Proposal Summary

Controlled Environment Horticulture Prescriptive Requirements for Space Conditioning Systems

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Prepared by: Garth Torvestad and Amy Droitcour (2050 Partners)

Measure Description

This proposed measure would establish prescriptive requirements and revise mandatory requirements for space conditioning systems providing heating, cooling, and dehumidification to support plant growth in Controlled Environment Horticulture (CEH) spaces. These requirements would only apply to CEH facilities with lighting power density (LPD) above a threshold (tentatively 30W/canopy square foot) and a minimum of 5000 sq. ft. of plant canopy. This measure would also provide a performance pathway through updates to California Building Energy Code Compliance (CBECC) software.

The measure would include the development of two or more prescriptive packages based on the plant canopy area. Prescriptive requirements would address mechanical heating, cooling, and dehumidification loads. At least one package would include federally regulated standalone dehumidifiers that are sized, designed, and controlled to be used in combination with efficient cooling, fans, and/or other dehumidification equipment as an efficient system. Prescriptive credit may be allowed for other process and building equipment.

Mandatory requirements would be revised to require the submission of design criteria, assumptions, and sizing calculations for space conditioning systems serving spaces with LPD above 30W/canopy sq. ft. [TBD].

The requirements will likely be the same for all 16 CA Climate Zones. Prescriptive measures would apply to new construction, additions, and major alterations. Replacing a single piece of equipment in a larger system would not trigger the prescriptive requirements (minimum threshold TBD).

As part of the restructuring of the code, this measure would also review and clean up code requirements (such as outdoor air ventilation requirements) that may negatively impact plant growth or efficiency.

Title 24, Part 6 does not currently include prescriptive measures for CEH spaces, and CBECC does not include a CEH prototype. To provide facility designers with flexibility in equipment selection, CBECC would need to be updated for use in demonstrating compliance using the performance approach.

Table 1 summarizes the scope of the proposed code change.

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 cannabis farms, are among the most energy-intensive buildings in California. In these facilities, the lighting and space conditioning systems make up about 80% of energy consumption, split roughly evenly between them. 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.

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, so sizing, design, and equipment requirements are vastly different from those for spaces designed primarily for

human occupancy. Since most conventional fixed-capacity HVAC equipment is designed for steady-state applications, it is poorly suited to the highly variable internal latent and sensible loads that characterize indoor farms.

Over the past decade there have been significant advances in the development of variable capacity, fully integrated space conditioning systems that can quickly adjust to these variations, offering better environmental control and far more efficient operation than fixed-capacity, decoupled systems without integrated controls. 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.

The failure of the market to naturally 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 still 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 40% less than energy use by a decoupled, code-minimum HVAC and dehumidification system. In Smith et al[1], an integrated HVAC/D in Portland, Oregon was shown to save 44% energy when compared to the previously installed code minimum baseline system of packaged roof top units (RTUs) and low cost, stand-alone dehumidifiers.

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

[1] https://www.energy350.com/wp-content/uploads/2019/08/3-0313_0466_000034-Smith-Non-Lighting-EE-in-Indoor-Cannabis.pdf

- 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
    - 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

(b)

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, greenhouse walls, hoop house walls, garden benches, hedgerows, fencing, garden beds, garden plots, or stakes delineating the perimeter. If plants will be grown in multiple tiers, the area of each tier should be summed to determine the plant canopy area. Plant canopy area includes all actively used growing surfaces, but excludes aisles, non-plant production zones, and equipment-only areas.

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")

CEH SPACE CONDITIONING SYSTEM includes dehumidification, heating/reheat, cooling, and/or ventilation strategies to manage temperature and humidity in the indoor growing environment and support plant health and growth.

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.

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 lighting intensity less than [TBD] 30 W/sq. ft. 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 HVAC 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 over 5,000 feet of total plant canopy area, space conditioning system(s) serving Indoor Controlled Environment Horticulture Spaces with lighting intensity over [TBD 30] W/sq. ft. of plant canopy area shall be sized to meet the design heating and cooling loads calculated according to [TBD NA11].

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

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

1. In facilities with between 5,000 and 22,000 square feet of total plant canopy area, space conditioning system(s) serving Indoor Controlled Environment Horticulture Spaces with lighting intensity over [TBD 30] W/sq. ft. of plant canopy area shall comply with the following:

A. The primary space conditioning system must be an integrated mechanical system providing cooling, heating, and dehumidification sized to meet at least ~80% (TBD) of peak latent and sensible load with the following capabilities:

i. Capacity modulation to meet variable compressor loads and sensible heat ratio ranging from a 0.45 (or lower) to 0.75 (or higher);

ii. Compressor(s) with at least 4 [TBD] stages of modulation;

iii. Modulating hot gas reheat capable of providing variable supply air temperature by recovering at least 85% [TBD] of total compressor load for reheat; and

iv. Variable speed supply fans capable of operating at a minimum speed of no greater than 60% [TBD].

B. If used, supplemental heating shall only operate when heating load exceeds hot gas reheat capacity and must be integrated with the central control system.

C. If used, standalone dehumidifiers shall be:

i. Controlled from a central controller that stages dehumidifiers automatically based on dehumidification load.

ii. Controlled to prevent operation when primary system is capable of satisfying 100% of cooling, heating, and dehumidification load.

D. Controls shall automatically stage the primary space conditioning system and standalone dehumidifiers to meet temperature and humidity setpoints.

2. In facilities with over 22,000 square feet of total plant canopy area, space conditioning system(s) serving Indoor Controlled Environment Horticulture Spaces with lighting intensity over [TBD 30] W/sq. ft. of plant canopy area shall comply with the following:

A. Four-pipe heat recovery chilled water system (capable of recovering [TBD]% of waste heat) with;

i. Wraparound heat pipe, OR

ii. Chiller sized to meet 100% of the load calculated for the case where lights are on for 60%[2] of total plant canopy area (for facilities with alternating 12-hour lighting schedule serving 40% to 60% of CEH space).

B. Chillers shall have efficiency rating of [TBD] or higher.

3. Field verification and testing. 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 [TBD NA7.X].

Title 24, Part 6:

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 and ~~All~~ alterations when at least [TBD] percent of the total capacity of ~~newly installed~~ heating, ~~ventilation, air conditioning,~~ cooling, and dehumidification systems is

[2] This limitation is designed to ensure that the facility operates on alternating 12/12 flowering cycle, flattening load and allowing the system to be shared between different rooms.

altered in buildings with indoor growing shall meet the applicable requirements of Sections 120.6(h)1, ~~and~~ 120.6(h)2, 120.6(h)6, and 140.9(d).

1.4 Reference Appendices

Appendix NA7.X Controlled Environment Horticulture Acceptance Tests

[TBD]

Appendix NA.9 Controlled Environment Horticulture Space Conditioning System Sizing

A. Load Calculations

1. In calculating design loads, the following inputs values shall be specified:

i. Lighting intensity and schedule

ii. Canopy area

iii. Irrigation rate and/or evapotranspiration rate

iv. Temperature and humidity setpoints and tolerances

i. Latent and Sensible Load Calculations.

a. [TBD; calculations would account for evapotranspiration loads (latent cooling loads and evaporative sensible heating loads), environmental setpoints, , and lighting loads. Calculations would account for variations in setpoints, internal loads, and outdoor climate factors (ambient temperature, solar radiation) throughout each grow cycle and TMY weather year.]