TITLE 24, PART 6 | 2028 CODE CYCLE

Unitary Heat Pump/Electric Resistance (HP/ER) Hybrid Heaters

Codes and Standards Enhancement (CASE) Proposal

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CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Proposal Description

- Code Change Proposal
- Benefits
- Background Information

Proposed Code Change

For nonresidential applications, proposed changes to prescriptive requirements, Sections 100.1, 140.5(a), and 141.0(b):

Unitary HPWH systems with integrated electric resistance heating elements installed in service hot water systems required to:

- Be installed according to manufacturers' ventilation guidelines and:
  - have a minimum compressor cut-off temperature less than or equal to 40°F inlet air temperature in efficiency mode and less than or equal to 47°F in hybrid mode, and
  - have the ability to operate in heat pump mode under Heating Design Drybulb (0.6%) if outside air is used to meet heat source requirements
- Be sized based on manufacturer specifications that consider capacity impacts of defrost cycles, nominal voltage in building, ambient temperature of 47°F, and cycling of electric resistance elements
- Follow installation requirements if part of a multiple water heaters, parallel arrangement.

See Title24stakeholders.com for proposal description, justification, draft code language, and requested data

Proposed Code Change – Derating Capacity

To ensure unitary HP/ER HPWH's deliver expected hot water while minimizing ER heating, the proposed code change in Joint Appendix 14.6 requires designers to size the water heaters based on the following conditions:

- Nominal voltage of the electric supply in the building
- Ambient temperature of 47°F, or an ambient temperature that the designer determines to be appropriate.
- The impact of defrost cycles, if applicable
- The average hourly maximum power output given the water heater's control algorithm for the heat pump and the ER elements.

Designers shall use manufacturer data to determine the output under these conditions. If the manufacturer does not provide these conditions, the output capacity shall be reduced to 80% of its rated value when determining the number and size of unitary HP/ER water heaters installed in the building.

Proposed Code Change – Installation

If multiple unitary HP/ER water heaters are configured in a parallel arrangement to deliver water to the supply of a recirculation system, the proposed code requirement in Joint Appendix 14.6 would require an installer to ensure that:

a) The temperature setpoint for storage and/or water supply is the same for all units to within 1°F and is set according to any approved construction documents, and

b) The heat pump On temperature setpoint, if controllable, is the same for all units to within 1°F and is set according to any approved construction documents, and

c) The heat pump Off temperature setpoint, if controllable, is the same for all units to within 1°F and is set according to any approved construction documents, and

d) The plumbing is configured in a reverse return configuration or in another manner such that the flow at both the minimum flow rate and maximum flow rate expected to be delivered into the recirculation system is balanced between the tanks to within 10%.

Benefits of the Proposed Change

- Increased energy efficiency of water heaters
- Increased cost effectiveness
- Reduced risk of running out of hot water
- Reduced risk of overcooling space
- Increased longevity of water heaters

Marked-up Code Language

See Title24stakeholders.com for marked-up code language

Title 24, Part 1	Title 24, Part 6	Reference Appendices
▪ No changes	▪ Section 100.1: Definitions and Rules of Construction ▪ Section 140.5(a) Nonresidential occupancies ▪ Section 141.0(a) Additions ▪ Section 141.0(b)2.N Alterations	▪ Joint Appendix 14 – Qualification Requirements for Hot Water Systems

Poll

Should the proposed measure be considered as a prescriptive requirement or a mandatory requirement?

- Prescriptive
- Mandatory

Market and Technical Considerations

- Current Conditions and Trends
- Potential Barriers and Solutions
- Technical feasibility

Current Market Conditions

- Current market share of HPWH's appears small but growing due to incentive programs
- Service hot water systems with unitary HP/ER HPWH's have been observed in supermarkets, hotels, and some foodservice. Expect the adoption is broader than these segments but with low penetration
  - **What other building/facility types are seeing installations of central HPWHs?**
- **SCAQMD zero NOx** water heater compliance dates for new buildings range from 2026 to 2028 (Rule 1146.2), and **BAAQMD** compliance dates range from 2027 to 2031.

Reference: https://www.aqmd.gov/docs/default-source/rule-book/recent-rules/r1146_2-060724.pdf?sfvrsn=8

Market Barriers and Solutions

Market Barriers	Potential Solutions
1. Limited current selection of commercial unitary HP/ER HPWHs 2. Designers and contractors lacking experience with central Service Hot Water Systems with unitary HP/ER HPWHs	1. Inform manufacturers of proposed requirements so that they can understand needs of the market. 2. Develop educational materials for design and contracting community

Poll

What percentage of nonresidential buildings (new construction and additions) have Unitary HP/ER HPWHs?

- 0 % to 10 %
- 10% to 25 %
- 25 % to 55 %
- 55 % to 75 %
- 75 % to 100 %
- Do Not Know

Poll

What percentage of nonresidential buildings install Unitary Hybrid HPWHs in alterations?

- 0 % to 10 %
- 10% to 25 %
- 25 % to 55 %
- 55 % to 75 %
- 75 % to 100 %
- Do Not Know

Technical Considerations

- Ventilation air needs depend upon a range of factors:
  - Heat sources in mechanical spaces
  - Location in mechanical spaces
  - Hot water usage and recirculation rates in building

  → *Measure must provide sufficient ventilation air over a broad set of use cases in addition to the 2025 code requirement for consumer water heaters while resulting in minimal burden*
- Proprietary control algorithms affect the use heat pumps and ER in units.

  → *Measure must promote operation in HP/ER mode as opposed to ER mode*
- Inappropriate sizing of unitary HP/ER water heaters can lead to inadequate hot water delivery and higher energy costs due to dependence on ER.

  → *Measure must ensure unitary HP/ER's are sized to deliver required hot water efficiently.*
- Installation practices for multiple heaters can impact HP/ER operation

  → *Measure must specify installation practices with sufficient specificity*

Technical Barriers and Solutions

Technical Barriers	Potential Solutions
1. Control algorithms may lead to performance differences.	1. Make code language agnostic to control algorithms and focus on performance
2. Ventilation requirements may be challenging to achieve especially in alterations/retrofits	2. Provide examples of proper ventilation in the compliance manual.
3. Situations where unitary HPWH are not feasible	3. Educational material to help identify when and where unitary HPWHs are appropriate for central SWH systems
4. HPWH compressor cutoff temperatures may not be easily accessible	4. Conduct research to characterize compressor cutoffs

Poll

Do the recommended requirements to provide adequate ventilation air to unitary HP/ER water heaters sufficiently account for the range of ambient environments? If not, please explain or offer alternative approaches.

Open ended response

Poll

What installation and setup requirements are needed to ensure that Unitary HP/ER water heaters achieve expected efficiency levels associated with rated values?

Open ended response

Poll

What else should we know? Are there market or technical barriers or solutions we should consider?

Open ended response

Per Unit Energy and Cost Impacts

Methodology and Assumptions

- Energy and Energy Cost Savings
- Incremental Costs

Alternative Energy Savings Methodology

- Since CBECC does not model distribution systems for NR, the Statewide CASE Team used a recirculation heat loss spreadsheet calculator to estimate distribution heat loss for selected prototypes.
  - The calculator uses pipe heat loss calculation methods defined in existing 2025 MF ACM Reference Manual
  - The calculator handles detailed recirculation pipe designs, installation conditions, and recirculation flow rates
- Given the CBECC software does not model the CHPWH properly, the Statewide CASE Team used an alternative energy savings methodology.
  - Use California Simulation Engine to model heating plant energy consumption for the measure case
  - Applied base case energy multiplier obtained from field and lab data to determine heating plant energy consumption for the base case

Reference: 2025_T24_CASE-Report-_MF-DHW-Final-1.pdf

Energy Efficiency Assumptions

Estimated Plant Coefficient-of-Performance for Measure Case and Base Case

Prototype	Base Case COP	Measure Case COP
OfficeLarge	1.3	1.8
OfficeMedium	1.9	2.2
OfficeMediumLab	1.8	2.3
RestaurantFastFood	1.9	2.5
SchoolSmall	1.6	1.95
SchoolLarge	1.3	1.8

Energy Modeling Assumptions

- Simulating energy savings in CBECC
- Simulating using the following prototypical buildings and climate zones

Prototypical Buildings

- Office (large, medium)
- School (large, small)
- Laboratory
- Restaurant (Fast Food)
- Assembly
- Retail (Large, Mixed Use, Medium, Strip Mall)
- Grocery

Climate Zones

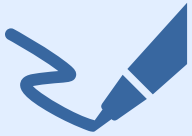
- CA Climate Zones 1 to 16

Key Modeling Assumptions

Prototype: Each Prototypical Building

Standard Design

1. Central HPWH running in hybrid mode
2. Continuous circulation
3. Hot Water Supply T = 135°F
4. Water Mains T = 40°F, 50°F, or 60°F (depending upon Climate Zone)
5. Ambient T = 50°F (based on inadequate ventilation)
6. Number of units based on manufacturer calculator
7. Unoptimized flow balancing



Proposed Design

1. Central HPWH running in hybrid mode
2. Continuous circulation
3. Hot Water Supply T = 135 °F
4. Water Mains T = 40°F, 50°F, or 60°F (depending upon Climate Zone)
5. Ambient T = 67.5°F
6. Number of units based on derated output of water heaters
7. Balanced Flow

Assumptions for Statewide Savings Estimates

The Statewide CASE Team estimated the percentage of building floor area impacted by the proposed measure in the following manner:

1) Estimated the percentage of statewide NR sq ft with commercial water heaters
2) Estimated the % of sq ft that will use electric water heaters by the following assumptions:
   - 100% of sq ft in areas covered by Air Quality Management District (AQMD) rules
   - 1% of sq ft in areas not covered by AQMD rules
3) Estimated % of electric water heaters that will use HPWH's
4) Estimated % of HPWH's that will be unitary water heaters

Assumptions for Statewide Savings Estimates, (cont)

- New Construction

Prototype	Percentage of statewide NR sq ft impacted by proposed measure															
	CZ01	CZ02	CZ03	CZ04	CZ05	CZ06	CZ07	CZ08	CZ09	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
OfficeLarge	0.0%	0.0%	2.3%	2.2%	0.0%	1.2%	0.2%	2.1%	2.6%	0.5%	0.2%	0.2%	0.0%	0.2%	0.1%	0.3%
OfficeMedium	0.1%	1.5%	0.7%	0.8%	0.1%	0.8%	0.1%	1.1%	1.5%	1.0%	0.1%	0.7%	0.1%	0.2%	1.8%	0.5%
OfficeMediumLab	0.2%	1.0%	1.2%	1.3%	0.2%	0.5%	0.2%	0.5%	0.7%	0.5%	0.2%	0.2%	0.2%	0.2%	0.5%	0.3%
RestaurantFastFood	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.4%	0.4%	0.4%	0.2%	0.1%	0.2%	0.2%	0.4%	0.2%
SchoolSmall	0.4%	2.4%	0.7%	0.7%	0.4%	0.6%	0.4%	0.7%	0.9%	0.9%	0.4%	0.5%	0.4%	0.2%	0.8%	0.6%
SchoolLarge	0.2%	0.5%	0.6%	0.5%	0.2%	0.4%	0.2%	0.7%	0.8%	0.9%	0.2%	0.3%	0.2%	0.1%	0.7%	0.4%
Assembly	0.4%	3.3%	2.3%	1.6%	0.4%	1.4%	0.4%	2.6%	2.3%	2.6%	0.4%	0.9%	0.4%	0.4%	2.2%	1.1%
RetailLarge	0.0%	0.0%	0.8%	0.8%	0.2%	0.6%	0.2%	0.8%	1.0%	0.7%	0.2%	0.4%	0.2%	0.1%	1.6%	0.4%
RetailMixedUse	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RetailMedium	0.1%	1.1%	0.4%	0.5%	0.1%	0.4%	0.1%	0.6%	0.7%	0.7%	0.1%	0.2%	0.1%	0.1%	0.8%	0.4%
RetailStripMall	0.0%	0.5%	0.3%	0.2%	0.1%	0.4%	0.1%	0.7%	0.5%	1.2%	0.1%	0.1%	0.1%	0.2%	0.7%	0.3%
Grocery	0.5%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.2%	0.5%

Assumptions for Statewide Savings Estimates , (cont)

- Alterations

Prototype	Percentage of statewide NR sq ft impacted by proposed measure															
	CZ01	CZ02	CZ03	CZ04	CZ05	CZ06	CZ07	CZ08	CZ09	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
OfficeLarge	0.00%	0.00%	0.19%	0.19%	0.00%	0.10%	0.02%	0.17%	0.21%	0.04%	0.02%	0.02%	0.00%	0.01%	0.01%	0.02%
OfficeMedium	0.01%	0.12%	0.06%	0.06%	0.01%	0.06%	0.01%	0.09%	0.12%	0.08%	0.01%	0.05%	0.01%	0.02%	0.14%	0.04%
OfficeMediumLab	0.02%	0.08%	0.09%	0.10%	0.02%	0.04%	0.02%	0.04%	0.05%	0.04%	0.02%	0.01%	0.02%	0.02%	0.04%	0.02%
RestaurantFastFood	0.01%	0.03%	0.02%	0.02%	0.01%	0.02%	0.01%	0.03%	0.04%	0.04%	0.01%	0.01%	0.01%	0.01%	0.04%	0.02%
SchoolSmall	0.03%	0.20%	0.06%	0.06%	0.03%	0.05%	0.03%	0.06%	0.07%	0.07%	0.03%	0.04%	0.03%	0.02%	0.06%	0.05%
SchoolLarge	0.02%	0.05%	0.06%	0.05%	0.02%	0.04%	0.02%	0.07%	0.08%	0.09%	0.02%	0.03%	0.02%	0.01%	0.07%	0.04%
Assembly	0.03%	0.28%	0.19%	0.13%	0.03%	0.11%	0.03%	0.22%	0.19%	0.22%	0.03%	0.08%	0.03%	0.04%	0.18%	0.09%
RetailMixedUse	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
RetailLarge	0.00%	0.00%	0.19%	0.18%	0.04%	0.14%	0.04%	0.18%	0.24%	0.17%	0.04%	0.10%	0.04%	0.03%	0.38%	0.09%
RetailMedium	0.01%	0.09%	0.03%	0.04%	0.01%	0.03%	0.01%	0.05%	0.05%	0.06%	0.01%	0.01%	0.01%	0.01%	0.06%	0.03%
RetailStripMall	0.00%	0.04%	0.02%	0.02%	0.01%	0.03%	0.01%	0.05%	0.04%	0.09%	0.01%	0.01%	0.01%	0.02%	0.05%	0.02%
Grocery	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.02%	0.04%

Preliminary Savings Estimates

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First -Year Natural Gas Savings (Million Therms)	First-Year Source Energy Savings (Million kBtu)	30-Year Present Valued LSC Savings (Million 2029 PV$)
New Construction & Additions	0.9	1.8	-	1.2	7
Alterations	5.7	11.1	-	7.0	44
Total	**6.6**	**12.9**	**-**	**8.2**	**52**

Incremental Cost Framework

Prototype(s): Each Prototypical Building

Baseline

First Cost

1. Unitary HPWH's: 120 gallon commercial unit. Sized to perform at rated conditions.
2. Installation of system and piping
3. Commissioning

30-Year Maintenance Costs

1. Equipment Replacement
2. Regular Maintenance

Proposed

First Cost

1. Unitary HPWH's: 120 gallon commercial unit. Sized with derating.
2. Installation of system and piping
3. Modification to allow for proper ventilation
4. Commissioning

30-Year Maintenance Costs

1. Equipment Replacement
2. Regular Maintenance

Approach for Gathering Costs

- Develop prototype designs and obtain cost data for baseline and measure case with contractors.
- Approach to collecting supplemental cost data:
  - RS Means
  - Contractor Outreach

- **Are you aware of cost data or willing to share cost data for installation of central heat pump water heaters?**

Compliance Verification

- Key Aspects of Compliance Verification
- Barriers and Solutions
- Revisions to Compliance Software

Key Aspects of Compliance Verification

The proposed measure would require:

- Additions to compliance forms LMCC-PLB, LMCC-PRF, LMCI-PLB, NRCC-PLB, NRCI-PLB, and NRCC-PRF. The designer and installer will fill out the forms to self attest that requirements were met.
- Plan checker and building inspector will review NRCC & NRCI forms that indicate the requirements were met.
- Changes to the compliance software

Compliance Barriers and Solutions

Compliance Verification Barriers	Potential Solutions
1. Verifying compliance with ventilation air requirements. 2. Verifying compliance with sizing requirements 3. Verifying compliance with installation requirements 4. Plan checkers will need to review additional items.	1. Develop guidance on determining ventilation air volumes. 2. Develop guidance and education on sizing methodology. 3. Provide guidance on determining whether flow requirements are met based on calculations or compliance with prescriptive reverse return configuration. 4. Develop educational materials for plan checkers on new requirement.

Compliance Software Updates

The Statewide CASE team will document modifications needed in the compliance software to account for ventilation air, compressor cutoff, sizing, and installation requirements.

Examples of potential changes:

- Prescriptive baseline:
  - Calculations of required air volume
  - Checklist item for compressor cutoff temperatures
  - Calculations of sizing requirements
  - Checklist for installation requirements
- Updates to the software calculation methods to reflect the new requirements
  - Calculations of equipment COP as a function of ambient temperature
  - Predictions of ambient temperature with different ventilation configurations
  - Estimates of ER use with different hot water delivery profiles

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More information on
CEC's 2028 proceeding website.

We want to hear from you!

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