2026 Water Heating Technology Priority Map

Final Report

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Abbreviations, Acronyms, and Glossary of Terms

Abbreviation/Acronym	Meaning
AWHP	Air-to-water heat pump
CO_2	Carbon dioxide
DAC	Disadvantaged communities
DHW	Domestic hot water
EE	Energy efficiency
eTRM	Electronic Technical Reference Manual
GHG	Greenhouse gas
GWP	Global warming potential
HPWH	Heat pump water heater
HTR	Hard-to-reach
HVAC	Heating, ventilation, and air conditioning
IOU	Investor-owned utilities
kW	Kilowatts
MFHP	Multifunction heat pump
SME	Subject-matter expert
TPM	Technology Priority Map
TSB	Total System Benefit
V	Volt
WH	Water heating

Glossary Term	Meaning
Technology Category	One of six broad technology categories (Whole Buildings; Heating, Ventilation, and Air Conditioning; Water Heating; "Lighting, Plug Loads, and Appliances;" Process Loads; and Portfolio Enhancements).
Technology Family	Functional grouping that provides description of program role, opportunities, and barriers.
Research Initiatives	Initiative in place of both subgroups and knowledge indices.
Research Initiatives Key	Visual aid that explains if each research initiative is at a level of high understanding, ranked on a low, medium, or high scale.
Rankings	Future Needs: Covers items that are not yet ready for consideration due to having high needs in validation, market analysis, measure development, or program development. Programs should not be discouraged from submitting proposals for research initiatives with a "Future Needs" classification but instead focus on making a strong argument for how the project outcomes can help fill in the missing gaps for validation or market analysis. Low: Covers items that have lower industry interest and/or uncertain impacts for energy efficiency due to having an expansive data set or information readily available or not being pertinent to the research initiative. Medium: Covers items that are an evolution of or offer promise to existing and common technologies for energy efficiency. This can be in the form of needs that are currently being addressed with existing projects or needs that may exist but are not critical to the objectives of meeting efficiency metrics. High: Covers items that have high industry interest and high impacts for energy efficiency.
Definitions	Narrative to provide additional clarification on the technology family scope.
Opportunities	Description of potential impacts and potential research areas.
Barriers	Description of key barriers and potential barriers research.
CalNEXT Priority	Communicates expected level of focus by CalNEXT subject-matter experts. *Note: Priorities will change as research is completed.*

Glossary Term	Meaning
High	CalNEXT has highlighted this technology family as having high energy savings, with any known barriers surmountable through targeted interventions within the technology category, and will prioritize funding projects under this technology family.
Medium	CalNEXT has highlighted this technology family as having moderate-to-high overall energy savings, with known barriers to entry that may be more challenging to address within the technology category, and will consider funding projects under this technology family.
Low	CalNEXT has highlighted this technology family as having moderate-to-high overall savings, but with difficult or unknown barriers to adoption within the technology category, and will not prioritize funding projects under this technology family.

Introduction

The Technology Priority Maps (TPMs) provide the CalNEXT program with a framework to externally communicate the priorities of the program, clearly define the central focus areas of the program, and assist with project screening. The TPMs will document the impact potential, programmatic research needs, and market readiness of all technology families across each of the end-use technology areas. They will drive product ideation and inform project selection. This Final Report covers the revision process for the 2026 Water Heating (WH) TPM.

2026 TPM Key Changes

When compared to other technology areas, the WH category has seen significant changes over the years. Notable recent drivers for these changes include the passage of the One Big Beautiful Bill Act[1] in 2025, which repealed many of the tax credits and much of the funding for state-administered incentive programs targeting the heat pump market, which was originally signed into law under the Inflation Reduction Act of 2022. In addition, research conducted by California's investor-owned utility (IOU) Codes and Standards Enhancement team related to multiple technology families has impacted the state of knowledge to varying degrees. Finally, the continued need for programs to transition to the Total System Benefit (TSB) metric has implications for both demand flexibility and low-global warming potential (GWP) refrigerants.

The CalNEXT program has completed 15 projects connected to the WH TPM since the start of 2025, as shown in Table 1 below. In the Residential and Small Commercial Heat Pump Water Heaters technology family, projects focused on addressing market barriers for water heater programs including financing and fuel conversion readiness; residential project outcomes include measure recommendations for multifunction heat pumps, and for addressing energy efficiency (EE) program barriers. Projects in the Commercial Domestic Hot Water (DHW) System Design area focused on carbon dioxide (CO_2) ultra-low-GWP refrigerant systems, as well as understanding barriers to adoption in the foodservice and small commercial sectors. Outcomes from commercial projects include measure recommendations for small and medium commercial and multifamily customers.

Table 1: Water Heating TPM projects.

Project Name	Project Tactic	TPM Area	Technology Family
Commercial Heat Pump Water Heater Focused Pilot	ETFP	Water Heating	Commercial Domestic Hot Water System Design

[1] To read the One Big Beautiful Bill Act, see: https://www.congress.gov/bill/119th-congress/house-bill/1/text.

Project Name	Project Tactic	TPM Area	Technology Family
Characterization of Central Heat Pump Water Heating (CHPWH) Deployment in Multifamily	Market Study	Water Heating	Commercial Domestic Hot Water System Design
CHPWH Unpressurized Storage Design Optimization	Paper Study	Water Heating	Commercial Domestic Hot Water System Design; Commercial Multifunction and Combination Air-to-Water Heat Pumps (AWHPs)
Packaged Central CO_2 Heat Pump Water Heater Multifamily Demonstration	Field Evaluation	Water Heating; Whole Buildings	Commercial Domestic Hot Water System Design; Envelope
Overcoming Key Barriers to Electrification of Foodservice Hot Water in California	Field Evaluation	Process Loads; Water Heating; Whole Buildings	Commercial Domestic Hot Water System Design; Integrated Systems; Pumping Systems
Restaurant Field Monitoring	Field Evaluation	Water Heating	Commercial Multifunction and Combination AWHPs
Multipurpose Hydronic CO_2 Heat Pump for Commercial Buildings	Paper Study	HVAC; Water Heating	Micro Heat Pumps; Decarbonized Designs for Complex HVAC Systems; Commercial Domestic Hot Water System Design
Tech Evaluation of Air-to-Water Heat Pumps	Field Evaluation	HVAC; Water Heating	Micro Heat Pumps; Residential Air-to-Air HPs and Controls; Unitary Electric Water Heaters and Single-Family Systems
Lab Evaluation of Integrated Controls for Commercial Buildings	Lab Evaluation	HVAC; Water Heating; Whole Buildings	Residential Air-to-Air HPs and Controls; Commercial Domestic Hot Water System Design; Envelope
Residential Heat Pump Financing Solutions Analysis	Market Study	HVAC; Water Heating	Residential Air-to-Air HPs and Controls; Unitary Electric Water Heaters and Single-Family Systems
Residential Multifunction Heat Pump Market Study	Market Study	HVAC; Water Heating; Whole Buildings	Residential Multifunction Heat Pumps; Integrated Systems

Project Name	Project Tactic	TPM Area	Technology Family
HPWH Conversion Readiness Program Focused Pilot	ETFP	Water Heating	Unitary Electric Water Heaters and Single-Family Systems
California Multifamily Split HPWH Market Study	Market Study	Water Heating	Unitary Electric Water Heaters and Single-Family Systems
Increasing Heat Pump Water Heater Deployment	Tool Development/ Enhancement	Water Heating	Unitary Electric Water Heaters and Single-Family Systems
Phase Change Material Applications in Multifamily Water Heating	Market Study	Water Heating	Unitary Electric Water Heaters and Single-Family Systems; Commercial Domestic Hot Water System Design

For the 2026 TPM update, the CalNEXT program team established a robust process for this initial phase of development and revisions. As with the 2025 TPM update, the project team is incorporating a stronger push to gather feedback directly from Water Heating subject-matter experts (SMEs) at the beginning of the revision process.

With that in mind, CalNEXT reformed the Water Heating TPM SME team, with representatives from each of the program team partners: AESC, Energy Solutions, TRC, UC Davis, and VEIC; additionally, the Ortiz Group provided feedback at the Draft Report's stakeholder outreach stage. The Water Heating SME team includes members who support an array of energy efficiency programs that use technologies covered by the Water Heating TPM, as well as members who support the California IOUs' Codes and Standards program. These emerging technology products are then contextualized into priority maps through a markets-and-solutions lens.

In 2026, the Water Heating SME team focused on revising and cleaning up the technology families based on energy efficiency and affordability standards, among annual revisions considering market changes and CalNEXT program priorities. Research initiatives should be at a higher level than project- or proposal-specific details, with the intent to provide guidance for project submitters rather than specific examples.

The end goal of these visual summaries is to have a clear representation of where the technology family stands in the portfolio, as well as what remaining research is needed. The research initiatives tables describe the two to five most important technology areas, with the current version providing a simplified ranking view of where the Water Heating portfolio stands for easier use and external understanding. To date, most research projects take place within a handful of technology families across Water Heating, which was a large driver in how the team chose technology families in 2026.

Table 2: Rankings and their meanings.

Icon	Meaning
Future Needs	Covers items that are not yet ready for consideration due to having high needs in validation, market analysis, measure development, or program development. Programs should not be discouraged from submitting proposals for research initiatives with a "Future Needs" classification but instead focus on making a strong argument for how the project outcomes can help fill in the missing gaps for validation or market analysis.
Low	Covers items that have lower industry interest and/or uncertain impacts for energy efficiency due to having an expansive data set or information readily available or not being pertinent to the research initiative.
Medium	Covers items that are an evolution or offer promise to existing and common technologies for energy efficiency. This can be in the form of needs that are currently being addressed with existing projects or needs that may exist but are not critical to the objectives of meeting efficiency metrics.
High	Covers items that have high industry interest and high impacts for energy efficiency.

One additional feature specific to the HVAC and Water Heating TPMs is a cross-listed technology family, Error! Reference source not found.[2]. The team made this development to better orient and provide consistency between the two TPM end uses, as well as to address an emergent system and design need: air-to-water heat pumps that can be deployed to address space conditioning demand under normal conditions with HVAC. This technology has relevant research initiatives in the Whole Buildings TPM as well.

The project team designed the cross-listed topic to ensure strong coordination across CalNEXT. As systems serving non-residential spaces grow, so does their complexity. Residential multifunction heat pumps are anticipated to be sold as a package of features, including thermal storage, hydronic heating, cooling, and hot water. This is in contrast with commercial systems, which appear to be heavily custom-engineered as a collection of components—such as heat recovery chillers, air-to-water heat pumps, service water controls, and thermal storage—all of which need to be sized, integrated, and controlled together to support large-scale building electrification.

Additionally, the Pool Heaters and Residential Pool Pumps technology family was moved from the Water Heating TPM to the Process Loads TPM in 2026; the project team made this change because Water Heating deals with either DHW technologies or joint HVAC hydronic systems (for example, multifunction heat pumps). The Pool Heaters and Residential Pool Pumps technology family included both pool pumps and pool heaters, which are seen as a better fit under the Process Loads TPM, specifically under the Pumps and Process Heating technology families, respectively.

Overall, the changes made in this 2026 TPM aim to increase technology transfers broadly across the portfolio, allowing the CalNEXT team to define new measures of interest and illustrate its efforts to

[2] https://calnext.com/resources/hvac/

bring them to the portfolio. Even for longer-term investments, the visual format of the research initiatives tables will provide more tactical guidance as to what type of research is needed to better encourage the progress of different technologies toward the goal of portfolio savings.

Stakeholder Feedback

TPM Advisory Committee Outreach

The TPM Advisory Committee outreach began in April 2026 when the team requested stakeholder feedback via email, through survey questions targeted for the Water Heating TPM, which resulted in updates to the Word document of the technology family narratives. The stakeholders who provided feedback are listed below in Table 3.

According to California's Electronic Reference Manual, from 2021 through 2025, deemed water heating claims represented almost 65 percent of the total deemed EE portfolio claims. However, the SME team expects significant savings changes as projects over this period are evaluated, and the team will stay alert for updates in this area.

Table 3: Advisory Committee outreach.

Organization
California Market Transformation Administrator (CalMTA)
California Public Utilities Commission (CPUC)
California Technical Forum (Cal TF)
Pacific Gas & Electric (PG&E)
Southern California Edison (SCE)
TECH Clean California

This outreach allowed advisory committee members to provide candidly written comments and suggestions, which were reviewed by the TPM coordinator and the 2026 Water Heating TPM SME team before being incorporated into the Revised 2026 Water Heating TPM section. A detailed account of these changes can be found in Table 8 in Appendix A.

Residential and Small Commercial Heat Pump Water Heaters

CalNEXT Priority: High

Definition

Commercially available integrated and split electric heat pump water heaters (HPWHs) meet the demands of residential households and small businesses, delivering hot water two to five times more efficiently than conventional electric resistance, standard gas water heaters, or fossil-fuel-fired water heaters. Innovations — including plug-in 120V and field convertible 120/240V models, low-GWP refrigerants, load-shifting capabilities, and alternative form factors — offer increased utility and environmental benefits while supporting diverse retrofit applications. The 2025 CA Potential and Goals Study found annual Total System Benefit potential of $30 billion in 2026 and rising through 2030, for all Residential Water Heating.[3]

Research Initiatives

Table 4: Residential and small commercial HPWH research initiatives.

Research Initiatives	Performance Validation Needs	Market Analysis Needs	Measure Development Needs	Program Development Needs
Plug-in 120V residential				
Small commercial				
Split systems and small form factor				
Connectivity and load shifting in HPWHs				

KEY High Needs Medium Needs Low Needs Future Needs

Opportunities

- Storage HPWHs are a critical residential and small commercial building decarbonization strategy, providing a cost-effective, electric water heating solution for load reduction and shifting usage out of carbon-intensive utility periods.
    - There is enormous potential for load shifting and shaping, load management, and the resulting greenhouse gas (GHG) reduction from shifting the heating schedule to times when the electricity grid has a lower marginal emissions rate and cost to operate. General

[3] https://public.tableau.com/app/profile/cpuc.pg.study.2025/viz/2025CPUCPGResultsViewer06-09Release/LandingPage; Scenario 1, Reference ZEAS 2030

load shape definitions and rules take priority and should be addressed first. Meanwhile, subsequent HPWH performance validation, measure, and program development will be important to accurately assess impacts and adoption pathways of split systems, 120V and convertible 120V/240V convertible unitary, and solar-assisted models.
    - It will also be necessary to evaluate the interaction of HPWHs with recirculation systems and optimize designs, including HPWH selection, upsizing storage capacity, and use of integrated or master mixing valves. Additionally, it will be important to standardize first-hour and recovery ratings for HPWHs—as well as appropriate design and installation best practices for installer training—to account for recovery rates of different HPWHs and ensure satisfactory performance for all residential users.
    - Significant gains have been made in developing best-practices guides for the sizing and installation of HPWHs; however, additional research is required to assess design solutions and applications in common recirculation pump designs found in many California homes and small businesses.

- Shifting to low-GWP refrigerants like CO_2 offers both increased performance and higher storage temperature capabilities, and eliminates the GHG emission impacts of refrigerant leakage.
    - To support the market shift, future research should identify and evaluate the performance of the best use cases of ultra-low GWP refrigerants in residential and small commercial HPWHs.

- Planned zero-emission regulations on residential water heaters statewide are based on reducing indoor exposure to combustion gases to households.
    - The assessment and attribution of non-energy benefits—such as health impacts from air quality and innovative solutions that increase equitable access to HPWHs—are important for supporting an accelerated transition away from gas water heaters.

- To achieve equitable, scalable HPWH market development, it is necessary to identify opportunities for equipment cost compression and lowering installation costs. Additionally, to establish a sustainable and sufficiently capitalized incentive program that enables accelerated HPWH adoption, it is critical to assess existing and new, innovative, and equitable financing mechanisms and market interventions.
- The quickest opportunities for market adoption and TSB come from "easy access" (e.g., located in a garage) gas electric resistance water heaters—which make up 7 percent of the California market—as well as new construction. To support these market sectors, implementers should design programs that support incentives for switching from an electric resistance water heater to an HPWH, along with enhanced builder engagement strategies.
- Plug-in 120V HPWH models offer disadvantaged community (DAC) and hard-to-reach (HTR) renters and homeowners a lower-cost and efficient alternative to 240V HPWH fuel-switching retrofits, overcoming common financial barriers and avoiding costly electrical infrastructure and panel upgrades. 120V split systems may provide a solution for manufactured housing stock with a solution to fit limited electrical capacity and space.
- Market transformation efforts from TECH Clean California and plans for a Market Transformation Initiative from CalMTA provide additional stakeholders and potential targets for technology transfer.

Barriers

HPWHs face many barriers, but most of them are due to market and installation practices, not shortcomings in the technology itself. HPWHs have installation challenges and operational features not found in common gas storage alternatives that can make fuel-switching more difficult.

- The cost effectiveness of HPWH fuel substitution can be negatively impacted due to high HPWH equipment and installation costs, current electrical and gas tariff structure, customer concerns about electric cost trends, and/or grid integration incentives.
- Plumbing contractors generally lack awareness of HPWHs and do not have expertise in their design and installation, including the disposal of condensate and ensuring adequate airflow and venting for proper performance.
- Electrical service or panel upgrades can be a significant cost barrier; market expertise and guidelines are needed to describe when load management strategies or 120V products may be deployed to mitigate the expense of an upgrade.
- Emergency replacements are the most common scenario for a new water heater installation in existing homes, which creates immediate cost, time, and complexity barriers to conversion from conventional gas water heaters, including hiring a separate electrical contractor. Regional initiatives are exploring how to streamline permitting processes to mitigate this issue.
- Split-incentive issues between property owners and rental ratepayers complicate the costs and benefits of HPWHs.
- Space, comfort, and noise issues can undermine the suitability of unitary HPWHs, requiring a smaller form factor, split designs, or relocation.
- The introduction of new low-GWP natural refrigerants will require reevaluating their performance, as well as addressing permitting barriers and perceptions of safety risks with local inspectors.
- There is an absence of a savings claims infrastructure, including Electronic Technical Reference Manual (eTRM) load shapes, rules for quantifying load shape benefits, rules for viable electric alternative measures to replace gas appliances, and the coordination on refrigerant leak reduction efforts.
- Mobile and manufactured homes, which are common in DAC and HTR communities, have unique challenges for the installation of HPWHs due to limited electric panel capacity (30A–100A), wiring concerns, and state agency rules on exterior installation.
- Typical water heater closets found in mobile homes have insufficient space (volume measured in cubic feet) and venting for the normal operation — let alone optimal performance — of HPWHs, which makes this technology unfeasible for fuel-switching scenarios without additional structural remediation.
- High water temperatures required by health and building codes for small commercial buildings may limit opportunities for HPWH applications and reduce performance. High setpoints promoted for demand flexibility may also reduce efficiency.

Related CalNEXT Projects

- ET24SWE0017 – Small Medium Business HPWH Emergency Deployments
- ET23SWE0020 – Emergency Replacement Heat Pump Water Heater Market Study
- ET23SWE0035 – Residential HPWH Market Study and Measure Gap Analysis

- ET23SWE0075 – HPWH Conversion Readiness Program Focused Pilot
- ET23SWE0074 – Plug-in 120V HPWH Measure Package Updates to eTRM
- ET22SWE0056 – Increasing Heat Pump Water Heater Deployment
- ET22SWE0036 – Residential Water Heater Sizing Measure Package Support
- ET24SWE0011 – DAC HTR Statewide Single Family Housing Characteristics Study
- ET23SWE0017 – Mobile and Manufactured Housing Market Characterization Study
- ET23SWE0063 – Residential Heat Pump Financing Solutions Analysis
- ET24SWE0044 – DIY HPWH Installation & Market Study
- ET25SWE0026 – California Multifamily Split HPWH Market Study
- ET24SWE0062 – Light-Duty Commercial Heat Pump Water Heater Focused Pilot

Resources and Links

The team mainly referenced CalNEXT projects in the development of this technology family work.

Commercial Domestic Hot Water System Design

CalNEXT Priority: High

Definition

Domestic hot water (DHW) systems are among the largest end uses poised for decarbonization. HPWH options offer higher efficiency than electric resistance and gas alternatives and can achieve significant energy and GHG savings. This technology research area covers efficient, demand-flexible DHW systems for multifamily and nonresidential applications, such as offices, hotels, healthcare, and foodservice. Hot water systems under this group may include a primary heat source (e.g., heat pump), storage, distribution, recirculation, pumping, valves, controls, temperature maintenance systems, heat recovery, and alternative heat sources (e.g., solar or geothermal).

Research Initiatives

Table 5: Commercial domestic hot water system design research initiatives.

Research Initiatives	Performance Validation Needs	Market Analysis Needs	Measure Development Needs	Program Development Needs
Split HPWH	High	High	High	High
Unitary HPWH	High	High	Medium	Medium
Load flexibility controls	High	Medium	High	High
Dual-fuel systems	High	High	Medium	Medium
Distribution system optimization and recirculation	Medium	High	High	High
Heat recovery	High	High	Medium	Medium

KEY High Needs | Medium Needs | Low Needs | Future Needs

Opportunities

This research area offers many important targets of research, development, and market transformation across different technologies, designs, and market segments, each with their own needs. These projects could be executed as field demonstrations, technology development, lab studies, market studies, modeling, market transformation tools, or novel program delivery mechanisms. The state of understanding and research needs may differ, based on design configuration (e.g., integrated, split, central, or clustered), segment (e.g., education, hospitality, healthcare, office, foodservice, or multifamily), or building vintage (i.e., new construction or retrofit).

Opportunities to address include:

- Reducing DHW system energy use and improving efficiency, designing without backup or temperature maintenance electric resistance (such as return-to-primary configurations), and reducing the complexity of all-electric centralized HPWHs.
- Quantifying defrost derate for output capacity of split heat pumps to ensure designers are aware of specific needs, depending on refrigerant type and split HPWHs models. Sufficient backup electric resistance or additional heat pumps may be necessary to ensure capacity is maintained on defrost design day.
- Exploring innovative program designs that can bring the benefits of HPWHs to DACs. Programs could quantify and enhance the benefits of commercial HPWHs for DACs by passing benefits to tenants, improving air quality, innovating financing mechanisms, or adopting other innovations in program delivery.
- Developing incentive programs for medium and large low-GWP commercial HPWHs in nonresidential and multifamily buildings. Innovative program designs can ensure the multiple value streams of efficiency, decarbonization, and grid-integration are all actualized.
- Demonstrating overseas HPWH technologies that use new low-GWP refrigerants and other form factors—such as low-GWP integrated HPWH or 20- to 30-gallon integrated HPWHs—for distributed point-of-use applications.
- Reducing cost and space requirements through new designs, configurations, and equipment selection of HPWHs, temperature maintenance, and storage tanks. This could be achieved in multiple ways, including technology development, field demonstrations, or design guideline development.
- Developing a guideline that defines existing designs, hot water temperatures, and loads for service hot water systems in non-residential building subsegments. This guideline should illustrate optimized designs and connect the complexity of service hot water systems to decision frameworks for owners, designers, contractors and programs. Additionally, it should demonstrate that hot water needs vary significantly in non-residential buildings—and that there is opportunity to simplify and electrify service hot water systems for some applications and move away from standard designs where appropriate.
- Design and field assessment of dual-fuel DHW systems to address the needs of high-load, rapid-recovery applications—such as existing commercial kitchens, hotels, and multifamily buildings with gas water heaters—with gas back-up, trim, or boost, as secondary to a primary HPWH. Dual-fuel hot water systems may present an opportunity to reduce first cost, deliver both gas and electric savings, and temper performance uncertainties by leveraging existing gas infrastructure during market transition, especially in the gas retrofit market.
- Demand flexibility controls demonstration and implementation guidance, which could include optimizing load flexibility controls to minimize energy costs and GHG emissions. Additionally, this guidance could provide technical and program-required recommendations for streamlined, onboard load-shift programming for HPWH systems.
- Evaluating automated, algorithmic load shift controls based on input parameters, such as monitored system operation, system capacity, hot water loads, total building coincident electrical demand, and utility rates (real-time or scheduled time-of-use).
- Assessing new unitary commercial HPWH designs at and above 12 kilowatts (kW) that offer more versatility for application in existing buildings, with features such as direct ducting

options, inlet filters rated for the minimum efficiency reporting value that capture grease and lint, additional operating modes that fully lock out the electric resistance operating mode, and integrated controls to optimize usage, cost, and GHG, based on time-of-use factors such as peak rate periods and utility flex alerts.

- Bringing clarity to designers for cost-effective drain water heat recovery scenarios and using recovered heat as a heat pump source thermal reservoir.
- Incorporating integrated exhaust air or refrigerant heat recovery systems at the water heater or point-of-use equipment location and exploring capture and recovery of cooling effects of HPWHs to offset cooling loads, such as in a commercial kitchen.
- Optimizing distribution systems through novel recirculation and load-matching control strategies, such as automatic balancing valves, combined optimization of temperature modulation, variable speed pumps with integrated constant return temperature control or occupancy-based inputs, distributed isolating valves, and pipe insulation.
- Incorporating high-performance master mixing valves to increase thermal storage capacity and usage, increase the tank temperature stratification with continuous recirculation, and reduce recirculation loop heat losses through precise control.
- Exploring innovative program pathways and strategies for supporting the remediation and upgrades of existing, recirculating DHW distributions systems—e.g., pipe insulation, pipe hangers, shower crossover repair, balancing, pump controls, and more.
- Improving system efficiency through clustered centralized systems.
- Enhancing the energy density and load matching of solar thermal and photovoltaic-assisted water heater designs.
- Increasing commercial HPWH thermal energy storage density and enhancing their performance by using phase-change materials while assuring reliability and durability.
- Assessing innovative utility rate structures or dedicated metering to facilitate decarbonization by mitigating operating cost burdens on building owners. New rates for decarbonized buildings or water heating can help avoid the financial burden that retrofits may realize when switching to electric heat pump water heating.

Barriers

Commercial HPWH systems are still in a nascent technological stage that continues to evolve. Physical space, electrical infrastructure, and installed costs are major upfront barriers that have slowed HPWH adoption in retrofit nonresidential and multifamily applications. Of particular concern are escalating operating costs and affordability, as the electricity-to-gas cost ratio per unit of energy is approximately six-to-one—significantly higher than in recent years. Other limitations include product availability of low-GWP, four-season heat pumps, as well as weight and noise.

Researchers and design firms have developed better sizing tools to right-size heat pumps, which mitigates cost and space requirements in multifamily buildings, but similar tools are needed for many other commercial HPWH applications. Current health department sizing requirements do not address the use of HPWH systems in commercial kitchens and do not account for storage volume as a factor in sizing water heater capacities. Recirculation systems—although important to improve hot water delivery time and minimize water waste—can heavily impact water heater performance in central multifamily and commercial buildings.

Barriers to address include:

- Lack of diverse, commercial-duty integrated heat pump products, such as 120- to 200-gallon HPWHs, as well as lack of outside installation, ducting, and high-performance air inlet filter options.
- Lack of field performance data for various designs, configurations, and applications—including system reliability and cost effectiveness—to enhance industry knowledge and confidence in various HPWH technologies, products, and use cases.
- Lack of easy-to-access case studies that span the diversity of buildings with commercial HPWHs (120V-integrated HPWHs, 240V-hybrid-integrated HPWHs, indirect central HPWHs, and HPWHs combined with complementing distribution strategies, including point-of-use heaters, heat recovery, master mixing valves, balancing, and others).
- Regulatory barriers to R290 HPWH development and adoption.
- Lack of design tools to select, appropriately size, and model HPWHs outside of multifamily applications.
- Minimal documentation and empirically determined hot water load profiles for various nonresidential building types.
- Ways to streamline electrical panel upgrades to support HPWHs or alternative technologies to minimize or eliminate the need for upgrades.
- Lack of HPWH familiarity for building permitting authorities and health departments.
- Lack of coordination between trades, such as engineering design, electrical, and plumbing.
- Changes in the tariff structure and grid integration incentives to mitigate cost-effectiveness concerns.
- Lack of code readiness activities to support electric ready code requirements for all nonresidential building types that use commercial water heaters.
- Lack of demonstration, guidance, and simplified implementation procedures of dependable demand flexibility and load-shifting controls.
- Lack of trusted distribution system software tools and design guides.
- Lack of trusted software tools and design guides to simplify solar hot water system designs.
- Lack of consistency among code requirements related to hot water setpoint temperatures.
- Lack of experience deploying drain water heat recovery, particularly with the variety of potential heat sources.
- Lack of experienced practitioners who can bring quality commercial-HPWH systems to building owners.
- Potential efficiency and reliability degradation with improperly designed or maintained recirculation systems served by large HPWHs.
- Legionella risk should be addressed through technological means to expand HPWH system use cases and confidence.
- Limited business case and value proposition for contractors to promote and install HPWHs due to higher installation complexity and costs.

Related CalNEXT Projects

- ET22SWE0017 – Commercial and Multifamily CO_2 Heat Pump Water Heater Market Study and Field Demonstration

- ET22SWE0019 – Market Potential for Heat Pump Assisted Hot Water Systems in Foodservice Facilities
- ET22SWE0048 – Commercial Kitchen Hot Water System Design Guide
- ET22SWE0028 – Packaged Central CO_2 Heat Pump Water Heater Multifamily Demonstration
- ET22SWE0046 – Restaurant Field Monitoring
- ET22SWE0047 – Master Mixing Valve Field Study
- ET24SWE0017 – Small Medium Business HPWH Emergency Deployments
- ET23SWE0057 – Overcoming Key Barriers to Electrification of Foodservice Hot Water in California
- ET23SWE0059 – CHPWH Unpressurized Storage Design Optimization
- ET24SWE0027 – Characterization of Central Heat Pump Water Heating Deployment in the Multifamily Market
- ET24SWE0029 – Multifamily Central Heat Pump Water Heater Field Study
- ET24SWE0030 – Central Heat Pump Water Heating Control Optimization
- ET22SWE0050 – Tech Evaluation of Air-to-Water Heat Pumps with Thermal Storage
- ET25SWE0017 – Return-to-primary Central HPWH System Field Demonstration
- ET25SWE0026 – California Multifamily Split HPWH Market Study

Resources and Links

- CalFlexHub — The California Load Flexibility Research and Development Hub (Lawrence Berkeley National Laboratory)
- Ecosizer — Commercial and Multifamily Building Sizing Tool (Ecotope)

Residential Multifunction Heat Pumps

CalNEXT Priority: High

Definition

Residential multifunction heat pumps (MFHPs) use an efficient compressor system to serve both the space conditioning and water heating requirements of a household—typically configured as a primarily hydronic system—and can come in multiple formats. Two-function (or combination) heat pump systems serve space heating and water heating demands, while three-function MFHPs also provide space cooling. This technology family is prioritized primarily as a heating, ventilation, and air conditioning (HVAC) water heating integration pathway.

Note: This technology family is cross listed with the HVAC TPM[4].

Research Initiatives

Table 6: Residential multifunction heat pump research initiatives.

Research Initiatives	Performance Validation Needs	Market Analysis Needs	Measure Development Needs	Program Development Needs
Two-function: water heating and space heating	High	Medium	High	Medium
Three-function: hot water, space heating, and space cooling[5]	High	Medium	High	High
Selection guidelines	High	High	Medium	Medium

KEY High Needs | Medium Needs | Low Needs | Future Needs

Opportunities

Residential MFHPs offer a novel pathway to decarbonization, providing an efficient alternative to existing gas-fired equipment or the current approach of multiple heat pumps, which consists of an HPWH and a packaged central heat pump. MFHPs can potentially replace space heating, space cooling, and water heating with a single system, depending on the configuration and design. They also have the potential to provide much higher TSB by extending the benefits of thermal storage to space heating—and potentially space cooling. Additionally, the single heat pump may free up a home's electrical panel capacity for other electrification uses, offer peak kW demand reduction, and could be deployed with less overall refrigerant charge than current heat pump practices.

MFHPs are relatively new to the US market, and, as a result, there are many opportunities to improve

[4] This technology family also cross-cuts with research initiatives 1 and 2 in the Integrated Systems technology family of the Whole Buildings TPM (https://calnext.com/resources/whole-buildings/).

[5] This research initiative is not in the eTRM at this time, leading to its current ranking.

the understanding of their performance and impact on the residential sector. Opportunities for research include:

- Laboratory testing of MFHPs to evaluate system performance in various applications.
- Field demonstration or performance validation of MFHP in new construction and existing building applications across different climate zones.
- Market assessment of MFHP for California homes, including cost and requirements associated with MFHP installation in new construction and existing buildings.
- Assessment of the potential TSB value of MFHPs (energy performance, demand flexibility, fuel substitution, and refrigerant emissions) compared with the efficiency of single-function separate heat pump, HVAC, and water heating equipment.
- Assessment of the bill impacts and customer economics of MFHPs (total costs of operation, operating costs under current rate structures, increased value of load shed, etc.) compared with the efficiency of single-function separate heat pump, HVAC, and water heating equipment.
- Development of modeling tools to compare various MFHP types, guide program development, and/or support early adopting market actors.
- Understanding workforce needs related to upselling practices to customers, comfort level of installation, and maintenance needs.
- Validation of customer amenability and confirmation that proper hot water temperature and space temperatures can be met.
- Field demonstration and cost-saving or bill performance validation for DACs and HTR residences in a fuel-switch scenario where electrical panel capacity is commonly limited.
- Market assessment and field performance of “all-in-one" heat pumps and energy recovery ventilator products.

Barriers

As an emerging technology in the US market, there are many barriers to MFHP adoption to address. It is necessary to understand the performance of MFHPs in the context of US homes, the development of testing and installation standards, and the development of equipment selection guidelines to learn how effective MFHPs could be in meeting California’s decarbonization goals—as well as in encouraging MFHP use in California. Specific barriers include:

- Absence of standardized testing procedures for MFHP evaluation, including heat recovery and simultaneous modes of operation.
- Lack of MFHP product offerings compared to international markets, particularly those where hydronic heating is common.
- Limited products on the marketplace that have been field tested and demonstrate good performance (combined water heating, space heating, and cooling coefficient of performance) and reliability.
- Limited understanding of how well MFHP systems manage occupant thermal comfort.
- Absence of a standardized installation procedure and contractor or installer knowledge.
- Lack of understanding of the efficiency and decarbonization opportunities of MFHPs compared to independent systems.
- Need for market assessment of MFHPs for California homes, including cost and requirements associated with new construction and retrofits.

- Absence of MFHP modeling and design tools.
- Lack of performance standards.
- Lack of awareness, knowledge of benefits, and understanding of sentiment within DACs and HTR communities.
- Retrofits may be constrained by the fact that water and space conditioning systems would rarely have to be replaced simultaneously for existing buildings.
- Current MFHP marketing has positioned these units as an option for luxury condos versus low-income or market rate properties due to their significantly higher installed cost and complexity, but with compactness and luxury (radiant or wall-based space heating) benefits. When compared to separate heat pump units, MFHPs are anticipated to not provide payback due to a range of barriers listed. Currently, MFHPs are not viable for most new construction and retrofit residential applications.

Related CalNEXT Projects

- ET22SWE0021 – Residential Multi-Function Heat Pumps: Product Search
- ET22SWE0051 – Residential Multi-Function Heat Pump: Heat Exchanger Improvement
- ET23SWE0047 – Residential Multi-Function Heat Pump Laboratory Testing
- ET23SWE0066 – Lab Test of a Variable Speed Air-to-Air Multi-Function Heat Pump
- ET24SWE0020 – Demonstration of "Combi" Air-To-Water Heat Pump
- ET22SWE0050 – Tech Evaluation of Air-to-Water Heat Pumps with Thermal Storage
- ET25SWE0024 – Residential Multi-function Heat Pump Market Study
- ET24SWE0058 – Multi-Function Heat Pump Research Home Test – Variable Speed

Resources and Links

- CalFlexHub - Integrated Heat Pump for Residential HVAC and DHW with Hot Water Storage

Commercial Multifunction and Combination AWHPs

CalNEXT Priority: Medium

Definition

Commercial multifunction air-to-water heat pumps (AWHPs) can serve water heating and space conditioning needs for multifamily or non-residential buildings. This multifunction category includes combination AWHPs that provide DHW and space heating; it also includes systems that additionally provide space cooling, using refrigerant to move thermal energy in air-to-hydronic and air-to-forced air conditioning distribution systems. They typically can provide two or three functions simultaneously.

Research Initiatives

Table 7: Commercial multifunction and combination AWHP research initiatives.

Research Initiatives	Performance Validation Needs	Market Analysis Needs	Measure Development Needs	Program Development Needs
Combination: DHW and space heating[6]	High	Medium	High	High
Two-function: DHW and space cooling	High	High	Low	Low
Multifunction: DHW, space heating and cooling	High	High	Low	Low
Sizing methodology	High	Medium	Low	Low
Modeling and software tool development	High	Medium	Low	Low
Test method development	High	High	Low	Low

KEY High Needs | Medium Needs | Low Needs | Future Needs

Opportunities

Multifunction AWHPs that can provide multiple hydronic services to a building can address efficiency and decarbonization market needs across multifamily and nonresidential sectors.

[6] The first research initiative is further advanced than two-function or multifunction equipment, thus has lower needs prioritization based on prior work on performance validation, market analysis, but higher needs for measure and program development since some work is already underway and it can be further expanded.

Opportunities to address include:

- Testing laboratory applications and field demonstrating various multifunction AWHP systems in new construction and existing buildings.
- Developing sizing tools based on building load inputs and development of multifunction AWHP performance maps.
- Developing modeling and software tools to be validated with laboratory and field demonstration data.
- Assessing electrical infrastructure impacts, especially in retrofit applications. Will multifunction hydronic heat pumps reduce the need for electrical service or panel upgrades when decarbonizing existing buildings? Can a multifunction hydronic heat pump use existing chiller electrical service?
- Conducting studies on retrofitting existing buildings with variable refrigerant flow systems with multifunction hydronic heat pumps. In applications where variable refrigerant flow systems are failing, multifunction hydronic heat pumps may be a cost-effective decarbonization solution with lower refrigerant charges.
- Assessing the benefits in space, cost, energy, peak power, and GHG emissions relative to decarbonization solutions that rely on separate heat pumps for DHW, cooling, and heating.
- Integrating thermal energy storage and quantifying the amount of energy available for load flexibility.

Barriers

Barriers to address include:

- Manufacturers, researchers, programs, and regulators need standardized test methods for combination and multifunction AWHPs with native controls that mimic real world conditions and operation for all products and all configurations.
- Multifunction AWHP efficiency may not be as high as separate heat pumps for DHW, cooling, and heating. This requires improved understanding of the definition of multifunction system efficiency and how controls, heat recovery, and system design can increase efficiency in multifunction AWHPs.
- Impacts on occupant comfort are not known. This requires improved understanding of controls, capacity, and system design that can maintain occupant thermal comfort, e.g., determining whether simultaneous water heating and space heating loads are being met.
- Multifunction AWHP technologies are more popular in international markets, particularly those in which hydronic heating prevails. More research is needed to understand and address the barriers to entry and possibilities in the US market.
- Research has not yet explored the load flexibility of multifunction AWHPs. Controls that incorporate function switching, thermal energy storage, and load up and shed require modeling, development, and testing.
- Early adopter approaches are often custom-engineered, site-built systems. Packaged designs are needed for design, equipment, installation, and commissioning cost compression.

Related CalNEXT Projects

- ET24SWE0042 – Multipurpose Hydronic CO2 Heat Pump for Commercial Buildings

- ET23SWE0048 – Commercial Air-to-Water HP Market Study

Resources and Links

The team mainly referenced CalNEXT projects in the development of this technology family work.

Discussion

Following approval of the 2026 Water Heating TPM, the program team will:

- Update the CalNEXT website with revised 2026 Water Heating TPM and this final report.
- Launch an email announcement through email outreach.
- Develop and submit the distribution report.
- Highlight any technology families to reinvestigate for the 2026 Focused Pilot TPM, which will support the 2027 Focused Pilot projects.

Appendix A: Water Heating Advisory Committee Feedback & Resolution Matrix

Table 8: Advisory Committee feedback and resolution matrix.

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
All Technology Families	Opportunities	Can the opportunities be prioritized based on impact (from high to low)? This prioritization should be applied across all families.	The project team discussed this suggestion further and would like to revisit for the 2027 TPM revision cycle.
General Narrative	2026 TPM Changes	What technology transfer outcomes have emerged from prior Water Heating TPM efforts?	Added paragraph and table to TPM Changes section. This is a trickier question because the team is looking at projects committed in 2022, 2023, 2024 and 2025 so they map to all TPM versions and all different stages of our "Tech Transfer" logic.
General Narrative	Stakeholder Feedback	Does this suggest diminishing savings potential as the water heating market becomes increasingly saturated?	No change: recent conversations point to significant savings revisions. Much of the high TSB values on record currently are driven by very high per-unit assumptions rather than high penetration.
Residential and Small Commercial Heat Pump Water Heaters	Definition	To better indicate the overall magnitude of the opportunity, would including technical potential in TPM be beneficial?	Results from 2025 Potential Study added.
Residential and Small Commercial Heat Pump Water Heaters	Opportunity #1	Do existing EE policy guidelines allow these benefits to be reflected in TSB? If not, what additional methodologies or policy updates would be required to capture them, and does the TPM propose to address these shortcomings?	Added language to highlight the needed policy updates, which would be more a focus of the Portfolio Enhancements TPM.

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
Residential and Small Commercial Heat Pump Water Heaters	Opportunity #6	120V split systems could be well-suited for mobile homes, particularly by addressing existing power and space constraints.	Added mention of split systems.
Commercial Domestic Hot Water System Design	General Narrative	**Suggested scope adjustments** • Distinguish more clearly between new construction, planned retrofit, and reactive replacement pathways, since these markets have different barriers, economics, and program interventions. • Elevate recirculation remediation and distribution optimization from a technical subtopic to a core implementation issue, especially for multifamily and commercial retrofits where system losses can undermine performance and customer satisfaction. • Add more explicit guidance on where packaged or semi-packaged solutions are feasible versus where projects remain highly custom-engineered. This distinction matters for whether the technology family is realistically	Agreed that construction, planned retrofit, reactive replacement, etc have different barriers and interventions, but those should be addressed at the proposal stage; TPMs are intended to guide project proposals without constraining them. Second point: Will pass this along to SMEs to update opportunities and barriers. Third point: This addresses tech transfer component of CalNEXT, and agreed that packaged and semi-packaged solutions generally are more favorable. Fourth and fifth points: Will pass this along to SMEs.

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
		scalable in normal program delivery. • Reframe demand flexibility controls around deploy ability: onboarding, controls integration, site commissioning, tariff compatibility, and verification of bill value—not just control logic. • Clarify which applications are best suited for dual-fuel transition pathways and whether these are intended as interim decarbonization strategies, cost-compression tools, or reliability and risk mitigation tools.	
Commercial Domestic Hot Water System Design	Definition	Does it include standalone, hybrid and central systems?	Any of those would apply, yes! Split, unitary, dual-fuel, and central all referenced throughout the RIs, opportunities, and barriers.
Commercial Domestic Hot Water System Design	Definition	This section captures the complexity of commercial domestic hot water system design well, including recirculation, controls, heat recovery, dual-fuel options, and distribution optimization. The main improvement needed is to connect that complexity to decision frameworks for owners, designers, contractors, and	Connecting that complexity for relevant stakeholders is important. Being that this is evolving with the nature of HP technology and types of systems, the code research evolution to distributed generation for smaller facilities and use of end us equipment with onboard heating to remove needs and size of main hot water system, it is even more complex than what this section prioritizes with the research initiatives. Coming back to connecting this complexity, this is best done in design guides, one being a CalNEXT funded design guide for foodservice

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
		programs.	which was completed a few years ago, the other being a HPWH system MF design guidelines being developed by ASHRAE. Certainly, more can be done through CalNEXT especially with NR buildings and dealing with the diversity of SHW systems with the various subsegments and sizes of buildings. We just added an opportunity based on these comments for NR to focus on defining the various types of systems and to enable connecting that complexity.
Commercial Domestic Hot Water System Design	General Narrative	**Implementation gap.** The section presents many valid technical opportunities and needs stronger prioritization around which use cases are nearest to scalable deployment and what evidence package would make them actionable for program administrators and implementers.	The section is divided into definition, research initiatives, opportunities, barriers, related projects, and resources. It is already lengthy. There is no general narrative in the section. I am not aware of examples from other sections that prioritize opportunities, or that define scalability, or ease of program development. I feel that we would need to add a section or more to discuss these aspects and that would need to be consistent with other sections in the WH TPM and also other TPMs. While all this is of value, it is a significant expansion of scope and we like to make sure that there is consistency and also TRM budget to do so. Zoe, Greg, Please advise.
Commercial Domestic Hot Water System Design	Opportunity #4	Is this associated with the development of a measure package? If so, it may be appropriate to highlight this as a key opportunity. This could be an opportunity across all tech families	Measure packages are already in place, rather this is calling out delivery channels and program design innovation to use the existing and future measures.
Commercial Domestic Hot Water System Design	Opportunity #7	How would this apply in jurisdictions that are implementing bans on combustion systems?	Amended text for this opportunity.

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
Commercial Domestic Hot Water System Design	Opportunity #10	Please elaborate what these designs are?	Unitary is the key distinguisher. There is only one current product at 12 kW and everything above is larger and split system. Additional larger unitary in this medium size range would have good market benefits.
Commercial Domestic Hot Water System Design	Opportunity #19	Please provide additional clarity	Clarified, new rates for decarbonized buildings or water heating can help avoid the financial burden that retrofits may realize when switching to electric heat pump water heating.
Residential Multifunction Heat Pumps	General Narrative	Does it also have synergies with the whole buildings TPM?	Yes, there are synergies with whole building strategies, but not at the same level as the impacts on HVAC direct savings and benefits, so it hasn't been fully cross-listed.
Residential Multifunction Heat Pumps	General Narrative	**Implementation gap.** This section would benefit from less conceptual discussion and more emphasis on where, for whom, and under what program conditions MFHPs could be deployed at scale in California.	The section is divided into definition, research initiatives, opportunities, barriers, related projects, and resources. There is no general narrative section. I am not aware of examples from other sections that discuss where, for whom, and under what program conditions MFHPs could be deployed at scale in California. I feel that we would need to add a section and that these topics would need to be consistent with other sections in the WH TPM and other TPMs. While all this is of value, it is a significant expansion of scope.
Residential Multifunction Heat Pumps	General Narrative	**Suggested scope adjustments** • Clarify whether this technology family is being prioritized primarily as a water heating pathway, a whole-home electrification	• Added sentence under definition to prioritize it under HVAC-WH integration pathway. • It is already noted under opportunities that MFHPs outperform separate units for electrical panel capacity and refrigeration charge reasons. I added peak kW demand reduction. It does not offer benefits but rather drawbacks on thermal storage

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
		pathway, an HVAC-water heating integration pathway, or an early-stage market characterization topic. Without that clarification, it is difficult to assess the intended downstream use of the work. • Sharpen the customer value proposition relative to simpler alternatives, especially a separate high-efficiency heat pump for space conditioning plus a standard HPWH. The report correctly notes potential benefits, but it should more directly identify the specific cases where MFHPs clearly outperform a two-product solution on cost, panel capacity, thermal storage value, or refrigerant reduction. • Add more explicit discussion of installer readiness, service pathways, fault isolation, and maintenance ownership, because integrated systems can create ambiguity about who installs and services what. • Strengthen the discussion of market segmentation. Not all California homes are good	value, installed and operating cost, complexity, ease of maintenance, familiarity, etc. • Added barrier that MFHPs have been marketed mainly for luxury condos due to installed cost (including hydronic emitters) and compactness benefits. That they will not provide a payback versus separate HPs thus not viable for market and low income new construction or retrofit applications at present time. • Frankly, it is too early for measure adoption, this is not included in final report.

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
		candidates. The report should identify likely lead adoption segments, such as specific new construction typologies, electrification retrofits with constrained panel capacity, or homes where hydronic integration offers a clear advantage. • Clarify what evidence is needed for measure development and program uptake, especially given that some research initiatives are not yet in eTRM and the product category is still emerging.	
Residential Multifunction Heat Pumps	General Narrative	The Residential Multifunction Heat Pumps section is strong, but it overlaps substantially with the same technology family in the HVAC TPM, and the two reports can be better harmonized to avoid duplication or confusion.	The HVAC and Water Heating TPMs are meant to have this technology family as cross-cutting, this has been made clear in the narrative.
Residential Multifunction Heat Pumps	General Narrative	Direct overlap: Residential Multifunction Heat Pumps The most explicit overlap is Residential Multifunction Heat Pumps, which the Water Heating report states is cross-listed with the HVAC TPM, and the HVAC report	After discussion with the SME (HVAC TPM), the Residential MFHP section of the WH TPM has been edited to match the HVAC TPM. The HVAC TPM has already been edited in response to stakeholder feedback - in future iterations of the TPM, we will consider the approach in the last comment regarding designation of a lead narrative with a shorter cross-reference in the other TPM.

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
		similarly states it is cross-listed with the Water Heating TPM. The two write-ups are highly similar in structure and content. Both describe MFHPs as integrated systems serving water heating and space conditioning, with optional cooling. Both emphasize laboratory testing, field demonstrations, market assessment, total system benefits and customer economics, modeling tools, and workforce needs. Both cite lack of standardized testing, limited product availability, installation uncertainty, limited market understanding, and lack of modeling tools as key barriers. **Recommendation on overlap.** Rather than maintaining two near-duplicate narratives, it may be better to designate one report as the lead narrative owner for Residential Multifunction Heat Pumps, keep a shorter cross-reference summary in the other report, and explicitly identify which program questions belong to HVAC, water heating, or integrated whole-home deployment. That would reduce duplication and better support downstream prioritization.	
Commercial Multifunction and Combination AWHPs	General Narrative	**Implementation gap.** The section should more explicitly address who bears performance and design risk, what evidence building owners need to proceed, and how CalNEXT outputs would reduce those risks in actual market delivery.	This is captured under barriers by providing a list of barriers that inhibit building owners proceeding including lack of awareness, only a small portion of products have shown good field performance, high cost, limited maintenance techs. The subsections are not setup to talk about implementation gaps explicitly.

Water Heating TPM Technology Family	Section	Suggestion or Comment	Action Taken & Justification
Commercial Multifunction and Combination AWHPs	General Narrative	**Suggested scope adjustments** • Narrow the focus toward applications where packaging and repeatability are plausible, rather than treating all multifunction combinations as equally viable. • Add stronger discussion of specification tools, procurement models, and design-assist resources needed to move beyond bespoke projects. • Clarify how this section relates to the HVAC TPM's hydronic and complex-system families to avoid fragmented treatment of overlapping hydronic topics.	Narrowing the focus where packaging and repeatability becomes a priority will create a field where preference is given to major manufacturers rather than establishing level playing field for all including startups. Due to lack of standard test method, it is an emerging and evolving market for MFHPs thus the team cannot develop reliable specification tools, procurement models and design assist resources until each product has been vetted in the field in various applications. There are major flaws, namely sufficient controls that hold the majority of products back on the market today. No subsection in this family where it is in scope or appropriate to discuss complex system families to avoid fragmented treatment.
Commercial Multifunction and Combination WHPs	General Narrative	This section identifies a promising but still early-stage market. The report highlights sizing, modeling, test method development, and field validation. However, for prioritization purposes, it would be stronger if it more clearly separated high-potential scalable pathways from custom-engineered demonstration pathways.	Without a test standard, there is no scalable pathway due to poor controls and lack of vetting by manufacturers on a good portion of the products out in the US market. No need to prioritize as scalability is not on the table.