STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

May 2018

Log No. _____

Code being amended: ☒ Commercial Provisions ☐ Residential Provisions

Code Section # _C405.3_____

Brief Description:

This proposal increases the efficiency requirement for lighting used for plant growth and maintenance.

Proposed code change text: (Copy the existing text from the Integrated Draft, linked above, and then use underline for new text and ~~strikeout~~ for text to be deleted.)

Add new definition in Chapter 2 as follows:

PHOTOSYNTHETIC PHOTON EFFICACY (PPE). photosynthetic photon flux divided by input electric power in units of micromoles per second per watt, or micromoles per joule as defined by ANSI/ASABE S640.

Modify section as follows:

C405.3 Lighting for plant growth and maintenance. ~~Not less than 95 percent of the~~ All permanently installed luminaires used for plant growth and maintenance shall have a ~~photon efficiency~~ *photosynthetic photon efficacy* of not less than 1.7 μmol/J for *greenhouses* and not less than ~~1.6~~ 1.9 μmol/J for all other indoor growing spaces as defined in accordance with ANSI/ASABE S640.

Exception: Buildings with no more than 40kW of aggregate horticultural lighting load.

Purpose of code change:

Indoor agriculture energy usage is projected to grow substantially nationwide over the next several years, driven in large part (but not entirely) by the legalization of medical and recreational marijuana. A total of 46 million square feet of grow area in the U.S. is lit by electric horticultural lighting, 58% of which was in supplemental greenhouses, 41% in non-stacked indoor farms, and 1% in vertical farms.[1] The majority of luminaires in indoor farms and greenhouses are inefficient high-pressure sodium and metal halide high intensity discharge lamps. Because of the large opportunity for energy savings by requiring more efficient luminaires in these applications, the IECC-2021 has adopted requirements for lighting in these applications.

[1] *Energy Savings Potential of SSL in Agricultural Applications*, U.S. Department of Energy: Office of Energy Efficiency and Renewable Energy, June 2020, www.energy.gov/sites/prod/files/2020/07/f76/ssl-agriculture-jun2020.pdf.

The efficiency metric of µmol/J (micromoles per Joule) in the IECC-2021 was developed in collaboration with the American Society of Agricultural and Biological Engineers and was developed specifically for lighting used for plant growth. It measures the number of photons emitted from the fixture per Joule of energy consumed. Lighting Power Density was developed as a metric to evaluate the light usable for visual tasks relative to the power consumed. Likewise, this metric was developed specifically to measure the light usable for plant growth relative to the power consumed.

Table 2-1 Best-in-Class Photosynthetic Photon Efficacy for Horticultural Lighting Products

Lighting Product Type	Best-in-Class PPE (µ-moles/joule)*	Source(s)
Mogul Base HPS	1.02	Table 3 from Nelson & Bugbee, "Economic analysis of greenhouse lighting: light emitting diodes vs. high intensity discharge fixtures", 2014 [8]
Double-Ended HPS (2014)	1.70	
Ceramic Metal Halide	1.46	
Fluorescent Induction	0.95	
T8 Fluorescent	0.84	
LED (2014)	1.70	
Double-ended HPS (2017)	2.1	Philips Lighting, MASTER GreenPower Plus Specification Sheet [9]
LED (2019)	3.2	Philips Lighting, GreenPower LED Toplighting Specification Sheet [10]
Future LED	> 4	DOE SSL Program, "2017 Suggested Research Topics Supplement: Technology and Market Context", 2017 [11]

Figure 1: U.S. DOE. 2020. Energy Savings Potential of SSL in Agricultural Applications.

The most common luminaires used in unregulated horticultural lighting are single-ended High Pressure Sodium and Metal Halide fixtures which have a typical efficacy of 1.02 µmol/J.[2] A double-ended HPS can meet the existing IECC standard of 1.6 µmol/J. The proposed update to the requirement does not require a technology shift within indoor horticulture as all technologies that met the existing standard can also meet the proposed standard

1.9 µmol/J is the efficacy requirement for cannabis operations in controlled environment horticulture spaces proposed for Title 24-2022 and was set following consultations during 2020 with the industry in California.[3] This efficacy requirement allows the most efficacious double-ended high pressures sodium luminaires and LED luminaires to be installed. 1.9 µmol/J is also the minimum efficacy required to be included in the DesignLights Consortium Qualified Products List (DLC QPL) for this type of lighting. However, at the time of the California Statewide Codes and Standards Enhancement (CASE) report for horticultural lighting, 92% of the products on the DLC QPL had an efficacy of 2.1 µmol/J of higher.[4] In 2019, the state of Illinois adopted 2.2 µmol/J as one of the compliance options for their horticultural lighting requirements.

The luminaire efficacy requirement proposed for greenhouses of 1.7 µmol/J is also consistent with standards proposed for Title 24 2022 and can easily be met by almost all LED luminaires on the market for this purpose as well as many double-ended high pressure sodium luminaires. A lower efficacy requirement for greenhouses was established in Title 24 due to lower operating hours in these

[2] Nelson JA, Bugbee B (2014) *Economic Analysis of Greenhouse Lighting: Light Emitting Diodes vs. High Intensity Discharge Fixtures*. PLoS ONE 9(6): e99010. https://doi.org/10.1371/journal.pone.0099010
[3] *Final CASE Report: Controlled Environment Horticulture*, California Statewide Codes and Standards Enhancement (CASE) Program, March 2021, https://title24stakeholders.com/wp-content/uploads/2021/03/2022-T24-NR-CEH-Final-CASE-Report_w-Addendum.pdf
[4] Ibid.

applications. Buildings that have lighting loads less than 40kW are proposed to be exempt from these requirements to limit additional financial burden on small grow operations.

These requirements are also consistent with an amendment currently being considered for ASHRAE Standard 90.1.

Your amendment must meet one of the following criteria. Select at least one:

- ☐ Addresses a critical life/safety need.
- ☐ The amendment clarifies the intent or application of the code.
- ☒ Addresses a specific state policy or statute. (Note that energy conservation is a state policy)
- ☐ Consistency with state or federal regulations.
- ☐ Addresses a unique character of the state.
- ☐ Corrects errors and omissions.

Check the building types that would be impacted by your code change:

- ☐ Single family/duplex/townhome
- ☐ Multi-family 1 – 3 stories
- ☐ Multi-family 4 + stories
- ☒ Commercial / Retail
- ☐ Institutional
- ☒ Industrial

Your name	Sean Denniston	Email address	sean@newbuildings.org
Your organization	New Buildings Institute	Phone number	503-481-7253

Other contact name Click here to enter text.

Instructions: Send this form as an email attachment, along with any other documentation available, to: sbcc@des.wa.gov. For further information, call the State Building Code Council at 360-407-9278.

Economic Impact Data Sheet

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants and businesses.

The proposal represents a 6.3% improvement for greenhouses and a 18.8% savings for indoor growing applications. Indoor growing facilities can vary in size, but the exception threshold can be used as an example of savings. US DOE estimates[5] that indoor growing facilities use lighting 5,200 to 6,570 hours per year. That results in a savings of 39-51 MWh per year for the smallest system subject to the requirement (40 kW, which corresponds to a 800-1000sf area[6]). DOE also estimates 2,000 hours of runtime in greenhouses, which would result in 5 MWh savings per year for the smallest system subject to the requirements. These will result in substantial operating savings for growers, particularly for operations that also require cooling to offset heat gains from lighting loads.

Provide your best estimate of the construction cost (or cost savings) of your code change proposal? (See OFM Life Cycle Cost **Analysis tool** and **Instructions;** use these **Inputs**. **Webinars on the tool can be found Here and Here**)

$Click here to enter text./square foot (For residential projects, also provide $Click here to enter text./ dwelling unit)

Show calculations here, and list sources for costs/savings, or attach backup data pages

Provide your best estimate of the annual energy savings (or additional energy use) for your code change proposal?

Indoor - 39-64 kWh/ square foot (or) Click here to enter text.KBTU/ square foot

Greenhouse - 5-6.3 kWh/ square foot (or) Click here to enter text.KBTU/ square foot

(For residential projects, also provide Click here to enter text.KWH/KBTU / dwelling unit)

Show calculations here, and list sources for energy savings estimates, or attach backup data pages

40 kW x (5200-6570 hours) x (18.8% savings) / (800-1000 sf)
40 kW x (2000 hours) x (6.3% savings) / (800-1000 sf)

List any code enforcement time for additional plan review or inspections that your proposal will require, in hours per permit application:

There is no additional plan review or site inspection time since code officials will just be checking for a different number.

[5] U.S. DOE. 2020. "Energy Savings Potential of SSL in Agricultural Applications."
[6] *Final CASE Report: Controlled Environment Horticulture*, California Statewide Codes and Standards Enhancement (CASE) Program, March 2021, https://title24stakeholders.com/wp-content/uploads/2021/03/2022-T24-NR-CEH-Final-CASE-Report_w-Addendum.pdf

All questions must be answered to be considered complete. Incomplete proposals will not be accepted.