

<b>DOCKETED</b>	
<b>Docket Number:</b>	24-BSTD-01
<b>Project Title:</b>	2025 Energy Code Rulemaking
<b>TN #:</b>	258644
<b>Document Title:</b>	Staff Memo – Revisions to 2025 Energy Code, Section 1404(a)3 - Dual-Fan Dual-Duct with Air-Source Heat Pump
<b>Description:</b>	This is a staff memo to justify the proposed revision to Section 140.4(a)3 of the 2025 Energy Code, on multi-zone space conditioning system types, specifically for dual fan dual duct systems, to support the August 2024 15-day language.
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<b>Organization:</b>	California Energy Commission
<b>Submitter Role:</b>	Commission Staff
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## MEMORANDUM

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**TO:** 2025 BUILDING ENERGY EFFICIENCY STANDARDS DOCKET (24-BTSD-01)

**FROM:** CALIFORNIA ENERGY COMMISSION (CEC)

**SUBJECT:** Justification for CEC-proposed Revisions to 2025 Energy Code, Section 140.4(a)3A on Multi-zone Space-conditioning System Types to Support the August 15-day Comment Period – Dual-Fan Dual-Duct with Air-Source Source Heat Pumps

**DATE:** AUGUST 22, 2024

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### INTRODUCTION

The June 2024 Express Terms for the 2025 Building Energy Efficiency Standards (2025 Energy Code) included proposed prescriptive requirements and options for multi-zone space-conditioning system types in Section 140.4(a)3. As proposed, Section 140.4(a)3Aiii allowed for prescriptive compliance using any HVAC air distribution system used in conjunction with an air-to-water heat pump (AWHP) space-heating loop. The proposed revisions to the August 2024 Express Terms, as published in the memo titled "*Justification for CEC-proposed Revisions to 2025 Energy Code, Section 140.4(a)3Aiii on Multi-zone Space-conditioning System Types to Support the August 15-day Comment Period – Variable Air Volume with Air-to-Water Heat Pump and Parallel Fan-Powered Boxes*" evaluates the AWHP space-heating loop together with parallel fan-powered boxes (PFPB) and additional energy efficiency measures specified in the subsection. The intent of this proposal was to allow Variable Air Volume (VAV) reheat systems to be used with an AWHP; also referred to as the VAV+AWHP, PFPB system. Stakeholder feedback recommended allowing air-source heat pumps (ASHP) as a prescriptive compliance option.

This memo describes analysis performed to evaluate the dual-fan dual-duct (DFDD) system configuration together with an air-source heat pump (ASHP) as an additional multi-zone space-conditioning system compliance option to Section 140.4(a)3. For the purposes of this document this system will be referred to as the DFDD+ASHP system.

### DISCUSSION

The analysis evaluates Long-term System Cost (LSC) equivalence of DFDD+ASHP with the VAV+AWHP, PFPB system. The supplemental justification for Section 140.4(a)3Aiii on Flexible Air Systems dated June 31, 2024<sup>1</sup> and the accompanying supplement on parallel fan-powered boxes (see memo titled "*Justification for CEC-proposed Revisions to 2025 Energy Code, Section 140.4(a)3Aiii on Multi-zone Space-conditioning System Types for the August 15-day Comment*")

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<sup>1</sup> TN#256845 <https://efiling.energy.ca.gov/GetDocument.aspx?tn=256845&DocumentContentId=92659>

Period – Variable Air Volume with Air-to-Water Heat Pump and Parallel Fan-Powered Boxes”) show the improvement of a VAV+AWHP system with PFPB over the 2022 Energy Code standard design system; a VAV system with chiller and gas boiler with reheat. To further increase design flexibility, a DFDD+VAV system with a chiller and direct expansion (DX) ASHP was analyzed in comparison to the VAV+AWHP, PFPB system.

To further increase design flexibility, a dual-fan dual-duct (DFDD) VAV system with a chiller and DX ASHP was analyzed in comparison to the VAV+AWHP, PFPB system. This system allows for an all-air multizone system without an AWHP. This analysis uses the Large Office prototype and is summarized in the following sections. The analysis comparing the DFDD+ASHP and the VAV+AWHP, PFPB systems uses the Integrated Environmental Solutions Virtual Environment (IES VE) software.

### Large Office Dual-fan Dual Duct (DFDD) Measures

The following measures were included for the Large Office prototype to achieve LSC equivalence against the VAV+AWHP, PFPB system:

- Separate VAV Hot Deck and Cold Deck air handling units (AHUs)
- Ventilation air is provided through the Cold Deck AHU; Hot Deck is 100% return air
- Cold Deck AHU with a chilled water-cooling coil with an integrated 100% airside economizer
- Hot Deck AHU with an ASHP heating coil compliant with the minimum efficiencies and controls of Section 110.2; as all systems must meet the applicable requirements of 110.2.
- AHU and terminal unit controls consistent with ASHRAE Guideline 36

Figure 1 presents the Large Office LSC savings results of the DFDD+ASHP system compared to the VAV+AWHP, PFPB option. For all climate zones, the DFDD+ASHP system showed improved or equivalent LSC performance.

Figure 1: Large Office LSC Savings for the DFDD+ASHP option versus the revised VAV+AWHP, PFPB option

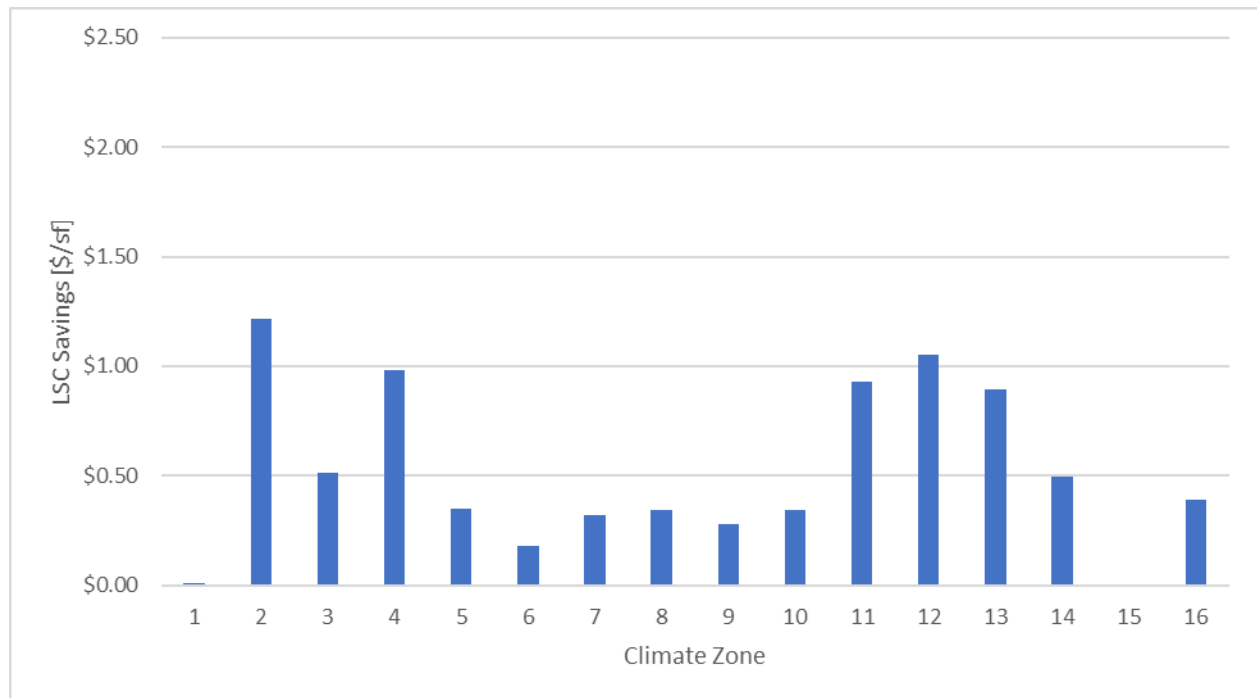


Table 1 Large Office LSC Savings for the DFDD+ASHP option versus the revised VAV+AWHP, PFPB option

Climate Zone	Benefit: Total LSC Savings (PV\$/sf)
1	0.01
2	1.21
3	0.51
4	0.98
5	0.35
6	0.18
7	0.32
8	0.35
9	0.28
10	0.34
11	0.93
12	1.05
13	0.89
14	0.50
15	0.003
16	0.39

## CONCLUSION

The DFDD+ASHP prescriptive option was shown to have LSC savings in all climate zones as compared to the VAV+AWHP, PFPB system. This analysis supports the inclusion of the DFDD+ASHP system as an additional prescriptive compliance option in Section 140.4(a)3 of the 2025 Energy Code.

## PROPOSED REVISIONS TO CODE LANGUAGE

Add Subsection 140.4(a)3Aiv to Section 140.4(a)3A as follows:

*iv. The space conditioning system shall be a dual-fan dual-duct (DFDD) system with hot and cold decks each served by separate fan systems, and:*

- a. When required by Section 140.4(e), economizers shall be located on the cold deck,*
- b. The hot deck shall supply 100% return air, except outdoor air may be supplied as required to supplement the cold deck to maintain the design minimum outdoor air rate,*
- c. The hot deck heating source shall be a heat pump, and*
- d. The DFDD and DFDD terminal unit control sequence shall comply with ASHRAE Guideline 36.*