High-Performance Measure Details

Measure Name
Heat Pump Water Heater with Storage for Commercial Food-Service Kitchens

Use Category
SHW - Water Heating Electrification

Effective Date
May 18, 2026

End Date
-

Version
2.2

Measure Code
LM402

Measure Stage
Early Adoption & High Priority Data Collection

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Technology Summary

Heat pump water heater (HPWH) systems with thermal storage are high-efficiency water-heating systems that use vapor-compression heat pump technology to generate domestic hot water (DHW) while relying on stored hot water capacity to meet short-duration peak loads. In commercial food-service kitchens, these systems are applicable to restaurants, institutional kitchens, cafeterias, commercial food preparation areas, and similar facilities with concentrated hot water use for ware washing, food preparation, cleaning, and sanitation.

Commercial kitchen DHW loads are often high, variable, and schedule-driven, with pronounced peaks during meal preparation, service turnover, and cleanup periods. Unlike conventional gas-fired water heaters, HPWH systems depend on coordinated heat pump capacity, primary thermal storage, temperature maintenance, and controls to meet peak demand reliably while maintaining efficient operation. For this reason, central HPWH systems serving commercial kitchens must be designed as integrated systems rather than simple equipment substitutions.

This measure focuses on centralized HPWH systems with shared primary thermal storage that directly serve commercial kitchen hot water demand. Primary storage acts as a thermal reservoir, allowing heat pump equipment to operate more steadily while supporting peak draw periods that may exceed instantaneous recovery capacity. Proper sizing, storage configuration, recirculation design, and control sequencing are critical to maintaining delivery temperatures, limiting standby and distribution losses, and reducing reliance on supplemental electric resistance heating.

Common performance gaps this HPM is intended to address include undersized storage or heat pump capacity, insufficient review of peak kitchen draw profiles, excessive reliance on backup heating, poor temperature maintenance strategies, inefficient recirculation operation, and incomplete controls integration between heat pump equipment, storage, boosters, and kitchen end uses. When designed and commissioned appropriately, central HPWH systems with thermal storage can support commercial kitchen electrification, reduce on-site fossil fuel use, improve system-level efficiency, and enable load shifting and grid-interactive operation.

Alignment with CEDA Program Goals

The CEDA program supports the implementation of energy efficiency measures that support Code Readiness's Long Term Tactical Plan (LTTP) to drive the goals of electrification, decarbonization, and load reduction.

Projects must meet one of the CEDA Inducement Requirements identified in the next section to receive an inducement and will be evaluated for level of interest in metering to support Code Readiness Objectives. This measure meets the CEDA program goals as follows:

- **Building partnerships with market stakeholders** by consulting on innovative technologies and best practices in energy efficiency, which can lead to the development of more effective solutions and accelerate the adoption of new technologies. As teams adopt the measure, this increases the volume of engineers able to design the equipment, contractors capable of installing the equipment, and owners able to operate the equipment.
- **Increasing the supply of high-performance measures and all-electric buildings** by combining electrification with energy efficiency, which can result in projects implementing measures to achieve greater energy savings, reduced emissions, and overall improved building performance. As more buildings specify and install heat pump water heating technologies in commercial food service facilities, this helps to increase the overall supply of heat pump water heating technologies in the market for others to use, including beyond new construction.
- **Increasing the demand for high-performance measures and all-electric buildings** by pushing for electrification that drives the need for technological advancements, supporting economic growth opportunities through innovation, and raising awareness of the benefits of electrification to increase consumer adoption. As demand in the market increases for newer technologies, the long-term benefit is increased demand for manufacturers and suppliers to provide additional options available in the market.
- **Advancing new high-performance measure technology** by raising public awareness about new technologies and their benefits, helping build acceptance and demand through market support advocacy efforts that can influence stakeholder decisions that enable technological innovation.
- **Providing Codes & Standards with projects of interest** to collect metered data that will inform future California energy codes.

CEDA Inducement Requirements

The inducement requirements below are intended to support early adoption of high-performance heat pump water-heating systems with thermal storage in commercial food-service applications. This measure addresses a market gap where commercial kitchen DHW systems are often served by gas-fired equipment or simple like-for-like replacements, while HPWH systems require more intentional design around storage capacity, peak load management, temperature maintenance, and controls.

CEDA inducements are intended to help offset implementation barriers, support electrification and decarbonization, and encourage project teams to adopt system designs that improve energy performance and provide useful market and operational data for future code readiness efforts.

Projects must provide the required supporting documentation specified below and satisfy one of the system-level design requirements to be eligible for an inducement. Eligibility is based on the final installed system configuration, documented design intent, and ability of the system to reliably serve the commercial kitchen DHW load while meeting applicable code and program requirements.

System Design Requirements

To be eligible for this measure, the project shall install a central domestic hot water (DHW) system utilizing heat pump water heating and shared primary thermal storage.

The system shall include a minimum of 200 gallons of primary DHW storage, defined as storage that directly serves the building hot water demand. Auxiliary storage components, including temperature maintenance tanks, swing tanks, or recirculation tanks, shall not count toward this threshold.

Systems composed of unitary or packaged heat pump water heaters, including installations with multiple units operating in parallel and relying solely on internal storage, are not eligible under this measure, regardless of total or aggregate storage capacity.

1. **Essential level**: Partial Electrification (Gas Water Heater and HPWH with Thermal Storage)
    a. The gas WH and HPWH system must supply 100% of the kitchen's DHW demand across all operational hours.
    b. The gas water heater must be an instantaneous gas water heater
    c. The heat pump and storage tank must deliver water at a minimum of 120°F consistently to meet sanitation and operational needs, per California Plumbing Code requirements.
        i. The thermal DHW storage tank must be sized to handle peak hot water demand (e.g., 200 gallons minimum, based on seating capacity and usage patterns), with insulation rated at R-12 or higher to limit standby heat loss.

2. **Premium level**: Full Electrification (HPWH System with Thermal Storage)
    a. The kitchen must install a fully electric HPWH system with thermal DHW storage, supplemented by electric heating if needed, to meet 100% of its DHW needs without reliance on fossil fuels.
        i. A backup electric resistance element (integrated or separate) may be included to ensure capacity during peak demand, limited to <20% of annual heating energy to maintain efficiency.
    b. The heat pump must be sized to meet peak hot water flow rates as specified in the California Plumbing Code and manufacturer guidelines, ensuring no shortfall during maximum usage (e.g., lunch/dinner rushes).

c. The fully electric HPWH must meet Title 24 prescriptive requirements or demonstrate compliance via the performance path, outperforming the baseline energy budget.
d. Design the storage tank to supply peak hot water demand (200 gallons minimum, based on kitchen size and usage), with insulation ≥ R-12 to reduce heat loss.
e. Electric hot water boosters (e.g., point-of-use units) must be installed for equipment requiring water above 120°F (such as commercial dishwashers needing 140°F+), ensuring compliance with health codes and equipment specifications.

Supporting Documentation Requirements

1. Provide engineered, stamped, and permitted construction plans demonstrating compliance with all state and local jurisdiction requirements and regulations for installation and operation.
2. Provide a sequence of operations for the DHW system design.
3. Provide equipment submittals stamped and approved by the responsible engineer of record.
4. Provide equipment-cost information for the DHW system design.

Incremental Measure Cost

The Incremental Measure Cost (IMC) values presented below are program calibration inputs used to support CEDA inducement calculations and portfolio-level cost-effectiveness screening. These values represent normalized estimates of the incremental first cost associated with implementing a qualifying central heat pump water heater (HPWH) system serving commercial kitchen domestic hot water (DHW) loads relative to a code-compliant centralized gas service water-heating baseline.

These IMC values are intended for program planning, market transformation analysis, and inducement calibration only. They are not intended to represent contractor bids, project reconciliation values, or guaranteed project-specific incremental costs.

Commercial kitchen DHW systems are characterized by high peak demand, rapid load variability, elevated temperature requirements, and significant recirculation and storage needs. As a result, central HPWH systems serving commercial kitchens are typically more storage-driven and integration-intensive than standard domestic hot water systems.

This measure applies only to central HPWH systems with shared primary thermal storage and does not apply to unitary or packaged HPWH systems addressed by deemed measures such as eTRM SWWH031.

Base Case

The Base Case represents a centralized gas service water-heating system designed to meet high peak domestic hot water demand typical of commercial kitchen applications.

The baseline system includes:

- Central gas-fired service water-heating equipment meeting applicable Title 20 and Title 24 requirements
- Conventional primary hot water storage and recirculation
- Standard controls, gas infrastructure, and venting
- Typical design, installation, and commissioning practices for centralized commercial kitchen DHW systems

The Base Case reflects standard industry practice for larger commercial food-service applications and assumes sufficient storage and recovery capacity to maintain required service levels during peak kitchen operation.

Measure Case

The Measure Case consists of a central domestic hot water (DHW) system serving commercial kitchen loads that incorporates heat pump water-heating (HPWH) technology with shared primary thermal storage.

Eligible systems shall:

- Utilize a central HPWH system configuration
- Include a minimum of 200 gallons of shared primary DHW storage
- Serve commercial kitchen loads characterized by high peak hot water demand
- Include system-level piping, recirculation, controls, and storage integration

The Measure Case may include one of the following configurations:

- **Essential Level:** A central system combining HPWH technology with an instantaneous gas water-heating system to meet 100% of the commercial kitchen DHW demand; or

- **Premium Level:** A fully electric central HPWH system utilizing thermal storage and electric backup heating, where necessary, to meet 100% of the commercial kitchen DHW demand without reliance on fossil-fuel-fired water heating during normal operation.

Compared to conventional gas systems, qualifying central HPWH systems generally require:

- Increased thermal storage volume
- Additional electrical infrastructure
- More advanced controls and system coordination
- Enhanced commissioning and operational verification

These requirements are driven by the high peak demand and rapid load variability characteristic of commercial kitchen applications.

IMC Values and Normalization

For commercial kitchen applications, the most appropriate normalization metric for incremental cost is:

$/Btu/h (system heating capacity)

Commercial kitchen DHW systems are typically sized based on peak demand and recovery requirements rather than building floor area or occupancy alone. Incremental costs therefore scale most directly with:

- Required heating capacity
- Primary storage volume
- Distribution and recirculation complexity
- System integration and commissioning requirements

Primary DHW storage volume is used to define representative system size classes because commercial kitchen HPWH systems are storage-driven and because storage volume is directly documented in construction drawings and equipment schedules.

Commercial Central Kitchen – Normalized by System Heating Capacity

Primary DHW Storage Size	Essential Level	Premium Level
Small: 200 – 499 gallons	$0.35/Btu/h	$0.50/Btu/h
Medium: 500 – 999 gallons	$0.30/Btu/h	$0.45/Btu/h
Large: ≥ 1,000 gallons	$0.25/Btu/h	$0.40/Btu/h

These values reflect:

- Central HPWH equipment premiums relative to gas systems
- Increased thermal storage requirements
- Electrical service and infrastructure impacts
- Additional piping, controls, and integration complexity
- Enhanced commissioning and operational verification
- Demand-response and load-flexibility capability for Premium systems

Smaller systems are expected to experience higher incremental costs per Btu/h because fixed integration, controls, and electrical costs are distributed across smaller system capacities. Larger systems benefit from economies of scale and greater load diversity.

Sources

IMC values are informed by a combination of publicly available studies, market data, and program experience, including:

- CalNEXT Food Service Electrification Report
- NEEA - Advanced Water Heating Specification Version 8.1
- ENERGY STAR Central HPWH Discussion Guide
- CalMTA Food Service Water Heating MTI Report
- Ecotope - Central HPWH Design Guide

Code Readiness Objectives

This measure supports CEDA's Code Readiness efforts by collecting performance and market data to inform future Title 24 improvements related to heat pump water heaters (HPWHs) with thermal energy storage (TES) in commercial kitchen applications. While current code and health regulations establish minimum requirements for hot water temperature, supply, and system capacity, they do not fully address system-level efficiency, storage optimization, or performance variability under the high and highly variable load conditions typical of food service facilities. The data gathered through this measure will help determine the most effective and scalable configurations of HPWH systems with storage that can reliably meet peak demand, maintain required delivery temperatures, and operate efficiently across a range of kitchen types and usage patterns.

The objectives include the following:

- **Evaluate system-level performance under real-world conditions, including** system coefficient of performance (COP), temperature maintenance efficiency (TMCOP), and system responsiveness to dynamic hot water demand profiles typical of kitchen operations.
- **Assess the impact of storage sizing and configuration on system performance, including** the ability to meet peak demand, maintain consistent delivery temperatures, and reduce reliance on supplemental electric resistance heating.
- **Quantify actual energy savings and load impacts relative to baseline gas or electric water heating systems,** including impacts on peak electric demand and load shifting opportunities.
- **Evaluate system effectiveness across kitchen types and operating conditions,** including variation in performance based on kitchen size, usage intensity, operating schedules, and climate conditions.
- **Identify cost drivers, installation complexity, and operational considerations associated with HPWH systems with TES,** including equipment sizing, storage integration, and control strategies, to inform cost-effectiveness and scalability.
- **Assess market readiness and implementation barriers,** including contractor familiarity, product availability, design practices, and commissioning requirements specific to commercial kitchen applications.
- **Inform future code development and program design,** including potential enhancements to Title 24 requirements related to system sizing, storage integration, performance expectations, and electrification pathways for commercial food service facilities.

Code Readiness Site Monitoring

If selected for Code Readiness monitoring, equipment energy consumption and mechanical system performance may be monitored on-site for a period of up to 24 months. To support performance evaluation and data collection, projects shall provide reasonable access for the installation and operation of metering, sensors, and communication equipment.

Projects equipped with a Building Automation System (BAS), Energy Management System (EMS), or equivalent platform should enable integration of advanced metering devices through the existing system to facilitate data collection and remote access. For projects without a BAS or EMS, the Code Readiness team may install temporary stand-alone data loggers, sensors, and communication equipment as needed to monitor system performance for the duration of the monitoring period.

Instrumentation may be installed or supplemented, where necessary, to measure key system and equipment parameters sufficient to evaluate system performance and operational characteristics. All monitoring equipment will be temporary and installed in a manner that minimizes disruption to normal building operations.

Data Benefits

Collected data will help support the following:

- Operational efficiencies of HPWHs with TES in kitchen applications.
- Efficiency and energy use of electric water heating and distribution systems in kitchens, including secondary temperature maintenance heating (depending on the configuration).
- Engineering configurations, temperature maintenance system details, and customization requirements.
- Product cost and availability of HPWHs with TES in CA.
- Costs of installation and avoided gas infrastructure costs.
- The data collected from this monitoring effort will provide a foundation for future research and analysis:
    - Investigate how performance varies across different kitchen sizes and types (e.g., fast food vs. fine dining), informing scalable system designs or modular storage solutions.
    - Quantify long-term energy savings and carbon footprint reductions across multiple sites, providing data to support sustainability claims and influence policy or incentive programs.
    - Analyze data to identify factors (e.g., air temperature, usage spikes) that most impact efficiency, guiding the development of next-generation heat pump designs with improved COP (Coefficient of Performance).
    - Benchmark heat pump water heaters against other technologies (e.g., gas, solar-assisted) using field data to highlight competitive advantages and areas for hybrid system development.

Sample Data Points

A sample set of data points that would ideally be collected is provided below for reference. This list will be redeveloped for each project based on the infrastructure and the need for the monitoring effort.

Data Points to Meter	Unit	Additional Specifications
HP Power	kW	Maximum and minimum values
Thermal Load Provided	BTU	Average and Peak Values
Operational Efficiency	COP	Efficiency is measured at each instance
Operational Efficiency	TMCOP	Efficiency of temperature maintenance
Supply Water Flow	GPM	Average
Supply Water Supply Temp	°F	Average
Supply Water Return Temp	°F	Average
Supply Water Load	BTU	Average
Secondary Water Flow	GPM	Average
Secondary Water Supply Temp	°F	Average
Secondary Water Return Temp	°F	Average
Secondary Water Load	BTU	Average
Pump(s) Power	kW	Average
Outdoor Temperature	°F	Measured at the heat pump or site
Outdoor Air Moisture Level	°F	Measured at the heat pump or site
Indoor Temperature	°F	Average
Building Mode (Occupied Unoccupied)	-	Flag indicating status
Storage Tank Temperature	°F	Average

Code Reference

The following codes, standards, and technical references are most relevant to this High-Performance Measure (HPM) and establish the applicable regulatory and technical framework for central heat pump water-heating systems serving commercial food-service kitchen applications. References include applicable California energy codes, appliance efficiency regulations, sanitation requirements, federal standards, and supporting industry guidance relevant to system efficiency, storage, controls, commissioning, and refrigerant management.

Applicable Codes and Standards

CODE	APPLICABLE CODE REFERENCE	EFFECTIVE DATE	CODE REVIEW DATE
CA Building Energy Efficiency Standards - Title 24, Part 6	Section 100.1; Section 110.3; Section 120.3; Section 120.6(k); Section 140.0; Section 140.1; Section 140.5; Section 140.9(b); Section 170.2(d)(2)	January 1, 2026	May 2026
CA Health and Safety Code - California Retail Food Code	Sections 114192 and 114195	January 2025	May 2026
California Appliance Efficiency Regulations - Title 20	Sections 1601-1608; Section 1605.1(f); MAEDbS certification	Updated continuously	May 2026
Federal Standards - Title 10 CFR	10 CFR Part 431 Subpart G; Sections 431.101, 431.102, 431.106, 431.110	Updated continuously	May 2026
ASHRAE References	ASHRAE Handbook - HVAC Applications, Ch. 51; ASHRAE 15; ASHRAE 34; ASHRAE 90.1; ASHRAE Guideline 36	2022	May 2026
NEEA / ENERGY STAR Guidance	NEEA AWHS v8.1; ENERGY STAR Central HPWH Systems Discussion Guide	2025	May 2026
CARB Refrigerant References	CARB Refrigerant Management Program; Title 17 CCR Sections 95374 and 95380-95398	Updated continuously	May 2026

Eligible Climate Zones and Building Types

Eligible Climate Zones

This high-performance measure applies statewide in **California Climate Zones 1-16** (Title 24). Applicants must identify the project's climate zone in the submittal.

Eligible Building Types

This high-performance measure applies to nonresidential buildings with commercial food-service kitchen operations that include significant domestic/service hot water demand for food preparation, ware washing, cleaning, and sanitation. Eligible applications may include, but are not limited to:

- Restaurants and commercial food-service facilities
- Institutional kitchens
- Cafeterias and dining halls
- Commercial kitchens in schools, universities, hospitals, and care facilities
- Hotel, resort, and event venue kitchens
- Food preparation areas serving commercial, public, or institutional occupancies

This measure is intended to apply only to the commercial kitchen domestic/service hot water system and associated kitchen hot water loads. It does not apply to general building domestic hot water systems unless the qualifying commercial kitchen load is served by the same eligible central HPWH system and is clearly documented in the project design.

Eligible Project Scopes

This high-performance measure applies to new construction, additions, and major alterations or retrofit projects that install a qualifying central heat pump water heater (HPWH) system with shared primary thermal storage serving commercial food-service kitchen domestic/service hot water loads.

Eligible project scopes may include, but are not limited to:

- New commercial kitchen construction with a qualifying central HPWH system.
- Building additions that include new or expanded commercial food-service kitchen hot water loads.
- Major alterations or retrofits that replace or substantially modify an existing commercial kitchen water-heating system.
- Projects where the qualifying kitchen DHW load is served by a larger central HPWH system, provided the commercial kitchen scope, load, and system design are clearly documented.

This high-performance measure does not apply to minor repairs, maintenance-only work, like-for-like equipment replacements that do not meet the measure requirements, or projects where the commercial kitchen hot water load is not served by the qualifying HPWH system.

Measure Exclusions

This high-performance measure does not apply to:

- **Unitary or packaged heat pump water heaters**, including single-unit installations or multiple units installed in parallel that rely solely on internal storage, regardless of individual or aggregate storage capacity.
- **Systems that do not utilize shared primary thermal storage**, including configurations where storage is distributed across individual units rather than provided through a centralized primary storage system.
- **Auxiliary or secondary storage components**, including temperature maintenance tanks, swing tanks, recirculation tanks, or buffer tanks, when used to meet the minimum primary storage threshold.
- **Point-of-use or distributed water-heating systems**, including systems that serve individual fixtures or localized loads without a central storage and distribution system.
- **Systems that do not serve commercial food-service kitchen loads**, including systems limited to general building domestic/service hot water uses such as restrooms, showers, laundry, or other non-kitchen loads without a qualifying commercial kitchen component.
- **Non-central or fragmented DHW configurations**, including projects with multiple independent water-heating systems that do not operate as a single integrated central plant.
- **Equipment or system scopes receiving incentives through a deemed measure or other incentive pathway for the same installed equipment and qualifying scope**, including applicable eTRM commercial heat pump water heater measures where the claimed scope is characterized as equipment-level rather than system-level.

Projects participating under this measure are not eligible to concurrently claim incentives under the CEDA Central HPWH HPM for the same installed equipment or system scope.

Reviewer Checklist

HPM Review Checklist: LM402 – HPWH with Storage for Commercial Food-Service Kitchens – V2.2

Checklist Description: This checklist captures the elements that must be present in the project design to be eligible for the high-performance measure inducement or consideration for additional site metering.

Project Name: _____ **Review Date:** _____

Assessment:

- ☐ Approved
- ☐ Not approved

Notes:

Reviewer: _____ **Signature:** _____

Essential Level Inducement Requirements	Comments
☐ Does the system include shared primary thermal storage that is a minimum of 200 gallons and directly serves the building hot water demand?	
☐ Does the HPWH system supply 100% of the kitchen's hot water demand across all operational hours?	
☐ Is the installed gas water heater an instantaneous gas water heater?	
☐ Does the HPWH system meet or exceed the energy efficiency standards of California's Title 24 through the performance compliance path?	
☐ Does the system deliver DHW at a minimum of 120°F consistently to meet sanitation and operational needs, per California Plumbing Code requirements?	
☐ Is the DHW thermal storage tank sized to handle peak hot water demand, with insulation rated at R-12 or higher to limit standby heat losses?	

Premium Level Inducement Requirements	Comments
☐ Does the system include shared primary thermal storage that is a minimum of 200 gallons and directly serves the building hot water demand?	
☐ Does the HPWH system with thermal storage meet 100% of its DHW needs?	
☐ If a backup system is needed, was a backup electric resistance heating system provided to ensure capacity during peak demand is satisfied, limited to <20% of the total annual DHW heating energy to maintain efficiency?	
☐ Was the HPWH sized to meet peak hot water flow rates as specified in the California Plumbing Code and manufacturer guidelines?	
☐ Does the HPWH system meet Title 24 prescriptive requirements or demonstrate compliance via the performance path?	
☐ Is the DHW thermal storage tank sized to handle peak hot water demand, with insulation rated at R-12 or higher to limit standby heat losses?	
☐ Are electric hot water boosters installed (if needed) for equipment requiring water above 120°F to comply with health codes and equipment specifications?	

Supporting Documentation Requirements for Inducement	Comments
☐ Were engineered, stamped, and permitted construction drawings provided?	
☐ Were equipment submittals, stamped and approved by the responsible engineer of record, provided?	
☐ Was equipment-cost information provided?	
☐ Was a sequence of operations documentation provided for the design?	

Site Metering Prerequisite	Comments
☐ Did the project install a Building Automation System (BAS), Energy Management System (EMS), or similar building management system so that advanced metering devices can be installed?	

Version History Log

Version	Effective Date	End Date	Change Description
1	October 11, 2024	June 14, 2025	N/A
2	June 15, 2025	May 17, 2026	Updated format, dual-fuel requirements, and checklist
2.2	May 18, 2026	-	Updated measure to the current CEDA HPM format, added IMC, and updated reviewer checklist & narratives