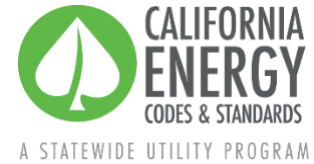


# Meeting Notes: September 24, 2025

Posted October 10, 2025



These notes summarize the content from the 2028 Title 24, Part 6 Code Cycle Utility-Sponsored Stakeholder Meeting on **Nonresidential Lighting and Controlled Environment Horticulture** topics.

If you are interested in providing feedback on any of the topics covered in this meeting, please email your comments to [info@title24stakeholders.com](mailto:info@title24stakeholders.com) by November 15, 2025. Comments received after then may not be incorporated into the Draft CASE Report.

## Quick Links:

- **[Key Points from Meeting](#)** – Read through highlights from each measure and review feedback requested from stakeholders.
- **[In-Meeting Questions / Comments](#)**– Navigate directly to questions asked during the meeting and responses from CASE Authors
- **[Zoom Polls & Responses](#)** – Review the Poll Questions asked during the meeting and see the responses from stakeholders.
- **[Meeting Materials](#)** (available on Title24Stakeholders.com) – Review slides, measure summaries, proposed code language and more on our website.

## Meeting Information

**Date:** 09/24/2025

**Time:** 11:00 am – 4:00 pm

**Host:** California Statewide Utility Codes and Standards Team

## Agenda:

| Time     | Topic                  | Presenter                                                                          |
|----------|------------------------|------------------------------------------------------------------------------------|
| 11:00 AM | Introduction           | Cosimina Panetti, Energy Solutions<br>Javier Perez, PG&E<br>Kelly Cunningham, PG&E |
| 11:15 AM | Lighting Power Density | Jon McHugh, McHugh Energy                                                          |

| Time     | Topic                                                                                 | Presenter                          |
|----------|---------------------------------------------------------------------------------------|------------------------------------|
| 12:00 PM | Luminaire Classification and Power Exception for Alterations & Retrofits (30 minutes) | Nicole Hathaway, 2050 Partners     |
| 12:30 PM | Lunch Break (30 Minutes)                                                              |                                    |
| 1:00 PM  | Lighting Controls                                                                     | Yao-Jung Wen, Energy Solutions     |
| 1:45 PM  | Controlled Environment Horticulture: Lighting Efficacy                                | Nicole Hathaway, 2050 Partners     |
| 2:30 PM  | Controlled Environment Horticulture: Daylight Responsive Controls for Greenhouses     | Nicole Hathaway, 2050 Partners     |
| 3:15 PM  | Controlled Environment Horticulture HVAC/D                                            | Garth Torvestad, 2050 Partners     |
| 4:00 PM  | Conclusion / Wrap-Up                                                                  | Cosimina Panetti, Energy Solutions |

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|                   |                                                                                        |                   |
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## California Energy Commission

### Contact for 2028 Code Cycle:

Any questions for the CEC can be sent to: [EnergyCodeUpdateInquiries@energy.ca.gov](mailto:EnergyCodeUpdateInquiries@energy.ca.gov)

### CEC Docket

Comments on the 2028 Energy Code efforts and process can be formally submitted to the docket: <https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=25-BSTD-03>

## Key Points from Meeting

The purpose and benefits of each measure presented at this meeting are noted below. Additionally, specific topics we are looking for feedback on from stakeholders are highlighted.

If you are a stakeholder and interested in providing feedback on topics related to the measures presented in this meeting, please email the CASE Authors noted above or send you feedback to [info@title24stakeholders.com](mailto:info@title24stakeholders.com).

## Lighting Power Density

- **Purpose:** Update 1) the prescriptive requirements for allowed lighting power density for nonresidential indoor spaces, and 2) the luminaire classification and adjusted indoor lighting power determination.
- **Benefits:** Align with industry standards and recommended design practices for modern luminaires, reduce energy bills.
- **Feedback requested:**
  - What is the Lamp Lumen Depreciation (LLD) factor you typically apply in indoor lighting applications?
  - What is the Total Light Loss Factor (LLF) you typically apply in indoor lighting applications that are clean (offices, etc.)?
  - How frequently are your projects unable to comply using the lighting allowances and you must trade-off with other building components using the performance software approach?
  - How frequently must you use the additional power allowances (decorative/display, tunable white etc.) to comply with the lighting budgets?
  - For a typical or average lighting project: What is the ratio of installed power to allowed power?
  - Which type of designs or design features have problems complying with the lighting power allowances?

## Luminaire Classification and Power Exception for Alterations & Retrofits

- **Purpose:** Update code language to allow use of new lamp wattage in determining lighting power in support of reusing existing luminaires in retrofit projects
- **Benefits:** Reduce retrofit burden, cost, and material waste while supporting reuse of existing luminaires to lower embodied carbon impacts.
- **Feedback requested:**
  - Which option do you prefer for addressing luminaire wattage labeling in retrofit situations? Use lamp label, lamp manufacturer label for luminaire, either, do nothing.
  - When and how should compliance with new wattage labeling requirements be verified?

## Lighting Controls

- **Purpose:** Make the following five incremental improvements to the mandatory lighting controls requirements: 1) require nighttime controls in the parking garage daylight adaptation zones; 2) add occupant sensing controls in more space types; 3) reduce occupant sensing control time delay to 15 minutes; 4) clarify multilevel lighting controls definition and update exception criteria; 5) mandate continuous dimming for daylight responsive controls regardless of multilevel lighting control exceptions.
- **Benefits:** Promote industry best practices, align with national standards and model codes, harmonize across various control requirement sections, and save energy.
- **Feedback requested:**
  - Parking garages: what percentage of your parking garage projects already automatically reduce daylight adaptation zone light level during nighttime? What is the size of the daylight adaptation zones, in percentage, in comparison to the entire parking garage? What is a reasonable assumption of the split between parking garages that operate 24/7 and those with set operating hours? What is a reasonable operating hour assumption for parking garages that don't operate 24/7?
  - What space types should, but are not currently required to, have occupant sensing controls? What space type will be problematic if occupant sensing controls are required, in place of time-based shut-off controls?
  - What are the challenges in implementing occupied standby controls triggered by lighting occupant sensing controls?
  - What space types or applications may be more prone to false-offs if the maximum time delay for occupant sensing controls is reduced from the current 20 minutes to 15 minutes?
  - How prevalent are non-dimmable LED luminaires (with non-dimmable drivers) used in your projects? If cost is the main reason for using non-dimmable LED luminaires, how much cheaper, in percentage, are they compared to dimmable LED luminaires?
  - When daylight responsive controls or automatic daylighting controls are required in your projects, how often do you implement them with on/off switching instead of continuous dimming?

### **Controlled Environment Horticulture: Lighting Efficacy**

- **Purpose:** Adjust the minimum Photosynthetic Photon Efficacy (PPE) of horticultural light sources from 2.3 to 2.5 micromoles per joule ( $\mu\text{mol/J}$ ).
- **Benefits:** Energy savings, cost savings, and consistent performance across crops for little to no incremental cost.
- **Feedback requested:**
  - In your experience, how common is CEH lighting with  $\geq 2.5$  PPE today?
  - What is the biggest barrier to adopting  $\geq 2.5$  PPE light fixtures?
  - What is the typical PPFD (Photosynthetic Photon Flux Density) you maintain in your cannabis flowering rooms?

### **Controlled Environment Horticulture: Daylight Responsive Controls for Greenhouses**

- **Purpose:** Add a mandatory control requirement for greenhouses with over 40 kW of connected horticultural lighting, ensuring supplemental lighting is automatically managed through either PAR sensor-based or Daily Light Integral (DLI) controls to optimize light use efficiency.
- **Benefits:** The proposed daylight-responsive controls would cut greenhouse lighting energy use by 9–26%, lower cooling loads, and reduce grid demand while improving crop consistency and grower control. By building on prior Title 24 measures, the proposal advances California's long-term strategy for efficient, low-carbon controlled environment horticulture.
- **Feedback requested:**
  - What percentage of new greenhouse construction in California ( $\geq 40$  kW horticultural lighting) do you think currently installs daylight-responsive lighting controls (PAR-based sensors or DLI)?
  - What percentage of greenhouse alterations in California ( $\geq 40$  kW horticultural lighting) do you think currently install daylight-responsive lighting controls (PAR-based sensors or DLI)?
  - Based on your experience, which best describes standard dimming practice for horticultural LED lighting?
  - What—if any—minimum time delay should be included in the code language to ensure persistent energy savings and avoid nuisance fluctuations?
  - In practice, does it make sense to allow a single sensor to serve multiple control zones (40 kW max), even though zones often have

different characteristics (e.g., shading, thermal curtains, blackout curtains)?

- Would it be useful to base a field verification protocol on existing manufacturer or installer commissioning practices?

### **Controlled Environment Horticulture HVAC/D**

- **Purpose:** For high-lighting intensity indoor farms (such as cannabis facilities), prescriptively require mechanical systems that can efficiently manage the variable latent and sensible loads typical of this agricultural process. Add mandatory requirement for latent and sensible load calculation and mechanical system sizing calculation.
- **Benefits:** Proposal will significantly reduce space conditioning energy use. Proposal will also address inconsistencies in the current code requirements, clarifying and improving the compliance process. Offering a performance pathway will allow design flexibility while mitigating concerns with federal preemption.
- **Feedback requested:**
  - What are the current market practices for indoor growing envelope design?
  - What are the rates of new construction for indoor Controlled Environment Horticulture (CEH) facilities?
  - What preferences, if any, do facility operators have for different types of space conditioning equipment? Why?
  - What is the appropriate range of sensible heat ratio (maximum and minimum) for the primary HVAC/D system?
  - What is the range of heat recovery (maximum and minimum) that should be required for the primary HVAC/D system?
  - What limits should be placed on the use of electric resistance heating in indoor farms?
  - Aside from sensible heat ratio and heat recovery, what are the key performance and quality specifications for integrated DX and decoupled HVAC/D systems that impact energy efficiency in indoor growing facilities?
  - What are the key attributes and differences between various integrated DX systems that impact energy efficiency in indoor growing facilities?
  - What are the cost considerations and economies of scale associated with chilled water systems?

- How does the replacement process differ between equipment types (e.g., compressor-only vs. whole unit replacement)?
- What are the key differences and/or advantages for less common, new or emerging dehumidification technologies? Can energy models represent these technologies? If not, what updates are needed?
- What is the typical canopy square footage threshold for choosing direct expansion (DX) systems versus chilled water systems?
- What documented impacts do improved control systems, integrated vs. decoupled systems, and other system attributes have on yield, quality, and energy savings?

### In-Meeting Questions / Comments

During the meeting, questions and comments were submitted in the Q&A pane in zoom as well as asked verbally during the meeting. Answers to the questions asked are provided below.

Attendees were also asked to respond to polls. Navigate directly to the [Zoom Polls & Responses](#) by clicking the link.

Due to time limitations, not all written questions and comments were discussed during the meeting but all have responses available in these meeting notes.

#### [Javier's CEC Intro]

1. **Question asked via Zoom question pane by Justin Lewis:** Can the presentation be shared with us?
  - a. Nikki Westfall: Yes, the presentations are currently available at <https://title24stakeholders.com/event/nonresidential-covered-processes-lighting-utility-sponsored-stakeholder-meeting/>  
The slides from the introduction are not currently available but will be posted there shortly.
2. **Question asked via Zoom question pane by Matthew Friedlander:** Javier, you mentioned that for 2028 we are focused on non-residential segments. Did you mean that is the focus of today's session, or that the entire 2028 effort is focused on non-residential?
  - a. Javier Perez: Hi Matthew. All 2028 Energy Code updates will exclude buildings of occupancy group R. This is due to Assembly Bill 130 (2025-2026). The California Building Standards Commission produced an information bulletin on 9/22 that explains this bill's impact on codes, and can be found here: <https://www.dgs.ca.gov/BSC/News/Page-Content/Building-Standards-Commission-News-List-Folder/IB-25-03-AB-130>

#### [Indoor Lighting Power Density, Jon McHugh]

3. **Question asked via Zoom question pane by Susan Vargas:** Glad to see that luminaires with removable lamps will be allowed. We have experienced a lot of early

failure of LEDs so replacing lamps only is our preferred option for reducing cost and avoiding waste.

- a. Nicole Hathaway: Please stay on for the Luminaire Classification and Power Exception for Alterations & Retrofits presentation coming up next! I have a few polls where we'd love to get your input on this topic specifically.
4. **Question asked via Zoom question pane by Steve Rosenstock:** LLD is for indoor LED fixtures only, correct?
  - a. Nicole Hathaway: Correct.
5. **Question asked via Zoom question pane by Susan Vargas:** We are not getting 50,000 hours from quite a few drivers. I can provide specifics from our Student Housing O&M group if helpful.
  - a. Bernie Bauer: We are interested in your findings and will want to look into this. Please send your findings to Jon Mchugh or to the Energy Solutions team.
  - b. Jon McHugh: Please reach out to [info@mchughenergy.com](mailto:info@mchughenergy.com), I look forward to learning what you are finding. Please also cc [info@title24stakeholders.com](mailto:info@title24stakeholders.com). Thanks.
6. **Question asked via Zoom question pane by Steve Rosenstock:** Are you going to show poll results?
  - a. Bernie Bauer: I believe they will be available but not sure if during this session. They will probably be posted on the site later.
    - i. *Update: [Zoom Polls & Responses](#) are available further on in these meeting materials. Navigate there by clicking the link above.*
7. **Question asked via Zoom question pane by Susan Vargas:** Type A retrofits are not the best option, but it's still better than doing nothing! Many customers may not have the budget to do a proper Type C retrofit until a renewal /TI project comes along. We'd rather see them do Type A LED upgrades rather than waiting years or for a failure. We have found that if ballasts have at least 5 years of life left it is cost-effective to do a Type A upgrade.
  - a. Bernie Bauer: Use of Type A is not the best option. You can still use it if you're not subject to code compliance. The type A can still be used under compliance

as well, but you don't get the savings as you would need to use the input ballast power not the new LED lamps.

8. **Question asked via Zoom question pane by Susan Vargas:** What did your LCA show?
  - a. Chris Uraine: Susan, we'd like to connect with you as you've had a lot of great questions and insights and are happy to discuss all the items you've mentioned today.
9. **Question asked via Zoom question pane by Susan Vargas:** Does anyone actually go back and change all of the switches after inspection? I think it's nice to have the option to "spot adjust" light levels for specific locations.
  - a. Bernie Bauer: The multi taps are somewhat new, we will be examining use. The problem with requiring max wattage for a luminaire can be with compliance. I had a feeling that this would be a compliance problem.
10. **Question asked via Zoom question pane by Drew Felker:** Do we do studies of real offices to see how accurate our cost savings methodologies are vs real world?
  - a. Bernie Bauer: Yes, we reach out to designers for such information.
11. **Question asked via Zoom question pane by Michael Jouaneh:** I don't see the actual code language for the LPD changes and elimination of Type A LED retrofit on the website. Is the correct file post on the website?
  - a. Jon McHugh: The code language can be found at:  
[https://title24stakeholders.com/wp-content/uploads/2025/09/2028-T24-Measure-Summary\\_Indoor-LPD-1.pdf](https://title24stakeholders.com/wp-content/uploads/2025/09/2028-T24-Measure-Summary_Indoor-LPD-1.pdf)  
For high intensity discharge (HID) or fluorescent luminaires with permanently installed or remotely installed ballasts, the wattage of such luminaires shall be the operating input wattage of the rated lamp/ballast combination published in the ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598. Solid state lighting (SSL) shall not be used in conjunction with HID or fluorescent ballasts.

#### **[Luminaire Classification and Power Exception for Alterations & Retrofits, Nicole Hathaway]**

12. **Question asked via Zoom question pane by Matt Golden:** As an HVAC contractor I would love to see, in addition to rated Wattage, rated BTU'S required to cool the fixture like we see on some dehumidifiers.
  - a. Jon McHugh: Matt, lighting is an internal gain and is treated similar to plug loads. Luminaire Watts x 3.413 Btu/h/W = \_\_\_\_\_ Btu/hr.  
Matt, if I have misunderstood your question, please reach out to me at [info@mchughenergy.com](mailto:info@mchughenergy.com).
13. **Question asked via Zoom question pane by Michael Jouaneh:** Thanks Jon/Bernie, I see it now. Good presentation. I was looking for the words "Type A" and didn't see them. I see "Solid state lighting (SSL) shall not be used in conjunction with HID or fluorescent ballasts," which is good but you should consider adding Type A in the language in the standard to provide more clarity that Type A is not permitted. The User's Manual can expand on this further and explain the different Type A, B, and C like your slide does.
  - a. Jon McHugh: Thanks for highlighting this issue that the code language "Solid state lighting (SSL) shall not be used in conjunction with HID or fluorescent ballasts." might not be readily interpreted that type A retrofits are not allowed for permitted projects. We have thought that applicability to type A retrofits would be described in the Nonresidential T-24 Compliance Manual rather than directly

in the standard as a note. We can confirm with CEC staff what their preference is for how these clarifications are addressed.

14. **Question asked via Zoom question pane by Michael Jouaneh:** For luminaire power calculation on wattage-selectable, if there was truly a way to lockout other selections then the selected wattage can be used for power calculations. If there is not, then the maximum selectable wattage should be used.
- a. Jon McHugh: Michael, I agree. We want to highlight this idea early on so we can learn from creative solutions that lighting manufacturers might come up with on how a selectable output luminaire can be converted to fixed output so stocking flexibility can be maintained but also having confidence that after the change is made to the luminaire that wattage is not increased.

### **[Indoor Lighting Controls]**

15. **Question asked via Zoom question pane by Justin Lewis:** I'm more interested in the HVAC side of things, but in general, plan check is important step to make it right, but many things still get missed during construction, so an improved inspection process can help catch even more.
- a. Yao-Jung Wen: Thank you very much for the comment. We've taken note of this and will reach out to you to discuss further!
16. **Question asked via Zoom question pane by Justin Lewis:** In addition to lab difficulties, control manufacturers in the past did not have setbacks in their base applications for temperature or ventilation.
- a. Nicole Hathaway: This is very helpful information! We've taken note of this and will reach out to you to discuss further!
17. **Question asked via Zoom question pane by Justin Lewis:** There were a lot of new spaces mentioned for occupancy based setbacks, I feel every one of those types of spaces could use a conversation on its own.
- a. Michael Mutmanský: Yes, further dialogue on any individual space type is valuable and we'd appreciate to have input from anyone on your thoughts. Please feel free to reach out to the CASE Team on this at your convenience.
  - b. Yao-Jung Wen: We would love to have these conversations. We can collectively decide what space types make sense.
18. **Question asked via Zoom question pane by Justin Lewis:** Our experience with lights and HVAC occupancy controls is that those systems are maintained by separate teams with separate skill sets. Further, if the integration is done at the building level, it makes troubleshooting much harder than if it was done with a hard contact relay locally to each room's lighting and HVAC systems.

- a. Nicole Hathaway: Thank you for the input, we've taken note of this and will reach out to you to discuss further!
19. **Question asked via Zoom question pane by Justin Lewis:** It makes it more straightforward to us to actually make the lighting system and the HVAC systems have literally separate occupancy sensors.
- a. Michael Mutmanskyy: We have heard both opinions on this, so we'd appreciate that your thoughts are brought to the CASE team through feedback here and as follow-up. Thanks.
  - b. Jon McHugh: We have heard from some that by using the lighting occupancy sensing control as an input to the HVAC system it is more readily apparent if the occupancy sensing control has failed  
Thanks Justin! We should talk more. Great project experience to share.
20. **Question asked via Zoom question pane Anonymously:** It is very hard and expensive to control HVAC controls through lighting control systems for buildings <10,000 square feet.
- a. Michael: Would these requirements require that the HVAC use the same system?
  - b. Yao-Jung Wen: In terms of building size, this is something we can look into. In terms of controlling lighting and mechanical systems together, even though the trigger is the occupancy sensor in the lighting system, it doesn't mean the same occupancy sensor has to be used to control the HVAC. So the two systems can still be controlled completely separately, if this approach makes the most sense for the project. The intention of the occupied control requirement is to achieve better integration and create savings, but implementing it using separate occupancy sensors for the HVAC system is allowed and is a valid approach.
21. **Question asked via Zoom question pane by Jon McHugh:** On occupant standby, the desire is to have the occupancy sensor cover the lighting and the HVAC. We are limiting the amount of outside air to the space. If you have a separate occupancy sensing control and it fails, you don't necessarily know, since you don't know right away if the HVAC fails to respond and behave correctly. With lighting, you know more or less right away.
- a. Justin Lewis: We did a program called smart lighting controls. The vendor was Watt Stopper. We wanted to do HVAC setpoint turndowns when unoccupied. This proved to be very difficult, as the time to hear from the lighting system took too long through BACnet. We tried using a relay that looked at the zone and determined if it was occupied or unoccupied from the lighting side. This was helpful for the HVAC side because you could check the relay with a voltmeter. An issue is that the lighting and HVAC could be handled by different teams. An HVAC zone can also span multiple rooms and lighting zones. This needs to be considered for cases where it doesn't work.

- b. Jon McHugh: Is there dry contact?
  - c. Justin Lewis: Dry contact is easier to deal with. But if you don't have that, having a separate sensor is easier. But when an occupancy sensor fails, knowing it through the lighting doesn't work, but not knowing the HVAC is a valid concern.
22. **Question asked via Zoom question pane by Justin Lewis:** One difficulty to coupling HVAC and lighting is that HVAC systems zoning don't match lighting zones, and so to couple them together requires some logic to define the overlap in programming.
- a. Michael Mutmanský: Thanks for the comment. This does present trouble for certain types of occupancy zones, and how the design industry resolves this difficulty is something the CASE Team is interested in hearing from stakeholders.
23. **Question asked via Zoom question pane by Kelly Seeger:** I am interested in the comment on changing the name of multilevel lighting controls. Can you reiterate what issue you're trying to resolve and what the thinking was?
- a. Yao-Jung Wen: Right now, the language is confusing, as the requirement may be interpreted as a hardware dimmer or a capability that provides continuous dimming. The term "multilevel lighting controls" is directly referenced by the daylight responsive controls requirement, and it doesn't make sense to use a manual dimmer for daylighting controls if multilevel lighting controls are interpreted as manual dimmers. We are proposing to position the multilevel lighting controls requirement as a control capability that provides continuous dimming that other controls can utilize, as opposed to a hardware dimmer. It doesn't matter how you access the continuous dimming; it just has to be there. It can be utilized by manual controls, i.e., manual dimmer, daylight responsive controls, and demand responsive lighting controls, wherever continuous dimming is called for.
  - b. Kelly Seeger: Basically, we are going from the thinking that it has to be a separate device that has to be a capability that is covered by something.
  - c. Jon McHugh: This is highlighted in the measure summary posted on the [title24stakeholder.com](http://title24stakeholder.com) website.
24. **Question asked via Zoom question pane by Michael Jouaneh:** I like the idea of clarifying the term multi-level controls. I always thought it was a capability of the luminaires and not the physical dimmer control. But I have also seen the confusion in the market this has caused. The manual dimmers requirements in the manual control section make a lot of sense and should be added at the minimum to match 90.1 or IECC requirements for spaces where manual dimmers are required.
- a. Yao-Jung Wen: Thank you, Michael, for the comment! Glad you agree with our assessment. We'd certainly love to align with 90.1/IECC as much as possible.

**[CEH Lighting Efficacy, Nicole Hathaway]**

25. **Question asked via Zoom question pane by Steven Long:** Has there been any evaluation of the PPE vs color spectrum output of the impacted lights?
- a. Joe Sullivan: Are you asking whether we've compared the spectra of LEDs below 2.5 PPE to those at or above 2.5 PPE? If so, then yes we have. Based on our analysis, we did not see a meaningful spectral difference between LEDs below 2.5 PPE vs. those at or above it, up until PPE at or above 3.0 PPE. Although, from the data we currently have, fewer than 15% of horticultural LEDs on the

market are under 2.5 PPE, so it's not a huge chunk of the market that would no longer be eligible.

26. **Question asked via Zoom question pane by Steve Rosenstock:** Is there any information about the total installed wattage of lighting installed in these facilities? Are people putting in more fixtures with higher PPE?
- Nicole Hathaway: Initial outreach is showing that many sites are installing more light for different use cases. Not seeing a drastic power reduction.
  - Amy Droitcour: We asked Nicole verbally. Her response indicated that stakeholder outreach is showing that many facilities are installing more lights when they move to higher PPE. We would be happy to get more stakeholder input on this.
27. **Question asked via Zoom question pane by Steven Long:** While I know your focus is on the code, not the CPUC required baselines, did you look into the CPUC more aggressive baselines?
- Amy Droitcour: Yes, we are aware of the CPUC baselines.
28. **Question asked via Zoom question pane Anonymously:** How is the compliance being verified with the micromol/J? For people who are not as familiar with this market, is it as simple as verifying LPD for compliance?
- Jon McHugh: Compliance is shown by taking the Photosynthetic Photon Flux (between 400-700nm) and dividing it by the Input Watts. Both of these are typical design features that a user would want to know for growing their plants (PAR light output) and electrical capacity needed.  
In some sense it is easier than calculating LPD as it is product specification.  
There is no limit on the power installed, this just makes sure what is installed is efficacious.
29. **Question asked via Zoom question pane Anonymously:** The market share referenced the Cannabis Business crop type. Is that the majority of the market in California? What other grower crops that would rely on other broader spectrums constitute a "significant" share of the market?
- Amy Droitcour: Market share is highly dependent on the facility type. The market share estimate shared during the presentation used the cannabis industry survey as a source but the percentage was weighted with data we have gathered for all major CEH crop types in the State.  
For Indoor CEH, cannabis is the overwhelming majority, making up over ~90% of the facility stock.  
For Greenhouse CEH, it is a significant portion at ~30%, but it is not the majority. The other significant crop categories, particularly in the large greenhouse market, are:  
Tomatoes, Flowers, & Vine Plants are the largest single segment in greenhouses, accounting for ~40% of the market.  
Leafy Greens, Microgreens, & Herbs is the other major segment, representing ~30% of the greenhouse market.  
These are our best estimates right now, and we're actively working to refine this data using sources like the CA DCC, USDA Hort. Census, industry reports, and stakeholder outreach, surveys, and interviews to help us get a clear, updated picture of artificial & supplemental lighting & LED use across all building and crop types in the State.

30. **Question asked via Zoom question pane by Justin Lewis:** What's the CASE email I should follow up with in regards to HVAC occupancy based turn down?
- a. Nikki Westfall: Great question - you can reach out to our lighting lead Yao-Jung Wen at [ywen@energy-solution.com](mailto:ywen@energy-solution.com), or send a note to [info@title24stakeholders.com](mailto:info@title24stakeholders.com) and we can make sure it gets to the right person.
31. **Question asked via Zoom question pane by Kelley Nicholson:** I think it is important to not only see fixture cost as a problem, but the cost of growing zones being down while the lights are being switched out and the labor cost of that job. Though the fixtures may be affordable, the extra costs can make it too expensive. If there was help with those expenses, more growers would be able to switch sooner.
- a. Amy Droitcour: Thank you for this input. The code would only be triggered when lighting is being replaced.
32. **Question asked via Zoom question pane by Shamim Ahamed:** Does that Excel tool estimate energy for HVAC and lighting, or only for lighting? If so, did you validate the tools? How did you incorporate the impact of evapotranspiration in your model?
- a. Joe Sullivan: Did we incorporate interactive effects in the energy savings model? Yes we do. We are using the same methodology as in previous years. We do take into account the interactive savings.  
Are we taking into account transpiration? In terms of lower dehumidification load? No, we do not take that into account in the lighting model. I'm happy to discuss this further but there are a lot of different building configurations and growing techniques growers can use and we are not able to capture all of that. So we just focus on interactive savings in wattage from lighting. It would be great to setup a time to chat further.
  - b. Shamim Ahamed, UC Davis: Happy to chat.
  - c. Amy Droitcour: The excel tool includes both lighting energy and cooling loads from lighting.
33. **Question asked via Zoom question pane by Shamim Ahamed:** Tomato is too low.
- a. Amy Droitcour: Thank you for this input! If you have more data to provide, we would appreciate it.
34. **Question asked via Zoom question pane by Matt Golden:** It almost seems like it's time to quantify the amount of actual heat output from each fixture in its rating process, this would help to more correctly match process loads to the cooling loads and differentiate higher efficiency fixtures.
- a. Jon McHugh: Matt due to the conservation of energy, the amount of heat out is equal to the amount of heat in. Some fixtures that are water cooled (like for some high intensity fixtures in cannabis growing) then have some heat to the fluid versus heat to the space. But virtually all nonresidential lighting for visibility does not have such a cooling system and all power into the fixtures results in the equivalent heat load in the space. The heat rating of the fixtures is the same as the input power rating. SI (System Internationale) units are watts and IP (inch-pound) units are Btu/hr.
  - b. Joe Sullivan: Adding on to what Jon said here.... The key with sensible loads & horticultural lighting, is how much of the lighting input power actually becomes heat in the room. Since we know the watts that reach the space and Watts = BTUs, we can calculate the sensible load. Now with remote drivers becoming

more common, adding a heat to space metric might be a good idea as it could help capture that and improve HVAC sizing.

**35. Question asked via Zoom question pane by Matt Golden:** I also missed where can we find the excel tool with cooling loads mentioned in the above question? (I'm not seeing it in the slides).

- a. Amy Droitcour: This spreadsheet is not shared publicly. We would like to meet with you to review it and discuss the approach and assumptions.

#### **[CEH Lighting Responsive Controls for Greenhouses, Nicole Hathaway]**

**36. Question asked via Zoom question pane by Gretchen Schimelpfenig:** Is there a reason the DLI controls study by Cornell University and USDA using modeling in multiple U.S. locations to estimate energy savings is not being used? That study has much higher savings % for many crops.

- a. Amy Droitcour: We have used a set of 8 studies, including studies from GLASE, to develop preliminary energy savings estimates. We will be calculating energy savings based on weather and measured light for all 16 climate zones. We would like to get your input on our assumptions for the calculations. We would also be happy if you shared the studies you are referring to so we can ensure we did not miss them.

**37. Question asked via Zoom question pane by Gene Giacomelli:** Is this for Greenhouse or sole source electrical lighting buildings, or both?

- a. Amy Droitcour: This measure only applies to Greenhouses.

**38. Question asked via Zoom question pane by Nadia Sabeh:** What type of alterations? To lighting only? Or to the entire structure?

- a. Amy Droitcour: This would only apply to lighting additions and alterations where more than 40 kW of aggregate horticultural lighting load is installed to serve greenhouse spaces.

**39. Question asked via Zoom question pane by Gretchen Schimelpfenig:** Can you please share the source of your data for the 16 million square feet of greenhouse? That is a lot smaller than what we see in the USDA Ag Census for "crops grown under protection" and the California DCC database of licensees.

- a. Amy Droitcour: This is the estimate of greenhouse square footage estimated to have 40 kW+ horticultural lighting load, not the total California greenhouse square footage. We would be happy to review any other sources for this value that you can provide.

**40. Question asked via Zoom question pane by Martin Vu:** I have concerns about Mandatory Requirements for Greenhouse Growers: The upfront investment in sensors, software, and installation is substantial, and many of these growers lack the technical staff or expertise to manage such systems.

- a. Amy Droitcour: Thank you for this input. We have provided two compliance paths to provide growers with flexibility to install a more simple, lower-upfront cost approach, or the more-complicated solution with higher energy savings. With a 40 kW lighting load, the savings even from the simple system is huge. This is comparable to the lighting wattage in a 100,000 sf warehouse which has been required to have a timeclock and daylighting controls since 2005. The simple path is essentially a timeclock and a daylighting control. We are still in the process of gathering incremental cost information, but preliminary data does not suggest installation would be overly burdensome. However, costs do increase as the control systems become more complicated

and provide additional functionality, beyond the PAR sensor & dimming control that would be required by the proposed measure.

We would be happy to discuss further.

41. **Question asked via Zoom question pane by Justin Jacobs:** Argus has been using PAR and DLI lighting control for over 10 years.

- a. Amy Droitcour: We would love to discuss your experience installing, using, and maintaining these systems!

42. **Question asked via Zoom question pane by Gretchen Schimelpfenig:** PAR values are not shared in TMY3 data, only solar radiation values. How do you plan to convert TMY3 data points to available PAR at the crop canopy?

You mentioned that PAR values will be used for 8760 data from TMY3. How are you planning on getting PAR values from TMY3?

- a. Jon McHugh: There are essentially solar radiation efficacy equations you can use to convert TMY3. You can make it more specific by making it an angular-dependent transmittance, but I think right now the model is just a fixed non-angular transmittance.
- b. Gretchen Schimelpfenig: What value are you planning on using, especially since the code is mandating double-layer coverings?
- c. Joe Sullivan: In the past we've used 83% as our assumption. An average of the number of different greenhouse envelope and glazing materials. The code will not directly mandate double pane glazing. We are still in the process of collecting data on glazing and envelope materials for different crop types. Preliminary savings based on 83% transmissions.
- d. Gretchen Schimelpfenig: The Smart Controls for Data-Driven Indoor Agriculture was just published by CalNext, and we have a higher savings percentage estimated for DLI controls, so we want to continue to align so that utilities aren't overestimating savings and the code isn't underestimating savings.
- e. Joe: There are a number of resources that provide PAR data. NASA and NREL. Pretty powerful databases and you can select any area in the country and collect any idea from the past 10 years in any part of the country
- f. Amy Droitcour: Solar radiation efficiency equations convert TMY3 irradiance into corresponding values into PPFD. These numbers extract the 400-900 nm. We use a transmittance value for the glazing to estimate the amount of light that gets through the greenhouse. Preliminary savings based on 83% transmission, but we would be happy to get more input on these values.

43. **Question asked via Zoom question pane by Gene Giacomelli:** Tomato DLI needs to increase to 20 - 25 Mol/m<sup>2</sup>/day of sun + supplemental; also 12 hours photoperiod can increase to 18 hours per day.
- a. Amy Droitcour: Thanks. This is very helpful. We would be happy to talk to you further about these values and any others you can provide input on.
44. **Question asked via Zoom question pane by Gene Giacomelli:** Couldn't DLI control compliance be determined from measurements by the control system of the lamps?
- a. Jon McHugh: Yes. If logging power consumption and measurement of PPFD or DLI, you can confirm that indeed. When plenty of daylight lights are turning off when enough DLI achieved.
  - b. Amy: Thank you for this input on compliance approaches!  
If the system is logging PPFD and energy consumption over the course of the day, we should be able to use this approach.
45. **Question asked via Zoom question pane by Shamin Ahamed:** Clarification on photoperiod. What is the basis of the calculation for the target DLI as well as for the photoperiod mentioned (200 vs 400 nm)?
- a. Joe Sullivan: PPFD assumptions based on outreach and data gathered in the past. Continuing to do outreach to stakeholders to verify these numbers are still accurate and true.
  - b. Shamim Ahamed: Overall it is better to identify the target DLI. Is it the total DLI target or artificial? If it's total, 25+.
  - c. Joe Sullivan: Good point about target and supplemental DLI. We can change terms there. Target would be light intensity from the sun through the greenhouse. Supplemental is from artificial lighting sources. For tomatoes DLI is a little low because the supplemental PPFD is most likely low?
  - d. Shamim Ahamed: Yes, should be at least 25+.
  - e. Joe Sullivan: Would love to talk with you more on this since we are still gathering data.
  - f. Gretchen Schimelpfenig: I agree with Shamim, tomatoes should be higher. Greenhouses do not stick to photoperiod as much because they want to achieve the DLI, they may extend or shorten photoperiod depending on solar resources that day.
  - g. Amy Droitcour: Thanks, Gretchen! We will be in touch to get your input on all these input assumptions.
46. **Question asked via Zoom question pane by Justin Jacob:** We install Apogee PAR sensors within the zone at crop level. Along with a PAR sensor outside of the greenhouse.
- a. Amy Droitcour: Thank you – looking forward to talking with you!
47. **Question asked via Zoom question pane by Gene Giacomelli:** My experience is 60 - 70% PAR transmission at mid-day for double-layer glazing, including the structural material which varies on age of glazing and the amount of overhead systems are installed [shade, energy screens].

- a. Amy Droitcour: Thank you for this helpful input! We would love to discuss this topic with you further to support our assumptions.
- 48. **Question asked via Zoom question pane by Gretchen Schimelpfenig:** Agree with Gene that the photoperiod for tomatoes can increase (after all, they have a vegetative and a fruiting phase just like cannabis).
  - a. Amy Droitcour: Thanks, Gretchen! We will be in touch to get your input on all these input assumptions.

**[CEH Space Conditioning, Garth Torvestad]**

- 49. **Question asked via Zoom question pane by Zachary Jenkins:** Why is desiccant dehumidification limited to only low DP applications?
  - a. Amy Droitcour: Desiccant is most often used in low dewpoint applications. This proposal would not preclude the use of various types of dehumidifiers as long as the primary system meets prescriptive requirements (prescriptive path) or the overall system meets the energy budget (performance approach).
- 50. **Question asked via Zoom question pane by Glen LaPalme:** Garth, I see the previous slide (8) mentioned indoor cannabis, would that change in definition apply only to indoor CEH facilities or greenhouses as well?
  - a. Amy Droitcour: The proposed code change is for high lighting intensity indoor CEH facilities (proposed threshold 30W/canopy sq ft), which would primarily be indoor cannabis.
  - b. Amy Droitcour: The change in definition of Directly Conditioned Space would exclude Controlled Environment Horticulture Space, which includes both greenhouse and indoor growing.
- 51. **Question asked via Zoom question pane by Liping Wang:** Thank you for the information. Can you please comment on the details about updating compliance software including CEA. The sizing requirement is important. However, the methodology for correct energy load calculation for growth spaces needs to be tested and validated. Can you please discuss this efforts?
  - a. Amy Droitcour: Thank you for your interest. We would be happy to meet with you to discuss our modeling efforts in detail. We have used measured latent and sensible load data and data from designers and consultants in these facilities to help inform the model inputs and assumptions and validate the results. We have taken a similar approach to informing the load calculations and sizing guide.
- 52. **Question asked via Zoom question pane by Kelley Nicholson:** Can you please share the poll data regarding the current % of new construction installing modulating HVACD and what % are installing 5-pipe chilled water with heat recovery?
  - a. Nikki Westfall: This information will be shared in the meeting notes! We'll follow up with those after the meeting and you will be able to see all of the responses from the polls today.
- 53. **Question asked via Zoom question pane by Zachary Jenkins:** In the day/night cycle the SHR in a space changes drastically. The latent load becomes the dominate load during night cycle and the sensible lighting load drops out of the space. A decoupled system can be designed to handle the sensible load with an inexpensive RTU, and a high efficiency (DOAS style) unit sized for the latent load. This can be done with a significant reduction in first cost compared to putting the entire load on an integrated system.

I would advocate more clarity be put into the prescriptive method to allow for high efficiency and economical design schemes like this.

- a. Garth Torvestad: We have heard similar comments from designers and distributors, and we've tried to craft the language to allow the primary system to handle most, but not all the load, since that is likely to be the most cost-effective approach. But since LED lighting is now a code requirement in California, sensible loads are less of an issue, and transitions from day to night are smoother. There are a couple of case studies coming in with energy savings close to what we are modeling right now. The model includes both sensible and latent load profiles. The prototype was developed considering the design of cannabis facilities. We will continue to refine and update the model. We are still looking for any performance data we can get.
- b. Amy Droitcour: Thank you for this input! We would love to discuss your design approaches to make sure the code will accommodate high efficiency, cost-effective designs.

54. **Question asked verbally by Shamim Ahamed:** EnergyPlus, working on getting heating mass balance in. Integrating it. Latent load is very difficult to model. Every crop is different. What are you doing to confirm it's correct for the load calculation? For the total load?

- a. Garth Torvestad: The model does incorporate the transpiration rate and evaporative cooling. Looking at existing facilities. Goal of the model is to represent high-lighting intensity crops like cannabis. Our goal is get it pretty close but it won't cover every variable or crop type this code cycle.

55. **Question asked verbally by Zachary Jenkins:** Laying out prescriptive requirements for integrated systems, completely agree. See potential risk for first cost. Of concern to farmers, moving everything into a fully integrated system. Any consideration for High efficiency dehumidification systems?

- a. Garth Torvestad: That is the kind of input we are looking for. What are those systems? Primary system looking at the percentage of the load it serves. Strategically looking at what's in the space, etc. Is a good system. The idea is to ensure that the primary system can cover most of the load and then using anything else when needed.

56. **Question asked verbally by Liping Wang:** Incorporating the modeling of CEH in code compliance software. Mentioned using EnergyPlus. Curious about the upgrade. Want to hear about the requirement and see how we can support that effort

- a. Garth Torvestad: Began with a subcontractor that has better controls than EnergyPlus. Big Ladder Software is doing the modeling. Can give you examples and we can talk offline. Controlling the EMS to control for latent separately. Addressing both sensible and latent loads and simulating equipment. We could get you on a call with Big Ladder.

57. **Question asked via Zoom question pane by Kelley Nicholson:** Auto grow has greenhouse and grow room controllers for dimming lights. Some based on DLI and solar, some just dimming in grow rooms. Please reach out to me as a supplier, happy to help.

- a. Amy Droitcour: Thank you, we will be in touch!

## Wrap-Up

The meeting concluded with a call to action and various methods presented for further participation throughout the code cycle. Several future scheduled meeting dates on various topics were presented. All Draft CASE Reports will be posted beginning December 2025 through March 2026 on [title24stakeholders.com](https://title24stakeholders.com).

We want to hear from you. Please reach out to the specific topic lead or [info@title24stakeholders.com](mailto:info@title24stakeholders.com) with feedback on the measures presented today.

The meeting adjourned at 4:00 PM PST.

## Zoom Polls & Responses

The Poll questions asked by CASE Authors during the meeting along with responses are provided below. Questions were either in a multiple choice or long answer format.

For multiple choice questions, the percentage and number of individuals that chose a particular response is noted in **blue**.

- 1. What is the Lamp Lumen Depreciation (LLD) factor you typically apply in indoor lighting applications? LLD is the reduction in light output over the life of the luminaire (typically around 50,000 hours). Select the closest one:**
  - a. 0.8 - **10% (2/21)**
  - b. 0.85 - **10% (2/21)**
  - c. 0.90 or greater – **19% (4/21)**
  - d. Not applicable to me – **62% (13/21)**
  
- 2. What is the Total Light Loss Factor (LLF) you typically apply in indoor lighting applications that are clean (offices, etc.)? The initial illuminance multiplied by the LLF is the maintained illuminance. Typically, LLF is the product of lamp lumen depreciation, luminaire dirt depreciation, and room surface dirt depreciation. Select the closest one:**

- a. 0.7 - **6% (1/16)**
  - b. 0.8 - **19% (3/16)**
  - c. 0.90 or greater - **6% (1/16)**
  - d. Not applicable to me – **69% (11/16)**
- 3. How frequently are your projects unable to comply using the lighting allowances and you must trade-off with other building components using the performance software approach?**
- a. Never - **6% (1/16)**
  - b. Rarely - **6% (1/16)**
  - c. Sometimes - **19% (3/16)**
  - d. Not applicable to me – **69% (11/16)**
- 4. How frequently must you use the additional power allowances (decorative/display, tunable white etc.) to comply with the lighting budgets?**
- a. Never – **6% (1/17)**
  - b. Sometimes – **24% (4/17)**
  - c. Usually – **6% (1/17)**
  - d. Not applicable to me – **65% (11/17)**
- 5. How frequently must you use the power adjustment factors to comply with the lighting budgets?**
- a. Never – **8% (1/13)**
  - b. Sometimes – **8% (1/13)**
  - c. Usually – **8% (1/13)**
  - d. Not applicable to me – **77% (10/13)**
- 6. For a typical or average lighting project: What is the ratio of installed power to allowed power?**
- a. 80% – 89% - **8% (1/12)**
  - b. 90% – 100% - **25% (3/12)**
  - c. Greater than 100% (i.e., need PAFs or performance trade-offs) - **17% (2/12)**
  - d. Not applicable to me – **50% (6/12)**
- 7. Which type of designs or design features have problems complying with the lighting power allowances? (Long answer question)**
- a. Projects that need to use high-quality lighting that allows RGB colors as well as CCT tunable.
- 8. Which option do you prefer for addressing luminaire wattage labeling in retrofit situations?**
- a. Option 1: Use Lamp Label – use labeled input power of the installed lamp and driver (Aligns with ASHRAE 90.1-2022 proposed language) - **17% (2/12)**
  - b. Option 2: Lamp Manufacturer Label for Luminaire– field-installed, permanent, preprinted label supplied by retrofit manufacturer – **25% (3/12)**
  - c. Option 3: Flexible Approach – allow both Option 1 or Option 2 – **58% (7/12)**

- 9. When and how should compliance with new wattage labeling requirements be verified?**
- a. Both plan check and inspection (documentation + field verification) - **38% (5/13)**
  - b. During inspection only (physical verification after installation) - **31% (4/13)**
  - c. During plan check only (documentation-based review) - **23% (3/13)**
  - d. Other (please specify in Q&A) - **8% (1/13)**
- 10. What percentage of your parking garage projects already automatically reduce light level in the daylight adaptation zone during nighttime?**
- a. 26-50% - **6% (1/17)**
  - b. Not applicable to me – **94% (16/17)**
- 11. Are there any space types currently considered problematic? Are there any additional space types we should consider? (Long answer question)**
- a. I don't see problems but if partial-off is an option then it should not be problematic.
  - b. Laboratory can be problematic when doing testing that is influenced by light levels. Waiting areas that are dark cause people to think stores are closed.
  - c. Hallways
  - d. Lab can be problematic in that there seems to be a difference in use case that would determine the occupied/unoccupied ventilation needs.
  - e. Lobby, main entry could potentially be problematic.
  - f. Corridors and irregularly shaped rooms
- 12. In your experience, how common is CEH lighting with  $\geq 2.5$  PPE today?**
- a. About half (26–50%) - **8% (1/12)**
  - b. Common (51–75%) - **58% (7/12)**
  - c. Somewhat rare (10–25%) - **25% (3/12)**
  - d. Very rare (<10%) - **8% (1/12)**
- 13. What is the biggest barrier to adopting  $\geq 2.5$  PPE light fixtures? Which of the following is the primary challenge preventing your facility—or others you know—from selecting LED fixtures rated at 2.5  $\mu\text{mol/J}$  or higher?**
- a. Already installed LED with less than 2.5  $\mu\text{mol/J}$  - **25% (3/12)**
  - b. Fixture cost – **50% (6/12)**
  - c. Other – **8% (1/12)**
  - d. Spectrum quality concerns – **17% (2/12)**
- 14. What is the typical PPFD (Photosynthetic Photon Flux Density) you maintain in your cannabis flowering rooms?**
- a. 1001–1200  $\mu\text{mol/m}^2/\text{s}$  - **80% (4/5)**
  - b. Above 1200  $\mu\text{mol/m}^2/\text{s}$  - **20% (1/5)**
- 15. What percentage of new greenhouse construction in California ( $\geq 40$  kW horticultural lighting) do you think currently installs daylight-responsive lighting controls (PAR-based sensors or DLI)?**
- a. 10-25% - **32% (6/19)**
  - b. 26-50% - **16% (3/19)**
  - c. 51-75% - **21% (4/19)**
  - d. Less than 10% - **16% (3/19)**
  - e. More than 75% - **5% (1/19)**
  - f. Not sure – **11% (2/19)**

- 16. What percentage of greenhouse alterations in California ( $\geq 40$  kW horticultural lighting) do you think currently install daylight-responsive lighting controls (PAR-based sensors or DLI)?**
- a. 10-25% - **24% (4/17)**
  - b. 26-50% - **24% (4/17)**
  - c. 51-75% - **12% (2/17)**
  - d. Less than 10% - **24% (4/17)**
  - e. Not sure – **18% (3/17)**
- 17. Based on your experience, which best describes standard dimming practice for horticultural LED lighting?**
- a. Lights are dimmed, with low-end dim range ~20% of full output – **8% (1/13)**
  - b. Lights are dimmed, with low-end dim range ~50% of full output – **31% (4/13)**
  - c. Lights are not typically dimmed (on/off only) - **46% (6/13)**
  - d. Other (please specify in Q&A) - **15% (2/13)**
- 18. What if any minimum time delay should be included in the code language to ensure persistent energy savings and avoid nuisance fluctuations?**
- a. 1 minute – **8% (1/13)**
  - b. 10 minutes – **38% (5/13)**
  - c. 5 minutes – **31% (4/13)**
  - d. No minimum delay needed – **23% 3/13**
- 19. In practice, does it make sense to allow a single sensor to serve multiple control zones (40 kW max), even though zones often have different characteristics (e.g., shading, thermal curtains, blackout curtains)?**
- a. Maybe — depends on facility design or crop type – **57% (8/14)**
  - b. No — each zone should have its own sensor – **36% (5/14)**
  - c. Yes — but only if calibration can be configured per zone – **7% (1/14)**
- 20. Would it be useful to base a field verification protocol on existing manufacturer or installer commissioning practices?**
- a. Yes — but we don't have specific protocols to share – **50% (4/8)**
  - b. No — commissioning practices are too variable – **13% (1/8)**
  - c. Maybe — more research is needed before deciding – **13% (1/8)**
  - d. Other (please specify Q&A) - **25% (2/8)**
- 21. What types of dehumidifiers do you commonly see used in high LPD indoor farms? Are there less common products and emerging technologies that you would want to be able to model? (Long answer question)**
- a. "Commonly see standalone VC dehumidifiers. Want to be able to model Liquid Desiccant dehumidifiers as they are being commercialized by several OEMs for this space"
  - b. High efficiency dehumidification system (HEDS) are a potential strategy here
  - c. Compressor based most common
  - d. Quest / Anden standalones and occasionally desiccant wheel
  - e. Solid and liquid desiccant systems
  - f. Quest and Anden DX standalones are most common
  - g. Chilled heat exchanger
  - h. Qwest, Anden are the most popular indoor dehumidifiers for cannabis
  - i. Using hydronic coils. Quest dehumidifiers

- j. Dessicant dehumidifier and indirect evaporative cooling for sensible
- 22. What is the current market share for new construction (including additions)? That is, what percentage of new construction indoor farms in California currently rely primarily on modulating integrated HVAC/D? (5,000—22,000 sq. ft. canopy)**
- a. 1-10% - **50% (4/8)**
  - b. 21-30% - **25% (2/8)**
  - c. 31-40% - **13% (1/8)**
  - d. 71-80% - **13% (1/8)**
- 23. What is the current market share for new construction (including additions)? That is, what percentage of new construction indoor farms in California currently rely primarily on a four-pipe heat recovery chilled water system with series heat recovery? (>22,000 sq. ft. canopy)**
- a. 1-10% - **40% (2/5)**
  - b. 11-20% - **20% (1/5)**
  - c. 31-40% - **20% (1/5)**
  - d. 51-60% - **20% (1/5)**
- 24. What aspects of code impacting CEH facilities require clarification or re-evaluation? (Long answer question)**
- a. Day/Night cycle needs considered
  - b. CO2 and fresh air requirements. CO2 alarms should be able to overcome fresh air requirements
  - c. CEH load calculation