

Proposal Summary



Data Centers Efficiency Improvements (HVAC)

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Measure Description

This proposal seeks to address data center/computer room code requirements in sections 100.1, 120.6(j)3 (mandatory), 140.9(a) (prescriptive), 141.1(b)1 of T24 Part 6 by including the following measures:

Measure 1: Computer Room Economizers (*Update Existing Sections 100.1, 140.9(a)1, 141.1(b)1*)

This measure would expand definitions related to computer rooms and data centers, such as adding Liquid-cooled Information Technology Equipment (ITE), facility water, and expanding guidance on ways to ensure computer room economizers are fully integrated. Additionally, this proposed change would expand the number of hours economizers must meet all or part of the computer room cooling load in newly constructed computer rooms and existing computer room additions and alterations by adjusting the 100 percent wet-bulb economizer threshold for air-cooled ITE, adding new economizer thresholds for >2MW liquid-cooled ITE loads, and imposing minimum water and air temperature differentials and variable flow requirements to ensure integrated economizer savings.

To create additional flexibility in complying with the proposed requirements, new exceptions would be added for new computer rooms using a heat recovery system meeting specified minimum capacity thresholds, and existing computer rooms being able to comply with the Title 24, Part 6 economizer requirements that were in effect when the building was permitted, when undergoing an addition or alteration.

Measure 2: Fan Control Requirements (*Update Existing Section 120.6(j)3*)

This measure proposes to modify mandatory requirements in section 120.6(j)3 by reducing the unitary air conditioner capacity threshold for when variable supply airflow is required in new and existing computer rooms. This would result in a greater number of unitary air conditioners for computer rooms being installed with variable speed supply fans that modulate airflow based on cooling load. The threshold for when variable

airflow fan control is required would be reduced from a 60,000 Btu/hr unit to a 30,000 Btu/hr unit.

Measure 3: Computer Room Heat Recovery (New Section 140.9(a)5)

This proposed measure would add prescriptive requirements to Section 140.9 to require new nonresidential buildings with both a computer room(s) and sizable heating loads to recover heat from the computer room(s) to serve other building heating loads. Computer room heat recovery is being defined as a mechanical system that transfers heat from a computer room(s) to provide heating to other zones or end-uses in the building that require heating. Heat recovery would be required in new buildings with computer rooms if the following conditions were met:

- Buildings with a design computer room(s) ITE load greater than 100 kW; and
- Buildings with non-computer room directly conditioned floor area greater than 35,000 ft².

The required capacity of the heat recovery system would depend on the peak cooling capacity of the computer room and the combined total peak heating capacity of the space heating system and service water heating (i.e., domestic hot water) system. The heat recovery system’s heat recovery capacity must be the lesser of the two values:

- 0.25 times the peak heat rejection capacity of the computer room system
- 0.25 times (the total capacity of the space heating system plus the SWH system)

Table 1 summarizes the scope of the proposed code change across all measures.

Table 1: Scope of Proposed Code Change

An “X” indicates the proposed code change is relevant.

Building Type(s)		single family
		multifamily
	X	nonresidential
Type of Change	X	mandatory
	X	prescriptive
	X	performance
Third Party Verification		no changes to third party verification
	X	update existing verification requirements
		add new verification requirements

Construction Type(s)	X	new construction
	X	additions
	X	alterations
Updates to Compliance Software		no updates
	X	update existing feature
	X	add new feature

Justification for Proposed Change

To achieve California’s ambitious climate action plan and hit carbon neutrality by 2045, addressing rising energy use in data centers is critical. With building emissions contributing to roughly 25 percent of California’s GHG emissions, increased growth in a highly energy intensive industry such as data centers has the potential to increase overall emissions and negatively impact statewide climate goals (California Air Resources Board 2022). In addition to increased emissions, dramatic rise in energy load to the grid to support data centers could potentially result in increased costs for consumers in the state, if not appropriately managed. One cost-effective way to manage demand growth in data centers is to increase their overall efficiency through energy code measures and technological advancements.

Although projections vary, energy consumption in data centers is projected to increase significantly over the next few decades. According to a recent Lawrence Berkeley National Laboratory (LBNL) report, “data centers consumed about 4.4 percent of total U.S. electricity in 2023 and are expected to consume approximately 6.7 to 12 percent of total U.S. electricity by 2028 (Shehabi, et al. 2024).” During this same time, data centers have become increasingly efficient in computer processing and server cooling technologies, especially with the rise of liquid-cooling technologies. These technologies have improved energy-efficiency, characterized by power usage effectiveness (PUE), by as much as ten percent in some data centers (McKinsey & Company 2024).

The state-of-the-art for data center design has advanced significantly since the 2022 requirements were developed in 2020 and will further evolve by 2029, when the 2028 standards take effect. One major change is the rapid growth of liquid-cooled servers, which are often cooled by 80-120°F supply water. It is also now common to cool air-cooled servers with 75-85°F supply air. This measure offers a tremendous opportunity to capture various advancements as described above via sub-measures that will improve the energy efficiency of data centers and computer rooms significantly.

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Data Needs / Information Requests

The Statewide CASE Team is seeking the following information to inform the code change proposal. Data may be provided anonymously. To participate or provide information, please email aroy@energy-solution.com directly and copy info@title24stakeholders.com.

- What are the most common types of cooling systems (air-cooled, water-cooled, evaporatively cooled, refrigerant-cooled systems) currently being designed in the computer room market in California?
- What supply air temperature and resets to the server rack and the space are commonly used in computer room designs?
- What is the frequency of ITE replacements?
- What are the top design factors that you believe have the largest impact on a data center's energy consumption?
- What do you think is the most overlooked energy efficiency opportunity in computer room/data center designs?
- What types of central cooling systems are typically being used in California (e.g., air-cooled chillers, dry coolers, evaporative cooling towers, etc.) for liquid-cooled ITE? For air-cooled ITE?
- What are the typical total ITE load (kW) and ITE load density (kW/rack or W/sf) are you observing with liquid-cooled designs? For air-cooled ITE designs?
- What percent of computer room design projects are new construction vs. retrofits?
- What type of economizing is mostly commonly being used to comply with Title 24 computer room requirements (e.g., airside economizing, waterside economizing with evaporative cooling towers, refrigerant economizing, etc.)? How does this change for computer rooms with sizable liquid-cooled ITE loads?
- For small IT rooms (< 5 tons), do you typically see variable speed supply fans used?
- Is there a minimum cooling capacity for computer rooms at which you recommend variable speed fans? Why?

- For liquid-cooled data centers, what are typical design technology cooling system (TCS) supply/return temperatures?
 - a. What are the main drivers of these design temperatures?
 - b. How do you anticipate these temperature requirements changing in the future? Why?
- What are typical CDU heat exchanger approach temperatures being designed?

Draft Code Language

1.1 Guide to Marked Up Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2025 documents are marked with blue underlining (new language) and ~~strikethroughs~~ (deletions).

1.2 Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

1.3 Title 24, Part 6:

Measure 1: Computer Room Economizers

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION:

LIQUID-COOLED INFORMATION TECHNOLOGY EQUIPMENT (ITE) are the components of ITE that are cooled by a fluid other than air and that do not use server fans to flow air across the components. Common liquid cooling fluids include water, glycol, and refrigerant. Individual servers can be partially liquid-cooled and partially air-cooled, with server fans serving the air-cooled components and pumps serving the liquid-cooled components.

AIR-COOLED ITE are the components of ITE that are cooled by the flow of air through the ITE equipment. Onboard server fans are typically used to move air through servers.

FACILITY WATER is the cooling fluid loop that carries heat away from liquid-cooled ITE (typically via a coolant distribution unit heat exchanger) toward plant-level heat rejection infrastructure (like chillers, cooling towers, and/or dry coolers).

COMPUTER ROOM ECONOMIZER is a system by which heat from ITE is rejected to the environment without the use of a refrigerant compressor. If a computer room

economizer is part of a cooling system that also includes a refrigerant compressor, then the system shall be fully integrated, meaning it shall be capable of providing partial economizer cooling without limiting the capacity of compressor cooling and without limiting the capacity of compressor-less cooling.

(a) Systems that DO meet the fully integrated criteria of a computer room economizer, include the following:

1. Waterside economizer heat exchangers that are piped in series with chillers on the chilled water side.
2. Air-cooled chillers with integrated economizer coils that are piped into the secondary circuit of a primary/secondary system. The fans serving the integrated economizer coils must be able to modulate speed without being limited by the need to maintain a minimum refrigerant head pressure.
3. Air-cooled chillers with integrated economizer coils that are served by dedicated economizer fans and not by condenser fans that serve refrigerant condenser coils.
4. Refrigerant economizer systems where 10-90% of the load on a refrigerant circuit can be met by a passive condenser or refrigerant pump, while the other 90% to 10% of the load is met by an active condenser or refrigerant compressor

(b) Systems that DO NOT meet the fully integrated criteria of a computer room economizer include the following:

1. Waterside economizer heat exchangers that are piped in parallel with chillers on the chilled water side.
2. Air-cooled chillers with integrated economizer coils that are piped into the primary circuit of a primary/secondary system, or on the chiller side of a chiller minimum flow bypass valve.
3. Air-cooled chillers with integrated economizer coils that are served by the same condenser fans that serve refrigerant condenser coils whose speed is limited by the need to maintain a minimum refrigerant head pressure.
4. Refrigerant economizer systems with one or more refrigerant circuits that must switch from refrigerant compressor operation to refrigerant pump operation.

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

- a. **Prescriptive Requirements for Computer Rooms.** Computer rooms with a power density greater than 20 W/ft² shall comply with this section.

1. ~~**Economizers.** Each individual cooling system primarily serving computer rooms shall include either:~~
 - a. ~~An integrated air economizer capable of providing partial cooling even when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load at 65°F to 80.6°F supply air temperature at outside air temperatures of 65°F dry-bulb and below or 50°F wet-bulb and below, and be equipped with a fault detection and diagnostic system as specified by Section 120.2(i); or~~
 - b. ~~An integrated water economizer capable of providing partial cooling even when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load at 65°F to 80.6°F supply air temperature at outside air temperatures of 50°F dry-bulb and below or 45°F wet-bulb and below.~~

1. **Economizers.**

- A. Each individual cooling system primarily serving computer rooms shall include a computer room economizer, as defined in section 100.1, capable of providing 100 percent of the expected system design cooling load at the following ambient conditions and at 75°F supply air temperature for air-cooled ITE. Compliance shall be determined with redundant equipment operating if the redundant equipment is expected to operate in normal operation.

<u>Type of ITE</u>	<u>Ambient Drybulb</u>	<u>Ambient Wetbulb</u>
<u>Air-Cooled ITE in a computer room with average air-cooled ITE design load > 25 kW/rack and served by a cooling system that does not evaporate water at these ambient conditions</u>	<u>≤ 55°F</u>	<u>any</u>
<u>All liquid-cooled ITE in buildings with a design liquid-cooled ITE load greater than 2 MW</u>	<u>≤ 75°F</u>	<u>≤ 75°F</u>
<u>All other ITE</u>	<u>≤ 65°F</u>	<u>≤ 60°F</u>

- b. The economizer shall be equipped with a fault detection and diagnostic system as specified by Section 120.2(i)
- c. Differential Temperature (dT) and Variable Flow
 - i. Air handling systems with a capacity exceeding 30,000 Btu/hr serving air-cooled ITE load shall be designed for a return to supply air dT of at least

20F. These systems shall be designed and controlled to vary airflow as a function of ITE load with a minimum airflow not to exceed 25% of design airflow, in order to maintain constant dT at ITE loads from 25% to 100%.

- ii. Chilled water and facility water systems serving air-cooled and liquid-cooled ITE shall be designed for a return to supply fluid dT of at least 15F. These systems shall be designed and controlled to vary fluid flow as a function of ITE load, in order to maintain constant dT at ITE loads from 25% to 100%.

EXCEPTION 1 to Section 140.9(a)1: Individual computer rooms with an ITE design load under 5 tons (18 kW) in a building that does not have any economizers.

EXCEPTION 2 to Section 140.9(a)1: A computer room with an ITE design load less than 20 tons (70 kW) may be served by a second fan system without an economizer if it is also served by a fan system with an economizer that also serves other spaces within the building, provided that all of the following are met:

- i. The economizer system is sized to meet the design cooling load of the computer room when the other spaces within the building are at 50 percent of their design load at outside air temperatures of 65°F dry-bulb and below and 50°F 60°F wet-bulb and below; and
- ii. An economizer system that can stop service to other spaces in the building when those spaces are unoccupied and serve only the computer rooms.

EXCEPTION 3 to Section 140.9(a)1: Computer rooms that reject heat to a heat recovery system that is sized to accept at least 50% of the design computer room heat and that serves a qualifying heating load. Qualifying heating loads include:

- i. Space heating systems and/or service water heating systems with design loads at least 5 times greater than the computer room design cooling load.
- ii. Processes determined by the Executive Director to require more than 50% of the design computer room heat for more than 3,000 hours/year.

2. **Power Consumption of Fans.** The total fan power at design conditions of each fan system shall not exceed 27 W/kBtu·h of net sensible cooling capacity.

3. **Air Containment.** Computer rooms with air-cooled computers in racks and with a ITE design load exceeding ten kW (2.8 tons) per room shall include air barriers such that there is no significant air path for computer discharge air to recirculate back to computer inlets without passing through a cooling system.

EXCEPTION 1 to Section 140.9(a)3: Expansions of existing computer rooms.

EXCEPTION 2 to Section 140.9(a)3: Computer racks with a design load less than 1 kW (0.28 tons) per rack.

EXCEPTION 3 to Section 140.9(a)3: Equivalent energy performance based on computational fluid dynamics or other analysis.

SECTION 141.1 – REQUIREMENTS FOR COVERED PROCESSES IN ADDITIONS, ALTERATIONS TO EXISTING NONRESIDENTIAL, AND HOTEL/MOTEL BUILDINGS

Covered processes in additions or alterations to existing buildings that will be nonresidential, and hotel/motel occupancies shall comply with the applicable subsections of section 120.6 and 140.9.

- a. **Lab and Process Facility Exhaust Systems.** All newly installed fan systems for a laboratory or process facility exhaust system greater than 10,000 cfm shall meet the requirements of Section 140.9(c).
- b. **Computer Rooms.** All newly installed computer room cooling systems and uninterruptible power supply systems in additions/alterations shall meet the requirements of Sections 120.6(j), 140.9(a)2, and 140.9(a)4 and comply with item 1 below.
 1. **Economizers.** Each individual cooling system primarily serving computer rooms in an existing building shall ~~include either:~~ meet the requirements of Section 140.9(a)1
 - ~~A. An integrated air economizer capable of partial cooling when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load up to 80°F room supply air temperature at outside air temperatures of 55°F dry-bulb and below or 50°F wet-bulb and below, and be equipped with a fault detection and diagnostic system as specified by section 120.2(i); or~~
 - ~~B. An integrated water economizer capable of partial cooling when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load up to 80°F room supply air temperature at outside air temperatures of 40°F dry-bulb and below or 35°F wet-bulb and below.~~

EXCEPTION 1 to Section 141.1(b)1: Individual computer rooms with an ITE design load under ~~5 tons (18 kW)~~ 10 tons (35 kW) in a building that does not have any economizers or modulating DOAS.

~~**EXCEPTION 2 to Section 141.1.(b)1:** New cooling systems serving an existing computer room in an existing building with an ITE design load up to a total of 50 tons (176 kW).~~

~~**EXCEPTION 3 to Section 141.1(b)1:** New cooling systems serving a new computer room in an existing building with an ITE design load up to a total of 20 tons (70 kW).~~

EXCEPTION 2 to Section 141.1(b)1: new cooling systems serving an existing computer room where:

- I. Total capacity of the new cooling system is less than 500 tons and less than 50% of the total computer room cooling system capacity, and
- II. the new cooling system includes an integrated computer room economizer capable of providing 100 percent of the design cooling load at 75°F supply air temperature at the following outside air conditions:

<u>Original Permit Date of Existing Computer Room</u>	<u>Dry-bulb</u>	<u>Wet-bulb</u>
<u>Before 1/1/2014</u>	<u>No economizer requirement</u>	
<u>1/1/2014 – 12/31/2022</u>	<u>55°F</u>	<u>35°F</u>
<u>1/1/2023 – 12/31/2028</u>	<u>65°F</u>	<u>45°F</u>

Measure 2: Fan Control Requirements

SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

(j) Mandatory requirements for computer rooms. Space-conditioning systems serving a computer room shall meet the following requirements:

1. **Reheat.** Each computer room zone shall have controls that prevent reheating, recooling and simultaneous provisions of heating and cooling to the same zone, such as mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled, either by cooling equipment or by economizer systems.
2. **Humidification.** Humidification shall be adiabatic. Nonadiabatic humidification, including but not limited to steam and infrared, is prohibited.

3. **Fan control.** Each unitary ~~air conditioner~~ direct expansion system with mechanical cooling capacity exceeding ~~60,000~~ 30,000 Btu/hr and each chilled water fan system shall be designed to vary the airflow rate as a function of actual load. Fan motor demand shall not exceed 50 percent of design wattage at 66 percent of design fan speed.

Measure 3: Computer Room Heat Recovery

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

a. Prescriptive Requirements for Computer Rooms.

5. Computer Room Heat Recovery. Buildings with a design computer room ITE load greater than 100 KW and a non-computer room conditioned floor area greater than 35,000 ft² shall include a heat recovery system, such as ducting hot aisles to the hot deck of a dual fan dual duct system, or a heat recovery chiller, capable of transferring the lesser of the following from the computer room cooling system to the space heating system and/or to the service water heating (SWH) system:

- A. 0.25 times the peak heat rejection capacity of the computer room system
- B. 0.25 x (capacity of space heating system + capacity of SWH system)

1.4 Reference Appendices

There are no proposed changes to the Reference Appendices.