHHA. (n.d.). *SB 535 Disadvantaged Communities. California Office of Environmental Health Hazard Assessment.* https://oehha.ca.gov/calenviroscreen/sb535

[95] California Air Resources Board. (n.d.). *AB 617: Community Air Protection Program.* https://www.arb.ca.gov/msprog/ab617/ab617.htm

proposition needs to be abundantly clear." As one program implementer explained, "With [underserved communities], the value proposition of electrification isn't an attractive one." While long-term benefits such as improved indoor air quality, health and safety, and reduced operating costs exist, the "threshold [to adopting a new technology] is higher" in underserved communities because upfront cost, financing limits, split incentives, and administrative frictions frequently outweigh long-term benefits and raise the perceived risk of disruption and underperformance.

In the customer survey, lower-income respondents show significantly less MFHP acceptance. Survey data reveals a 20-percentage-point gap in MFHP acceptance between income groups: only 41% of respondents earning under $50,000 accepted the MFHP recommendation compared to 61% of those earning $100,000 or more. This gap widens to 34 percentage points when comparing the lowest-income households in the oldest homes (36% acceptance among those under $50K in pre-1978 homes) to higher-income households in newer homes (70% acceptance among those earning $150K+ in post-1990 homes).

Awareness and trust. Stakeholders consistently cited low awareness of HP technologies in underserved areas. One program implementer observed, "Awareness of HPs in these communities is the last thing on the list of priorities. It doesn't break through the noise of their everyday life." This lack of awareness is compounded by systemic distrust of government and utilities, which undermines participation in rebate or incentive programs. As one program implementer summarized, "Even if you have rebates and incentives, [underserved customers are] not going to trust that they'll actually get their money back." They added, "sometimes there is skepticism about [something that looks] '"too good to be true'. Sometimes free isn't good enough" to convince people. Doubts about hidden expenses, bureaucratic complexity, and language barriers often hinders participation.

Survey findings also highlight greater technology caution among low-income households. Only 37% of respondents earning under $50,000 identified as early technology adopters compared to 72% of higher-income respondents. Conversely, 63% of lower-income respondents preferred to "wait until technology is proven" or "becomes common"—more than double the 28% rate among higher-income respondents. This supports stakeholder observations that the "threshold to adopting a new technology is higher" in underserved communities.

Upfront cost barriers. High upfront installation costs is a major barrier to MFHP adoption among underserved consumers. As one stakeholder noted, "People in underserved communities have more limited disposable income," making the elevated cost of MFHPs "a significant hurdle for adoption." Among survey respondents earning under $50,000, 74% ranked upfront cost as a top-three priority when selecting new equipment—compared to 53% of higher-income respondents. This 21-point gap confirms stakeholder observations that limited disposable income makes the elevated cost of MFHPs "a significant hurdle." Additional concerns were raised about early retirement scenarios. One energy expert cautioned, "If in fact it's more expensive to replace two systems when only one of your systems breaks," that may not be viable. For homeowners already financially constrained, early retirement of a water heater may be a non-starter. While all income groups expressed concern about replacing functioning equipment, lower-income respondents were more likely to view it as disqualifying MFHPs from consideration-- 32% of those with income under $50,000 called early replacement a "dealbreaker," compared to 21% of higher-income respondents. Open-ended responses from lower-income respondents reinforce this barrier, with comments like "I just got a new furnace so do not want to replace it" and "Do[n']t need the added expense."

Operating cost and energy burden. Many stakeholders highlighted concerns about ongoing operating costs. As with other electrification measures, some residents fear higher utility bills, particularly where electric rates remain elevated. One program implementer explained that community members are "aware of front-of-the-meter horror stories," in which customers who electrified their homes later faced unexpectedly high electricity bills. This is particularly salient for underserved communities where homes often have lower thermal efficiency, limiting the achievable energy savings. As one stakeholder summarized, "There may be a less thermally efficient home, and so the operating expenses may be higher than in better-maintained or more efficient homes." Furthermore, in cases where MFHPs add cooling to homes that did not have it before, they also introduce a new cost that can "become an energy burden or a cost burden to them that didn't exist before." While some stakeholders highlighted the potential for energy savings, comprehensive performance data is not yet available to accurately estimate MFHP energy usage under real-world conditions magnifying uncertainty about operating costs in comparison to separate HPs. Unpredictable or increased utility bills would exacerbate already disproportionate energy burdens among underserved households.

Reliability and serviceability confidence. For MFHPs to be viable in affordable housing or low-income contexts, reliability is paramount. Developers and property managers emphasized that residents expect appliances to "just work." As one affordable-housing developer put it, "I want an appliance, and I want it to work. Reliability is crucial in affordable applications." This concern extends beyond equipment performance to include maintenance networks, parts availability, and manufacturer stability. Downtime can have immediate health and safety implications—especially for vulnerable residents dependent on consistent heating, cooling, or hot water. Until MFHPs demonstrate a proven track record and robust servicing infrastructure, many affordable-housing operators will remain reluctant to adopt them.

Installation and space constraints. Installation logistics also present equity concerns. In dense or space-limited housing types, equipment footprint directly affects habitability and rentable square footage. As one expert emphasized, "Space is an equity issue. You can't take rentable or usable square footage away." Another noted that "Title 25 right now is dealing with that space issue for mobile homes, because you can't take up closet space or livable, rentable square footage in a mobile home for a HPWH."

Stakeholders stressed the need for efficient, minimally disruptive installation processes—particularly for retrofits. To avoid scheduling delays and extended service interruptions, "the execution of installation needs to be thoroughly vetted, efficient, and easy assembly-like installation." Many residents wish to avoid the inconvenience and uncertainty associated with complex retrofits—an aversion that is often more acute in underserved communities where time off work, temporary relocation, and unexpected costs pose greater burdens and trusted contractors can be harder to secure.

User experience and maintenance burden. Ease of use and minimal maintenance are particularly important in affordable housing settings. One stakeholder summarized the sentiment succinctly: "If [residents] have to do anything on a regular basis—that's a problem." Complex control interfaces, filter maintenance, or water system flushing requirements could discourage acceptance if not designed for low-touch operation.

Non-energy impacts. Health and safety ranked 5th of 6 priorities for the lowest-income survey respondents. Among those earning under $50,000, only 25% selected health and safety (e.g., removing gas or toxins from the home) as a top-three priority when choosing new equipment. This trails far behind upfront cost (74%), energy efficiency (62%), operating costs (50%), and comfort (44%). The rating is similar across income groups (25–31%), but the gap between health/safety and cost priorities is far wider for lower-income households. For households earning under $50,000, the gap between "upfront cost" as a priority (74%) and "health/safety" (25%) is 49 percentage points. For higher-income households ($150K+), this gap narrows to 25 percentage points (56% vs 31%). This suggests that although MFHPs may offer health benefits, particularly to lower-income households, that group may not be able to weigh those advantages heavily against immediate financial pressures.

Uncertain value proposition. There is a broader ethical concern: advancing full home electrification in underserved communities without strong protections could unintentionally worsen energy insecurity. Households already struggling with high utility bills may be pushed further into energy burden if electrification technologies are adopted without cost controls, validated performance, or appropriate program safeguards.

Stakeholders agreed that achieving equitable electrification will require clear, credible communication of long-term benefits and tailored support for underserved households. As one expert observed, “Long-term, you’ll be way better off all electric.” But to reach that point, “we would really have to craft the value proposition for the homeowner.”

Building this value proposition will demand coordinated outreach, trusted local partnerships, flexible incentive design, and robust demonstration projects in underserved communities. Without addressing affordability, reliability, and perceived risk, MFHPs are unlikely to gain traction among the very communities that stand to benefit most from their health and comfort improvements.

Underserved communities often face overlapping structural barriers. For example, lower-income households living in older homes encounter compounded challenges: among respondents earning under $50,000 in pre-1978 homes (about 12% of the sample), only 36% accepted MFHPs, and 46% viewed panel upgrades as an outright dealbreaker. More broadly, over half (53%) of lowest-income households live in pre-1978 homes, where aging electrical systems and limited space intensify both financial and installation constraints. Lower-income respondents expressed cost-focused and skepticism-related concerns. Qualitative responses from lower-income respondents who rejected MFHPs cited themes consistent with stakeholder observations: cost concerns ("It all has to do with the cost"), uncertainty about reliability ("I am unsure of the cost and reliability of the heat pump system"), preference for familiar technology ("Just stick to what I know"), and resistance to mandates ("I like my current heater, and see no reason to comply with rulings that may change").

Program Implications

This section synthesizes the program implications from the findings related to program design and implementation, emphasizing how incentives, messaging, and financing mechanisms can shape customer adoption of MFHPs. Additional insights from consumer survey data will be incorporated in the Final Report to further refine these program recommendations.

Framing Benefits Beyond Energy

Stakeholders consistently highlighted that non-energy benefits are often undersold but may be the most resonant with customers. Program messaging should elevate comfort, health, and safety advantages rather than focusing solely on efficiency metrics. One energy expert argued consumers should be coached to think broadly about MFHPs' benefits: "You don't have gas combustion in your home anymore. Is my home drafty the way it used to be? Am I exposed to potential air pollutants that can harm me long-term, or irritate my kid's asthma? Those are things that people pay attention to."

Framing electrification as part of a larger home-improvement or "whole-home" package—"Let's do your insulation at the same time we do your [MFHP]"—can integrate MFHPs naturally into conversations about modern, healthy, resilient homes. Programs should explicitly communicate health benefits, noise reduction, and the avoidance of indoor pollutants and GHG emissions. As one program manager put it, "If folks can really think about it from a holistic perspective—[as in] 'How am I going to get combustion appliances out of my house for safety?'—that's the message that resonates."

Messaging and Awareness

Stakeholders emphasized that effective rebate and incentive programs must begin with strong, relatable messaging. Outreach should target homeowners with aging HVAC or water heating equipment—using data from seasonal tune-ups or comfort services to prompt proactive replacement before failure. As one expert noted, "To encourage early retirement, create messaging about avoiding future unexpected failure and inconvenience." Programs can borrow from models like the light bulb transition—combining codes, standards, and incentives to create clear consumer expectations for change.

Awareness and socialization are also critical. "People need to know someone that has [an MFHP]—a neighbor, friend, colleague—or see a demonstration," said one energy expert. Demonstration projects, field monitoring, and visible case studies can build trust and normalize adoption. This aligns with stakeholders' recommendations to "highlight the number of people around you electrifying" and create social networks where residents share both positive and negative experiences independent of program messaging. As one expert cautioned, "I heard all these wonderful things from the utility program, but I didn't hear anything about the stuff that I experienced, or my neighbors experienced." Honest messaging—acknowledging both benefits and challenges—will strengthen public confidence. Otherwise consumers may wonder: "Can I really trust that this is a good thing? Because I don't think I'm getting the whole story."

Incentive Structure and Accessibility

Stakeholders stressed that incentive design should balance accessibility, simplicity, and timeliness. Installers complained about the additional work created by the incentive paperwork. As one installer noted, "We've had to hire third-party companies just to help us process these rebates, because it becomes such a headache. There's just so many requirements, and I feel like they're just constantly changing." Instead, incentives need to be "As fast as possible with low barriers to entry. Incentives should apply to a wide range of products… [and require] very small amounts of paperwork." Stakeholders preferred midstream or upstream rebates for lower-income customers, passed transparently to consumers, while tax credits were deemed more suitable for higher-income households. Installers also emphasized simplicity and proof of purchase: "Here's the receipt and we provide the ratings—the AHRI number on the proposal. Here is the check that I wrote or proof that I actually purchased it."

Programs should also explore performance-based, technology-neutral incentives that reward measurable outcomes rather than prescriptive equipment choices. As one manufacturer explained, "If it's performance-based and you get better performance with an MFHP, then you have an incentive to buy one. If you don't, then you don't."

Ensuring rebate processing at scale was seen as critical to success. Stakeholders noted that some firms "benefited from incentive programs because they could crank them out," suggesting that programs should encourage installers, distributors, or third-party processors to achieve economies of scale.

Behavioral and Financial Motivators

Stakeholders suggested using loss aversion and social norms to motivate participation. Messaging that frames rebates as temporary or scarce can drive earlier action, such as: "Change is coming down the road. We have incentives right now that may not be available later." Similarly, linking MFHP adoption to broader societal transitions—like EVs—helps convey inevitability: "A major motivator with EVs was that it's inevitable. People expect it to be needed down the road."

Several participants proposed creative rebate models—such as trade-in or "cash for clunkers" programs—to make early equipment retirement more appealing. Bundled pricing or "free-tank" messaging could help consumers perceive value while simplifying the decision process. Tools such as calculator apps or interactive guides could further support homeowners in comparing baseline and MFHP systems: "Having them in real-world situations… and you can compare them to the cost of a baseline system—that would help make the case."

Financing Mechanisms

While incentives lower upfront costs, financing remains a major barrier. Stakeholders highlighted the need for low-cost, low-friction financing, ideally through mission-driven local lenders serving low- and moderate-income households. Current programs were described as "too expensive or cumbersome… [so customers] end up going with much more expensive private financing because it's easier to use." Alternatively, leasing was also proposed as an attractive option to encourage MFHP adoption. Stakeholders observed that inclusion of leasing models within incentive frameworks would be pivotal in facilitating market transformation.

On-bill financing (or "pay-as-you-save") models were viewed as promising if designed with proper consumer protections and guaranteed bill savings. "If this technology can actually lower bills… it could cover financing costs," one expert said. However, others cautioned that loan terms must match realistic payback periods: "You'd have to adjust the terms of that loan to make it work… it might have to be a crazy long term to pencil out."

Discussion and Recommendations

Product Landscape

While a number of MFHPs are "listed" or shown in presentations, they are not truly available for sale in California; in fact only three models are commercially available in California at the time of writing. Certification hurdles (e.g., Title 20) and incentive eligibility delays mean that display does not equate to actual market presence. Federal and state refrigerant rules (AIM Act, SB 1206) plus certification and testing requirements (Title 20, UL, AHRI) raise costs for manufacturers, creating barriers for smaller firms. Programs like TECH Clean California, SGIP, and IRA rebates create short-term opportunity, but shrinking or fully allocated funding increases market risk for both existing and new entrants. (For more details about incentive programs, see Appendix C.)

Frequent shifts in product lines and company commitments undermine customer and contractor trust. Market exits have already created stranded assets. Customers and contractors fear being left with unsupported systems if manufacturers exit. Confidence depends on long-term commitment, parts compatibility, and support networks. Continued tracking of MFHP availability in Title 20 databases, paired with field demonstrations and contractor training, could help distinguish between products that are merely "listed" and those with meaningful commercial presence, gradually building confidence in the market.

Recommendations

- Track MFHP listings in Title 20 databases and supplement with field demonstrations to distinguish between products that are only "listed" and those with real commercial presence.
- Explore policies or market mechanisms (e.g., installer guarantees, acquisition pathways) that reduce stranded asset risk for customers.
- Continue dialogue on aligning US certification and testing with international protocols to reduce duplicative costs and accelerate market entry.
- Assess strategies to smooth the transition as current incentive funding phases down, ensuring manufacturers don't delay or abandon new product launches.
- Encourage participation from established domestic brands that could provide contractors and customers with greater assurance of long-term support.
- Provide early adopter manufacturer incentives to decrease risk of US market entry and require warranty and parts availability commitments for incentive eligibility to address the risk of stranded assets.

Design and Installation

System Design

MFHPs are designed to provide a cohesive mechanical system, offering a combined solution for DHW and space heating and cooling with one outdoor unit. This presents several advantages. MFHPs require a single outdoor unit, and fewer components and materials than a two-HP system, which could simplify installation and reduce costs at market maturity. Perhaps the largest design advantage to MFHPs is that they significantly reduce electrical load compared to separate systems, using 25–40 amps vs. 85–115 amps for separate systems, because they do not rely on electric resistance backup heating. The lower load would allow many homeowners to electrify without triggering costly panel or service upgrades, which can range from $2,000 to $30,000 or more, and add complexity and months-long delays. By avoiding service upgrades, MFHPs reduce friction for both consumers and contractors, providing a smoother low-power electrification pathway than two separate HPs. Lower load requirements also benefit utilities by reducing strain on community transformers and wires. This deferral of infrastructure upgrades supports grid planning and GHG reduction goals, though panel upgrade avoidance is not guaranteed with MFHPs if customers plan to install EVs, solar, or induction cooking. Additional modeling work or demonstration projects are needed to generate robust estimates of the cost and time savings associated with avoided panel upgrades. Outreach efforts would be needed to clearly communicate this benefit to consumers and contractors, to help position MFHPs as a “friction-reduction” solution for panel-constrained homes.

Despite its design advantages, current MFHP system designs have several shortcomings. MFHPs’ water tanks have problems with thermal stratification. Usability and reliability challenges in MFHP controls also remain a major barrier to adoption- with confusing interfaces, underutilized programmable features, and fragmented third-party systems that risk obsolescence or lack of long-term support. It is unclear whether additional functions, such as incorporating ventilation or batteries for power backup, could be added to expand system utility, cost effectiveness, and market viability.

Recommendations

- Equipment and controls design:
  - Strengthen long-term support and reliability of control systems by requiring commitments to firmware updates, serviceability, and backward compatibility.
  - Improve user interface design and programmability by prioritizing intuitive dashboards and clear functionality that enable both installers and end users to easily configure settings (e.g., prioritizing hot water).
  - Evaluate whether meeting California’s load flexibility requirements justifies additional R&D investment. If so, design MFHPs to communicate with the new protocol or establish compatibility with both space conditioning and water heating protocols.
  - Advance MFHP designs optimized for cold climates, including improved compressors, refrigerants, and defrost strategies without reliance on electric resistance backup.
  - Consider adding features such as ventilation and battery backup to increase MFHP value, while taking steps to minimize associated cost increases.
  - Enhance installer training and facilitate integration with widely adopted third-party smart thermostats that could bridge usability gaps until industry-wide standards mature.
- Reduced load

- Explicitly incorporate avoided panel and service upgrade costs into program cost-effectiveness analyses and incentive design.
- Highlight this benefit in consumer-facing marketing as one of MFHPs' strongest differentiators.
- Train contractors to position MFHPs as a "friction-reduction" solution for panel-constrained homes.
- Support demonstration projects quantifying time and cost savings from avoided panel and service upgrades.
- Engage utilities to recognize MFHPs' lower load profile in grid planning and integrate them into electrification readiness strategies.
- Consider utility incentives that reward technologies, like MFHPs, that minimize transformer and feeder upgrade needs.
- Frame MFHPs as one of several solutions for constrained homes, while positioning them most strongly in the niche where panel upgrades are otherwise unavoidable.
- Explore hybrid incentive structures that combine MFHP promotion with support for load-management technologies.

Installation

MFHPs require proper sizing for three distinct loads, but guidance is limited and equipment size options are constrained. Installation and commissioning presents both opportunities and challenges. The space-saving and flexible installation characteristics of MFHPs create significant opportunities for broader adoption. MFHPs require only a single outdoor unit and allow flexible placement of the water tank—without the need for ventilation, condensate drainage, or dedicated electrical circuits—making them especially suitable for compact or space-constrained multifamily units. Ensuring the correct refrigerant charge is more complex than with separate HP systems. While MFHPs offer "synergistic efficiencies" like heat recovery during simultaneous cooling and hot water production, realizing these benefits requires controls strategies that maximally align coincident demand. Current control logic for water heating in MFHPs may be rudimentary, simply using a hysteresis without "outdoor temperature aware" or "water temperature aware" logic for optimal efficiency, particularly in warmer conditions where the compressor might short cycle.

Recommendations

- Equipment sizing
  - Develop standardized sizing protocols and best practices across manufacturers and programs that account for MFHPs' three distinct loads (space heating, cooling, and water heating), including clear guidance on tank sizing and capacity adjustments.
  - Create and disseminate practical tools and calculators (e.g., simplified Manual J aids, load-sizing worksheets, or software plug-ins) to help contractors perform accurate load assessments without relying on oversizing shortcuts.

- Expand contractor training programs to emphasize rightsizing practices, explain the risks of oversizing or undersizing, and highlight manufacturer-specific variations in equipment and tank design.

- Commissioning
    - Publish standardized guidance on refrigerant charging for MFHPs under different operating conditions, including temperature, pressure, and multimode system settings.
    - Develop commissioning checklists and verification protocols to ensure proper installation quality, refrigerant charge, and system calibration.
    - Provide targeted training for contractors on complex commissioning challenges (e.g., variable-speed systems, multiload balancing, multi-zone configurations).
    - Incentivize Quality Installation and commissioning by linking rebates or program participation to verified commissioning outcomes, not just equipment sales.
- Controls optimization
    - Explore methods to optimize simultaneous operation and establish standardized control requirements across MFHP products to ensure that all systems can consistently capture these efficiency opportunities.
    - Develop smarter algorithms that incorporate outdoor and water temperature awareness to reduce short cycling and improve efficiency. Pair this development with field studies to test proactive strategies for maximizing simultaneous mode operation under real-world conditions.

Performance, Reliability and Serviceability

Performance

MFHPs can achieve higher overall efficiency by integrating heating, cooling, and hot water production. Heat recovery provides a significant advantage during cooling seasons, where the waste heat generated from air conditioning can be used to heat DHW for "free." This "simultaneous mode" operation has been found to be 33 percent more efficient than running these functions separately. Some systems can intelligently balance demand, for instance, switching from cooling mode to hot water heating mode if cooling demand is met but hot water is needed. In colder climates, some MFHPs can perform defrost cycles using heat from the DHW tank offering advantages (e.g., no cold air and energy savings from avoiding inefficient electric resistance heating), though the suitability of MFHPs for cold-climate operation remains an open question. MFHPs also avoid some of the limitations of HPWH (e.g., limited hot-water capacity, comfort impacts, siting constraints) while retaining the efficiency and electrification benefits of HPs. Early evidence suggests that MFHPs could play a role in expanding electric water-heating adoption, particularly in space-limited and cold-climate markets.

Despite their many design advantages, reported energy savings for MFHPs remain largely theoretical, with few lab or field demonstrations to date. Further demonstration efforts would clarify whether such efficiencies can be achieved consistently at scale. However, without clear, recognized metrics or robust field studies and case data, consumers and utilities struggle to trust stated MFHP performance or validate ROI and reliability. MFHPs can also offer load-shifting capabilities for hot water heating, allowing systems to preheat water during off-peak hours or when electricity is cheaper, which can reduce operational costs and grid strain. Future work is needed to develop demand response protocols for MFHPs and explore how these systems could be aligned with existing protocols for both space conditioning and water heating.

Through their peak load benefits, at scale MFHPs can help to electrify communities while avoiding or delaying the need for costly upgrades to the distribution system. If well managed, MFHPs could also improve capacity utilization and shave peak demand. They also offer environmental benefits by reducing overall and peak load emissions through their efficiency and load shifting potential, respectively. The true value of MFHPs should reflect their positive externalities to the grid and the planet.

Recommendations

- Conduct additional field studies and large-scale pilot projects to quantify MFHP performance including cold-climate models and side-by-side comparisons with separate space-conditioning and water-heating HP systems to validate reliability, efficiency, and occupant comfort under real-world conditions.
- Develop a centralized repository of evidence (e.g., literature reviews, case study databases, and pilot project results) to give contractors, utilities, and policymakers easy access to real-world performance data.
- Standardize energy savings metrics and reporting formats so results from different studies and programs can be compared consistently.
- Support research to estimate the value of grid and environmental benefits of MFHPs and design programs that promote them in proportion to the societal benefits they offer.

Reliability

MFHP reliability is “still a big unknown.” There are no reliable estimates of the EUL of MFHPs. Furthermore, the reliability of the system itself is inherently more vulnerable in the sense that failure of one of the end uses may result in others not working. With little long-term reliability evidence, contractors and developers hesitate to recommend MFHPs, particularly in multifamily housing where hot water loss can trigger tenant relocations. Controls are also seen as a potential point of failure. Concerns about MFHP reliability are compounded by the market risk, with the potential for manufacturers to abandon product lines leaving stranded assets. Supporting market maturity among products offered by established OEMs may help to alleviate this risk.

Recommendations

- Fund large-scale pilots and long-term demonstrations; require public reporting on failure rates and maintenance outcomes.

- Establish incentive eligibility criteria on warranty and parts availability commitments to reduce the risk of stranded assets.
- Encourage manufacturers to minimize reliance on complex proprietary controls by using hardwired, easily replaceable components and standardized parts.
- Explore integration strategies that use traditional, always-on components (e.g., desuperheaters for DHW) to improve reliability, ease commissioning, and ensure faster recovery when issues occur.

Serviceability

Stakeholders debate whether MFHPs are more or less complicated to service than two separate HP systems. While they have only a single compressor, there are numerous critical components—heat exchangers, fan coils, and refrigerant loops—that can cause system failure. Repairs involve multiple subsystems, requiring contractors to stock a broader range of parts to ensure effective and timely service. Maintenance issues that impact water heating, which could derive from a failure on the HVAC side, will likely be treated as an emergency, increasing the urgency with which contractors would be expected to address them. Systems may also require periodic tuning to maintain optimal performance. The same specialized knowledge and multi-trade coordination required during installation will also shape how easily MFHPs can be serviced—factors that heavily influence contractor willingness to recommend them and customer confidence in adopting them. Continued research and field studies on maintenance requirements will be critical to developing a complete lifecycle cost analysis for MFHPs, including long-term service patterns, reliability outcomes, and owner satisfaction.

Recommendations

- Create maintenance protocols tailored to MFHPs, including checklists troubleshooting common performance issues.
- Provide contractor training and homeowner education resources to reduce performance degradation over time and ensure end users understand maintenance needs.
- Develop and test adaptive tuning strategies to help MFHPs maintain balanced performance across seasons without manual intervention.

Costs

Upfront Costs

High upfront cost is a significant barrier to MFHP adoption, with estimates ranging from $20,000 to $40,000, significantly more than alternatives. Stakeholders consistently stressed that cost parity with separate HP systems is essential; MFHP adoption will only take off if their installed costs are "the same or less… If it's a wash, or ideally cheaper, that would be the best." Targeted rebates could help in the short-term. At market maturity, some stakeholders suggested that MFHPs achieve lower installation and permitting costs than separate HP systems. However, this has not yet been realized at scale; instead, prices tend to be high and highly variable, undermining market trust.

Recommendations

- Improve cost transparency by collecting and publishing standardized installed cost data for MFHPs and alternatives.
- Support cost reduction strategies through R&D, streamlined installation practices, and workforce training.
- Target incentives to the incremental cost gap to achieve cost parity with separate systems and encourage early adoption.

Operating Costs

California has a significant spark gap—the price difference between one unit of energy from gas versus electricity. Many assume "electricity is expensive" without recognizing that gas prices are also rising, and real-world data shows a mixed picture of savings. Discounted HP tariffs can improve competitiveness, but lack of clarity on MFHP eligibility for discounted rates hinders adoption. Limited field studies and cost tracking make it difficult to determine the operating cost of MFHPs versus other technologies, leaving consumers risk averse.

Recommendations

- Clarify and expand utility rate eligibility so MFHPs qualify for all-electric or HP-specific discounted tariffs.
- Improve consumer education to address misconceptions about electricity vs. gas costs and highlight long-term fuel price trends.
- Promote load shifting and storage integration to hedge against peak electricity prices and demonstrate bill savings potential.
- Conduct and publish real-world operating cost studies comparing MFHPs to separate systems across climate zones, load shapes, and utility territories.

Cost-Effectiveness

MFHPs lack reliable cost data and field studies, leaving lifecycle value compared to separate systems uncertain. Without trusted data, the efficiency advantage remains speculative. Most customers prioritize cost, reliability, and function over marginal efficiency gains. MFHPs face a price premium relative to both separate HPs and gas systems, making the value proposition weak in most cases. Failures are harder to service than standalone systems, and contractors and design firms are reluctant to take on unfamiliar technologies that increase risk without clear benefits.

Recommendations

- Fund field demonstrations and lifecycle cost studies that directly compare MFHPs with conventional systems, including total installed cost, reliability, and operating performance.
- Design rebate structures that directly offset upfront cost premiums, while also communicating reliability and serviceability benefits rather than focusing only on efficiency.

- Provide training, technical guidance, and potential risk-sharing mechanisms to reduce business model uncertainty and encourage early adoption by the trades.

Workforce

Many contractors are hesitant to promote or service technologies that increase their exposure to callbacks, liability, or dissatisfied customers. Underlying contractor (and consumer) hesitancy is a lack of trust and market immaturity. Contractors fear being left with stranded assets or unsupported products if a manufacturer exits the market, while consumers worry about long-term serviceability and parts availability. This mutual caution creates a self-reinforcing cycle: limited contractor familiarity with MFHPs discourages consumer adoption, and limited demand gives contractors little incentive to learn how to install and service them. Building service confidence will require coordinated strategies that address both sides of this trust gap. Demonstration projects and early service partnerships could help establish maintenance protocols, document reliability, and showcase positive customer experiences. As training expands and more contractors gain hands-on familiarity, MFHPs are likely to follow the same trajectory as early heat-pump markets—initial hesitation followed by rapid normalization once technicians and homeowners see that the systems can be installed and serviced effectively.

Recommendations

- Create detailed installation guides to ensure consistent installation quality.
- Make MFHP trainings more intuitive and accessible; use visual and interactive tools such as 3D videos to explain installation and testing.
- Expand demonstration-based training, continuing education modules, and partnerships between manufacturers, utilities, and trade organizations to accelerate readiness.
- Develop ROI documentation and use cases to give contractors “hard facts” for customer decision-making.
- Integrate workforce training and certification into ongoing incentive and pilot programs in partnership with manufacturers and utilities.
- Clarify and modernize licensing requirements to allow limited cross-trade work and reduce coordination barriers among HVAC, plumbing, and electrical trades.
- Create a certified vendor or preferred contractor program (e.g., MassSave model) to ensure quality and customer confidence.
- Focus early workforce development in metropolitan areas with strong policies and incentives to build regional “centers of excellence.”

Policy

Equipment Standards

The absence of performance ratings for MFHP systems is a significant barrier to market entry and maturity. Current test methods (UEF, HSPF2, SEER2) misrepresent performance, ignoring simultaneous operation and heat recovery. Without recognized performance ratings, MFHPs are treated as minimum-efficiency equipment, and incentives and code compliance are uncertain. MFHPs' load management potential has not yet been fully tested. High certification costs and regulatory uncertainty discourage manufacturer entry.

Recommendations

- Standards development
  - In the short-term, leverage ASHRAE testing standard 206 to develop a rating standard for US programs. Develop a dedicated MFHP test procedure and rating system through DOE and ENERGY STAR. Where feasible, coordinate with international standards bodies to align protocols and lower barriers.
  - Develop a standardized demand-response protocol specifically for MFHPs.
  - Evaluate whether meeting California's load flexibility requirements justifies additional R&D investment. If so, design MFHPs to communicate with the new protocol or establish compatibility with both space conditioning and water heating protocols.
  - Streamline certification processes to reduce duplicative testing.
- Programs
  - Design pilot incentive pathways for MFHPs until national standards exist.
  - Update compliance software (CBECC-Res and Com, Title 24 models) to credit simultaneous operation and heat recovery.
  - Create new efficiency labels with metrics that capture "work-together" performance.
  - Modify state and utility rebate frameworks to recognize combined efficiencies, not just single-function ratings.

Refrigerant

Longer refrigerant lines and multiple indoor runs increase leak potential and service risks. Transport and installation risks add to safety concerns, with failure rates of 3 to 10 percent during setup. Transitioning to low-GWP refrigerants introduces flammability and toxicity challenges. Larger refrigerant volumes and dispersed components amplify both leak and safety risks. Looking ahead, manufacturers may need to re-engineer their MFHPs to incorporate new refrigerants while meeting safety standards and ensuring ongoing compliance with charge limits. Manufacturers and installers must balance competing priorities of climate compliance, performance, and occupant safety—with updates to safety standards, expanded use of precharged refrigerant lines, increased installer training, and additional field verification to help ensure safe deployment and alignment with evolving refrigerant regulations. Upcoming research will explore the tradeoff between the environmental benefits of ultra-low GWP options and the safety risks, including the relative feasibility and advantages of air-to-air and air-to-water MFHPs.

Recommendations

- Equipment standards and policies on refrigerant
  - Explore performance standards that include refrigerant charge limits specific to MFHPs to align with UL requirements.
  - Incorporate installation safety standards into incentive program eligibility to ensure best practices are followed.
  - Provide clear guidance for residential MFHPs in updated fire and building codes to account for A2L refrigerants.
- Equipment design
  - Promote design innovations that reduce total refrigerant charge or use secondary loops to limit refrigerant indoors.
  - Support R&D into factory-sealed MFHP designs or modular configurations that minimize field refrigerant handling. Encourage manufacturers to offer precharged, quick-connect systems to reduce field error.
  - Fund lab testing and demonstrations to evaluate performance and safety trade-offs of ultra-low GWP refrigerants, and the trade-offs between air-to-air and air-to-water MFHP technology.
- Installer training
  - Expand installer training and certification requirements for refrigerant management to promote safe handling of A2L refrigerants and emergency procedures and reduce installation failure rates.
- Consumer education
  - Pair refrigerant transitions with strong consumer education campaigns to build trust in MFHPs as both climate- and health-friendly solutions.
  - Develop clear consumer-facing communication on refrigerant safety, including monitoring technologies and engineering safeguards.

Building Electrification and Decarbonization

Various state and local policies promote heat pump adoption either directly or indirectly. MFHPs offer a pathway to low-power residential electrification, and likewise, efforts to electrify will open doors for MFHPs. Critical R&D and large-scale demonstrations as well as appropriate performance standards and testing methods will be critical to establish MFHPs as an effective option to meet California's building decarbonization goals.

Recommendations

- Policy and codes

    - Use statewide BPS and all-electric construction requirements to drive MFHP adoption, especially in multifamily housing.
    - Align building and fire codes with MFHP-friendly electrification pathways, positioning MFHPs as a preferred compliance option for decarbonization targets.
- Incentives and financing
    - Award bonus points in competitive affordable housing tax credit scoring for projects that meet state goals using high-efficiency MFHPs.
    - Shift to performance-based, technology-neutral incentives that explicitly value MFHPs' thermal storage and load-shifting benefits so higher upfront costs are fully compensated.
- R&D, standards, and demonstrations
    - Fund critical R&D, lab work, and large-scale demonstrations to validate MFHP performance, grid benefits, and suitability for low-power residential electrification.
    - Develop and adopt MFHP-specific performance standards and test methods that reflect multi-function operation and grid-interactive capabilities.
- Grid and equity outcomes
    - Prioritize MFHP deployment in capacity-constrained communities to enable concentrated electrification without triggering costly transmission or transformer upgrades.
    - Frame MFHPs as a cost-efficient electrification strategy that helps limit long-term energy burdens for low-income and vulnerable households.

Customer Considerations

There are several barriers to adoption on the consumer side that apply across market segments.

Awareness about MFHPs is very low. Significant public education efforts will be required to introduce MFHPs to the market and highlight their distinct benefits over separate HP systems. Improving public understanding of how HPs operate, their energy performance, and long-term cost savings is a critical step toward broader adoption. Stakeholders doubt whether consumers will be willing to pay a premium for MFHPs. Rebates will be critical to closing the cost gap. Most water heaters and HVAC systems are replaced only after failure, leaving little opportunity for planned MFHP adoption. In emergency replacement situations, customers prioritize speed and low cost, defaulting to standard products. Many homeowners resist retiring functional equipment ("waste not, want not"), even when financial incentives are offered. Modular installation approaches may avoid the hurdle of early equipment replacement. Consumers may balk at the idea of losing all three end uses when just one fails. MFHPs' efficiency advantage—a key theoretical selling point—may be a low priority for consumers, especially when alternative equipment (e.g., standard HPs, gas appliances) are cheaper and proven.

Recommendations

- Launch targeted outreach campaigns to engage households with aging systems before failure occurs.
- Provide decision-making tools (e.g., ROI calculators, lifecycle cost comparisons) to highlight long-term savings of planned MFHP adoption.
- Expand rapid-install contractor training and stocking programs so MFHPs can be deployed quickly.
- Establish early replacement incentives that cover the incremental cost of retiring functional equipment.
- Pilot bundled incentive programs that encourage replacing HVAC and water heating together.
- Develop staged adoption pathways (e.g., MFHP-ready HVAC paired with existing water heater).
- Explore "plug-and-play" MFHP solutions that minimize installation complexity during emergency scenarios.
- Explore the option of installing the MFHP water tank as a backup system until the primary water heater fails.
- Develop redundancy options (e.g., backup elements, modular designs) and create consumer guidance on outage scenarios.
- Ensure service response times for MFHPs are comparable to conventional water heaters or HPWHs.

Market Segments

Stakeholders believe that MFHPs offer features that are attractive across all housing types—better performance than HPWHs, space saving, energy efficiency, load flexibility, and low electrical panel requirements.

MFHPs show promise for retrofits and new construction of both single and multifamily homes. Each segment poses opportunities and challenges. MFHPs can avoid costly panel upgrades and require just a single installer, making them most impactful in the retrofit market, but complicated by the dominance of emergency replacements, mismatched equipment lifespans, and site variability. In new construction, MFHPs would avoid the issues of early retirement, out-of-cycle replacements, and some installation complexities, but some of MFHPs' greatest selling points are negated such as low electrical load and siting flexibility.

Single-family homes may be the most promising early market for MFHPs, particularly among affluent households, where owners can afford the cost premium, are able to secure incentives, and value non-energy benefits such as comfort, resilience, and lower emissions. The tendency towards emergency replacements and unitary systems create challenges in the single-family market. MFHPs can address space and panel constraints common in multifamily housing and retrofitting whole buildings would create scale economies. However, multifamily building owners are often risk averse, have little incentive to invest in energy efficiency, and favor centralized mechanical systems.

For consumers in underserved communities, MFHPs offer a promising pathway to electrification, energy efficiency, and improved thermal comfort and indoor air quality, but financial, informational, and trust barriers impede adoption. Energy burdened households can ill-afford uncertainty or variability in upfront or operating costs. Thus, while underserved communities could stand to benefit the most from MFHPs, they are the least well positioned to take on the high (and unpredictable) costs and risks associated with this as yet unproven technology.

Recommendations

- Support field demonstrations to identify the most promising configurations by building type.
- Prioritize clear guidance on incentive eligibility.
- To promote deployment of MFHPs in underserved communities:
    - Provide enhanced incentives for low-income households and affordable-housing developers, support panel-upgrade deferrals where MFHPs fit within existing capacity, and offer simple, no-cost financing tools to avoid credit or documentation barriers.
    - Partner with trusted local organizations, provide multilingual information, and streamline incentive processes to reduce skepticism, administrative burden, and fear of “hidden costs.”
    - Require strong manufacturer service commitments, expand contractor and maintenance-staff training, and explore extended warranties and remote diagnostics to ensure MFHP systems “just work” for vulnerable residents.
    - Pair MFHP installations with weatherization and rate-sensitive controls, and offer bill-protection or cost-stabilization measures to prevent increased energy burden—especially in older, less efficient homes.
    - Fund MFHP demonstration projects in underserved communities, produce clear performance data, and use real customer stories to make the value proposition tangible for households with higher technology caution.
    - Create installation playbooks for common underserved housing types, prioritize compact and low-noise MFHP configurations, and support pre-inspection programs to minimize disruption, uncertainty, and lost usable space.

Conclusions

MFHPs are at an early but important inflection point in California’s building decarbonization landscape. As integrated systems providing space heating, cooling, and DHW, MFHPs offer a pathway to reduce installation complexity, electrical loads, and grid stress. However, the technology remains in a formative stage, with limited commercial availability, unresolved performance standards, and uncertain cost competitiveness relative to separate systems.

Across stakeholder interviews and market research, several consistent themes emerged. First, technical maturity and equipment standardization remain critical hurdles. MFHPs must demonstrate consistent field performance, reliability across climate zones, and adaptability to future refrigerant transitions. Second, the market is constrained by product instability and limited manufacturer continuity, which erode confidence among contractors and consumers. Third, the lack of recognized test procedures and performance ratings limits incentive eligibility and hinders integration into existing program frameworks.

At the same time, MFHPs show tangible promise in defined use cases. Their low power requirements make them especially compelling in panel-constrained homes and multifamily retrofits, where avoided service upgrades can significantly reduce electrification costs and delays. MFHPs offer additional benefits to the distribution system, enabling the avoidance or deferment of costly upgrades if deployed at scale. Field demonstrations validating these benefits could shift perception from theoretical potential to demonstrated value.

Nonetheless, the technology's overall business case remains unclear. Stakeholders repeatedly cited high upfront costs, uncertain energy savings, and workforce barriers as persistent hurdles. As one manufacturer admitted, "I've struggled with trying to figure the value proposition out. Saving breaker space and a few other random benefits are outweighed by drawbacks." Until reliability and service networks mature, uptake is likely to remain limited to early adopters and niche applications.

Moving forward, coordinated action across agencies, manufacturers, and utilities will be essential. Hands-on demonstrations, standardized commissioning, and workforce development should occur in tandem with policy alignment on standards and refrigerant compliance. Programs can play a pivotal role by rewarding verifiable performance and serviceability rather than prescriptive compliance, while bridging the cost gap through targeted, time-limited incentives.

Ultimately, MFHPs' success will depend on converting technical potential into proven, scalable performance—demonstrating clear, quantifiable benefits to consumers, utilities, and the grid. With sustained collaboration, transparent performance data, and a strong policy signal, MFHPs could evolve from early-market uncertainty into a practical and equitable solution supporting California's broader electrification and climate goals.

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US Environmental Protection Agency. (n.d.). *Regulatory actions for technology transitions.* https://www.epa.gov/climate-hfcs-reduction/regulatory-actions-technology-transitions

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Appendix A: Stakeholder Interviews

The questions below reflect the full protocol used to guide stakeholder interviews. Interviews were tailored to each participant, and WCEC prioritized the questions most relevant to their background and expertise to stay within the allotted time.

Overall

1. From your perspective, what's the market opportunity for MFHP in California?
    a. What advantages does it offer over separate heat pumps? furnace/AC combos?
    b. What market segments are most promising?
    c. What types of homes (e.g., size, layout, age) are best suited for MFHP installations?
    d. Can you speak to the potential for MFHP adoption in homes that already use heat pumps for space or water heating?
2. From your perspective, what are the biggest challenges about getting MFHPs to the CA market?
3. Currently, which manufacturers offer MFHPs in the CA market?
    a. Which manufacturers do you consider key players in the MFHP market?
    b. What notable changes have taken place in the market over the past year? (For example, market entries and exits)
4. What would encourage more manufacturers to enter the California MFHP market?
5. What are the biggest barriers to customer adoption of MFHPs?
    a. When considering MFHPs, how significant of a barrier do you think it would be for customers to replace equipment that is still functioning, like a water heater? What could be done to overcome this barrier?
    b. What concerns have customers raised about installing a single system for space and water heating?

Installation and Workforce

6. How does MFHP installation compare to separate heat pump systems?
    a. From your experience, what are the biggest technical challenges associated with MFHP installation?
7. What are the challenges associated with integrating MFHPs with existing home systems? (e.g. duct layout, water heating configuration) How do you advise/train installers to address those challenges?
8. Beyond the general shortage in HVAC, electrical, and plumbing trades, what unique skills or coordination challenges do MFHP installations require?

a. Can you speak to the current level of contractor readiness—both in terms of skills and cross-trade coordination—for MFHP installations?

9. What workforce training or other guidance would make MFHP installations more feasible at scale?

10. How technically viable are MFHPs in homes with limited electrical capacity (100–199 amps)?

    a. Do you think MFHP manufacturers should highlight in their marketing strategies the possibility for home electrification without requiring a panel upgrade? (To what extent is avoiding electrical panel upgrades a factor in MFHP adoption?)

11. What methods does your company advise installers to use for sizing MFHPs? Are Manual J calculations standard practice? How does your company advise installers to appropriately size the water tank for MFHPs?

12. How important do you think efficiency gains are in influencing adoption decisions (e.g., modeled vs. real-world cost/benefit)?

Technical Advancements

13. What can you tell us about technology development underway on residential MFHPs?

    a. Do you know of what performance issues that are currently being addressed?

14. Do current MFHP product offerings support CTA-2045 or other load management protocols?

    a. How do you view the role of MFHPs in helping utilities meet demand flexibility goals?

Costs

15. What is the typical installed cost for an MFHP?

16. From your understanding, how does that compare with separate heat pumps for space conditioning and water heating?

17. Do you know if MFHPs are currently eligible—or likely to be eligible—for discounted electricity rates?

18. What financing approaches (e.g., on-bill, leases) do you think would be effective in supporting MFHP adoption?

19. What different adoption patterns of heat pumps, in general, are you seeing by income level, housing type (single-family/multifamily; new vs existing), or region (climate zone, utility program, local policies)? MFHPs?

    a. What types of homes (e.g., size, layout, age) are best suited for MFHP installations?

Policy

20. How do current policies or incentive programs (e.g., TECH, SGIP, BUILD) accommodate and support MFHP adoption?

21. What types of programs or incentives would be necessary to entice customers to consider MFHPs?
22. What sort of outreach strategies should programs use to raise awareness and encourage participation in incentives?
23. Are there some examples of past or current programs that offer good models for MFHP rollout?

Underserved Communities

24. What potential benefits could MFHPs offer to underserved or historically marginalized communities?
25. What unique challenges might underserved communities face when it comes to adopting MFHPs?

Closing

26. Are there any other recommendations for program implementers to ensure successful MFHP adoption?
27. Is there anything we haven't covered that YOU think we should know about or consider?
28. Is there anyone else you think we should talk to?

Appendix B: Technology Assessments

Table 3. Technology Characteristics and Adoptability Assessment - MFHPs vs. ASHPs - According to Stakeholders (N=15)

Category	Characteristic	Most Common Response	Response Distribution
Economic	Initial investment	High	High: 11, Medium: 4
	Operating costs	Medium	Medium: 9, Low: 6
	Return on investment	Medium	Medium: 8, Low: 7
	Market availability	Low	Low: 14, Medium: 1
Technical	Technical compatibility	Medium	Medium: 9, High: 3, Low: 3
	Performance	Medium	Medium: 8, High: 4, Low: 3
	Return on investment	Low	Low: 7, Medium: 7, High: 1
	Complexity of installation	High	High: 9, Medium: 4, Low: 2
	Complexity of use	Low	Low: 7, Medium: 6, High: 2
	Complexity of maintenance	Medium	Medium: 9, High: 4, Low: 2
	Energy savings	Medium	Medium: 9, High: 4, Low: 2
Informational	Observability	Low	Low: 11, Medium: 4
	Trialability	Low	Low: 13, Medium: 2
Externalities	Environmental impacts	Low	Low: 13, Medium: 2
	Non-energy impacts	High	High: 8, Low: 4, Medium: 3

Table 4. Technology Characteristics and Adoptability Assessment - MFHPs vs. HPWHs - According to Stakeholders (N=14)

Category	Characteristic	Most Common Response	Response Distribution
Economic	Initial investment	High	High: 12, Medium: 2
	Operating costs	Medium	Medium: 8, Low: 5, High: 1
	Return on investment	Low	Low: 10, Medium: 2, High: 2
	Market availability	Low	Low: 13, High: 1
Technical	Technical compatibility	Medium	Medium: 8, Low: 4, High: 2
	Performance	Medium	Medium: 8, High: 3, Low: 3
	Return on investment	Low	Low: 10, Medium: 3, High: 1
	Complexity of installation	High	High: 8, Medium: 6
	Complexity of use	Low	Low: 7, Medium: 6, High: 1
	Complexity of maintenance	Medium	Medium: 9, High: 3, Low: 2
	Energy savings	Medium	Medium: 9, High: 3, Low: 2
Informational	Observability	Low	Low: 11, Medium: 3
	Trialability	Low	Low: 14
Externalities	Environmental impacts	Low	Low: 10, Medium: 4
	Non-energy impacts	High	High: 8, Low: 3, Medium: 3

Table 5. Non-energy Impacts Assessments by Stakeholders (N=15)

Impact Type	Functional Outcome	Physio-logical	Socio-logical	Psycho-logical	Economic	Practical
Positive	Spatial Quality	33%	27%	40%	20%	53%
	Thermal Quality	40%	13%	27%	13%	47%
	Air Quality	27%	13%	20%	13%	20%
	Acoustic Quality	40%	33%	40%	7%	27%
	Visual Quality	20%	27%	33%	13%	33%
	Building Integrity	7%	13%	13%	33%	53%
Negative	Spatial Quality	0%	7%	7%	20%	27%
	Thermal Quality	7%	7%	7%	20%	13%
	Air Quality	7%	0%	0%	7%	7%
	Acoustic Quality	13%	0%	13%	7%	7%
	Visual Quality	7%	7%	7%	7%	7%
	Building Integrity	0%	0%	0%	7%	13%

Appendix C: Incentive Programs

Federal

The Inflation Reduction Act (IRA), signed in August 2022, committed $369 billion to climate and energy initiatives, including household electrification incentives administered at the state level.[96] California was allocated over $582 million, with $291 million designated for the HOMES rebate program, targeting energy efficiency retrofits in single-family and multifamily homes.[97] A temporary freeze of federal funded programs under the IRA, including the HOMES program, occurred in January 2025 when agencies were ordered to pause funding obligations. The freeze was rescinded and blocked in court in February 2025[98], but, as of October 2025, there is no clear public indication that the HOMES rebate program has fully launched in California and rebates are not yet available.[99]

Working in conjunction with the HOMES program, the High-Efficiency Electric Home Rebate Act (HEEHRA) was designed to provide point-of-sale discounts on HP systems and HPWHs. As of November 2024, $45 million in rebates were available through TECH Clean California.[100] As of October 2025, there are rebates available with amounts depending on region and the specific program. Table 6 provides a brief overview.

Table 6. Status of TECH Clean program incentives, October 2025

Status	Incentive description
Currently available	• Single-family HEEHRA Rebates: Income-qualified residents can access rebates for HP HVAC systems statewide. • Single-family TECH Incentives: Available statewide for HP HVAC systems and HPWHs. • Multifamily HEERA Rebates: Available for projects statewide. • Small Multifamily TECH HPWH Incentives: Available to multifamily residents and property owners statewide.
Fully reserved	• Single-family TECH Incentives: Fully reserved for HVAC and water heater HPs in single-family homes.

[96] *Inflation Reduction Act Guidebook | Clean Energy*. (n.d.). The White House. Retrieved on March 7, 2024, from https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/

[97] California Energy Commission. (2024, October 10). *New federally-funded residential energy rebate programs launching in California.* Retrieved from: https://www.energy.ca.gov/news/2024-10/new-federally-funded-residential-energy-rebate-programs-launching-california

[98] Democracy Forward. (2025, February 25). *New judge issues national injunction to block Trump administration's devastating attempt to halt funding for essential services.* Democracy Forward. https://democracyforward.org/updates/new-judge-issues-national-injunction-to-block-trump-administrations-devastating-attempt-to-halt-funding-for-essential-services/

[99] California Energy Commission. (2025). *Inflation Reduction Act residential energy rebate programs* [Web page]. Retrieved October 2025 from: https : // www . energy . ca . gov / programs-and-topics / programs / inflation-reduction-act-residential-energy-rebate-programs

[100] TECH Clean California. (2024, November 7). *New HEEHRA rebates and heat pump HVAC incentives are now available*. Retrieved from: https://techcleanca.com/about/news/new-heehra-rebates-and-heat-pump-hvac-incentives-are-now-available/

Status	Incentive description
(no new applications or reservations accepted)	• 3CE incentives are fully reserved for this program cycle. • Single-family TECH Incentives: Fully reserved for single-family HPWHs non-SMUD POU customers and any customers whose home bedroom or bathroom configurations do not fall within the California Plumbing Code (Chapter 5, Table 501.1(2) in 2022 California Plumbing Code, e.g. homes with 7+ bedrooms or 4+ bathrooms, etc.)

Source: https://techcleanca.com/incentives/

The Energy Efficient Home Improvement Credit[101]—commonly known as "25C" under the tax code and established by the IRA—has been revised for the 2024–2025 tax years. The program continues to provide a federal tax credit of up to $2,000, or 30 percent of costs, whichever is lower for the installation of HPs in existing homes.[102] The updated structure includes a $1,200 annual cap, with an additional $2,000 targeted to qualifying HP systems.[103] The credit, once available through 2032, now ends on December 31, 2025 and covers a broader range of energy-efficiency improvements, including home energy audits. As of February 4, 2025, a new requirement stipulates that eligible equipment must be purchased from manufacturers registered with the IRS.[104] As of January 1, 2025, ENERGY STAR Most Efficient HPs qualify for the tax credit and "must meet or exceed the highest efficiency tier (not including any advanced tier) established by the Consortium for Energy Efficiency (CEE)."[105] For HPWHs to be eligible for the tax credit, they must be ENERGY STAR certified and also "must meet or exceed the highest efficiency tier (not including any advanced tier) established by the CEE."[106] Additionally, builders can claim up to $2,500 per home for ENERGY STAR-certified equipment in new homes.[107]

Despite these opportunities, ongoing legal and political uncertainty—particularly efforts to dismantle or pause IRA funding—has created instability for program implementation, making future availability of these federal incentives unclear.

As of October 2025, the ENERGY STAR program remains active, but its future is uncertain. The EPA has announced a reorganization plan aimed at restructuring or eliminating its Office of Atmospheric

[101] Internal Revenue Service. (2025). F*requently asked questions about energy efficient home improvements and residential clean energy property credits: Energy efficient home improvement credit—qualifying expenditures and credit amount.* Retrieved from: https://www.irs.gov/credits-deductions/frequently-asked-questions-about-energy-efficient-home-improvements-and-residential-clean-energy-property-credits-energy-efficient-home-improvement-credit-qualifying-expenditures-and-credit-amount

[102] EnergySage. (2024, March 26). *Heat pump incentives, tax credits, and rebates.* ENERGY Sage. Retrieved from: https://www.energysage.com/heat-pumps/heat-pump-incentives/

[103] Internal Revenue Service. (2024). *Energy Efficient Home Improvement Credit (section 25C).* Retrieved from: https://www.irs.gov/credits-deductions/energy-efficient-home-improvement-credit

[104] Internal Revenue Service. (2025). *Energy Efficient Home Improvement Credit — Qualified Manufacturer Requirements* [Web page]. Retrieved from: https://www.irs.gov/credits-deductions/energy-efficient-home-improvement-credit-qualified-manufacturer-requirements

[105] ENERGY STAR. (2025). *Federal tax credits for energy efficiency in 2025: What you need to know*. US Environmental Protection Agency. Retrieved from: https://www.energystar.gov/products/ask-the-experts/federal-tax-credits-energy-efficiency-2025-what-you-need-know

[106] ENERGY STAR. (n.d.). *Heat pump water heaters tax credit*. U.S. Environmental Protection Agency. Retrieved November 25, 2025 from https :https://www.energystar.gov/about/federal-tax-credits/heat-pump-water-heaters

[107] ENERGY STAR. (2024). *Section 45L tax credits for home builders*. US Environmental Protection Agency. Retrieved from: https://www.energystar.gov/about/federal-tax-credits/ss-45l-tax-credits-home-builders

Protection, which oversees the ENERGY STAR program.[108] Congress is still negotiating FY 2026 appropriations and how it treats ENERGY STAR will depend on those results. In response, more than 1,200 stakeholders—including manufacturers, utilities, and environmental groups—have urged federal agencies to preserve the program, and some policymakers have proposed transferring ENERGY STAR administration to the Department of Energy.[109]

TECH Clean California

TECH Clean California is a statewide initiative aimed at accelerating the adoption of clean space and water heating technologies in homes across California to help reach the state's goals of installing six million HPs by 2030 and achieving carbon neutrality by 2045. This program provides midstream incentives for residential HPs by issuing payments directly to contractors, who can either apply the incentive at the point of sale or pass it on to the customer within 30 days of receipt.[110] This contractor-based approach streamlines the process for customers, reducing administrative burden and lowering participation barriers—particularly for hard-to-reach populations. A core objective of the program is to advance HP adoption in disadvantaged communities. Nearly 50 percent of TECH's incentive funding is earmarked for "equity communities,"[111] which include single-family homes in CalEnviroScreen 4.0 designated areas and households enrolled in low-income assistance programs such as CARE or FERA.[112]

As of June 2025, the program had supported the installation of 45,939 space-conditioning HPs in both single-family (42,924) and multifamily (3,015) homes[113], accounting for roughly 5 percent of all residential HPs installed in California since 2020.[114] Most of the residential HPs installed through TECH are ducted split systems for space conditioning.[115] Installations of HPWHs have been concentrated in the Bay Area and Sacramento, where established regional programs and experienced contractor networks have supported higher uptake.

BUILD Program

California's BUILD program offers a performance-based incentive structure that creates potential opportunities for MFHP adoption, particularly in new construction projects. Incentives are tied to avoided GHG emissions, with a base rate of $150 per metric ton, determined using the BUILD

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[108] Washington Post. (2025, May 6). *Trump administration plans to end Energy Star program for home appliances.* https://www.washingtonpost.com/climate-environment/2025/05/06/energy-star-program-epa-trump/

[109] The Guardian. (2025, May 7). *Utility bills could rise as Trump's EPA to end Energy Star program, experts warn*. https://www.theguardian.com/us-news/2025/may/07/energy-star-program-ends-utility-bills

[110] TECH Clean California. (n.d.). *TECH Incentives Overview and Eligible Project Types*. Retrieved on June 7, 2025, from https://frontierenergy-tech.my.site.com/contractorsupport/s/article/Incentives-Overview

[111] TECH Clean California. (September 26, 2023). *TECH Equity Budget Report*. Tableau Software. https://public.tableau.com/views/TECHEquityBudgetReport/TECHEquityDRAFTdashboard?:embed=y&:showVizHome=no&:host_url=https%3A%2F%2Fpublic.tableau.com%2F&:embed_code_version=3&:tabs=no&:toolbar=yes&:animate_transition=yes&:display_static_image=no&:display_spinner=no&:display_overlay=yes&:display_count=yes&:language=en-US&publish=yes&:loadOrderID=0

[112] TECH Clean California. (September 6, 2023). *Equity Budget and Spending*. https://techcleanca.com/public-data/equity-budget-and-spending/

[113] TECH Clean California. https://techcleanca.com/

[114] TECH Clean California. (2024). *TECH Public Reporting Data*. https://techcleanca.com/public-data/download-data/

[115] Sarkisian, D., Kirwan, D., Parker, S., Hotaling, A., & Fink, M. (2023). *Heat Pump HVAC Retrofit Cost Drivers*. TECH Clean California. https://techcleanca.com/documents/2641/Heat_Pump_HVAC_Retrofit_Cost_Drivers_v4W3bW0_kiFU8k4.pdf

Calculator Pathway.[116] To qualify, projects must install approved Core Technologies, including high-efficiency HPs for space and water heating.

While MFHPs are not explicitly listed, projects that install both approved HVAC and water-heating HPs—core components of MFHP systems—can qualify. In particular, MFHPs that meet or exceed efficiency standards and use low-GWP refrigerants may be well positioned to help projects maximize their GHG reductions and incentive eligibility.

The BUILD program supports a range of housing types, with significantly higher incentives for multifamily buildings, offering over $39,000 for low-rise and over $500,000 for high-rise projects.[117] Additional funds are available for enhancements like JA13-compliant water heaters and smart thermostats.[118] These features align closely with the integrated capabilities of MFHP systems, making MFHPs a strong candidate for BUILD-supported electrification in both single-family and multifamily construction.

SGIP

The California Self-Generation Incentive Program (SGIP) presents a growing market opportunity for MFHPs by supporting load-flexible, low-emission HP retrofits in California's IOU territories. In 2023, SGIP launched a dedicated HPWH program with over $80 million in funding, offering substantial rebates—$4,885 for low-income customers and $3,800 for others—issued through the TECH program to contractors.[119]

Though currently focused on water heating, SGIP's requirement for load management capabilities aligns well with MFHP systems, which can shift energy use to off-peak hours. An additional $1,500 incentive is available for units using low GWP refrigerants.[120]

Half of the program's funds are reserved for low-income customers, with added incentives to cover related upgrade costs, making MFHPs a compelling option for equity-focused retrofits.[121] If future SGIP expansions allow incentives for integrated MFHP systems—not just standalone water heaters—this could significantly increase market demand for MFHPs in both single-family and multifamily applications.

Utility Programs

California's diverse electricity market—comprising IOUs, publicly owned utilities (POUs), and community choice aggregators (CCAs)—offers a broad and active landscape for HP adoption. All three

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[116] California Energy Commission. (n.d.). *Building Initiative for Low-Emissions Development (BUILD) Program*. Retrieved from: https://www.energy.ca.gov/programs-and-topics/programs/building-initiative-low-emissions-development-program-build/build

[117] California Energy Commission. *BUILD Incentives. Low Rise Multifamily*. https://www.energy.ca.gov/media/8470; *High-Rise Multifamily.* https://www.energy.ca.gov/media/8472.

[118] California Energy Commission. (2022). *BUILD Incentives Program Guidelines*. https://www.energy.ca.gov/sites/default/files/2022-03/CEC-300-2022-001-CMF.pdf

[119] California Public Utilities Commission. (2024, February 23). *CPUC provides additional incentives and framework for electric heat pump water heater program.* Retrieved from: https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-provides-additional-incentives-and-framework-for-electric-heat-pump-water-heater-program

[120] California Public Utilities Commission. (2022, April 7). *CPUC provides additional incentives and framework for electric heat pump water heater program.* Retrieved from: https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-provides-additional-incentives-and-framework-for-electric-heat-pump-water-heater-program

[121] TECH Clean California. (n.d.). *Statewide Heat Pump Water Heater Incentives (SGIP Program Overview)*. https://techcleanca.com/documents/3631/SGIP_Program_Overview_Flyer_-_WEB_v231124_tGZ0P8k.pdf

utility types provide incentives for HPs, with IOUs playing a particularly influential role through their extensive energy efficiency programs. These IOU-administered programs, regulated by the CPUC and backed by roughly $1 billion annually, fund rebates, workforce training, and market development to accelerate the adoption of energy-efficient technologies, including HPs.[122]

MFHPs that meet verified energy savings thresholds may qualify for these rebate programs, which issue incentives at multiple levels of the supply chain—upstream, midstream, and downstream. IOUs and smaller utilities alike participate in initiatives such as the Golden State Rebate Program and Energy Savings Assistance (ESA) Program, both of which support electrification through financial incentives for home-energy upgrades, like weatherization, and high-efficiency products including HPWHs. According to the TECH Clean California HEEHRA rebate program documentation and CPUC incentive program details, rebates can be as high as $8,000 for income-qualified households, with typical rebates for heat pump HVAC units ranging between $1,000 to $4,000 depending on income level and efficiency.[123] As such, an approximate average rebate in California would be estimated around $2,000 per unit, with higher incentives available for higher-efficiency equipment.

[122] Walton, R. (2019, August 2). *California opens $1 B in efficiency funding to electrification.* Utility Dive. Retrieved from: https://www.utilitydive.com/news/california-opens-1b-in-efficiency-funding-to-electrification/560096/
[123] TECH Clean California. (n.d.). *HEEHRA rebates*. Retrieved from https://techcleanca.com/incentives/heehrarebates/