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Statewide CASE Team Refrigeration Comment Letter Threshold Size For Proposed Small CO2 System Exception

Additional submitted attachment is included below.

CALIFORNIA ENERGY CODES & STANDARDS
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2028 TITLE 24 REFRIGERATION COMMENT LETTER: THRESHOLD SIZE FOR PROPOSED SMALL CO2 SYSTEM EXCEPTION

November 5, 2026

California Energy Commission

Docket No. 25-BSTD-03

On June 25, 2026, the Statewide CASE Team docketed a comment letter (comment 271012) recommending adjustments to the code language for refrigerated warehouses and commercial refrigeration. This memo presents the results of a market review and interviews that informed the Statewide CASE Team's recommendation that, for transcritical CO2 gas coolers, freezers with 20 tons or less of total heat of rejection (THR) and coolers with 40 tons or less of THR be exempted from the air-cooled gas cooler prohibition. This recommendation would allow systems of these sizes to use air-cooled gas coolers as an additional compliance option.

The purpose of this letter is to document how the Statewide CASE Team arrived at the 20- and 40-ton thresholds. There were two main components:

1) Review of existing products in the marketplace
2) Stakeholder interviews

The California Statewide Codes and Standards Enhancement (CASE) initiative presents recommendations to support California Energy Commission (CEC) efforts to update California's Energy Code (Title 24, Part 6), including revisions to simplify and clarify existing code requirements. Three California Investor-Owned Utilities (IOUs)—Pacific Gas & Electric, San Diego Gas & Electric, and Southern California Edison—sponsored this effort.

1. Product Review

1.1 Background

The CASE Team surveyed existing transcritical CO2 system products via review of manufacturer literature and communications with three major gas cooler manufacturers and nine condensing unit manufacturers. This included various face-to-face discussions and electronic communications. Factors considered included system cost and market availability of adiabatic gas coolers.

The prevalence of CO2 refrigeration systems has grown rapidly in recent years and continues to accelerate, with transcritical systems displacing other past configurations, and California seeing the strongest activity, driven by limits to the global warming potential of allowable refrigerants. The greatest growth is in smaller systems, including numerous manufacturers entering the US from Europe, along with existing US manufacturers introducing CO2 products. The Statewide CASE Team's recommendation addresses both relevant system configurations:

1) Systems with unitized gas coolers
2) Systems with separate gas coolers, whether remote or coupled on one frame

1.2 Unitized Gas Coolers

Condensing units with integral unitized gas coolers have a standardized combination of compressor and gas cooler, offering a table of capacities at different application conditions. Typically, these are available in fixed models across multiple cabinet sizes for low- and medium-temperature ranges. None of the surveyed standardized products were available with conventional adiabatic precooling. Instead, these systems rely on sufficient gas cooler surface area to operate at their rated ambient drybulb temperatures. As recently as two years ago, these systems did not exceed 5 tons of capacity, but product offerings continue to increase in size. Given the small size, standardized design, compliance and certification methods, and typical applications of these systems, adiabatic precooling would have disproportionately high first cost and maintenance cost.

1.3 Separate Gas Coolers

Compressor systems with remote gas coolers, or with gas coolers on a common frame but not integrally unitized, are generally engineered to application-specific requirements. Because the gas cooler is selected independently, either dry or adiabatic cooling can be considered. The choice depends on product availability and cost-effectiveness of

adiabatic cooling, including both initial and maintenance costs. Both factors are influenced by system size.

1.4 Category Caveats

The use of the terms “condensing unit” and “compressor system” here is descriptive and not definitional. A very large custom package with compressors and gas coolers on one frame could be called a condensing unit. It can be expected that, as with halocarbon systems, even quite small CO2 systems will be offered with a “matching” remote gas cooler, as they still retain the “off-the-shelf” characteristics described above for small condensing units. In addition to the above, there are now or there may emerge “overlap” products.

Some CO_2 condensing units are also offered with an "adiabatic" option that sprays water directly into the gas cooler's entering air, without adiabatic media. It is the Statewide CASE Team's understanding that these spray methods are a lower-cost method to improve design capacity but can also be prone to coil fouling, low saturation efficiency, and high drift losses. The Statewide CASE Team suggests that future work develop a definition of "adiabatic" for Title 24 compliance.

2. Stakeholder Feedback

As documented in the Statewide CASE Team’s Covered Process Refrigeration Comment Letter submitted on June 25, 2026, interviews with 16 people across 12 stakeholder organizations informed the proposal. That letter includes a table summarizing these interviews. A subset of that table, focusing on remarks and interviews related to these thresholds, can be found in Section 4 of this letter. In summary, the CASE Team received suggestions for thresholds in the range of 20 to 50 tons, one interviewee specifically endorsed the proposed 20- and 40-ton THR limits, and two other interviewees supported a 20-ton threshold based on combined low- and medium-temperature capacity.

3. Threshold Determination

Given the product survey and stakeholder feedback, the Statewide CASE Team proposed the 20- and 40-ton size thresholds to allow smaller systems and standardized products to use air-cooled gas coolers. Adiabatic cooling is generally not cost-effective for smaller systems and is poorly suited to standardized products. The different thresholds reflect the typical cooling capacity differences between low-temperature and medium-temperature equipment of similar physical size.

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4. Stakeholder Interviews

Table 1 shows a summary of the stakeholder interviews conducted in preparation of this comment letter.

Table 1. Stakeholder interviews

Stakeholder (No. of Staff Present)	Date	Takeaways
Association #1 (1)	5/18/2026	– The 20-ton (freezer) and 40-ton (cooler) thresholds are sound. The real problem is timing. Relief is needed now, not next code cycle. – Many CO2 systems are anticipated to go in before January 1, 2029, (2028 Title 24 code) so small systems need immediate relief. – A lot of near-term activity is small (≤10-ton) as modular add-ons in additions and remodels at existing sites – Early CO2 adopters span big-box, pharmacy, convenience-store, quick-serve restaurant, and biotech, driven by HFC-reduction goals. – Air-cooled alternatives would help smaller systems reach compliance.
Contractor #1 (2)	4/30/2026	– Whole-system efficiency and COP would be a better basis than per-component rules, because good controls save far more than incrementally better hardware. – AHRI 420 is effectively a near-monopoly. Compressors and condensers face no equivalent test mandate, so singling out evaporators is hard to justify. – On variable Vi, booster compressors shouldn't need it. A swept-volume threshold makes sense, with high-stage treated differently than boosters.

Stakeholder (No. of Staff Present)	Date	Takeaways
		– The adiabatic threshold should be higher—closer to 50 tons than 20. Water is scarcer than energy in California, so air-cooled alternatives should be allowed (parallel compression, ejectors). – Many plants are oversized (≈2 times what they need). A load-sizing guideline (IIAR or ASHRAE) would be better than the "350 sf/ton" rule of thumb.
Manufacturer #4 **(1)**	2/23/2026	– Performance-based requirements would be better than prescriptive ones, which limit innovation across the many emerging CO2 technologies and permutations. – CO2 efficiency is highly geography-sensitive (dry- and wet-bulb). Adiabatics use less water than some alternatives but still consume it, and water is sometimes more precious than electricity. – Getting too prescriptive on small systems (≤10 tons) makes CO2 extremely expensive—below 10 tons, conventional refrigerant may cost $1,000-$2,000/ton and CO2 can be ≈10 times that. – Requirements should be segregated by capacity range: adiabatic grows more attractive and more apples-to-apples with other refrigerants at larger capacities (≈100 tons and up). – Real-world adiabatic problems are common: dirt clogs the wetted media, water distribution across the pads is a perennial concern, and without commissioning the equipment often doesn't operate as intended.

Stakeholder (No. of Staff Present)	Date	Takeaways
Manufacturer #5 **(1)**	3/2/2026	– Adiabatic is just one of several hot-climate CO2 fixes (ejectors, parallel compression, higher design pressure, flooded evaporators)—and it uses water in water-scarce areas of California. – Not all adiabatic designs are equal: single-pass dumps water, spray-on-coil causes drift and condenser fouling, and some owners never turn the water on. – An adiabatic size threshold around 20 tons (summed low- and medium-temp) makes sense. It has no place on the small systems that stores are increasingly adding. – Title 24 gas-cooler TDs are poorly informed—the 6°F air-cooled TD is too low (2–3°F would be better) and the 15°F adiabatic dry-coil TD is far too high (should match the air-cooled value). – Ejector technology and service expertise are scarce in the U.S., so owners default to standard boosters. – CO2 performs well under AWEF, which rates at the lower ambient temperatures where CO2 (which can go down to ≈50°F condensing) performs well.
Owner #1 **(1)**	3/26/2026	– A minimum size threshold for TCCO2 gas coolers would help—TCCO2 is already costly and adiabatic performance is questionable, and most TCCO2 units lack an adiabatic option anyway. – Their TCCO2 condensing units run 3-4 times the cost of HFC units, so owners won't game a threshold by stacking small units. A 20-ton minimum (low- plus medium-temp) with energy-equivalent alternatives would work, ideally aligned with CARB (pounds of charge). – Adiabatic concerns center on reliability, maintenance, water use, and whether the adiabatic-mode design capacity can be trusted. – The retail heat-recovery requirement is hard to interpret for refrigeration-only retrofits and remodels that never touch the HVAC system. This results in either overcomplicated projects or falling short during permitting. – An interim CEC clarification is needed now. Then do a later code revision to address summer heat rejection not being aligned with HVAC loads, year-round domestic hot water not being a code option, and the challenge that systems are often spread across the store.

Stakeholder (No. of Staff Present)	Date	Takeaways
		– Money spent to comply with heat recovery is money not spent on other, potentially better, efficiency measures.