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 non-residential applications:

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

- Be installed according to manufacturers' guidelines and:
  - 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
  - the ability to operate in heat pump mode under Heating Design Drybulb (0.6%) if outside air is used to meet heat source requirements

OR

- Unit meets requirements of NEEA Advanced Water Heater Specification for Commercial HPWH for Tier 2 or higher and have no continuous recirculation system.
- Exception for systems with very low recirculation flow rates, thresholds TBD

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

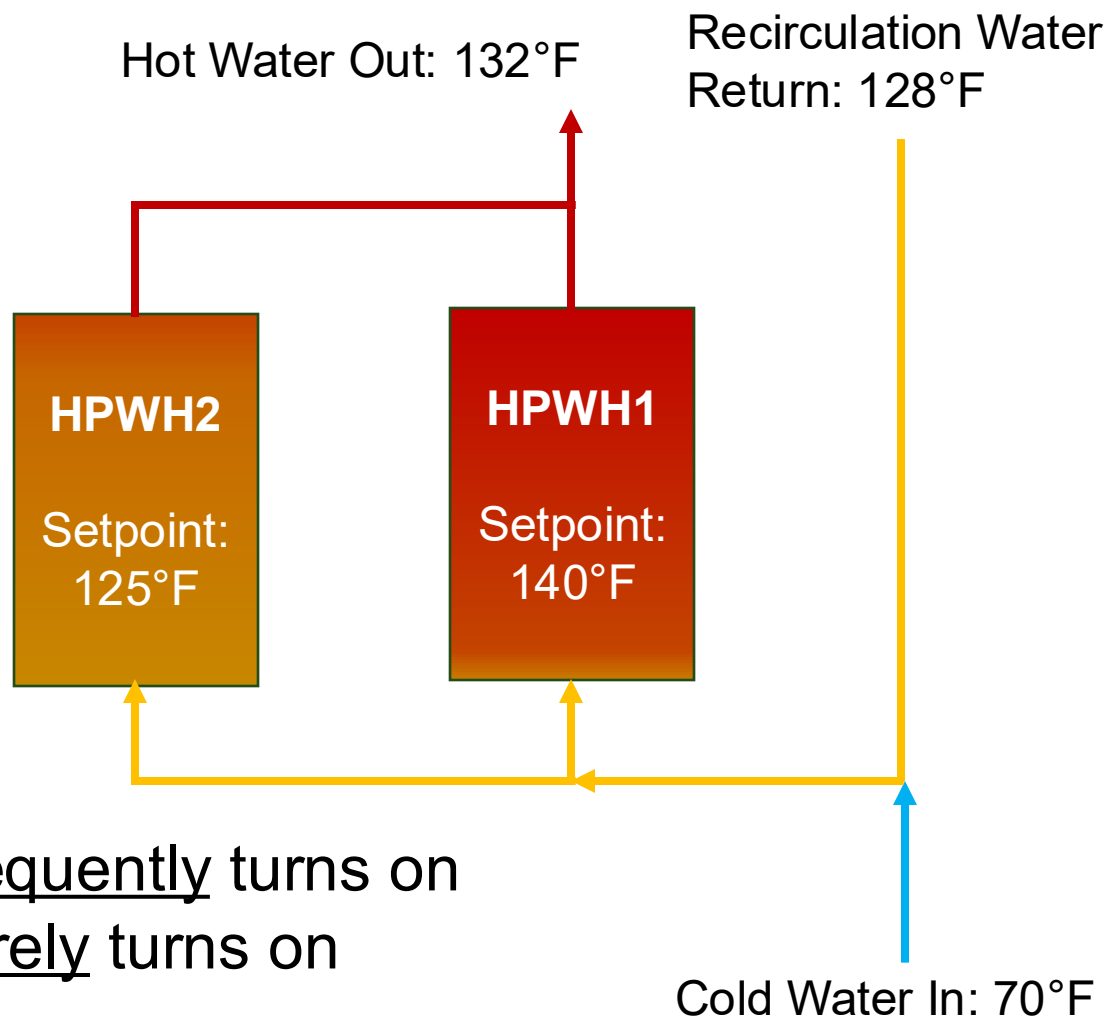
Benefits of the Proposed Change

- Energy efficiency of water heater more closely matching expected heat pump water heater efficiency
- Increased cost effectiveness
- Reduced risk of running out of hot water
- Reduced risk of overcooling space

Background Information – Systems

- Field studies have observed central service hot water systems with poor performance
- Excessive electric resistance use has been implicated in this poor performance
- Improper configuration of multiple HPWH in a single system can lead to excessive use of electric resistance.

Example of Improper Configuration



- **HPWH1** frequently turns on
- **HPWH2** rarely turns on

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	▪ None

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 with incentive programs
- Service Water Heating Systems with unitary hybrid HPWH 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?**
- Existing systems that are retrofitted may not have the air volume to support drop-in replacement of unitary HP/ER that are installed indoors
- Upcoming SCAQMD and BAAQMD rulings (covering 60% of Californians)are driving current adoption. There is currently no alignment with these AQMD requirements in Title 24 for NR buildings outside of large schools

Market Barriers and Solutions

Market Barriers	Potential Solutions
1. Limited selection of unitary hybrid HPWHs 2. Designers and contractor lacking experience with central Service Water Heating Systems with unitary hybrid HPWHs	1. Conduct research to identify additional suitable HPWHs 2. Develop educational materials for design and contracting community

Current Market Share

Market share: percentage of buildings that already use the proposed technology or design practice (at or above the proposed stringency level)

Slide not shown

Current Market Share

New Construction and Additions	X%	▪ Text ▪ Text
Alterations	X%	▪ Text ▪ Text

Poll

What commercial buildings (new construction and additions) have Central Service Hot Water Systems with Unitary Hybrid HPWHs?

- Office (large, medium, small)
- School (large, small)
- Laboratory
- Restaurant
- Grocery

Poll

What commercial building with Central SHW systems installed Unitary Hybrid HPWHs in alterations?

- Office (large, medium, small)
- School (large, small)
- Laboratory
- Restaurant
- Grocery

Technical Considerations

- Many factors and assumptions contribute to calculating the minimum supply air requirement
  - Recirculation heat loss (if any)
  - Ambient environment conditions
  - Hot water load and draw profile
  - HPWH duty cycle
  - Control algorithms
- Methods to determine air requirements are not always clear enough to assess them over a broad range of use cases.
- Control algorithms, installation, and configuration will affect ER use even with ideal conditions
- Are the minimum air supply requirements sufficient?

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. Develop ventilation best practices design guides that accompany standard or 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 HPWH are appropriate for central SWH systems
4. HPWH compressor cutoff temperatures may not be easily accessible	4. Conduct research to characterize compressor cutoffs

Poll

What needs to be done to ensure intended operation occurs regardless of control scheme?

Open ended response

Poll

Do recommended ventilation requirements sufficiently account for the range of environments?

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

Energy and Energy Cost Savings Methodology

- We leveraged water usage (GPD/square foot) data provided by Ecotope; the data was sourced from an LBNL study. Compare annual savings using different operational approaches
- Estimate savings per square foot of nonresidential buildings.
  - Construction estimates from CEC New Construction and Existing Buildings Construction Forecast Data
  - Share of buildings with HPWHs estimated from 2025 CASE report data and regional air quality rulings. Initial estimate: 50% of new installations will be HPWH with recirculation
  - Estimated number of unitary systems based on design and field research experience. Initial estimate: 50% of HPWH are unitary in most nonresidential buildings.

Preliminary Savings Estimates

Unitary HP-ER Hybrid Heaters	First Year Statewide Electricity Savings (GWh)	First Year Statewide Natural Gas Savings (Million Therms)	Confidence Level in Preliminary Energy Savings (low, medium, high)
NR	27.3	N/A	Medium

Energy Modeling Assumptions

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

Prototypical Buildings

- Office (large, medium, small)
- School (large, small)
- Laboratory
- Restaurant
- Grocery

Climate Zones

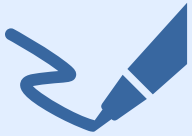
- CA Climate Zones 1 to 16

Key Modeling Assumptions

Prototype: Each Prototypical Building

Standard Design

1. Central HPWH running in hybrid mode
2. Continuous circulation
3. Hot Water Supply T = 125 °F



Proposed Design

1. Central HPWH running in hybrid mode with optimized settings:
    1. Proper Sizing
    2. Plumbing configuration leading to balanced flow
    3. Adequate ventilation
    4. Proper controls
    5. Compressor cut-off as specified

Incremental Cost Framework

Prototype(s): Each Prototypical Building

Baseline

First Cost

1. 120 Gallon HPWH
2. Installation of system and piping
3. Commissioning

30-Year Maintenance Costs

1. Equipment Replacement
2. Regular Maintenance

Proposed

First Cost

1. 120 Gallon HPWH
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 of Refrigeration System

Approach for Gathering Costs

- Develop Basis of Design and obtain cost data for baseline and measure case with contractors.
- Approach to collecting supplemental cost data:
  - RS Means
  - Contractor and Distributor Surveys

- **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 NRCC-PLB and NRCI-PLB. 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 compressor cutoff requirements. 2. Plan checkers will need to add an additional check of plans.	1. Require manufacturers to report data on cutoff requirements. 2. 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 compressor cutoff and ventilation requirements.

Examples of potential changes:

- Prescriptive:
  - Checklist item for compressor cutoff temperatures
  - Calculations of required air volume
- Updates to the software calculation methods to reflect the new requirements

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More information on
CEC's 2028 proceeding website.

We want to hear from you!

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