High-Performance Measure Details

Measure Name
Pool and Spa Air-to-Water Heating Technology

Use Category
Swimming Pool Electrification

Effective Date
March 31, 2025

End Date
December 31, 2025

Version
2

Measure Code
LM404

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Technology Summary

A heat pump pool heater (HPPH) is a type of hot water heater that is designed to tolerate the chemicals found in pool and spa water. Like a heat pump water heater system, a HPPH is an energy-efficient water heater that uses the vapor compression cycle rather than natural gas to heat incoming pool or spa water. Unlike a natural gas water heater that burns gas to generate heat, this system takes heat from the ambient air and moves it to the pool or spa water. This operation makes the HPPH capacity and efficiency dependent on the ambient outdoor air temperature. At lower temperatures, their capacities and efficiencies are reduced, but they can operate efficiently above temperatures between 45°F - 50°F.

This measure encourages the use of HPPHs as the primary heating source. HPPHs are rated by output capacity and are typically advertised at their high air temperature (80°F), high humidity (80% relative humidity), and 80°F entering water temperature test point (commonly denoted as 80/80/80). This is one of the test points required by the California Appliance Efficiency Standards (Title 20). Once standards are established for this equipment, manufacturers will only be permitted to publish ratings at the DOE test procedure rating condition, which is High Air Temperature (80°F) - Mid Humidity (63% RH) level (commonly denoted as 80/63/80) specified in Section 6 of AHRI Standard 1160.

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 on the equipment 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 that 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 pool and/or spa heaters, this helps to increase the overall supply of heat pump pool and/or spa heaters 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 listed below are intended to support the adoption of electrification in the current market by increasing energy efficiency, decreasing costs, and decreasing carbon emissions. Projects receive inducements based on market impacts, savings, and influence. Lower-level inducement requirements must be satisfied to be eligible for higher-level inducements.

Inducement Requirements

- **Essential level**:
    - Provide a heat pump pool or spa heating system serving a commercial, public, or high-rise multi-family building.
    - Provide engineered, stamped, and permitted construction plans demonstrating that the heat pump pool or spa heating system design fully complies with all state and local jurisdiction requirements and regulations.
    - Provide equipment submittals stamped and approved by the responsible engineer of record.
    - Provide equipment-cost information.

- **Premium level:**
    - Minimum COP: HPPHs must meet minimum Coefficient of Performance (COP) requirements.
        - Equipment rated prior to May 31st, 2028, must have a COP of no less than 5.5 at the High Air Temperature-Mid Humidity rating condition.
            - See Table 110.4-B from the 2025 CASE report for NR Pool and Spa Heating, copied below in the Code References, for the minimum efficiencies, including equipment rated on or after May 31, 2028.
    - Sizing: The HPPHs must be appropriately sized to meet the pool or spa heating needs, calculated using manufacturer specifications.
        - If manufacturers do not include information on sizing HPPH, sizing shall use equations provided in the 2025 energy code. See Appendix JA16 – Criteria for Pool and Spa Heating Systems.
            - Appendix JA16.3 from Title 24 2025 Joint Appendices, copied below in Code References.

Code Readiness Objectives

The data collection effort should focus on achieving the following objectives:

- Quantify Actual Energy Savings: Measure and compare the energy consumption of pools using AWHPs as the primary heating source against baseline scenarios using gas heaters.
- Evaluate Cost-Effectiveness: Gather data on the costs and savings associated with using AWHPs, including installation, operation, maintenance, and energy bills.
- Assess AWHP Performance: Document AWHP performance across various climate zones, considering factors such as ambient temperature, humidity, and pool/ spa usage patterns.
- Define applications where HPPHs may not be a good fit or may need supplemental systems to meet loads.

Site Metering Prerequisite

- Project must install a Building Automation System (BAS), Energy Management System (EMS), or similar building management system to facilitate the installation of advanced metering devices.
- If selected for Code Readiness metering, equipment energy and performance data may be monitored at the site for a period of up to 12 months.

Data Benefits

- Operational efficiencies of central HPWH in commercial applications.
- Efficiency and energy use of water heating and distribution systems, including secondary temperature maintenance heating (depending on the configuration).
- Engineering configurations, temperature maintenance system details, and customization requirements.
- Product cost and availability of larger HPWH products in CA.
- Costs of installation versus equipment in commercial and MF applications.
- Avoided gas infrastructure costs.
- The data collected from this monitoring effort will provide a foundation for future research and analysis:
    - Optimizing HPPH Sizing and Control Strategies: Research can investigate strategies to optimize HPPH sizing and controls to further enhance energy efficiency and performance in different climate conditions.

- Evaluating Cold-Climate Performance: Investigate HPPH performance and the feasibility of extending their operational range in colder climates, potentially reducing reliance on backup heating systems.
- Integration with Smart Grid and Demand Response Programs: Explore the potential for integrating HPPHs with smart grids and demand response programs to optimize energy use and manage peak demand.

Sample Data Points

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

Data Points to Meter	Unit	Additional Specifications
Heat Pump Power	kW	Maximum and minimum values
Thermal Load Provided	BTU	Average and Peak values
Operational Efficiency	COP	Efficiency measured at each instance
Temperature Set-point	°F	Average
Water Flow	GPM	Average
Water Supply Temperature	°F	Average
Water Return Temperature	°F	Average
Water Load	BTU	Average
Pump(s) Power	kW	Average
Outdoor Dry-bulb Temperature	°F	Measured at heat pump or site
Outdoor Wet-bulb Temperature	°F	Measured at heat pump or site
Pool Water Temperature	°F	Average

Code Reference

California Appliance Efficiency Regulations (Title 20). Section 1605.1(g)(1) is for federally regulated appliances and 1605.3(g)(3) is for non-federally regulated appliances.

- Section 1605.1(g)(1) follows federal standards minimum thermal efficiency for natural gas pool water heaters and requires a minimum coefficient of performance (COP) of 3.5 for heat pump pool heaters.
- Section 1605.3(g)(3) requires that for heat pump pool heaters manufactured on or after March 1, 2003, the average of the COP at standard temperature rating and the COP at low temperature rating shall not be less than 3.5.

California Building Energy Efficiency Standards (Title 24). Section 110.4(b).2 requires the installation of any pool or spa equipment in a heated pool shall be installed with an outdoor pool cover.

2025 Final CASE Report. Requirements and min efficiency Table 110.4-B: Heat Pump Pool Heater Minimum COP Efficiency Requirements

- A heat pump pool heater as the primary heating system shall meet the efficiency requirements in Table 110.4-B, shown below, taken from the 2025 Final CASE Report for NR Pool and Spa Heating.

Table 110.4-B: Heat Pump Pool Heater Minimum COP Efficiency Requirements			
Equipment Type	**Efficiency**	**Compliance Date**	**Test Procedure**
Heat Pump Pool Heater	Coefficient of Performance (COP) of not less than 5.5 at the High Air Temperature - Mid Humidity rating condition.	Manufactured prior to May 31, 2028	10 C.F.R. section 430.23(p) (Appendix P to subpart B of part 430)
Heat Pump Pool Heater	Integrated Thermal Efficiency (TE_I) not less than: $TE_I = (600(PE)) / (PE+1,619)$ Where *PE* is the active electrical power, in Btu/h.	Manufactured on or after May 31, 2028	10 C.F.R. section 430.23(p) (Appendix P to subpart B of part 430)

- Reference Appendices JA16: 2025 Building Energy Efficiency Standards
  - Sizing Methodology - JA16.3 Heat Pump Pool Heater Sizing
    - A heat pump pool heater (HPPH) shall be sized using the HPPH manufacturer's specifications. The following sizing provisions shall be applicable if the HPPH manufacturer's specifications do not include information on HPPH sizing:
      a. Determine the desired pool temperature in °F.
      b. Determine the average temperature for the coldest month of pool use in °F.
      c. Determine temperature rise in °F by subtracting the average temperature for the coldest month from the desired pool temperature.
      d. Calculate the pool volume in gallons.
      e. Calculate the time needed for the HPPH to achieve the 10°F degree rise in hours. This shall not exceed 17.5 hours.
      f. Use equation JA16-1 to determine the Btu/h output requirement of the HPPH.

      Equation JA16-1:

      $$Qout = (Vp \times 8.33 \times \Delta T) \div t$$

      Where:
      - Qout is the output heating capacity of the HPPH.
      - Vp is the pool volume in gallons.
      - 8.33 is the weight of a gallon of water at 62°F in pounds per gallon.
      - ΔT is the pool temperature rise in °F, and shall not exceed 10°F.
      - t is the time needed for the HPPH to achieve the 10°F degree rise in hours and shall not exceed 17.5 hours.

Eligible Climate Zones and Building Types

Eligible Climate Zones:

This measure is applicable in all California climate zones.

Eligible Building Types:

This measure is applicable to high-rise multifamily buildings of four or more habitable stories above grade, public, and commercial buildings.

Measure Exclusions

This high-performance measure excludes heat pump water heating systems not designated to heat pools or spas.

Reviewer Checklist

High-Performance Measure Review Checklist: Pool and Spa Air-to-Water Heating Technology

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 project have a heat pump pool or spa heating system serving a commercial, public, or high-rise multi-family building?	
☐ 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?	

Premium Level Inducement Requirements	Comments
☐ Are the HPPH(s) rated prior to May 31st, 2028, and have a COP of no less than 5.5 at the High Air Temperature-Mid Humidity rating condition (80F/63%/80F)?	
☐ Were the HPPH(s) right-sized to meet the pool or spa heating needs, calculated using manufacturer specifications or sized using the equations provided in the 2025 energy code per Appendix JA16 – Criteria for Pool and Spa Heating Systems?	

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	March 30, 2025	N/A
2	March 31, 2025	December 31, 2025	Updated format, requirements, checklist