Proposal Summary

Unitary HP/ER Hybrid Heaters

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Measure Description

This measure would add prescriptive requirements to Title 24 Part 6 to ensure that unitary Heat Pump / Electric Resistance (HP/ER) hybrid water heaters are specified and installed in a way that minimizes electric resistance use. The proposed measure would apply to new construction, alterations, and additions in Nonresidential (NR) buildings.

The measure would require unitary HP/ER HPWHs to be installed according to the manufacturer's design and installation guidelines, set a minimum compressor cutoff temperature for both heat pump only and hybrid (heat pump and electric resistance) operating modes, and require that the HP/ER HPWH can operate in heat pump-only mode under the heating design day 0.6% dry bulb temperature. The measure would also specify sizing requirements for unitary HP/ER HPWH's and installation practices when multiple units are installed in central systems with recirculation.

Table 1 summarizes the scope of the proposed code change.

Table 1: Scope of Proposed Code Change

An "X" indicates the proposed code change is relevant.

Building Type(s)		single family	**Construction Type(s)**	X	new construction
		multifamily		X	additions
	X	nonresidential		X	alterations
Type of Change		mandatory	**Updates to Compliance Software**		no updates
	X	prescriptive		X	update existing feature
		performance		X	add new feature
Third Party Verification	X	no changes to third party verification			
		update existing verification requirements			
		add new verification requirements			

Justification for Proposed Change

In California approximately 22 trillion BTUs are used for water heating in commercial buildings (CBECS microdata 2018). The majority of the SHW energy use (79%) is from natural gas with just 19% from electricity (CBECS microdata 2018). Utility incentive programs for HP/ER HPWHs have attempted to capture a portion of this opportunity, but configuration and operation issues are demonstrating lower than expected performance (in terms of coefficient of performance, COP) when HP/ER HPWH's are installed as the heat source for central DHW systems.

One key component contributing to reduced COP is the activation of the ER heating elements. ER heating can be triggered for several reasons including but not limited to:

- HPWH supply air temperature is too low for compressor operation due to
    - Insufficient space and/or ventilation in installation location
    - Cool winter temperatures
    - HPWH operating mode: some models have 10°F lower compressor cut out temperature in efficiency (HP only) mode versus Hybrid mode setting
- HPWH control algorithm attempts to avoid a potential hot water runout event[1] from:
    - Inappropriate sizing of HPWH given expected ambient conditions, voltages, and defrost cycles
    - Perceived deficiency in tank heating capacity due to unexpected temperature profile in the tank that arises from recirculation systems, master mixing valves, or pump controls.
- Improper balance of heating requirements on multiple water heaters installed in a parallel arrangement due to
    - Imbalanced flow through the water heaters
    - Different temperature setpoints for the water heaters.

Ensuring that installed hybrid HPWHs comply with the manufacturers' installation guidelines will minimize the chance that HPWHs will overcool the space in which they

[1] Runout event: Any period where the delivered supply water temperature from the water heating equipment falls below the intended temperature for the application as determined by the project requirements and the designer.

are installed. If the space is overcooled, the heating capacity of the heat pump will decrease and the HPWH will need to use more ER heating to meet demand. Enforcing a specific HPWH compressor cutoff temperature will improve efficiency and help designers understand the HPWH operation characteristics to ensure that it can deliver hot water in all conditions. By sizing the unitary HPWH for the conditions expected in the field, the designer will minimize the risk of hot water runouts and enable greater use of the heat pump relative to the ER elements. By requiring proper installation practices when multiple water heaters are installed with a recirculation system, the heating demand will be split equally between the HPWHs and will optimize the performance of the entire system.

By accomplishing the above goals, installations of central systems with unitary hybrid HPWHs will be more successful and demonstrate the capability for electrification without the high energy costs associated with ER heating.

Data Needs / Information Requests

The Statewide CASE Team is seeking the following information to inform the code change proposal. Data may be provided anonymously. To participate or provide information, please email William Healy, WHealy@trccompanies.com directly and copy info@title24stakeholders.com.

Data needs:

- Design drawings and compliance forms from utility programs and design consultants to understand current design practice, technical feasibility, and market readiness, and to inform energy analysis assumptions.
- Surveys and interviews with HPWH manufacturers, designers, energy consultants, program implementers, and advocates to assess market readiness, technology adoption and building practitioner capability.
- Literature to inform energy analysis approach / assumptions, establish baseline, understand design practice, technical feasibility, and environmental and non-energy impacts, including:
    - Manufacturer resources, such as design guides, installation and operational manuals sizing tools, product performance and feasibility reports, and training material.
    - Industry publications, such as industry standards and design guides, technical reports, conference presentations, and case studies.

- Resources from advocacy groups, trade associations, or research institutions, including the NEEA, national laboratories, and the New Building Institute (NBI)-led Advanced Water Heating Initiative (AWHI).
- Publications from research projects funded by CEC EPIC, U.S. DOE, and utilities.
- Field demonstration and/or lab testing data to understand the impact of sizing, recirculation, and ventilation of central HPWH systems on their performance.

Draft Code Language

1.1 Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

1.2 Title 24, Part 6

SECTION 140.5

a) **Nonresidential occupancies**. Service hot water systems in nonresidential buildings shall meet the requirements of (1 or 2) and 3 below, or meet the performance compliance requirements of Section 140.1:

1) School buildings less than 25,000 square feet and less than 4 stories in climate zones 2 through 15. A heat pump water heating system that meets the applicable requirements of Sections 110.1, 110.3, and 120.3.

2) All other occupancies. A service hot water system that meets the applicable requirements of Sections 110.1, 110.3, 120.3, and 140.5(b)

3) For integrated unitary heat pump water heating systems with integrated electric resistance heating elements serving all nonresidential occupancies:

A) The water heating system shall be sized to meet the requirements of JA14.6.1

B) The water heating system shall meet the installation requirements of JA14.6.2

C) The water heating system shall meet the requirements of i or ii:

i. meet the following requirements,

(a) The minimum heat pump water heater compressor cut-off temperature shall be equal to or lower than 40°F ambient air temperature in efficiency mode and equal to or lower than 47°F in hybrid mode.

(b) If the primary heat pump water heater is a unitary system without direct ducting to the outside, the system shall comply with the manufacturer's minimum air volume requirements. If multiple unitary heat pump water heaters are installed in a space, then the minimum air volume shall be

the sum of the air volume requirements for each unitary heat pump water heater installed in the space.

(c) If outside air is used to meet the heat source requirements whether by installation outdoors, providing vents to the outdoors, or ducting outdoor air to the unit, the primary heat pump water heater shall be able to operate in heat pump mode under Heating Design Drybulb (0.6%) as described in Table 2.3 from JA2.

(ii) meet the requirements of NEEA Advanced Water Heater Specification for integrated commercial heat pump water heater Tier 2 or higher, and have noncontinuous recirculation system

1.3 Reference Appendices