



**TITLE 24, PART 6**

**2028 CODE CYCLE**



# Welcome to the Statewide CASE Team's Utility Sponsored Stakeholder Meeting



Topics: AWHP Alignment with Boiler and Chiller  
Requirements



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# Agenda

Proposal Description

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Market and Technical Consideration

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Technical Barriers and Solutions

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Per Unit Energy and Cost Methodology

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Compliance and Enforcement

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Discussion and Next Steps

# Proposal Description

- Code Change Proposal
- Benefits
- Background Information



**Photo credit: Red Car Analytics**

# Proposed Code Change

1. Align staging/isolation requirements for multi-unit air-to-water heat pump (AWHP) and water-to-water heat pump (WWHP) plants with those for chillers and boilers
2. Requires testing to verify isolation is achieved
3. Applies to all non-residential new construction, and additions and alterations in all climate zones

**See [Title24stakeholders.com](https://Title24stakeholders.com)**  
for proposal description,  
justification, draft code  
language, and requested data

# Benefits of the Proposed Change

The Proposed recommendations will

- Clarify which hydronic system requirements for boilers and chillers also apply to AWHPs
- Increase average installed efficiency of AWHP systems in non-residential buildings by eliminating unnecessary pump energy and thermal losses when unused AWHPs are turned off
- Intervene before improper AWHP staging practices become difficult to change as the market rapidly increases in the coming years

# Background Information

- Recent studies have indicated that installed AWHP efficiency in non-residential buildings can be significantly below expectations (as much as 37% lower COP at rated conditions)<sup>1</sup>
- One observed cause was pumps that circulate water even when AWHPs are not operating
- Multi-unit AWHP/WWHP systems can waste pump energy and suffer heat losses if unused heat pumps are not isolated or reduced to the minimum flow rate specified by the manufacturer when the flow of water is turned off
- Requirements for AWHPs and WWHPs are not clearly delineated in the code, but should be very similar to those for boilers and chillers

1. Weitze, H., Stober, W., and Gantley, M., Nonresidential Hydronic Heat Pumps: System Operation Field Study and Analysis, PGNE Code Readiness Final Project Report ET21PGE7201-2, October 2024. <https://etcc-ca.com/reports/code-readiness-final-project-report-nonresidential-hydronic-heat-pumps-system-operation>

# Marked-up Code Language

See [Title24stakeholders.com](https://Title24stakeholders.com) for marked-up code language

Title 24, Part 1

- No changes

Title 24, Part 6

- Add Section140.4(k)4 to the prescriptive path, making AWHP/WWHP isolation requirements match those for chillers and boilers (140.4(k)2-3). Flow through any AWHP must be reduced to the manufacturer’s recommended minimum flow rate or turned off when it is not operating, while maintaining flow through operating units.

Reference Appendices

- No changes, but staged AWHP and WWHP systems must be tested in accordance with NA7.5.7



# Market and Technical Considerations

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

# Current Market Conditions

- AWHP sales represent a significant market share and rapid growth in Japan and Europe
- In California, the number of installed AWHPs is small, but new policies encouraging all-electric buildings, new AWHP product lines reaching the market, new financial incentives for AWHPs, and more clear and comprehensive code requirements are expected to encourage a rapid increase in market adoption for all non-residential building types
- Uncertainty of installed performance based on field studies of AWHPs in non-residential buildings presents a significant market barrier when more reliable (though perhaps lower) performance can be achieved with other options
- Lack of clear requirements for AWHPs and WWHPs compared to other hydronic systems may lead to slow adoption and resistance to the technology from code officials

# Market Barriers and Solutions

## Market Barriers

1. Unclear requirements for multi-unit systems in Title 24
2. First cost
3. Lack of trained installers
4. Insufficient utility incentives



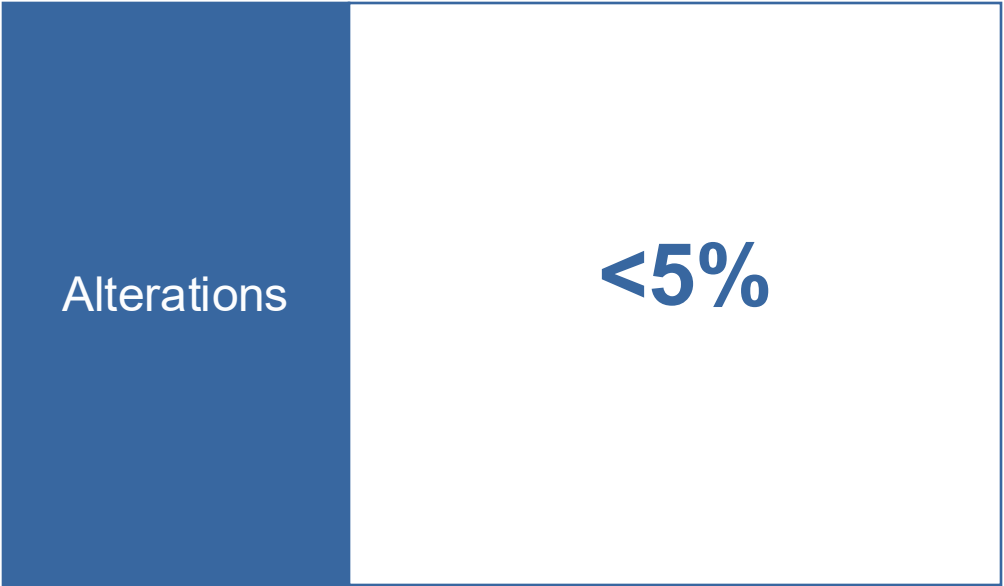
## Potential Solutions

1. Reconcile treatment of AWHPs and WWHPs with chillers and boilers where appropriate
2. Equipment costs should decrease as more product lines become available and economies of scale reduce cost of production
3. Improved training availability and content
4. Better performance and cost data to inform incentives

# Current Market Share

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

## Current Market Share



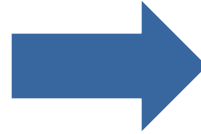
# Technical Considerations

- Installed and operating performance of AWHPs in non-residential buildings often do not match expectations/advertised performance
- Energy can be wasted through unnecessary pump power and loss of energy if heated/cooled water passes through heat pumps that are not operational in a staged system
- Possible energy losses have not been quantified

# Technical Barriers and Solutions

## Technical Barriers

1. Multi-unit AWHP and WWHP systems are uncommon and standard practice for isolating unused units is unknown
2. Average energy savings for the measure is challenging to calculate because of the numerous non-residential design configurations and control strategies



## Potential Solutions

1. Interviews with designers and installers that have experience with non-residential AWHPs and have participated in Title 24 stakeholder engagement during previous cycles
2. Model savings using EnergyPlus once standard design practice has been determined for several common system configurations.

## Poll

**Are there other requirements for chillers and boilers that should also be applied to AWHPs and WWHPs?**

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

- Using CEC's methodology and metrics for non-residential buildings
- Model New Construction with default standard design
- Model Alterations with modified standard design
- For the purpose of cost-effectiveness analysis
  - Standard Design will include water being pumped through non-operating AWHPs in larger prototype building types with a staged central plant
  - Proposed Design will turn off or divert water flow around non-operating AWHPs, or reduce flow to manufacturer's specified minimum level if appropriate

# Energy Modeling Assumptions

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

## Prototypical Buildings

- All large non-residential building types

## Climate Zones

- All climate zones

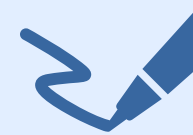
# Key Modeling Assumptions

**Prototype:** All large building types likely to have multi-unit AWHP/WWHP systems



## Standard Design

1. Standard practice water flow controls for isolated AWHP units. Details are under investigation



## Proposed Design

1. Water flow bypasses, of flow rate is greatly reduced or shut off when AWHP unit is nonoperational

# Incremental Cost Framework

**Prototype(s):** All large non-residential building types likely to have multi-unit AWHP/WWHP systems



## Baseline

### First Cost

1. Equipment controls and plumbing consistent with standard practice for multi-unit systems
2. Installation using typical practice
3. Standard commissioning practice



## Proposed

### First Cost

1. Controls and plumbing necessary to avoid circulation of conditioned water through unused AWHPs
2. Installation of proper flow controls and plumbing
3. Acceptance testing consistent with NA7.5.7

# Approach for Gathering Costs

- Estimate first cost for proper AWHP isolation compared to typical installation practices utilized by installers through interviews with designers and installers
- Quantify possible reduction or increase in maintenance and repair costs over the life of the equipment through interviews with building owners and facility managers
- Model possible energy cost savings using EnergyPlus



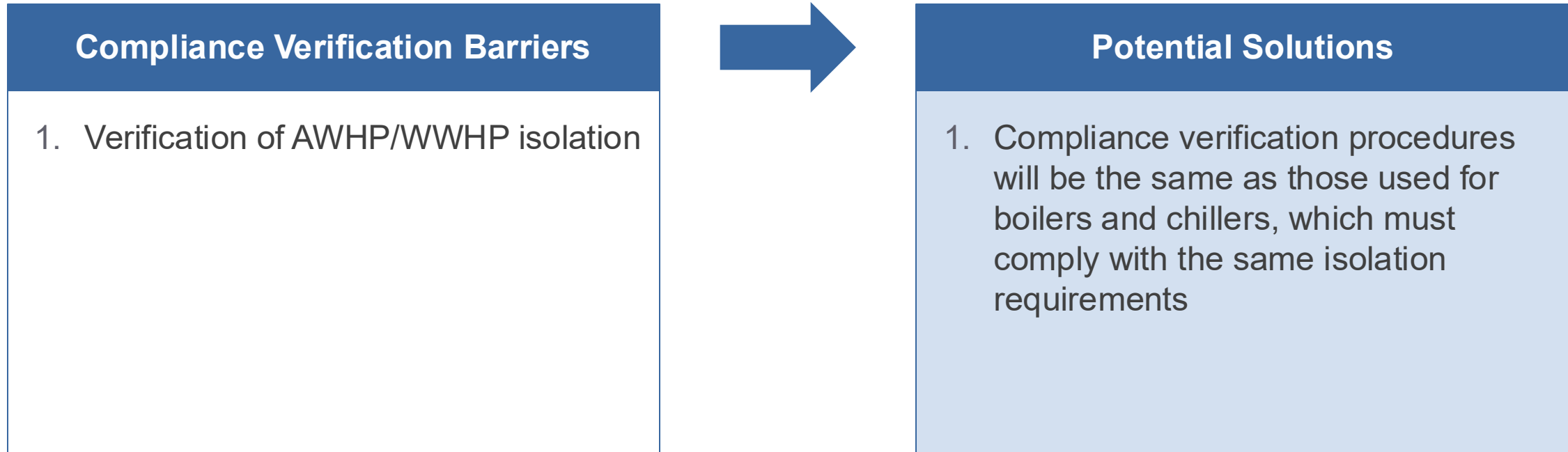
# Compliance Verification

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

# Key Aspects of Compliance Verification

- Verify proper plumbing and controls are in place to isolate unused AWHP/WWHP units
- Ensure verification of isolation controls according to the test procedures in NA7.5.7

# Compliance Barriers and Solutions



# Compliance Software Updates

- No changes required for multi-unit AWHP systems
- WWHP systems may need to be included with mostly the same inputs as AWHPs
- Because this measure would be prescriptive, an equipment derating must be applied in the performance path for systems that do not properly isolate unused AWHPs/WWHPs

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More information on

CEC's 2028 proceeding website.

# We want to hear from you!