Submeasure Proposal Summary

2022 California Energy Code (Title 24, Part 6)

Controlled Environmental Horticulture Submeasures:

- Horticulture Lighting Minimum Efficacy
- Environmental and Irrigation Controls
- Efficient Dehumidification and Reuse of Transpired Water
- HVAC and Circulation Fan Minimum Performance Specifications

Updated: September 10, 2019

Prepared by: Stefaniya Becking, Kyle Booth, Joe Sullivan, Greg Barker

Introduction

The document summarizes proposed code changes that will be discussed during a utility-sponsored public stakeholder meeting on September 19, 2019. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. To provide your comments, email info@title24stakeholders.com by October 3, 2019.

Measure Description

The Statewide CASE Team proposes to evaluate indoor horticulture measures for inclusion in the 2022 update cycle of Title 24, Part 6, Building Energy Efficiency Standards. The proposed measures aim to save energy and water, while maintaining product quality and production volume for crops grown in non-stacked and stacked indoor farms. The Statewide CASE Team will consider the plant growth requirements for the following crops in the evaluation of the proposed measures: cannabis, microgreens, vegetable transplants, basil (representing herbs category), lettuce (representing leafy greens category), tomatoes (representing vine plants category), and roses.

Controlled environment horticulture is best categorized as a covered process. The targeted sections of Title 24, Part 6 for the proposed measures include:

- 120.6 Mandatory Requirements for Covered Processes and
- 141.1 Requirements for Covered Processes in Additions, Alterations to Existing Nonresidential, High-Rise Residential, and Hotel/Motel Buildings.

Horticultural Lighting Minimum Efficacy

The Horticultural Lighting Minimum Efficacy measure requires a minimum photosynthetic photon efficacy (PPE) of XX micromole per Joule for luminaires used for plant growth and maintenance in indoor horticulture facilities. Appropriate minimum efficacy for horticultural lighting will be validated through manufacturer and stakeholder outreach. Lighting power density for a cultivation space will also be evaluated.

Environmental and Irrigation Controls

The Environmental and Irrigation Controls measure proposes mandatory lighting, temperature, humidity, and irrigation controls in indoor horticulture as well as an acceptance test for those controls. Vapor pressure deficit will be evaluated as a possible control parameter. The Statewide CASE Team will consider simple controls such as thermostats, switches, time clocks, irrigation timers, irrigation controllers, pressure sensors for irrigation lines as well as more complex controls that use computerized equipment. Interactions of lighting and heating, ventilation, and air conditioning (HVAC) systems will be considered.

Efficient Dehumidification and Reuse of Transpired Water

The Efficient Dehumidification and Reuse of Transpired Water measure proposes minimum efficiency levels for dehumidification, as well as requires reuse of transpired water in indoor horticulture facilities with more than XX square feet of canopy. The Statewide CASE Team will evaluate air-to-air heat exchange dehumidifiers, desiccant dehumidification, and heat recovery from condenser waste heat. Interactive effects of cooling and dehumidification equipment will be considered since many cooling systems provide some amount of dehumidification. The Statewide CASE Team will also consider requirements for filtering condensate from a dehumidification system prior condensate reuse.

Circulation Fan Minimum Performance Specifications

The Circulation Fan Minimum Performance Specifications measure sets minimum performance specifications in cubic feet per minute per Watt (cfm/W) for circulation systems in indoor horticulture. The Statewide CASE Team will refer to Bioenvironmental and Structural Systems (BESS) Laboratory ratings for agricultural circulation fans.

Draft Code Language

The proposed changes to the Standards are provided below. Changes to the 2019 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions).

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

PROCESS, COVERED is a process that is regulated under Part 6, Section 120.6 and 140.9, which includes computer rooms, data centers, elevators, escalators and moving walkways, laboratories, enclosed parking garages, commercial kitchens, refrigerated warehouses, commercial refrigeration, compressed air systems, ~~and~~ process boilers, and controlled environment horticulture facilities.

ANSI/ASABE S640 JUL2017 is the American National Standards Institute / American Society of Agricultural and Biological Engineers document titled "Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)," (ANSI/ASABE S640 JUL2017).

AHAM is Association of Home Appliance Manufacturers.

AHAM Standard DH-1-2017 is the Association of Home Appliance Manufacturers document titled "Dehumidifiers," 2017 (AHAM Standard DH-1-2017).

AHRI is the Air-Conditioning, Heating, and Refrigeration Institute.

AHRI Standard 910 is the AHRI document titled "Performance Rating of Indoor Pool Dehumidifiers."

AHRI Standard 920 is the AHRI document titled "Performance Rating of DX-Dedicated Outdoor Air System Units."

ASHRAE STANDARD 51 is the American Society of Heating, Refrigeration, and Air-Conditioning Engineers document titled "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating." 2016 (ASHRAE 51-16 (ANSI/AMCA 210-16)),

CONTROLLED ENVIRONMENT HORTICULTURE definitions:

Controlled Environment Horticulture (CEH) facility is Occupancy Group F-1 or U building or space that is used for plant growth and production by manipulating indoor environmental conditions including the use of artificial lighting.

Photosynthetic Photon Efficacy (PPE) is photosynthetic photon flux divided by input electric power in units of micromoles per second per electric watt, or micromoles per joule. **Photosynthetic Photon Flux** is the rate of flow of photons between 400 to 700 nanometers in wavelength from a radiation source as defined by ANSI/ASABE S640 JUL2017.

Horticultural Lighting consists of luminaires used for plant growth and maintenance. Horticultural luminaires may have either plug-in or hardwired connections for electric power.

Direct-expansion Commercial Dehumidification System is a vapor compression refrigeration system that provides dehumidification, air circulation, and air reheating. System components include a cooling/dehumidifying coil, an air reheat coil, one or more compressors, and an air moving device. The system may also include a refrigerant heat recovery device and an air-to air heat recovery device.

Direct-expansion Dedicated Outdoor Air System (DX-DOAS) is a vapor compression refrigeration system that dehumidifies 100 percent of outdoor ventilation air and delivers it directly or indirectly to the conditioned space. The system reheats ventilation air by using a refrigerant circuit, sensible wheel, heat pipe, or other heat transfer device. The system may precondition outdoor air by using an enthalpy wheel, sensible wheel, desiccant wheel, plate heat exchanger, heat pipes, or other heat transfer device.

Moisture Removal Efficiency (MRE) is a measure of efficiency of a dehumidification system in removing moisture. It is the quotient of the moisture removal capacity of a dehumidification system by the power input, expressed in lbs of moisture/kWh.

Vapor Pressure Deficit is the difference between the saturated water vapor pressure of air and the actual water vapor pressure of moist air in units of pounds per square inch or Pascals.

SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

(h) **Mandatory Requirements for Controlled Environment Horticulture Facilities**

1. **Canopy Calculations.** Canopy shall be calculated by adding surface area of spaces that will be used for growing and maintaining plants. Canopy may be noncontiguous, but each unique area included in the total canopy calculation shall be separated by an identifiable boundary that includes, but is not limited to, interior walls, shelves, fencing. If plants are being cultivated using a shelving system, the surface area of each level shall be included in the total canopy calculation.

2. **HVAC.** HVAC systems used to condition space for plant production in CEH facilities shall comply with Section 110.2(a).

3. **Dehumidification.**

A. Dehumidification equipment in CEH facilities shall be one of the following:

i. Single package and split-system direct-expansion commercial dehumidification systems with a minimum MRE of XX lbs of moisture per kWh, tested in accordance with AHRI Standard 910.

ii. Single package and remote condenser DX-DOAS commercial dehumidification units without energy recovery that have a minimum MRE of XX lbs of moisture per kWh, tested in accordance with AHRI Standard 920.

iii. Single package and remote condenser DX-DOAS commercial dehumidification units with energy recovery that have a minimum MRE of XX lbs of moisture per kWh, tested in accordance with AHRI Standard 920.

iv. Single package direct-expansion dehumidification units designed to operate within the conditioned space that:

a. Include heat rejection outside of the conditioned space; and

b. Have a minimum integrated energy factor of XX liters/kWh at 80^0F and 60 percent relative humidity design conditions, tested in accordance with AHAM Standard DH-1-2017.

B. CEH facilities with more than XX square feet of canopy and with stand-alone dehumidification system(s) shall reuse transpired water for irrigation.

EXCEPTION to Section 120.6(h)3: If air conditioning systems have humidistatic controls, then mechanical cooling may be used in lieu of a stand-alone dehumidification system.

4. Circulation Fans. Circulation fans used for air movement in CEH facilities shall be tested in accordance with ASHRAE Standard 51 and shall meet fan efficiency requirements listed in TABLE XX.

TABLE XX. CIRCULATION FANS - MINIMUM EFFICIENCY REQUIREMENTS

CIRCULATION FAN DIAMETER	**MINIMUM EFFICIENCY**
≤ 12 inches	XX cfm/Watt
13-19 inches	XX cfm/Watt
20-23 inches	XX cfm/Watt
24-26 inches	XX cfm/Watt
27-29 inches	XX cfm/Watt
30-35 inches	XX cfm/Watt
36-42 inches	XX cfm/Watt
43-49 inches	XX cfm/Watt
50-53 inches	XX cfm/Watt
≥ 54 inches	XX cfm/Watt

5. **Horticultural Lighting.** In CEH facilities with more than XX square feet of canopy, lighting used for plant growth and plant maintenance shall meet the requirements of A and B below:

A. Luminaires used for plant growth and plant maintenance shall have a photosynthetic photon efficacy of not less than XX micromoles per joule rated in accordance with IES LM-79-08 for wavelengths from 400 to 700 nanometers;

B. The lighting power density for total cultivation space shall not exceed XX watts per square foot of canopy.

6. **Environmental and Irrigation Controls.** CEH facilities shall have the following controls:

A. Time-switch lighting controls that comply with Section 110.9(b)1.
B. Thermostatic controls that comply with Section 120.2(a).
C. Humidity controls capable of controlling environment to a specified vapor pressure deficit value.
D. Irrigation controls that allow automated irrigation of plants.

7. **Environmental and Irrigation Controls Acceptance**. Before an occupancy permit is granted for CEH facilities subject to 120.6(h), the following equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.XX.

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

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

Controlled Environment Horticulture Facilities. All newly installed heating, ventilation, air conditioning systems, dehumidification systems, or circulation fans shall meet the applicable requirements of Section 120.6(h).

Alterations to indoor lighting systems that include XX% or more of the luminaires serving an enclosed space shall meet the requirements of Section 120.6(h)5.

NOTE: For alterations that change the occupancy classification of the building, the requirements of Section 141.1 apply to the occupancy that will exist after the alterations.

SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

3. Lighting wattage excluded. The watts of the following indoor lighting applications may be excluded from Adjusted Indoor Lighting Power.

[…]

G. Lighting for plant growth or maintenance for decorative purposes, if it is controlled by a multi-level astronomical time-switch control that complies with the applicable provisions of Section 110.9. For controlled environment horticulture, the requirements of Section 120.6(h) apply.

Existing Code Language

2019 Title 24, Part 6 does not have requirements specific to controlled environment horticulture facilities.