

Proposal Summary



Controlled Environment Horticulture: Space Conditioning Systems for Indoor CEH

Updated February 8, 2026

Prepared by: Garth Torvestad, Amy Droitcour, and Lydia Miner (West Monroe Partners)

Measure Description

This proposed measure would establish mandatory sizing requirements and controls requirements for space conditioning systems providing heating, cooling, and dehumidification to support plant growth in CEH indoor growing spaces and would prescriptively require these systems meet key functional and performance metrics.

These requirements would only apply to space conditioning systems serving CEH spaces with a lighting power density greater than 30 watts (W) per plant canopy square foot in indoor CEH facilities with at least of 5000 ft² of plant canopy area. (Plant Canopy Area is the aggregate horizontal surface area occupied by actively growing vegetation within a cultivation facility. It is measured by the boundaries of the specific grow trays/benches utilized, excluding non-productive spaces such as aisles, walkways, ancillary equipment zones, and structural columns).

The Statewide CASE Team has developed a new indoor CEH prototype and building energy model for facilities meeting these conditions. The Statewide CASE Team is recommending that these capabilities be introduced to the California Building Energy Code Compliance Software (CBECC) software. Should this space type be available in the CBECC software, facilities subject to these new prescriptive requirements would also have the option to comply via the performance pathway.

These proposed requirements recognize that functions of cooling and dehumidification equipment are highly interactive and must be considered together, as a part of a space conditioning system that manages both temperature and humidity in CEH spaces. The prescriptive requirements would require the applicant to identify a primary space conditioning system on the design documents. This primary system would be required to have a variable sensible heat ratio, to be capable of modulating the amount of dehumidification process heat recovered to reheat dehumidified air between 10 percent

and 90 percent, and to be sized to meet at least 80 percent of the peak combined sensible and latent load.

These prescriptive requirements of variable SHR (sensible heat ratio), modulating heat recovery, and minimum size of a combined cooling and dehumidifying system would be used to set an energy budget for compliance via the performance approach where any system that can be modelled could comply if it requires less long-term energy cost than the base system.

Because the prescriptive requirements are based on a functional description of range of required sensible heat ratios, range of heat recovery modulation and minimum combined cooling and dehumidification size to design capacity, a variety of primary systems could comply with the requirements such as: an integrated direct expansion (DX) system, a desiccant-based system, or a heat recovery chiller system.

An example compliant integrated DX system is repurposed DX Dedicated Outdoor Air System (DOAS) or pool dehumidification equipment that has configured, sized, and programmed for 100% recirculated air. Integrated DX systems use variable speed or staged compressor systems in combination with variable speed fans to modulate the ratio of sensible cooling to dehumidification that occurs at the evaporator coil, depending on supply air conditions and humidity and temperature setpoints. The dehumidified air then passes over an indoor reheat coil to reheat the air to desired supply air temperature using waste heat from the dehumidification process. These systems modulate the amount of waste heat that goes to the indoor reheat coil versus rejecting the heat to an outdoor condenser coil, in a process known as modulating hot gas reheat.

An example of a compliant desiccant system is Mojave HVAC's liquid desiccant cooling and dehumidification system that cools incoming air and dehumidifies with a liquid desiccant. This system uses condenser heat for the regeneration (desiccant drying) process.

A four-pipe heat recovery chiller system uses a chilled water loop and fan coils to dehumidify and cool return air, with a separate hot water loop that reheats the dehumidified air to the desired temperature. Water in the hot water reheat loop is heated using waste heat generated through the process of cooling the water supplied to the chilled water loop.

The mandatory sizing requirement would require the submission of calculated sensible and latent loads and sizing calculations for space conditioning systems serving indoor CEH spaces with a lighting power density greater than 30 W per canopy square foot.

The method for calculating the load and the sizing requirements would be defined in a new Nonresidential Appendix.

In addition to the primary space conditioning system, the proposed requirements would allow the use of supplemental equipment to meet sensible or latent loads exceeding the primary system's capacity.

Mandatory requirements would require the installation of a central control system that fully utilizes the capacity of the primary space conditioning system, modulates heat recovery to provide the minimum heat needed, and when additional capacity is needed, stages the minimum amount of supplemental capacity.

Mandatory requirements for the primary system would require that it be controlled to do the following:

- Modulate sensible heat ratio (SHR) in response to room conditions and temperature and humidity setpoints;
- Modulate reheat to reject or recover dehumidification process heat, as needed to meet supply air setpoints; and
- Limit the use of primary heating (i.e. resistance, furnace, or boiler) heat to periods when the use of recovered process heat cannot meet supply air setpoints.

Controls for supplemental unitary dehumidification equipment without variable SHR or heat rejection capability would be required to do the following:

- Integrate and stage supplemental equipment with primary system to meet temperature and humidity setpoints;
- Stage unitary dehumidifiers in response to humidity sensors (including those that measure relative humidity, dewpoint, or wet bulb);
- Only activate dehumidification equipment when either: 1) all waste heat can be used in the space without creating additional cooling load, or 2) the primary system cannot satisfy 100 percent of cooling, heating, and dehumidification loads.

The requirements would be the same for all 16 California Climate Zones. The proposed requirements would apply to new construction, additions, and major alterations.

Replacing a single piece of equipment in a larger system would not trigger the requirements. The code would be triggered by additions or alterations that increase plant canopy area by at least 5000 square feet. The code would also be triggered by alterations that replace greater than 50 percent of the total capacity of heating,

ventilation, air conditioning, cooling, and dehumidification systems serving at least 5000 square feet of plant canopy area in indoor growing.

This code change proposal would also revise requirements for outdoor air ventilation requirements, that may negatively impact plant growth or efficiency in CO2 enriched spaces.

Title 24, Part 6 does not currently include prescriptive measures for CEH spaces, and CBECC does not currently include an indoor CEH prototype. To provide facility designers with flexibility in equipment selection, the Statewide CASE Team recommends that CBECC is updated so it can be used to demonstrate compliance using the performance approach.

Table 1 summarizes the scope of the proposed code change. Note that this proposal includes acceptance testing performed by a field technician. Because the field technician is typically a member of the installation team, this acceptance testing is not considered “third party verification.”

Table 1: Scope of Proposed Code Change

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

Building Type(s)		single family	Construction Type(s)	X	new construction
		multifamily		X	additions
	X	nonresidential		X	alterations
Type of Change	X	mandatory	Updates to Compliance Software		no updates
	X	prescriptive			update existing feature
	X	performance		X	add new feature
Third Party Verification	X	no changes to third party verification			
		update existing verification requirements			
		add new verification requirements			

Justification for Proposed Change

CEH facilities, particularly indoor facilities with high lighting power density, are among the most energy-intensive buildings in California. In these facilities, the lighting and space conditioning systems make up about 80 percent of energy consumption, split

roughly evenly between the two systems. Each of these two end-uses provides significant opportunities for savings. Until this code cycle, CEH lighting has been the primary focus of Title 24, Part 6, leaving significant opportunity for code to regulate CEH space conditioning systems and achieve deep statewide savings. For indoor cannabis facilities, flower rooms contribute roughly 86 percent of facility energy use. A field study of flower rooms in two California CEH facility found an average Energy Use Intensity (EUI) of 760 kBtu/yr per ft².¹

Since large-scale indoor farming is relatively new, driven primarily by legalization of cannabis in California, CEH facility designers initially had little choice but to repurpose conventional HVAC equipment and dehumidifiers to manage sensible and latent loads in indoor farms. However, space conditioning systems designed to support plant growth need to adapt to highly variable latent and sensible loads (room SHR), which can most effectively be conditioned by HVAC and dehumidification systems with variable equipment SHR² (sensible heat ratio). Sizing methods, design approaches, and equipment requirements are vastly different from those for spaces designed primarily for human occupancy, and equipment designed to maintain human comfort is poorly suited to the unique conditions found in CEH process spaces. (A CEH process space is any room or area where the primary function is the cultivation of plants, and the environmental conditions are controlled for the plant-growing process, not for human comfort.)

Over the past decade, industry has significantly advanced the development of variable capacity, fully integrated space conditioning systems suitable for high latent loads, and capable of quickly adjusting to highly variable loads, which offer better environmental control and far more efficient operation than fixed-capacity fully decoupled³ systems. Unfortunately, many designers continue to use inefficient fully decoupled equipment in the design of new facilities, even though much more efficient, better performing, integrated equipment is now available from multiple manufacturers and has been recommended for energy efficiency and more precise environmental control in industry best practices guides for several years.

¹ Controlled Environment Horticulture: Energy Consumption and Environmental Control Field Study <https://www.etcc-ca.com/reports/controlled-environment-horticulture-energy-consumption-and-environmental-control-field>

² Room SHR refers to the ratio of sensible to total (both latent and sensible) heat in the space, while Equipment SHR refers to the ratio of sensible cooling capacity to total cooling capacity of the cooling/dehumidification equipment (prior to reheat).

³ Background section provides relevant definitions.

The market's failure to broadly adopt this more efficient space conditioning equipment presents an excellent opportunity for the energy code to develop new efficiency requirements for CEH facilities.

The opportunity for energy savings is very high because energy intensity of indoor farms is very high, market adoption of efficient space conditioning systems is relatively low, and the current energy code language does not address CEH HVAC systems or the interaction between HVAC and dehumidification systems. Statewide CASE Team energy modeling of HVAC and dehumidification systems indicate that energy used by more efficient integrated HVAC/dehumidification (HVAC/D) systems is approximately 25 to 40 percent less than energy use by a decoupled, code-minimum HVAC and dehumidification system, consistent with measured and modeled data.

Furthermore, the more precise temperature and humidity control provided by variable-capacity integrated systems can increase crop yields, reduce mold risk, and help avoid crop loss. As demonstrated in a recent comparative study⁴, facilities using these systems can produce more dried product per square foot and per kWh, improving both space and energy resource efficiency.

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 Amy Droitcour amydroitcour@2050partners.com directly and copy info@title24stakeholders.com.

- Market practice for indoor farm envelope design
- Performance and quality specification for integrated and decoupled systems
- Key attributes and differences between different integrated DX systems
- Cost considerations and economies of scale for chilled water systems
- Typical threshold (canopy square footage) for direct expansion (DX) vs chilled water
- Typical lifespan and maintenance intervals for equipment
 - Standalone dehumidifiers

⁴ A summary of the study findings is available at <https://drive.google.com/file/d/1ynf0Jg7nlo1EmWs3rsjwkzdDJkWGJ6RL/view>. A link to the full report will be updated once the report is made public.

- Conventional cooling equipment
- Integrated DX
- Chillers
- Fan coils
- Differences in replacement process (compressor vs. whole unit) for different equipment types
- Price per ton for different equipment types
- Other equipment costs / savings for different system types
- Documented impact on yield / quality from improved control, integrated vs. decoupled systems, other system attributes
 - Rates of new construction of CEH facilities, awareness of cannabis facility construction in jurisdiction
- Attributes, advantages, and modeling approaches for new/emerging dehumidification technologies
- Reasons facility operators object to integrated space conditioning equipment
- Percent of indoor farms installing integrated space conditioning systems without standalone dehumidifiers or with only a small number of standalone dehumidifiers.
- Percent of indoor farms installing hydronic space conditioning systems.
- Percent of indoor farms with hydronic space conditioning systems that include 4-pipe heat recovery chillers with wraparound heat pipes.

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

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

Section 100.1(b) – Definitions

CONDITIONED SPACE, DIRECTLY is an enclosed space that is provided with wood heating, mechanical heating that has a capacity exceeding 10 Btu/hr-ft², or mechanical cooling that has a capacity exceeding 5 Btu/hr-ft². Directly conditioned space does not include process space or CEH space. (See “process space” and “Controlled Environment Horticulture (CEH) Space”)

...

CONTROLLED ENVIRONMENT HORTICULTURE (CEH) SPACE is a building space dedicated to growing plants production by manipulating indoor environmental conditions, such as through electric lighting, irrigation, mechanical heating, mechanical cooling, or dehumidification. CEH space does not include building space where plants are grown solely to decorate that same space.

...

DEHUMIDIFICATION SENSIBLE TEMPERATURE RECOVERY RATIO (DSTRR): the difference between the dry-bulb air temperatures leaving the integrated HVAC system and leaving the dehumidifying coil divided by the difference between the dry-bulb temperature of the air entering the unit and the dry-bulb temperature of the air leaving the dehumidifying cooling coil.

...

INTEGRATED DX HVAC/D SYSTEM is a direct expansion HVAC and dehumidification system designed to handle both sensible and latent heat removal. Integrated DX HVAC/D systems may include, but are not limited to: HVAC systems with a sensible heat ratio of 0.65 or less and the capability of providing cooling, dedicated outdoor air systems, single package air conditioners with at least one refrigerant circuit providing hot gas reheat, and dehumidifiers modified to allow external heat rejection.

...

PLANT CANOPY AREA is the area, in square feet, where mature, or flowering, plants are grown. Each part of the total canopy area is defined by clearly identifiable physical boundaries around all areas that will contain mature plants. Physical boundaries include, but are not limited to, interior walls, shelves, or greenhouse walls delineating the perimeter. Where plants will be grown in multiple tiers, the area of each tier shall be summed to determine the plant canopy area. Plant canopy area includes all actively used growing surfaces, and excludes aisles, non-plant production zones, and equipment-only areas.

...

SENSIBLE HEAT RATIO is the percentage of an HVAC system's total cooling capacity that goes towards lowering air temperature (sensible heat) versus removing moisture (latent heat) calculated as Sensible Heat Capacity / Total Heat Capacity.

SECTION 120.1 – REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

TABLE 120.1-A– Continued Minimum Ventilation Rates

Occupancy Category – <i>Miscellaneous Spaces</i>	Minimum Occupant Load Density (persons / 1000 ft²)	Area-based Minimum Ventilation R_a (cfm/ft²)	Air Class	Notes
Bank vaults/safe deposit	5	0.15	2	F
Banks or bank lobbies	5	0.15	1	F
Computer (not printing)	5	0.15	1	F
Freezer and refrigerated spaces (<50°F)	0	0	2	E
<u>Controlled Environment Horticulture Spaces with Carbon Dioxide Enrichment</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>-</u>

SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

(h) Mandatory requirements for Controlled Environment Horticulture (CEH) spaces.

1. **Indoor growing, dehumidification.** Dehumidification equipment in Controlled Environment Horticulture (CEH) spaces with less than or equal to 5000 square feet of total plant canopy area or with lighting power density less than or equal to 30 Watts per square foot of plant canopy area shall be one of the following:

- A. Dehumidifiers subject to regulation under federal appliance standards tested in accordance with 10 CFR 430.23(z) and Appendix X or X1 to Subpart B of 10 CFR Part 430 as applicable, and complying with 10 CFR 430.32(v)2;
- B. Integrated DX HVAC/D system with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat;
- C. Chilled water system with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat; or
- D. Solid or liquid desiccant dehumidification system for system designs that require dewpoint of 50°F or less.

...

6. Indoor growing, space conditioning systems. In facilities with greater than 5,000 square feet of total plant canopy area, indoor CEH spaces with lighting power density greater than 30 Watts per square foot of plant canopy area shall comply with all of the following:

A. Sizing, space conditioning system. Space conditioning system(s) shall be sized to meet the design heating, cooling, and dehumidification loads calculated according to [TBD NA.9].

B. Heat recovery. Equipment used for dehumidification shall be capable of meeting a dehumidification sensible temperature recovery ratio of at least 0.9.

C. Supplemental heating. If used, electric resistance heating or combustion heating equipment shall comply with the following:

i. Equipment shall be sized to meet heating loads that cannot be met with heat recovered from the dehumidification process according to [TBD NA.9].

ii. Equipment shall be controlled to only operate when heating load exceeds 100% of the available dehumidification process heat.

D. Integrated temperature and humidity controls. Controls for space conditioning equipment shall meet all of the following requirements:

i. One integrated control system shall control both humidity and temperature based on readings from humidity and temperature sensors co-located within the plant canopy.

ii. Controls shall automatically stage or modulate all space conditioning equipment to meet temperature and humidity setpoints.

E. Dehumidification equipment without modulating heat recovery and modulating heat rejection. If used, dehumidification equipment without modulating heat recovery and modulating heat rejection shall:

i. Be controlled from a central controller that sequences unitary dehumidifiers automatically based on dehumidification load.

ii. Only be activated during periods when all waste heat can be used in the space or when other space conditioning equipment cannot satisfy 100% of cooling, heating, and dehumidification loads.

F. Field verification. Field verification of specified equipment and functional performance tests shall demonstrate the correct installation and operation of components, systems and system-to-system interfaces in accordance with the test requirements in [TBD NA7.X].

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

(d) Prescriptive Requirements for Controlled Environment Horticulture (CEH) Indoor Growing Spaces.

1. Space conditioning systems for CEH indoor growing spaces. In facilities with over 5,000 square feet total canopy area, space conditioning systems serving indoor CEH Spaces with lighting power density greater than 30 Watts per canopy square foot shall comply with all of the following:

- A. Construction documents shall identify a primary space conditioning system capable of providing cooling, dehumidification, and reheat using heat recovered from the dehumidification process. The primary space conditioning system shall be an integrated DX HVAC/D system, a four-pipe chilled water system, or a desiccant dehumidification system.
- B. The primary system must be sized to meet at least 80% of peak latent and sensible load.
- C. The primary system and controls shall be capable of the following in response to process needs, indoor temperatures and humidity conditions:
 - i. Modulate sensible heat ratio in response to measured indoor growing space conditions and temperature and humidity setpoints;
 - ii. Modulate heat recovery between 0% and 90% of heat of rejection of the primary system, as needed to meet supply air setpoints;
 - iii. Modulate heat rejection outside of the space between 10% and 100% of heat of rejection of the primary system;
 - iv. Modulate supply fan speed in response to measured space conditions and temperature and humidity setpoints; and
 - v. Controlled in accordance with 120.6(h)6D.

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

(c) Controlled Environment Horticulture Spaces.

1. Indoor Growing, Space-Conditioning Systems and Dehumidification. For all additions or alterations that increase plant canopy area by at least 5000 square

feet, and all alterations that replace greater than 50 percent of the total capacity of heating, cooling, and dehumidification systems serving at least 5000 square feet of plant canopy area in indoor growing spaces shall meet the applicable requirements of Sections 120.6(h)1, 120.6(h)2, 120.6(h)6, and 140.9(d).

1.4 Reference Appendices

Appendix NA7.X Controlled Environment Horticulture Acceptance Tests

NA7.x.1.1 Indoor Growing Space Conditioning Control Construction Inspection

Prior to Functional testing, verify and document the following:

- (a) Primary space conditioning equipment type and sensible cooling capacity, latent cooling capacity, dehumidification heat recovery capacity, and heating capacity are shown on plan documents.
- (b) If supplemental electric resistance heating or combustion heating system is installed:
 - a. Capacity is shown on plan documents.
 - b. A control system is installed capable of limiting supplemental heating system operation to only turn on when the space heating load exceeds the dehumidification heat rejection capacity.
- (c) If dehumidifiers without modulating heat rejection/recovery capacity are installed:
 - 1. Capacity is shown on plan documents.
 - 2. A control system is installed capable of automatically turning the dehumidifier system on and off based on space dehumidification load.
- (d) Temperature and humidity sensors used for space conditioning system control are installed in the plant canopy.

NA7.x.1.2 Indoor Growing Space Conditioning Control Functional Testing

Each space conditioning thermal zone (typically a single room) shall undergo the following tests.

- (a) **Sensible-Only Cooling Test.** Simulate a sensible cooling load with no dehumidification load and no heating load in the space. Turn on lights and adjust space conditioning setpoints as needed. Verify and document the following:
 - 1. Space conditioning system supply fan runs continuously.
 - 2. Cooling compressor runs to sensibly cool the space.
 - 3. Dehumidification equipment is off.
 - 4. Supplemental heating and heat recovery equipment is off.

5. Space conditioning setpoints are met.

(b) Sensible + Latent Cooling Test. Starting with the same setpoints and room conditions as the previous test, reduce space humidity setpoint to create a dehumidification and reheat load in the space. Verify and document the following:

1. Space conditioning system supply fan runs continuously.
2. Cooling compressor runs to sensibly cool and dehumidify the space. Other types of dehumidification (e.g., desiccant) may be used.
3. Heat recovery system operates to capture at least 90% of heat rejected from dehumidification and uses it for space heating.
4. Dehumidification equipment without modulating heat recovery only turns on if equipment with modulating heat recovery (if present) cannot meet space conditioning setpoints.
5. Supplemental heating equipment is off.
6. Space conditioning setpoints are met.

(c) Heating + Latent Cooling Test. Starting with the same setpoints and room conditions as the previous test, reduce sensible cooling load in the space such that the heating load exceeds the sensible cooling load to simulate a net heating load with latent cooling load in the space. Turn off lights and adjust space conditioning setpoints as needed. Verify and document the following:

1. Space conditioning system supply fan runs continuously.
2. Dehumidification heat recovery system runs to dehumidify the space and captures at least 90% of heat rejected from dehumidification and uses it for space heating.
3. Dehumidification equipment without modulating heat recovery only turns on if equipment with modulating heat recovery (if present) cannot meet space conditioning setpoints.
4. Supplemental heating equipment turns on to meet the space dry-bulb temperature setpoint.
5. Space conditioning setpoints are met.

NA7.x.1.3 Indoor Growing Space Conditioning Variable SHR Control Functional Testing

Where systems are prescriptively complying with 140.9(d)1, each space conditioning thermal zone (typically a single room) shall undergo the following tests.

- (a) Step 1: Simulate a sensible cooling load with no dehumidification load and no heating load in the space. Turn on lights and adjust space conditioning setpoints as needed. Verify and document the following:
1. Space conditioning system supply fan runs continuously.
 2. Cooling compressor runs to sensibly cool the space.
 3. Evaporator coil leaving air temperature modulates and supply fan speed modulates to meet space conditioning setpoints.
 4. Dehumidification equipment is off.
 5. Supplemental heating and heat recovery equipment is off.
 6. Record room dry-bulb temperature, room relative humidity, supply air temperature, and supply fan speed.
 7. Space conditioning setpoints are met.
- (b) Step 2: Starting with the same setpoints and room conditions as the previous test, reduce space humidity setpoint to create a dehumidification and reheat load in the space. Verify and document the following:
1. Space conditioning system supply fan runs continuously.
 2. Cooling compressor runs to sensibly cool and dehumidify the space. Other types of dehumidification (e.g., desiccant) may be used.
 3. Evaporator coil leaving air temperature decreases and supply fan speed increases to meet space conditioning setpoints.
 4. Heat recovery system operates to capture at least 90% of heat rejected from dehumidification and uses it for space heating.
 5. Dehumidification equipment without modulating heat recovery only turns on if equipment with modulating heat recovery cannot meet space conditioning setpoints.
 6. Supplemental heating equipment is off.
 7. Record room dry-bulb temperature, room relative humidity, supply air temperature, and supply fan speed.
 8. Space conditioning setpoints are met.

Appendix NA9 Controlled Environment Horticulture Space Conditioning System Sizing

NA 9.1 Purpose and Scope

The purpose of this load calculation and sizing calculations is to provide instructions for calculating loads and sizing space conditioning equipment in Controlled Environment Horticulture spaces. These calculations will enable determination of whether a design complies with 120.6(h)6A.

1. This load calculation and sizing procedure is applicable to CEH spaces with lighting power density greater than 30 Watts per canopy square foot in CEH facilities with canopy area of 5,000 square feet or larger.

NA9.2 Canopy Square Footage

Canopy square footage is a critical input used to determine the energy intensity of indoor CEH spaces, perform load calculations, and correctly size equipment. Canopy area is also used as a trigger to determine which cannabis facilities are subject to code requirements.

To determine canopy area at indoor grow rooms, boundaries in the form of trellising, trays, shelves, etc. serve to demarcate the canopy of the cultivation area.

1. When plants will be cultivated on benches or tables above the floor, the bench is used as the identifiable boundary to demarcate the canopy in the room. Aisles or walkways are not included in the canopy area.
2. When plants are cultivated on shelving to grow vertically, the area of each shelf in each tier is summed to calculate the canopy area. In this case the canopy area may be greater than the room area.
3. For indoor facilities without tables or benches, the floor space area of the room that will be dedicated to growing plants is used.

NA9.3 Load Calculations

1. In calculating design loads, the following inputs values shall be specified:
 - a. Ambient design conditions, including the summer design (0.4%) dry bulb temperature, the summer design (0.4%) mean coincident wet bulb temperature, and the winter design (99%) dry bulb temperature.
 - b. For each unique room or other CEH space where lighting intensity is greater than 30W/canopy square foot, provide the following:
 - a. Canopy square footage, calculated as described in NA9.2 Canopy Square Footage.
 - b. For the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, provide the following inputs

- i. Dry bulb room conditions for lights on and lights off conditions.
- ii. Wet bulb room conditions for lights on and lights off conditions.
- iii. Horticultural lighting wattage. This is the total aggregate horticultural lighting power, including all ballast or driver multipliers. This value should account for any dimming used in different parts of the grow cycle.
- iv. Motor heat in the room for lights on and lights off conditions. This includes the circulation fan power.
- v. Plant irrigation per day.
- vi. Percentage of irrigation transpired during the lights-on period. This value shall be no less than 70% and no greater than 80%.
- vii. Lights on period length in hours per day.
- viii. Envelope load is optional and may be included.

2. Latent and Sensible Load Calculations.

1. The Sensible Space Load is calculated for the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.

1. The Sensible Space Load is calculated as the sum of the Horticultural Lighting Load, The Motor Heat Load, and the Standalone Dehumidifier Load. Power in kW can be converted to loads in BTU/hr by multiplying by 3415 BTU/hr/kW.

2. The Evapotranspiration Load is calculated for the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.

1. The Evapotranspiration Load is calculated as the Plant Irrigation in gallons/day, converted to lbs per day by multiplying by 8.33 lbs/gallon, then multiplying by the % of Total Irrigation Transpired during lights on or lights off, and divided by the number of hours the lights are on or off per day, and multiplying by 1060 BTU/lb of water.

NA9.4 Cooling or Integrated Space Conditioning System Equipment Specification

1. The Cooling or Integrated Space Conditioning System Performance is listed for the loads and operating conditions described the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.

2. System Air Flow in CFM is the system load side (room) air flow at the performance condition.
3. Total Cooling Capacity in BTU/hr is the total system cooling capacity at the operating condition to address the combined sensible and latent load condition.
4. The Latent Removal Capacity in BTU/hr is the energy of the water removed from the load side of the equipment and is equal to 1060 BTU/lb of water removed, per hour.
5. The Sensible Heat Ratio is calculated as the sensible portion of the Total Cooling Capacity divided by the the Total Cooling Capacity.

$$\text{Sensible Heat Ratio} = \frac{\text{Total Cooling Capacity} - \text{Latent Removal Capacity}}{\text{Total Cooling Capacity}}$$

6. The Reheat Capacity is the amount of air reheating that must be provided to the airstream to satisfy the room condition.
7. Recovered Heat Capacity is the amount of heat that is recovered using any of a variety of means to be utilized as reheat for the load air stream.

NA9.5 Additional Equipment Specification

(a) Additional equipment, including standalone dehumidifiers and supplemental heating shall be specified as follows

1. The quantity of standalone dehumidifiers shall the specified
2. The moisture removal capacity, the moisture removal efficiency, and the motor power of the standalone dehumidifiers shall be specified for the loads and operating conditions described the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.
3. The total hourly moisture removal capacity can be calculated as the moisture removal capacity per dehumidifier, converted to lb/hr, and multiplied by the quantity of standalone dehumidifiers in the space. This shall be calculated for the loads and operating conditions described the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.
4. The supplemental heating capacity shall be specified in BTU/hr for the loads and operating conditions described the

first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.

NA9.6 System Capacity

(a) The Total System Cooling Capacity shall be calculated as the total cooling operating capacity specified for the equipment for the loads and operating conditions described the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.

(b)The Total System Latent Removal Capacity shall be calculated as The Cooling/Integrated System Latent Removal Operating Capacity plus the standalone dehumidifier Total Hhourly Moisture Removal Capacity converted to BTU/hr. This shall. Be calculated for the loads and operating conditions described the first day of the grow cycle, the last week of the grow cycle, and a midpoint between weeks 3 and 6, for lights on and for lights off conditions.