

Agenda



Notes from 2022 Title 24, Part 6 Code Cycle
Utility-Sponsored Stakeholder Meeting for:

Posted October 14, 2019

Covered Processes: Controlled Environmental Horticulture

Meeting Information

Meeting Date: Thursday, September 19, 2019

Meeting Time: 8:30am – 11:30am PST

Meeting Host: California Statewide Utility Codes and Standards Team

Meeting Attendees

First Name	Last Name	Email	Affiliation
<i>Utility Staff</i>			
Kelly	Cunningham	KACV@pge.com	PG&E
Chris	Kuch	Christopher.Kuch@sce.com	SCE
John	Barbour	JBarbour@semprautilities.com	SDG&E
James	Kemper	James.Kemper@ladwp.com	LADWP
<i>Codes and Standards Enhancement (CASE) Team Members</i>			
Alanna	Torres	atorres@energy-solution.com	Energy Solutions
Chris	Uraine	curaine@energy-solution.com	Energy Solutions
Heidi	Werner	hwerner@energy-solution.com	Energy Solutions
Kyle	Booth	kbooth@energy-solution.com	Energy Solutions
Simon	Silverberg	ssilverberg@energy-solution.com	Energy Solutions
Stefaniya	Becking	sbecking@energy-solution.com	Energy Solutions
Marisa	Lee	mlee@energy-solution.com	Energy Solutions
Jon	McHugh	jon@mchughenergy.com	McHugh Energy
Joe	Sullivan	Joe@cultivateeo.com	Cultivate Energy Optimization
Eric	Stern	Eric@cultivateeo.com	Cultivate Energy Optimization
Rahul	Athalye	Rathalye@noresco.com	NORESCO
<i>California Energy Commission</i>			
Christopher	Meyer	Christopher.Meyer@energy.ca.gov	Energy Commission
Larry	Froess	Larry.Froess@energy.ca.gov	Energy Commission
Payam	Bozorgchami	Payam.Bozorgchami@energy.ca.gov	Energy Commission
Peter	Strait	Peter.Strait@energy.ca.gov	Energy Commission

Thao	Chau	Thao.Chau@energy.ca.gov	Energy Commission
Simon	Lee	Simon.Lee@energy.ca.gov	Energy Commission
<i>Other</i>			
Aaron	Gunzner		Air Movement and Control Association (AMCA)
Adrian	Giovenco		InSpire Transpiration Solutions
Adrian	Ownby		Energy Commission
Andre	Patenaude		Emerson Commercial and Residential Solutions
Andrew	Jackson		Signify
Armando	Ramirez		Energy Commission
Armin	Hauer		EBM Papst
Bryan	Jungers		ESource
Buzz	Schaeffer		Hussman
Cheng	Moua		Energy Commission
Courtney	Bonas		Brummitt Energy
Dan	Aronowitz		The Hawthorne Gardening Company
Dan	Novicki		Desert Aire LLC
Daniel	Dettmers		Therma-Stor
Danuta	Drozdowicz		Energy Commission
Derek	Smith		The Resource Innovation Institute (RII)
Eric	Sturm		Trane
Haile	Bucaneg		Energy Commission
Hunter	Bercow		Coolsys Energy Design
Ian	Atkins		Surna Inc.
Ian	Burnside		PG&E
Jeanne	Fricot		Center for Sustainable Energy

Jeff	Boldt		IMEG Corp.
Jeff	Mang		Hogan Lovells
Joe	Loyer		Energy Commission
John	Bade		2050 Partners
Josh	Spalding		Quest
Kelly	Morairty		Energy Commission
Kelly	Seeger		Signify
Kendra	Minkler		Urban-Gro, Inc.
Kenneth	Loshelder		Surna Inc.
Laura	Breit		ColeBreit Engineering
Matthew	Haro		Energy Commission
Max	Struck		MaxLite
Mike	Saunders		Emerson Commercial and Residential Solutions
Nadia	Sabeh		Dr. GreenHouse
Paul	Van Lare		Trane
Pete	Kalambakas		Coolsys Energy Design
Randy	Young		Sheet Metal Workers 104
Sean	Denniston		New Building Institute
Ted	Tiffany		Guttman & Blaevoet
Tom	Paine		Consol
Troy	Rippe		Surna Inc.
Vrushali	Mendon		Resource Refocus
Walter	Stark		Walter Stark Consulting

Meeting Agenda

Time	Topic	Presenter
10 minutes prior to call	Live Attendee Poll	
8:30-8:35	Meeting Guidelines	Rebecca Avilés (Energy Solutions)
8:35-8:40	Opening Remarks from the California Energy Commission	Payam Bozorgchami (Energy Commission)
8:40-8:45	Overview and Welcome	Kelly Cunningham (PG&E)
8:45 - 9:00	Building Codes Introduction	Heidi Werner (Energy Solutions)
9:00-11:20	CASE Presentation: Controlled Environmental Horticulture	Kyle Booth (Energy Solutions), Steffi Becking (Energy Solutions) Joe Sullivan (Cultivate Energy Optimization)
11:20-11:25	Wrap Up and Action Items	
11:25-11:30	Closing	Alanna Torres (Energy Solutions)

Meeting Notes

1.1 Welcome and Meeting Ground Rules

- Rebecca Avilés (Energy Solutions) presented

1.2 Energy Commission Process Overview

- Peter Strait (Energy Commission) presented
- Kelly Cunningham (PG&E) presented
- Heidi Werner (Energy Solutions) presented on the California Energy Code

1.3 CASE Presentation: Controlled Environment Horticulture (CEH)

- Presentation is available [here](#)
- Submeasure summaries are available [here](#)

1.3.1 Measure Overview (Kyle Booth (Statewide CASE Team presented))

1. Rahul Athalye (NORESKO): Are greenhouses currently regulated?
 - a. Ted Tiffany (Guttman & Blaevoet): Conditioned greenhouses are.
2. Jeff Boldt (IMEG Corp): Does evaporative cooling count as being condition controlled?

- a. Thao Chau (Energy Commission): No, since it is not mechanically conditioned.
 - b. Peter Strait (Energy Commission): Note that it may depend on the specific type of evaporative equipment - there are AC units that use evaporative precooling, for example. It is not as simple as "evaporative = not conditioned".
 - c. Ted Tiffany (Guttman Blaevoet): No, it will not trigger the conditioned space requirements if you do not exceed 10Btu/h/sf for heating and 5Btu/h/sf for cooling. See definitions for conditioned space in Section 100.1.
3. Randy Young (Sheet Metal Workers 104): What type of duct work is allowed?
 - a. Ted Tiffany (Guttman Blaevoet): Ducts will be dictated by Title 24 Chapter 4, the California Mechanical Code.
 4. Max Struck (MaxLite): I think a power density requirement can be a slippery slope where the intensity of the crops can vary vastly. This should be focused on the fixture level efficacy.
 5. Sean Denniston (New Building Institute): A photosynthetic photon efficacy (PPE) requirement passed through the committee phase for the 2021-International Energy Conservation Code (IECC).
 6. Jeff Boldt (IMEG Corp.): Are there diminishing returns as photon density rises, or is it linear at all commonly used lighting levels?
 - a. Joe Sullivan (Cultivate Energy Optimization): There are diminishing returns for photosynthetic photon flux density (PPFD) but only after a certain level. Plants can only take in so much light, and once saturated their photosynthetic processes decline. The amount of light plants can use is also connected to their environment (e.g., temperature CO₂), so it is not necessarily black and white.
 - b. Nadia Sabeh (Dr. Greenhouse): It also depends on the type of plant. Some plants, like cannabis, require a very high PPE, but lettuce relatively little.
 7. Sean Denniston (New Building Institute): Cannabis producers in Colorado pushed back against a PPE requirement in Denver based on a "product consistency" argument. They did not want to use one kind of lighting in Denver when they could use different lighting in the rest of the state out of a concern that the different lighting would lead to different product characteristics.
 - a. Kyle Booth (Energy Solutions): How will this impact California?
 - b. Sean Denniston (New Building Institute): Probably less of an issue in California since it is statewide and the market is technically state-based and not interstate.
 8. Rahul Athalye (NORESKO): If there are office or other conventional spaces in the CEH facility, they should be subjected to lighting power density (LPD) requirements. PPE requirements would apply to grow areas.
 - a. Steffi Becking (Energy Solutions): Yes, PPE requirements would apply to grow areas only. Just to clarify: the proposal is to apply LPD and PPE requirements to the plant canopy. Other non-canopy areas in the facility should be subject to LPD requirements only.
 - b. Rahul (NORESKO): Growers probably want to do their own thing when it comes to supplying the amount of light and power, and each plant needs different amounts of light. I am wondering if they do not want limits on LPD.
 9. Walter Stark (Walter Stark Consulting): A sensible heat ratio should be considered.
 10. Thao Chau (Energy Commission): To clarify, the PPE requirements apply to "canopy" correct?
 - a. Joe Sullivan (Cultivate Energy Optimization): Yes, the PPE requirements apply to the plant canopy.

11. Sean Denniston (New Building Institute): An additional concern with LPD is that lumens are weighted toward the yellow part of the spectrum. This is great for human visual purposes. Plants generally do not care about that part of the spectrum, so the LPD would require that the lighting efficiently produce light that the plants do not even use. LPD is really the wrong metric.
12. Ian Burnside (PG&E): Growers will often mix different lighting technologies to get the overall desired spectrum. It would be good to allow a blended PPE of all fixtures in the system to allow growers to meet code PPE and ensure product quality.
 - a. Joe Sullivan (Cultivate Energy Optimization): Yes, a mix of technology would be fine, as long as the entire system meets PPE throughout the canopy.
13. John Bade (2050 Partners): Be careful on circulation fans. They may be preempted by the Department of Energy's ceiling fan regulation. Apparently, the definition of ceiling fans in the regulation covers circulation fans as well.
14. Thao Chau (Energy Commission): Is the LPD for plant canopy a new category added to Table 140.6?
 - a. Steffi Becking (Energy Solutions): The current proposal is not to add LPD for plant canopy in Table 140.6; but have LPD requirements for canopy area in the covered processes section of the California Energy Code.
15. Sean Denniston (New Building Institute): That is the advantage of PPE. It has no impact on light quantity. It is a pure efficiency metric for the equipment: photons out per Joule in.
 - a. Ian Burnside (PG&E): PPE is my preference as well.
 - b. Thao Chau (Energy Commission): I agree.
16. John Bade (2050 Partners): Is air filtration an issue? Do they run all their air through "high MERV" (minimum efficiency reporting value) filters?
 - a. Nadia Sabeh (Dr. Greenhouse): Most growers are focused on eliminating the risk from various mold spores, like powdery mildew and botrytis. MERV 11 and MERV 13 filters are sufficient at removing mold spores. There really is no need to use high efficiency particulate air (HEPA) or other more restrictive particle filters, which just add to the fan power requirements.
17. Laura Breit (ColeBreit Engineering): Carbon dioxide enrichment (almost always utilized) makes airside economizers unreasonable.
 - a. Nadia Sabeh (Dr. Greenhouse): I agree with you. There is also the issue of odor mitigation. If we want to require ventilation and economizers then we need to loosen up the odor mitigation requirements.

1.3.2 Technical Considerations (Joe Sullivan (Statewide CASE Team presented))

18. Nadia Sabeh (Dr. Greenhouse): Are you only looking for operators in California? Or can they be out of state?
 - a. Kyle Booth (Energy Solutions): We are looking at California, and the Bay Area or Sacramento area would be preferable.
19. Ted Tiffany (Guttman Blaevoet): Kyle, I have a handful I will talk to you about offline.
20. Laura Breit (ColeBreit Engineering): We probably know some growers in Oregon that may be interested in allowing you to take energy measurements.
 - a. Kyle Booth (Energy Solutions): Thanks, let us touch base.
21. Adrian Giovenco (Inspire Transpiration): We would be happy to connect you to some facilities.
22. Derek Smith (RII): RII can share aggregate data and can separate California farms from farms in other states.

23. Nadia Sabeh (Dr. Greenhouse): How did you estimate those energy reduction savings?
 - a. Kyle Booth (Energy Solutions): The savings are preliminary and will be refined as we gather more research and perform analysis. We made some baseline and high efficiency assumptions for lighting and percent savings increases for other measures. It was assumed that some of the existing facilities already employ energy efficient technologies, and that was factored into the savings analysis.
24. Daniel Dettmers (Therma-Stor): You can put myself and Josh Spalding on the list to talk to about tours and gathering energy use data.
25. John Bade (2050 Partners): What if a designer creates a built-up dehumidification system that does not fall under AHRI 910 or AHRI 920 (e.g., they use chillers)? Does the language preclude that?
26. Nadia Sabeh (Dr. Greenhouse): Please add to your list of references ASABE/ASHRAE X653 Standard "Heating, Ventilating, and Air Conditioning (HVAC) for Indoor Plant Environments without Sunlight." We are near completion of our first draft which will be sent out for first review and comment by the standard committee this year.
27. Derek Smith (RII): How are you defining LPD? Are you considering it as a "per room" maximum or a weighted average across all cultivation stages? This is a critically important consideration.
 - a. Joe Sullivan (Cultivate Energy Optimization): Right now, it is the average across the entire plant canopy within the building.
28. *Poll: Should there be exemptions for air-sided economizers due to contamination issues with introducing outside air? See Figure 3 at the end of this document for a summary of results*
 - a. Nadia Sabeh (Dr. Greenhouse): The issue with air-side economizers is not necessarily contamination (that is a perceived risk). It is more about containing CO₂ and odors inside the building.
 - i. Ian Burnside (PG&E): I agree.
 - ii. Laura Breit (ColeBreit Engineering): Also, some growers are concerned about cross contamination from nearby facilities.
 - iii. Nadia Sabeh (Dr. Greenhouse): I do think that growers have a valid concern about pesticide drift from nearby farms in rural areas. If pesticides get on the indoor crop, they may not pass lab tests.
 - iv. Adrian Giovenco (Inspire Transpiration): I agree.
 - b. Laura Breit (ColeBreit Engineering): Yes, but the facility should be required to show that they are efficient as economizers. There are other technologies available.
 - i. Ted Tiffany (Guttman Blaevoet): Laura hit the nail on the head, there are currently economizer exceptions if they have higher efficiency units. I would say if a local jurisdiction has restrictions on odor they should have a path to comply with high efficiency options. See current code sections on economizers in the trade off table, Table 140.4-D.
29. Jon McHugh (McHugh Energy): Why are alterations to lighting based on percentage of luminaires instead of based on number of luminaires as parallel to requirements for commercial lighting?
30. Armin Hauer (EBM Papst): If the proposed CEH regulation really targets circulation fans as opposed to ventilating fans, then the test standard is AMCA 230 and not ASHRAE 51 (which is AMCA 210 and takes a chamber or a tunnel and is pretty much the same as ISO 5801).
31. Ian Burnside (PG&E): There are also facilities that do "once through cooling". They do not enrich with CO₂ and save on dehumidification and cooling energy.

32. Armin Hauer (EBM Papst): ANSI/AMCA Standard 230-15 “Laboratory Methods of Testing Air Circulating Fans for Rating and Certification” – the purpose of this standard is to establish uniform methods for laboratory testing of air circulating fans to determine performance (forward or reverse flow) in terms of airflow rate for rating, certification or guarantee purposes. A circulation fan does not develop fan static pressure because it is used without a barrier between its inlet and its outlet. Circulation fans develop velocity pressure and thrust. BESS Lab uses AMCA 230 for circulation fan testing. That measures fan thrust and electric input power. The test report includes airflow (calculated from thrust and air density). Ratings can then be done in terms of cfm-per-watt, and FEI (fan energy index).
33. Randy Young (Sheet Metal Workers 104): Yes, HVAC requirements should be developed, as well as exhaust ventilation requirements should be considered, not just for the odors inside but those that permeate outside as well.
34. Sizing requirements for thresholds to trigger code compliance:
 - a. Steffi Becking (Energy Solutions): The proposal does not have specific numbers, but we are looking forward for feedback to get those numbers.
 - b. Unknown: Align those requirements with the license types of the cannabis industry
35. Armin Hauer (EBM Papst): I propose that the fan metric includes the effect of fan guards (inlet, outlet as needed).
36. Armin Hauer (EBM Papst): The AMCA 230 standard is based on thrust. The ASHRAE 51 standard will not work on that. Do these fans need fan guards? I propose that fan guards not be included in the rating. Not using cubic feet per minute (cfm) per watt method but one where you can specify 1 index for all fans.
 - a. John Bade (2050 Partners): I am not sure if AMCA is the best test.
 - b. Armin Hauer (EBM Papst): I am willing to share analysis.
 - c. John Bade (2050 Partners): I am interested in looking at that data.
37. John Bade (2050 Partners): Yes, definitely include HVAC requirements. In my last job with an HVAC manufacturer I saw specifications for indoor agriculture projects with very poor energy efficiency.
38. Jon McHugh (McHugh Energy): For economizers would CO₂ enrichment be an exception when CO₂ enrichment controls are installed?
39. Walter Stark (Walter Stark Consulting): Like dedicated outside air system (DOAS), choose three conditions to test all systems and establish moisture removal efficiency (MRE).
40. Nadia Sabeh (Dr. Greenhouse): Without CO₂ enrichment, ventilation can be used as the source of CO₂.
41. Jon McHugh (McHugh Energy): For economizers, and not CO₂ enrichment, could the economizer be there but the operator can decide whether to enable depending upon the operation of their neighbors – (i.e., pesticide drift)?
42. Derek Smith (RII): I would encourage you to reach out to the International Cannabis Farmers Association on the minimum size threshold. My sense is you want to align with cottage and other smaller levels in license types.
 - a. Joe Sullivan (Cultivate Energy Optimization): That is a great suggestion. We will follow up with you on that. We are looking at specific square foot conditions for facility types but we want to make sure it applies to call types of crops.
43. Nadia Sabeh (Dr. Greenhouse): The other thing to be careful with on economizers, is that they need to be based on both dry-bulb temperature (DBT) and dew-point temperature (DPT). Remember, we are not just controlling temperature, we are controlling humidity. There are very

few climates where both the outside temperature and moisture content are lower than the grow room environment.

44. Jon McHugh (McHugh Energy): There is still a requirement for ventilation for the health of workers in these environments. What is done for ventilation air?
45. Walter Stark (Walter Stark Consulting): The more efficient DH options have no rating options. We do not want to put these options at a disadvantage.
 - a. Joe Sullivan (Cultivate Energy Optimization): That is a great point. Would you still suggest MRE minimum efficiency requirements?
 - b. Walter Stark (Walter Stark Consulting): Yes, I think MRE is the value to use. We need to establish the conditions used to establish MRE. We can take a shot at this, but I think the growers input would trump any values we could provide.
 - c. Joe Sullivan (Cultivate Energy Optimization): Yes, I think you are right. That is one of our goals we are trying to achieve with our grower surveys and interviews.
46. Eric Sturm (Trane): Section 120.6 (h) 3. Dehumidification - this lists four options for equipment--all of which are indicated to be direct expansion. Does the exception listed on page 4 [of the submeasure summary file] allow other types of cooling systems, including chilled water and air handling units??
 - a. Kyle Booth (Energy Solutions): Other types of cooling systems will be allowed. The dehumidification code language is specific to the dehumidification equipment and will not limit cooling system types.
 - b. Eric Sturm (Trane): Kyle, both dehumidification and cooling can be provided by a single piece of equipment, or several (roof top units and dehumidifiers). Could the language be updated to make it more clear that multiple cooling and dehumidification system types are permissible?
 - c. Kyle Booth (Energy Solutions): Yes, great feedback Eric. We want to be inclusive of the various technology types, so we will investigate clarifying the language around that.
47. Ian Burnside (PG&E): There are some proposed water-cooled light emitting diode (LED) systems that use heat captured from LEDs to reheat from dehumidification.
 - a. Steffi Becking (Energy Solutions): Have you seen these systems used in CEH facilities?
 - b. Ian Burnside (PG&E): This has not been used yet and is only proposed in California. I think the company has used them in Washington. I can share the specification sheet of the equipment if you like.
48. Jon McHugh (McHugh Energy): Is anyone using carbon filters for exhaust air?
 - a. Daniel Dettmers (Therma-Stor): I have seen carbon filters, ozone (not much), photocatalytic oxidizers, and custom blend carbon filters used for both inside and to reduce "smell" that is sent outdoors.
49. Aaron Gunzner (AMCA International): Regarding any proposals or other changes related to fans, I am happy to facilitate follow-up meetings with AMCA Directors.
 - a. Kyle Booth (Energy Solutions): Thanks Aaron, we would certainly like to follow up with you after. I will connect with you offline to set up a meeting about the circulation fan submeasure.
50. Walter Stark (Walter Stark Consulting): Fans are typically oscillating.
51. Jon McHugh (McHugh Energy): What are the reference resources for LPD's by crop type?
 - a. Ted Tiffany (Guttman Blaevoet): Different crop types get very different lighting requirements.

- b. Nadia Sabeh (Dr. Greenhouse): The risk with LPD is that if it is done on square footage basis of a building there is stacked farming to consider. What is the requirement: surface area, square footage, benched area? Still can be done but it is risky. Growers would consider the lit surface area to be what is important but for HVAC the entire area is important. So do you normalize based on lighting area or total area?
- 52. John Bade (2050 Partners): Is the ratio of places with plants a lot bigger than the spaces without?
 - a. Nadia Sabeh (Dr. Greenhouse): on average 80 – 90% of the floor area is occupied by plants. Probably closest to 85%.
 - b. John Bade (2050 Partners): I assume heat from lights and transpiration overwhelm anything the workers are doing?
 - c. Nadia Sabeh (Dr. Greenhouse): Yes, generally there are not that many people in a room. On harvest or transplant days, the people load can be very high, so there can be a spike. These days usually signal the beginning or end of the growing process.
- 53. Nadia Sabeh (Dr. Greenhouse): I would like to join any future discussions on circulation fans. There are a lot of performance metrics I would like to see tested and reported.
- 54. Steffi Becking (Energy Solutions): The LPD requirement is currently for square feet of canopy and the Statewide CASE Team wants to make sure this includes surface area of stacked levels, so it is applicable to both stacked and non-stacked. Trigger for lighting alterations is consistent with commercial triggers.
- 55. Jon McHugh (McHugh Energy): If proposal is strictly based on PPE, then you are not trying to have an average rated LPD. Rather than changing conditions of different life stages of plant are people moving plants around the buildings?
 - a. Nadia Sabeh (Dr. Greenhouse): Yes.
 - b. Jon McHugh (McHugh Energy): Are there different lighting intensities for different stages of life cycle?
 - c. Nadia Sabeh (Dr. Greenhouse): Yes, there should be. Flowering plants may have higher intensity lighting needs compared to cannabis. Some growers do keep the same lighting levels but most change intensity over the life of the plant. So, what is the LPD based on? How does that impact the productivity of crop?
 - d. John Bade (2050 Partners): What if someone decides to grow a different crop in the same area? Do they have to comply with a previous regulation?
- 56. Jon McHugh (McHugh Energy): What percent of facilities are color changing rather than dimming?
 - a. Nadia Sabeh (Dr. Greenhouse): For cannabis, sometimes people use blue light as the plant matures. Most color changing fixtures are LEDs. Overall, this is not very popular.
 - b. Joe Sullivan (Cultivate Energy Optimization): Have you seen actual micro-joule difference per stage of development?
 - c. Nadia Sabeh (Dr. Greenhouse): I have not seen people choosing light based on efficiency. I would not say people are picking a certain efficacy based on stage of crop. Having a higher efficacy lamp may lead to cost differences and potential savings.
 - d. Nadia Sabeh (Dr. Greenhouse): One of the biggest complaints from growers on high pressure sodium lamps is regarding their life span. The operating cost for LEDs therefore may be lower. Are we assuming this is out of the box efficiency?
 - i. Joe Sullivan (Cultivate Energy Optimization): We are considering energy impact and lifecycle.

- e. Jon McHugh (McHugh Energy): I am surprised to see lights do not last as long.
 - i. Joe Sullivan (Cultivate Energy Optimization): Plants are going to react to lighting degradation very quickly.
 - ii. Sean Denniston (New Building Institute): In a growing application, the light lasts until its usable output goes below a certain level. When this went through IECC for the 1.6 standard it was so high pressure sodium (HPS) lamps were included. The only thing keeping HPS in the market is cheapness and convention that people are used to it.
 - iii. Nadia Sabeh (Dr. Greenhouse): Probably the biggest barrier is that people are used to HPS. Growth is the biggest concern to investors and growers. Also remember that HVAC requirements will change because there is less heat from the light source. Plants may transpire less which has benefits and drawbacks such as less energy but slower growing. The change of one factor impacts 10 things downstream.
 - iv. Ted Tiffany (Guttman Blaevoet): Modeling tools do not have that well established.
57. Jon McHugh (McHugh Energy): What is the need for reheat?
- a. Nadia Sabeh (Dr. Greenhouse): It is all about dehumidification. One needs to drop the dewpoint in air to a low enough temperature to remove moisture. After cooling the air to a certain degree, it needs to be re-raised. This is even more critical when the lights are off. One proposal of practices that shouldn't be allowed is using a unit heater in front of an air conditioner.
 - b. Walter Stark (Walter Stark Consulting): One of this biggest factors causing need for reheat is that you have an evaporative cooling machine.
 - i. Nadia Sabeh (Dr. Greenhouse): While facilities are pumping the room with heat from lamps, plants transpire and are cooling the surrounding environment. Typically, this is a latent load, not a sensible load being adjusted.
58. Jon McHugh (McHugh Energy): Would CO₂ enrichment be a concern as well?
- a. Kyle Booth (Energy Solutions): Even though we mentioned contamination is an issue, CO₂ is as well.
 - b. Jon McHugh (McHugh Energy): Is CO₂ enrichment used throughout the plant life?
 - i. Nadia Sabeh (Dr. Greenhouse): It is usually used for most stages of the plant's growth but not usually when they are young.
 - ii. Jon McHugh (McHugh Energy): Are people actually growing basil in places like warehouses in California?
 - 1. Walter Stark (Walter Stark Consulting): I have seen it as certain regulations are pushing people in doors.
 - 2. Nadia Sabeh (Dr. Greenhouse): There are not a lot of non-cannabis crops happening in doors since the climate is good.
 - iii. Jeff Boldt (IMEG Corp): Is there a diurnal cycle?
 - 1. Nadia Sabeh (Dr. Greenhouse): Yes, most plants need that. There is some debate as some growers operate lights 24/7. Every plant needs to accumulate a certain amount of light photons, daily light integral (DLI) per day. Cannabis has the highest requirements. If a plant needs a certain number of light photons in a 24-hour period, then some people

use low intensity. If you think of energy, that is ideal as you get HVAC savings. Growers are wary of that strategy.

59. Ted Tiffany (Guttman Blaevot): We need to address greenhouse language. If you have not fully conditioned greenhouses, they begin to be impacted by glazing limitations in other Title 24 codes.
60. Walter Stark (Walter Stark Consulting): The moisture removal efficiency section does not refer to specific temperature or humidity conditions. Thus, it is a moving target.
 - a. Kyle Booth (Energy Solutions): We listed AHRI standards to mention standards that relate but are not necessarily exactly what we are looking for.
 - b. John Bade (2050 Partners): This will give you a single integrated rated number.
61. Walter Stark (Walter Stark Consulting): I think we are missing the chilled water option.
62. John Bade (2050 Partners): We are missing a number of technology options. A lot of systems do not have standards. They are a lot of good dehumidification technologies out there.
 - a. Joe Sullivan (Cultivate Energy Optimization): Currently, if the MRE of a dehumidification unit meets minimum requirements and is tested in accordance to AHRI910/920 then it would be covered under the proposed code. We are still working on identifying all types of dehumidification equipment for CEH facilities and would like additional input on what we may be missing.
63. Joe Sullivan (Cultivate Energy Optimization): Has anyone seen desiccant units?
 - a. Jeff Boldt (IMEG Corp): I do not but it could be a good use in this context. Potentially, we should consider getting rid of reheat needs.
 - b. Dan Dettmers (Therma-Stor): We offer desiccant. There are primary gas desiccants at the end of a power line or grid. I have not heard of transferring mold. They are somewhat self-cleaning.
 - c. John Bade (2050 Partners): I think it is good to split discussion in liquid and dry desiccant.
64. Nadia Sabeh (Dr. Greenhouse): Nadia is the co-chair of a committee developing standards for HVAC for indoor agriculture without sunlight. They are working with a group of researchers from various universities who are launching a project to study interactive effects of lighting, HVAC, and irrigation on vertical farms production and costs.
 - a. Eric Sturm (Trane): Nadia, can you comment on when we will see a public review draft of the joint ASHRAE/ASABE standard? Will the public review be held through ASABE, ASHRAE, or both?
 - b. Nadia Sabeh (Dr. Greenhouse): We are starting with a committee review. I do not expect to submit for public review until 2020. It will be held through both ASABE and ASHRAE.

Poll Results

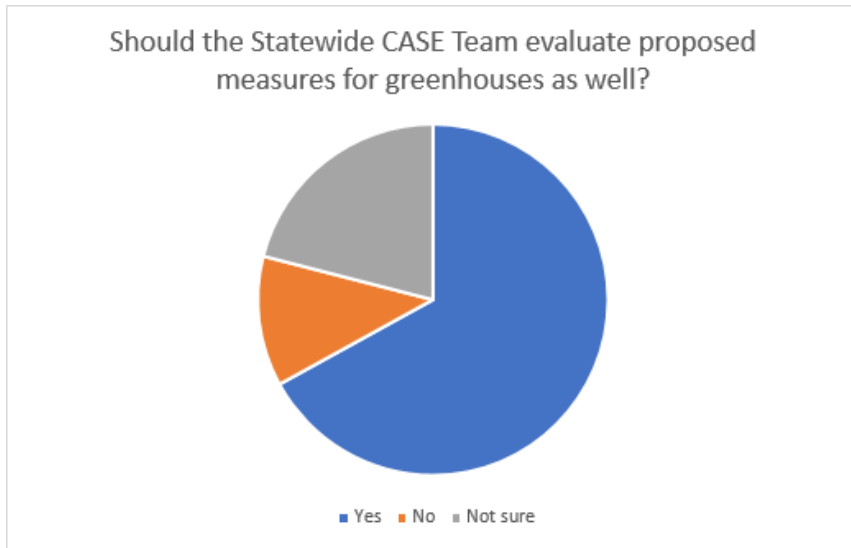


Figure 1: Results of Poll 1, Multiple Choice/Single Answer

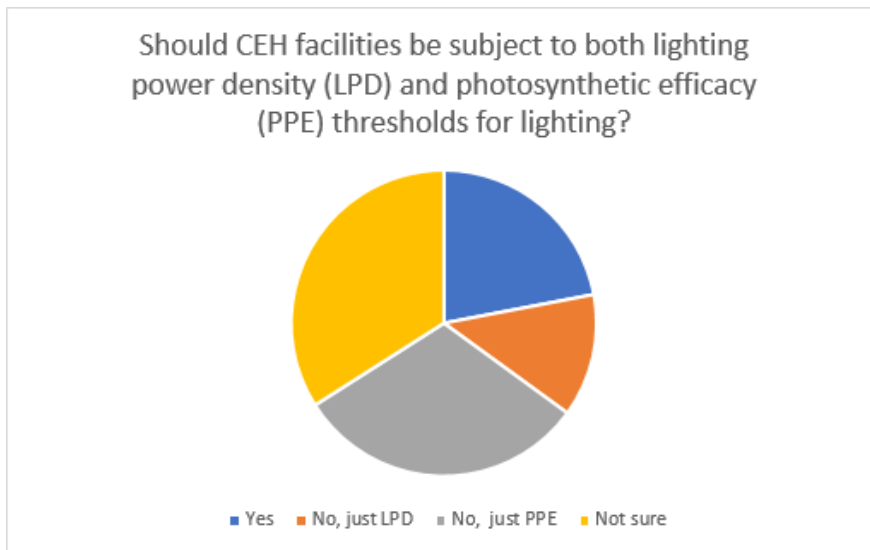


Figure 2: Results of Poll 2, Multiple Choice/Single Answer

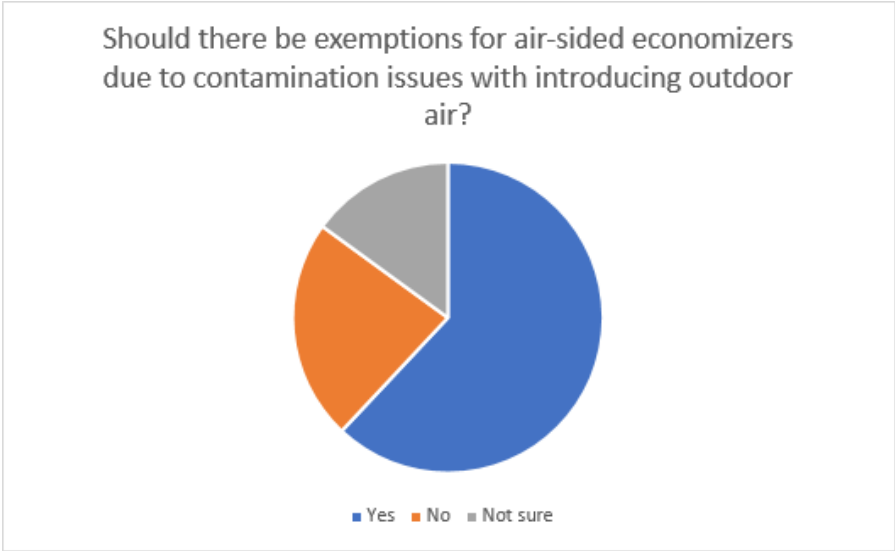


Figure 3: Results of Poll 3, Multiple Choice/Single Answer