High-Performance Measure Details

Measure Name
Central Heat Pump Water Heater Systems

Use Category
SHW – Water Heating Electrification

Effective Date
November 9, 2026

Version
5

Measure Code
LM402

Measure Stage
Early Adoption & High Priority Data Collection

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Technology Summary

Central heat pump water heater (CHPWH) systems are all-electric domestic and service hot water (DHW/SHW) plants that use one or more heat pumps, located in a **central plant**, to serve multiple dwelling units or building-level hot water loads. Heat pumps move heat from ambient or outdoor air into water at several times the efficiency of electric resistance (ER) heating and displace on-site natural gas combustion, which makes CHPWH systems a foundational electrification strategy for high-rise multifamily, lodging, healthcare, education, and other commercial buildings.

Heat pumps produce hot water more slowly than gas burners, so CHPWH systems rely on **thermal storage** to meet peak draws. This HPM recognizes two plant architectures:

1. **Storage-type CHPWH systems** store heated **potable water** in primary storage tanks. Systems with a hot water recirculation loop also include a **temperature maintenance (TM)** approach that offsets recirculation losses, most commonly an ER "swing tank" in series with primary storage, or a **parallel loop tank** reheated by a dedicated multi-pass heat pump. The NEEA *Advanced Water Heating Specification* (AWHS) defines qualified piping configurations and modeled system coefficient of performance (**SysCOP**) tiers for these systems, published on its Commercial/Multifamily HPWH Systems **Qualified Products List (QPL)**.

2. **Thermal battery (tankless) CHPWH systems** store heat in a **non-potable thermal storage medium**, such as a water-glycol mixture or phase change material (PCM), and heat potable water **on demand** through an isolated heat exchanger. Commercially available configurations include integrated units with a built-in thermal battery, split systems that pair outdoor heat pump modules with indoor thermal batteries, and packaged heat pumps with PCM battery modules. These systems store little or no potable water, which reduces plant footprint and limits stored potable water, while retaining the thermal storage needed to ride through peak draws and to shift heat pump operation.

In multifamily new construction, a single-pass primary heat pump with an **ER swing tank** has become **standard practice**. It is documented as standard central HPWH design in the *2025 Title 24 Multifamily Domestic Hot Water CASE Report* and is the multifamily system basis in the CA eTRM measure package SWWH028-09. Because recirculation losses are a significant share of multifamily DHW energy, serving them with ER limits system efficiency. **Heat pump temperature maintenance** and **higher-efficiency primary equipment** are the main remaining opportunities to go beyond code.

Thermal battery systems are newer to the California market. No federal or industry test procedure yet rates their system-level performance, the AWHS qualified piping configurations were developed around potable-water storage, and the Title 24 prescriptive requirements for multifamily central systems (§170.2(d)2A) assume primary potable storage with a recirculation loop tank. Multifamily projects using these systems will typically demonstrate code compliance through the **performance approach**. This HPM provides a defined pathway so CEDA can support these systems now and collect the field data needed to inform future codes, standards, and specifications.

The HPM is organized into **three sub-measures** (*Table 1*): two tiers for storage-type systems (**CHPWH-S1** and **CHPWH-S2**) and a thermal battery pathway (**CHPWH-TB**), so project teams and reviewers can cite exactly what is being claimed.

Alignment with CEDA Program Goals

The **California Energy Design Assistance (CEDA)** program is a Market Support program intended to support the long-term success of California's nonresidential and high-rise multifamily new construction market by advancing decarbonization, accelerating adoption of emerging and high-performance technologies, informing future codes and standards, and helping project teams achieve deeper energy and operational performance. **High-Performance Measures (HPMs)** support these objectives by creating opportunities for projects to implement, evaluate, and build market experience with technologies and design practices that extend beyond conventional practice.

Projects seeking a CEDA HPM inducement must meet the applicable requirements identified in the following section. Where aligned with Code Readiness priorities, selected projects may also provide market, design, cost, operational, or metered performance information that can help inform future California Codes and Standards activities.

This measure supports **CEDA's Market Support** objectives by:

- **Increasing market demand** by giving owners and design teams a defined path for CHPWH designs that go beyond code-equivalent configurations, through heat pump temperature maintenance and higher-efficiency primary equipment, and for emerging thermal battery systems that would otherwise have no clear program pathway.
- **Increasing market supply and delivery capability** by building designer, contractor, and manufacturer experience with parallel loop temperature maintenance, QPL-listed configurations, thermal battery systems, and manufacturer-authorized startup.

- **Building market partnerships and knowledge** by providing technical guidance on configuration selection, recirculation and temperature maintenance strategy, and ER controls, and by collecting manufacturer feedback on listing and compliance barriers for new product classes.
- **Advancing innovation and accessibility** by supporting technologies with smaller plant footprints, reduced potable water storage, low-GWP refrigerants, and readiness for future load flexibility.
- **Supporting Code Readiness and future market transformation** by documenting configurations, temperature maintenance approaches, ER operation, installed costs, and thermal battery field performance to inform deemed measure development, future Title 24 updates, and future specification and test-procedure work.

CEDA Inducement Requirements

This HPM supports CHPWH systems in CEDA-eligible **nonresidential and high-rise multifamily new construction** projects that go **beyond code-equivalent central HPWH design**. Under the **2025 Title 24, Part 6** Energy Code, a multifamily central system meeting the prescriptive heat pump configuration in §170.2(d)2A, or using an AWHS commercial HPWH at Tier 2 or higher, is a code-recognized compliance option. This HPM therefore focuses inducements on systems that improve **system efficiency** beyond that baseline: higher modeled system efficiency, **heat pump temperature maintenance** in place of ER, or, for thermal battery systems, heat-pump-primary design with high-efficiency equipment.

Eligibility is determined by sub-measure (*Table 1*). CEDA identifies the applicable sub-measure during project review based on the plant architecture and temperature maintenance approach shown in the construction documents. Each CHPWH system is assigned to **exactly one** sub-measure.

The **HPM performance quantity** is the AWHS v8.1 QPL tier for storage-type systems (*Table 2*) and the **rated heat pump COP** for thermal battery systems. The measure is **technology-neutral**: criteria are defined by function, configuration, and published ratings, not by product, brand, or refrigerant.

Inducements under this HPM are based on the **efficiency and electrification impacts of the installed equipment**. Load-flexibility readiness requirements support future grid-interactive operation and Code Readiness data collection only. ***CEDA does not provide inducements for load shifting, demand response (DR) capability, or DR program participation under this HPM, and DR enrollment is not required.***

Table 1. *Central Heat Pump Water Heater (CHPWH) Sub-Measures*

Sub-Measure	Name	Plant Architecture	Efficiency Basis	Additional Design Features
CHPWH-S1	Beyond-Code Storage CHPWH	Potable primary storage in an AWHS qualified piping configuration	AWHS v8.1 QPL tier per *Table 2* (S1)	Vendor-authorized startup; heat pump TM controls, where used
CHPWH-S2	High-Performance Storage CHPWH	Potable primary storage in an AWHS qualified piping configuration	AWHS v8.1 QPL tier per *Table 2* (S2)	All S1 features, plus monitoring and controls integration and load-flexibility readiness
CHPWH-TB	Thermal Battery (Tankless) CHPWH	Non-potable thermal storage (water-glycol, PCM, or similar); potable water heated on demand	Rated heat pump COP ≥ 4.0 (multifamily) or ≥ 4.3 (nonresidential)	Heat-pump-primary sizing, ER controls, recirculation strategy, load-flexibility readiness, remote alarms

Notes: TM = temperature maintenance; ER = electric resistance; QPL = AWHS Commercial/Multifamily HPWH Systems Qualified Products List; PCM = phase change material. All sub-measures are tracked under ***LM402****.*

Measure Eligibility (ME) – All Projects

1. **Qualifying Scope**
   1.1. The project shall install a **central heat pump water heating system** as the **primary source** of DHW/SHW for the loads it serves, in a qualifying building type.
   1.2. A **central system** consists of heat pump equipment and thermal storage located in a **single central plant location** that serves more than one dwelling unit, guest room, or sleeping unit, or building-level nonresidential loads. Multiple heat pumps, modules, or cascaded banks installed together in one plant location are considered **one central system**.
   1.3. Heat pump equipment shall be the **primary heat source**. ER and other heat sources are limited to backup, supplemental, freeze-protection, or defrost operation as defined in the System Design Level Requirements.
2. **Sub-Measure Assignment**
   2.1. Each claimed system shall be assigned to **exactly one sub-measure**. CEDA identifies the applicable sub-measure during project review.
   2.2. **Storage-type systems** (heated potable water held in primary storage) are assigned to **CHPWH-S1** or **CHPWH-S2** based on *Table 2*.
   2.3. **Thermal battery systems** (heat stored in a non-potable medium, with no primary potable storage) are assigned to **CHPWH-TB**. Optional downstream potable buffer or temperature maintenance tanks do not change this assignment.
3. **Ratings and Listings**
   3.1. Storage pathway eligibility is based on the AWHS v8.1 Commercial/Multifamily HPWH Systems **QPL** as published at the time of CEDA design review. Adoption of a later AWHS version will be made through a documented HPM version revision.
   3.2. The **AWHS climate zone** used to read QPL tiers is determined from the project county's IECC climate zone, per AWHS v8.1 §3.4.1: **Hot** (IECC 1–2), **Mild** (IECC 3–4), **Cold** (IECC 5–6), and **Extremely Cold** (IECC 7–8). Most California locations fall in the **Mild** zone.
   3.3. For **CHPWH-TB**, the rated COP is the heat pump COP at full output capacity, excluding ER elements, as listed in the ENERGY STAR Certified Commercial Water Heaters database, the DOE Compliance Certification Database, or the CEC MAEDbS. Where no listing exists, a manufacturer-published rating with its test basis (10 CFR 431, Subpart G, for covered commercial HPWHs) is accepted. This approach is consistent with the eligibility rules in eTRM measure package SWWH028-09.
4. **Normalization Quantity**
   4.1. The normalization quantity is the **rated heat pump compressor heating output capacity (kBtu/h)** of the primary heat pump equipment in the claimed system, **excluding** ER elements, temperature maintenance heaters, and storage, consistent with SWWH028-09. For products with integral ER elements, use the manufacturer's **heat-pump-only output**. Scheduled or nameplate outputs that include ER shall not be used.
5. **Inducement Basis**
   5.1. Inducements are based on the **efficiency and electrification impacts** of the installed equipment and are determined by CEDA during project review.
   5.2. Load-flexibility readiness provisions in this HPM are **design and data-collection requirements**. No portion of the inducement is attributable to, or contingent on, load shifting, DR capability, or DR program participation, and **DR enrollment is not required**.
   5.3. For **CHPWH-TB**, inducements may also reflect the **emerging-technology and Code Readiness value** of early installations, subject to CEDA program approval and the inducement caps. CHPWH-TB projects may be prioritized for Code Readiness monitoring.
6. **Eligible Project Types and Climate Zones**
   6.1. As defined in *Eligible Climate Zones, Building Types, and Project Scopes*.

7. **Code Compliance**
   7.1. All projects shall comply with **Title 24, Part 6** (the edition applicable to the project's permit application, currently **2022 or 2025**), the **Title 20** Appliance Efficiency Regulations, applicable federal efficiency standards, applicable EPA and CARB refrigerant regulations, the California Plumbing Code, and applicable local codes.
   7.2. HPM requirements are intended to be **above code** and do not replace code compliance obligations. The project's Title 24 compliance approach (prescriptive or performance), including how the water heating system was represented in compliance software, is documented for program records.
8. **Interaction with Other HPMs and Programs**
   8.1. The same equipment shall **not** be claimed under this HPM and under a deemed measure package or another CEDA HPM, except as stated below.
   8.2. The **Heat Pump Water Heater Integrated with High-Performance Distribution System** HPM may be claimed as an add-on for **distribution scope** (pipe sizing, recirculation pump controls, balancing), with no double counting.
   8.3. The **Low-GWP Refrigerants** HPM may be claimed together with this HPM where the system meets that HPM's requirements, per its stacking provisions.
   8.4. Plants located in more than one location serving a single building are addressed by the **Semi-Central Heat Pump Water Heater Systems** HPM. Individual heat pump water heaters are addressed by deemed measure packages or the **Heat Pump Deemed Measure Gap Pathway** HPM.
   8.5. When a California eTRM deemed measure package becomes available for **multifamily new construction central HPWH systems**, multifamily projects eligible for that package will be directed to the deemed pathway, and multifamily eligibility under this HPM will be revisited through a documented version revision.
9. **Version Transition**
   9.1. Projects with a CEDA Results Report or savings claim issued under Version 4 may be reviewed under Version 5 at CEDA's discretion where the installed system meets Version 5 requirements, and CEDA may update the estimated inducement accordingly. Otherwise, treatment of projects in progress follows **CEDA program policy**.

System Design Level Requirements (SDLR) – New Construction

Requirements are organized by pathway. **CHPWH-S1** and **CHPWH-S2** share the common storage pathway requirements in item 1, and **CHPWH-S2** includes all CHPWH-S1 requirements. **CHPWH-TB** has a single set of requirements.

1. **Storage Pathway – Common Requirements (CHPWH-S1 and CHPWH-S2)**
   1.1. The primary HPWH shall be listed on the **AWHS v8.1 QPL** and installed in an AWHS **qualified piping configuration** (AWHS v8.1 §3.3.5), consistent with the vendor's design guidance for the listing. QPL listing demonstrates the AWHS product requirements (vendor warranty, standards testing, vendor design guidance, and compressor-failure alarm), which are not restated in this HPM.
   1.2. System startup shall be performed by a **vendor-authorized service provider**.
   1.3. Where **heat pump temperature maintenance** is used to meet *Table 2*:
      1.3.1. Recirculation return shall be routed to a temperature maintenance tank piped in **parallel** with primary storage (AWHS v8.1 Figure 5) and reheated by a **dedicated multi-pass heat pump** rated by its manufacturer for the tank's entering water temperature range.
      1.3.2. The temperature maintenance heat pump shall be sized to carry the **design recirculation heat loss** at design conditions.

1.3.3. ER in the temperature maintenance tank, if provided, shall operate as **backup only**: controls enable ER only when the heat pump cannot maintain the tank setpoint, and ER operation is **alarmed or logged**.

1.4. The system shall meet the *Table 2* criterion for its temperature maintenance approach and the project's AWHS climate zone.

Table 2. *Storage Pathway Efficiency Criteria (AWHS v8.1 QPL Tier in the Project's AWHS Climate Zone)*

Temperature Maintenance Approach	AWHS v8.1 Configuration	CHPWH-S1 Beyond-Code Storage	CHPWH-S2 High-Performance Storage
Heat pump TM (all systems)	Single-pass, parallel loop tank reheated by multi-pass HPWH (Figure 5)	Primary HPWH listed at **Tier 2 or higher** in a single-pass configuration	Primary HPWH listed at **Tier 3 or higher** in a single-pass configuration
ER TM, systems serving dwelling units[1]	Single-pass, swing tank (Figure 4)	Listed at **Tier 4**	**Not eligible**
ER TM, all other systems	Single-pass, swing tank (Figure 4)	Listed at **Tier 3 or higher**	Listed at **Tier 4**
No separate TM tank	No circulation; returned to primary; integrated; multi-pass (Figures 2, 3, 6, 7, 8)	Listed at **Tier 3 or higher**	Listed at **Tier 4**

[1] Systems with a hot water recirculation loop serving multifamily dwelling units, hotel/motel guest rooms, or other sleeping units. Tiers are read from the QPL for the installed configuration and the project's AWHS climate zone (§ME 3.2). Parallel loop configurations are not separately listed on the QPL, so the primary HPWH's single-pass listing (Swing Tank or Single Pass Return to Primary) is used. For reference, AWHS v8.1 Mild climate tiers correspond to minimum SysCOPs of 2.00 (Tier 2), 2.50 (Tier 3), and 3.00 (Tier 4).

2. **CHPWH-S1 – Beyond-Code Storage CHPWH**
   2.1. The system shall meet item 1 and the **CHPWH-S1** criterion in *Table 2*.
3. **CHPWH-S2 – High-Performance Storage CHPWH**
   3.1. The system shall meet item 1 and the **CHPWH-S2** criterion in *Table 2*.
   3.2. **Monitoring and controls integration:** the system shall be integrated with a building automation system (BAS), energy management system (EMS), or the manufacturer's remote monitoring platform, capable of trending heat pump power or energy, primary storage and TM tank temperatures, heat pump and ER operating status, and alarms. QPL listings with the AWHS **Performance Monitoring** designation (AWHS v8.1 Appendix H) satisfy this item.
   3.3. **Load-flexibility readiness:** controls shall be capable of **pre-charging storage** ahead of peak periods and **reducing heat pump operation** during peak or grid events using stored heat, through either an **EcoPort (CTA-2045)** certified product with the communication module installed, or a BAS/EMS external signal with a corresponding sequence of operations. DR enrollment is not required (§ME 5.2).
4. **CHPWH-TB – Thermal Battery (Tankless) CHPWH**
   4.1. **Architecture:** heat pump equipment shall charge a **non-potable thermal storage medium** (water-glycol, PCM, or similar), and potable water shall be heated on demand through a heat exchanger **isolated** from the storage medium. Integrated and split configurations are eligible. Primary potable storage is not required.
   4.2. **Rated efficiency:** rated heat pump COP **≥ 4.0** for systems serving multifamily dwelling units and **≥ 4.3** for nonresidential systems, per §ME 3.3. Products listed on the AWHS QPL shall also be listed at **Tier 2 or higher** for the project's AWHS climate zone. *(Proposed CEDA criterion, aligned with the SWWH028-09 minimum qualifying efficiencies.)*
   4.3. **Heat-pump-primary sizing:** design documentation shall identify the operating conditions (ambient temperature and hot water demand) under which the heat pump equipment and thermal storage meet the hot water demand **without ER heating**, consistent with §170.2(d)2Avii, and shall show that they meet

the **average-day** hot water demand at the design outlet temperature without ER. ER may supplement during design-day peak periods, low-ambient conditions, or for redundancy.

4.4. **ER controls:** the commissioned operating mode shall be **heat-pump priority**, meaning ER engages only when the heat pump and thermal storage cannot maintain delivery temperature, or for freeze protection or defrost (e.g., hybrid or self-learning modes). ER operating status shall be **logged or reported** through the equipment controller, manufacturer monitoring service, or BAS/EMS. Electric-only or ER-primary modes shall not be the commissioned mode.

4.5. **Recirculation and temperature maintenance:** where the system serves a recirculation loop, recirculation losses shall be carried by the heat pump and thermal storage, or by a separate heat pump TM heater, per the manufacturer's approved piping configuration. ER TM heaters are limited to backup operation per item 1.3.3.

4.6. **Load-flexibility readiness:** the system shall be capable of receiving an external signal to shift or curtail heat pump operation, through either an **EcoPort (CTA-2045)** certified product with the communication module installed, or a **BAS/EMS connection** (e.g., remote enable or setpoint control) with a corresponding sequence of operations. Where the product supports thermal storage pre-charge, it should be included in the sequence. DR enrollment is not required (§ME 5.2).

4.7. **Remote monitoring and alarms:** the system shall provide remote fault notification for heat pump faults, through the manufacturer's monitoring service or a BAS/EMS alarm point.

4.8. System startup shall be performed by a **manufacturer-authorized representative**, or by the installing contractor following the manufacturer's startup procedure, with a completed startup record.

Supporting Documentation Requirements (SDR)

Documentation already included in the project drawings, schedules, submittals, control sequences, Title 24 compliance documents, or cost estimate **does not need to be duplicated**. This section identifies the **minimum information needed to verify** sub-measure eligibility, the claimed tier or pathway, and the above-code design features.

All Projects

1. **Construction Documents**
   1.1. Plumbing plans, schedules, and piping schematics identifying the central plant, heat pump equipment (manufacturer, model, quantity, and rated output capacity), thermal storage (tank volumes and setpoints, or thermal battery capacity), temperature maintenance approach, recirculation configuration, and controls sequence of operation.
2. **Equipment Submittals**
   2.1. Approved submittals for the heat pump equipment, storage tanks or thermal batteries, temperature maintenance heaters, and system controls.
3. **Ratings and Listings**
   3.1. **CHPWH-S1 and CHPWH-S2:** the QPL listing (identifier, configuration, and tier for the project's AWHS climate zone).
   3.2. **CHPWH-TB:** the ENERGY STAR, DOE CCD, or MAEDbS listing, or manufacturer-published rating with test basis, showing rated COP; and the QPL listing, if any.
4. **Title 24 Compliance Documentation**
   4.1. The project's Title 24, Part 6 compliance documents for the water heating system, identifying the compliance approach (prescriptive or performance) and how the system was represented in compliance software (e.g., equipment type and efficiency entered).

5. **Startup and Installation Verification**
   5.1. Startup documentation from the vendor- or manufacturer-authorized provider, or, for CHPWH-TB, the contractor's completed manufacturer startup record.
   5.2. Nameplate photos, or equivalent confirmation during CEDA verification, showing that installed models **match the submitted models**.
6. **Cost Information**
   6.1. Installed cost information **as available**, through any of the following: an AIA-style pay application or schedule of values, contractor invoices, or bid or estimate line items. Separating water heating system equipment and installation costs is helpful but not required, and itemized invoices are not required.

Pathway-Specific Documentation

Additional documentation is required **only** where the All Projects items do not already demonstrate the requirement.

7. **Heat Pump Temperature Maintenance (*Table 2*, Heat Pump TM)**
   7.1. Temperature maintenance heat pump submittal showing multi-pass operation and its rated entering water temperature range.
   7.2. Design recirculation heat loss and the selected TM heat pump capacity.
   7.3. Controls sequence showing ER staged as backup only, with alarm or logging.
8. **CHPWH-S2**
   8.1. Monitoring and controls integration: points list or platform description showing the trended points in §SDLR 3.2, or the QPL Performance Monitoring designation.
   8.2. Load-flexibility readiness: EcoPort certification listing with the communication module shown on submittals, or a BAS/EMS integration description; and a controls narrative describing normal setpoints, pre-charge strategy, and allowable setback during peak or grid events.
9. **CHPWH-TB**
   9.1. Manufacturer data confirming a non-potable thermal storage medium and an isolated potable water heat exchanger.
   9.2. Sizing documentation per §SDLR 4.3, including average-day and design-day load, design outlet temperature, the operating conditions under which ER is expected to supplement, heat-pump-only output capacity, and thermal storage capacity, using the manufacturer's sizing tool or an engineering calculation.
   9.3. Controls documentation showing the commissioned heat-pump-priority mode, ER staging, and how ER operation is logged or reported.
   9.4. Recirculation and temperature maintenance approach, per the manufacturer's piping configuration.
   9.5. Load-flexibility readiness documentation (EcoPort listing with the communication module, or BAS/EMS points and sequence) and the remote fault notification method.
   9.6. Manufacturer warranty terms, for program records.

Incremental Measure Cost

The Incremental Measure Cost (IMC) values below are **program calibration inputs** used to support CEDA inducement development and cost-cap screening. They represent normalized estimates of the incremental first cost of installing a CHPWH system that meets this HPM's requirements, relative to a code-compliant central gas service water heating system serving the same load.

These values are intended for program planning and inducement calibration only. They are **not** contractor bids, project estimates, or reconciliation values, and actual project costs will vary with system configuration, building type, site conditions, and market factors.

IMC values are derived primarily from installed project cost data in the CPUC-approved measure package SWWH028-09, *Large Heat Pump Water Heater, Commercial and Multifamily, Fuel Substitution* (effective November 2, 2026), used as a **proxy** for new construction. SWWH028-09 costs are normalized per kBtu/h of rated heat pump compressor output capacity, the same normalization quantity used in this HPM (§ME 4), and are based on California program projects from 2022–2024, inflated to 2026 dollars. Values will be **revisited as CEDA obtains participating-project cost data**.

Base Case

The Base Case is a **code-compliant natural gas central water heating system** serving the same load:

- **CHPWH-S1 and CHPWH-S2:** a natural gas central storage water heater system (SWWH028-09 standard-efficiency base case).
- **CHPWH-TB:** a natural gas instantaneous (tankless) central water heater system, the like-for-like gas counterpart to an on-demand system (SWWH028-09 standard-efficiency base case).

For multifamily buildings, a gas central system under the 2025 Energy Code must also include a **solar water heating system** (§170.2(d)2B) and meet **electric-ready** requirements for central systems (§160.9(f)). SWWH028-09 base costs do not include these items, so the multifamily IMC values below may **overstate** incremental cost. CEDA will refine this as new construction cost data becomes available.

Measure Case

The Measure Case is a CHPWH system meeting the System Design Level Requirements for the applicable sub-measure:

- **CHPWH-S1:** the SWWH028-09 measure case for the sector (multifamily: 4.0 COP central system; nonresidential: 4.3 COP central system).
- **CHPWH-S2:** the CHPWH-S1 measure case plus a planning adder for higher-efficiency primary equipment, heat pump temperature maintenance, and monitoring and controls integration.
- **CHPWH-TB:** the SWWH028-09 nonresidential 4.3 COP measure case, applied as a proxy for integrated thermal battery systems in all sectors.

IMC Values and Normalization

IMC values are normalized to **$/kBtu/h of rated heat pump compressor output capacity**, excluding ER elements and storage (§ME 4). This unit matches the SWWH028-09 claim unit and scales with plant size across multifamily and nonresidential applications.

IMC = *(Measure Material + Measure Labor) − (Base Material + Base Labor)*

Table 3. *Incremental Measure Cost by Sub-Measure ($ per kBtu/h of Rated Heat Pump Output Capacity)*

Sub-Measure	Sector	Base Material	Base Labor	Measure Material	Measure Labor	Full Measure Cost	IMC[3]
CHPWH-S1	Multifamily	$378	$122	$501	$432	$932	**$432**
CHPWH-S1	Nonresidential	$413	$134	$451	$177	$628	**$82**
CHPWH-S2	Multifamily	$378	$122	$575[1]	$432	$1,007	**$507**
CHPWH-S2	Nonresidential	$413	$134	$501[1]	$177	$678	**$132**
CHPWH-TB	All	$182[2]	$78[2]	$451[2]	$177[2]	$628	**$369**

[1] Planning assumption: CHPWH-S1 full measure cost plus 8%, applied to material, for higher-efficiency primary equipment, heat pump temperature maintenance, and monitoring and controls integration. Proposed CEDA calibration assumption.

[2] Base: SWWH028-09 natural gas instantaneous standard-efficiency case. Measure: SWWH028-09 nonresidential 4.3 COP measure case, used as a proxy until thermal battery project cost data are available. Proposed CEDA calibration assumption.

[3] Values rounded to the nearest dollar. IMC values are calculated from unrounded package costs and may differ by $1 from the difference of rounded table entries.

Calculation basis: For each sub-measure, the IMC is the difference between the SWWH028-09 measure case and base case costs (material plus labor) for the **closest matching offering**, following that package's cost methodology. SWWH028-09 multifamily measure costs reflect central CO2 split systems with ER swing tanks and include project infrastructure line items. Commercial measure costs reflect integrated systems. See the referenced eTRM measure for details.

These values represent typical incremental costs for new construction, including additions and alterations eligible for CEDA participation. They are intended for **program inducement calibration**, not project-specific cost reconciliation.

Sources

IMC values are informed by publicly available deemed measure cost data, code development research, and program experience, and are intended to reflect typical market conditions rather than project-specific pricing, including:

- eTRM SWWH028-09, *Large Heat Pump Water Heater, Commercial and Multifamily, Fuel Substitution* (2026): https://www.caetrm.com/measure/SWWH028/09/
- California Statewide Utility Codes and Standards Team, *2025 Title 24, Part 6 CASE Report – Multifamily Domestic Hot Water* (2023): 2025 T24 CASE Report – MF DHW
- Feng, J., Chu, Y., Delagah, A., and Zeyghami, M., *Central Heat Pump Water Heating Systems for Decarbonizing Multifamily Buildings: Market Assessment, Energy Performance and Cost Impact Analysis*, ACEEE Summer Study (2024): ACEEE 2024 Proceedings
- CalNEXT, *Commercial and Multifamily CO2 Heat Pump Water Heater*, ET22SWE0017 (2023): ET22SWE0017 Final Report

Code Readiness Objectives

This measure supports CEDA's Code Readiness role by generating **project-level evidence on how CHPWH configurations, temperature maintenance approaches, and emerging thermal battery systems perform** in California new construction. With the 2025 Energy Code establishing a prescriptive central HPWH pathway for multifamily buildings, the remaining questions center on temperature maintenance efficiency, ER use, and how new system architectures fit codes, test procedures, and specifications.

Routine CEDA verification under this HPM is limited to the documentation in the *Supporting Documentation Requirements*. Deeper field monitoring applies **only** to projects **separately selected** for Code Readiness activities.

The objectives include the following:

- **Compare heat pump and ER temperature maintenance** in multifamily new construction, including TM energy, ER runtime, and system COP, to inform the multifamily central HPWH deemed measure under development and future Title 24 updates.
- **Characterize thermal battery field performance**, including field system COP, the effect of recirculation on thermal storage and heat pump efficiency, ER share of heating energy, usable storage during peak draws, and low-ambient performance, to support future test procedures, specification listing methods, and compliance modeling.
- **Quantify load-flexibility potential** of primary storage and thermal batteries, including the duration and magnitude of load shift achievable without affecting delivery temperatures. This is data collection only; DR participation is not required.
- **Document Title 24 compliance approaches** for thermal battery systems, including how compliance software represents them (e.g., as packaged HPWHs with zero storage volume), to identify compliance software and code language gaps.
- **Collect installed cost, product availability, and contractor experience data** by sub-measure to recalibrate IMC values.

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 12 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, consistent with AWHS v8.1 Appendix H where applicable. All monitoring equipment will be **temporary** and installed in a manner that **minimizes disruption to normal building operations**. Monitored parameters are **not** HPM eligibility requirements.

Data Benefits

Collected data will help support:

- Development of the **multifamily central HPWH deemed measure** for new construction, including primary efficiency and temperature maintenance offerings.
- **Test-procedure and specification development** for thermal battery and PCM-based systems.
- **Compliance software modeling** of parallel loop and thermal battery systems.
- Field-based **sizing assumptions** for storage-type and thermal battery systems.
- Future **load-flexibility program design** using measured storage capability.
- **Recalibration of IMC values** using participating-project cost data.

Sample Data Points

A sample set of data points is provided below for reference. This list will be re-developed for each project based on the sub-measure, the available infrastructure, and the needs of the monitoring effort.

Data Point	Unit	Additional Specifications
Minimum/Core Data Points		
Heat pump electric power and energy	kW, kWh	Per heat pump or bank; 1- to 15-minute intervals
ER element power and energy	kW, kWh	Separate current transducer on ER circuits
Temperature maintenance heater power	kW	Heat pump or ER, as installed
Cold water inlet flow and temperature	GPM, °F	Paired flow and temperature measurement
Hot water supply temperature	°F	Leaving the plant or mixing valve
Recirculation return flow and temperature	GPM, °F	At the return to the plant
Ambient or outdoor air temperature	°F	At the heat pump air inlet
Calculated/Derived Metrics		
Delivered water heating energy	Btu	Water flow × temperature rise
Recirculation (TM) heat loss	Btu	Recirculation flow × supply–return ΔT
System COP (SysCOP)	COP	Delivered energy ÷ total electric input, including ER, TM, and pumps; interval and seasonal
Heat pump share of heating energy	%	Heat pump versus ER operation
Optional/Technology-Specific Data Points		
Primary storage tank temperatures	°F	Storage pathway; multiple tank heights
Thermal battery temperature or state of charge	°F or %	TB pathway; from manufacturer controller
Recirculation pump power	W	Spot or continuous measurement
Operating mode and load-flexibility signal status	Flag	From equipment controller or BAS
Defrost events	Count	From controller or inferred from power data

Code Reference

Applicable Codes and Standards

The table below identifies current federal and California regulatory requirements and industry specifications that may affect the Base Case or Measure Case for this HPM. Applicability varies by **building type, system configuration, and sub-measure**. For water heater classifications and federal test methods, see the *Code Requirements* section of eTRM measure package SWWH028-09.

CODE	APPLICABLE CODE REFERENCE	EFFECTIVE DATE	CODE REVIEW DATE
CA Building Energy Efficiency Standards – Title 24, Part 6	**§170.2(d)2A**, prescriptive heat pump central systems serving multiple dwelling units: single-pass primary HPWH, recirculation returned to a loop tank, primary setpoint ≥ 135°F, loop tank setpoint ≥ 10°F lower, compressor cut-off ≤ 40°F, and design documentation of operating conditions without auxiliary heat; or a NEEA AWHS commercial HPWH at Tier 2 or higher	January 1, 2026	November 2026
CA Building Energy Efficiency Standards – Title 24, Part 6	**§170.2(d)2B**, gas or propane central systems serving multiple dwelling units, including solar water heating (solar savings fraction 0.20/0.35, or 0.15/0.30 with drain water heat recovery)	January 1, 2026	November 2026
CA Building Energy Efficiency Standards – Title 24, Part 6	§170.2(d)2C–2E, multifamily central system distribution: Appendix M pipe sizing, thermostatic master mixing valves (RA4.4), and pipe insulation field verification (RA3.6.3)	January 1, 2026	November 2026
CA Building Energy Efficiency Standards – Title 24, Part 6	§170.1, multifamily performance approach	January 1, 2026	November 2026
CA Building Energy Efficiency Standards – Title 24, Part 6	§110.3, mandatory service water heating requirements, including §110.3(c)4 recirculation loops and **§110.3(c)7** air-source heat pump water heaters	January 1, 2026	November 2026
CA Building Energy Efficiency Standards – Title 24, Part 6	§110.1, §120.3, and §140.5, nonresidential service water heating equipment, pipe insulation, and prescriptive requirements	January 1, 2026	November 2026
CA Building Energy Efficiency Standards – Title 24, Part 6	§160.4 and **§160.9(f)**, multifamily mandatory water heating and electric-ready requirements for gas central systems	January 1, 2026	November 2026
CA Plumbing Code – Title 24, Part 5	Appendix M, peak water demand calculation (referenced by §170.2(d)2C)	January 1, 2026	November 2026
CA Appliance Efficiency Regulations – Title 20	§1605.1(f)(1), water heaters	January 1, 2021	November 2026
Federal Standards – 10 CFR Part 431	**§431.110(a)**, commercial water heater energy conservation standards (gas storage and instantaneous base cases)	October 9, 2015; October 6, 2026	November 2026
Federal Standards – 10 CFR Part 431	§431.102 and §431.106, Subpart G, commercial water heater definitions and test procedures, including the commercial HPWH COP test (Appendix E)	See SWWH028-09	November 2026
NEEA Advanced Water Heating Specification	**AWHS v8.1**, Chapter 3 (commercial/multifamily systems), qualified piping configurations (§3.3.5), SysCOP tiers (§3.4.2), demand response capability (§3.3.6), M&V (Appendix H), and Commercial/Multifamily QPL	July 15, 2024	November 2026
ENERGY STAR	Commercial Water Heaters Version 2.0, commercial heat pump water heaters (COPh ≥ 3.0)	October 1, 2018	November 2026

CODE	APPLICABLE CODE REFERENCE	EFFECTIVE DATE	CODE REVIEW DATE
Federal Refrigerant Regulations – 40 CFR Part 84	Subpart B, AIM Act Technology Transitions restrictions on higher-GWP HFCs in new products and systems, by sector and subsector	January 1, 2025	November 2026
CARB Refrigerant Regulations – 17 CCR	HFC prohibitions and GWP limits for stationary end uses, and Refrigerant Management Program requirements for systems with more than 50 lb of high-GWP refrigerant; applicability depends on end use and charge	Varies by end use	November 2026

Eligible Climate Zones, Building Types, and Project Scopes

Eligible Climate Zones

This high-performance measure applies statewide in **California Climate Zones 1–16** (Title 24). Climate zone is confirmed from the project's Title 24 compliance documentation. The **AWHS climate zone** used for QPL tiers is determined per §ME 3.2.

Eligible Building Types

This high-performance measure applies to:

- **High-Rise Multifamily:** buildings with **four (4) or more habitable stories above grade**, including dwelling units and common-area loads served by the central system.
- **Nonresidential: commercial, public, agricultural, and industrial** facilities with DHW/SHW loads (e.g., lodging, dormitories, healthcare, education, food service, fitness, and civic buildings).

Eligibility is based on the **qualifying system and sub-measure** shown in *Table 1*, not on building type alone. Multifamily eligibility will be revisited when a deemed measure package for multifamily new construction central HPWH systems becomes available (§ME 8.5).

Eligible Project Scopes

This high-performance measure applies to:

- **New construction**, including **additions and alterations eligible for CEDA participation**, which are covered under the same requirements as new construction.

This high-performance measure does not apply to (not in scope):

- **Low-rise residential** (single-family and multifamily with three or fewer habitable stories above grade).
- **Equipment replacement** projects that do not meet CEDA participation eligibility.

Measure Exclusions

The following are **not** eligible under this HPM:

1. **Non-central systems**, including individual, unitary, or point-of-use water heaters serving a single dwelling unit or single load, and systems that do not meet the central system definition (§ME 1.2).
2. **Distributed plants** in more than one location serving a single building, which are addressed by the **Semi-Central Heat Pump Water Heater Systems** HPM.
3. **Pool and spa** water heating, which is addressed by a separate CEDA HPM.
4. **Space heating systems** and combination systems in which DHW/SHW production is secondary or opportunistic, such as four-pipe air-to-water heat pumps or heat recovery chillers.
5. Systems in which **heat pumps are not the primary heat source**, including systems where ER or fuel-fired equipment serves the majority of the annual load or ER is the commissioned primary operating mode.
6. **Code-equivalent systems** that meet only §170.2(d)2A or the AWHS Tier 2 alternative, and systems that do not meet the System Design Level Requirements for a sub-measure, including storage-type products not listed at the *Table 2* tier and thermal battery products below the CHPWH-TB rated COP.
7. **Process or industrial hot water loads** that do not serve DHW/SHW end uses.
8. Systems that **cannot be documented** with the listings, ratings, or information required in the *Supporting Documentation Requirements*.
9. **Double counting.** *The same equipment, incremental cost, or performance benefit shall not be claimed under more than one CEDA HPM or deemed measure package, except as allowed in §ME 8.*

Exclusion from this HPM does **not** necessarily mean exclusion from other CEDA offerings.

CEDA program administrators reserve the right to determine whether claimed measures constitute overlapping scope for the same equipment, controls integration, or monitoring infrastructure.

Reviewer Checklist

HPM Reviewer Checklist: LM402 – Central Heat Pump Water Heater Systems – V5

Checklist Description: This checklist captures the minimum design and post-installation elements used to confirm HPM inducement eligibility and identify projects for optional Code Readiness monitoring.

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

Assessment:

☐ Approved
☐ Not approved

Notes:

Reviewer: _____ **Signature:** _____

Reviewer Checklist – High-Performance Measure Requirements

Use this checklist to confirm that the submitted project scope, design documents, and supporting documentation demonstrate compliance with the claimed sub-measure. Review only the items applicable to the claimed scope.

Project Eligibility

☐ Nonresidential or high-rise multifamily (**4+ habitable stories**) new construction, including CEDA-eligible additions and alterations (§ME 6; *Eligible Project Scopes*)

☐ Title 24 climate zone confirmed and **AWHS climate zone** identified (Hot, Mild, Cold, or Extremely Cold) (§ME 3.2)

Qualifying System Scope

☐ **Central system** in a single plant location serving multiple dwelling units or building-level loads (§ME 1.2; Excl. 1, 2)

☐ Heat pump is the **primary heat source** for DHW/SHW loads, not pool/spa, space heating, or process loads (§ME 1.3; Excl. 3–5, 7)

☐ Same equipment **not** claimed under a deemed measure package or another HPM, except allowed add-ons (§ME 8; Excl. 9)

Sub-Measure Selection *(select one per system; §ME 2)*

☐ **Storage pathway (shared):** primary HPWH on the **AWHS v8.1 QPL**, installed in a qualified piping configuration; vendor-authorized startup (§SDLR 1.1–1.2)

- ☐ **Heat pump TM** (if used): parallel loop TM tank reheated by a dedicated **multi-pass heat pump** sized for design recirculation loss; ER backup only, alarmed or logged (§SDLR 1.3)
- ☐ **CHPWH-S1:** meets the **S1** criterion in Table 2 for the TM approach and AWHS climate zone (§SDLR 2)
- ☐ **CHPWH-S2:** meets the **S2** criterion in Table 2; monitoring and controls integration; load-flexibility readiness (§SDLR 3)

☐ **CHPWH-TB:** non-potable thermal storage with an isolated potable heat exchanger; rated COP **≥ 4.0** (multifamily) or **≥ 4.3** (nonresidential), and QPL **Tier 2+** if listed; heat-pump-primary sizing (**average-day demand without ER**); heat-pump-priority mode with ER logged or reported; recirculation carried by heat pump or thermal storage; EcoPort module or BAS/EMS signal; remote fault notification; startup record (§SDLR 4)

HPM Reviewer Checklist: LM402 – Central Heat Pump Water Heater Systems – V5

*Example: a CO2 split system in the Mild climate zone, listed at Tier 3 as a swing tank and serving multifamily dwelling units, is **not eligible** as a swing tank design (Tier 4 required for S1). Redesigned with a **parallel loop TM heat pump**, the same primary HPWH (Tier 3 single-pass listing) qualifies for **CHPWH-S2** if the S2 monitoring and readiness items are met.*

Installation Verification

☐ Installed models match the submittals, by nameplate photos or CEDA verification (§SDR 5)

☐ Startup documentation from the vendor- or manufacturer-authorized provider, or manufacturer startup record for CHPWH-TB (§SDR 5)

☐ Heat pump TM and CHPWH-TB: commissioned mode is **heat-pump priority**, with ER staged as backup (§SDLR 1.3.3, 4.4)

☐ CHPWH-S2 and CHPWH-TB: EcoPort module or BAS/EMS signal installed; DR enrollment **not** required (§SDLR 3.3, 4.6)

Code and Scope Coordination

☐ Title 24 compliance documents identify the compliance approach and how the water heating system was modeled (§ME 7; §SDR 4)

☐ Add-on HPMs (High-Performance Distribution; Low-GWP Refrigerants) claimed only for separate scope or per stacking provisions (§ME 8.2–8.3)

☐ Normalization quantity recorded: **rated heat pump output capacity (kBtu/h)**, heat-pump-only, excluding ER and storage (§ME 4)

Supporting Documentation

☐ Plans, schedules, piping schematics, and controls sequence (§SDR 1)

☐ Approved equipment submittals (§SDR 2)

☐ QPL listing (S1/S2) or rated COP source (TB) (§SDR 3)

☐ Pathway-specific documentation, where applicable (§SDR 7–9)

☐ Cost information, as available (§SDR 6)

Note: Deeper trend logging or metering is required only if the project is separately selected for Code Readiness monitoring.

Version History Log

Version	Effective Date	End Date	Change Description
1	June 14, 2023	May 16, 2024	Initial release
2	May 17, 2024	March 30, 2025	Updated format and sample data points list
3	March 31, 2025	February 1, 2026	Updated format, requirements, and checklist
4	February 2, 2026	November 8, 2026	Updated design, documentation, incremental measure cost, and review requirements; sunset of Essential tier reflecting 2025 Title 24 code updates
5	November 9, 2026	Active	Restructured into three sub-measures: **CHPWH-S1** (replaces Advanced), **CHPWH-S2** (replaces Premium), and new **CHPWH-TB** thermal battery pathway; anchored storage criteria to AWHS v8.1 QPL tiers with a heat pump TM option; removed the 119-gallon exclusion; rebased IMC to SWWH028-09; updated format, code reference, exclusions, and checklist

***Note**: The version identified as 'Active' is the current published version and remains in effect until superseded by a subsequent published version. CEDA may update, replace, or retire High-Performance Measures without prior notice. End dates are assigned to prior versions once superseded.*