Southern California Edison Indoor Horticulture

Measure Eligibility and Calculation Methodology Guidance Document

Indoor Horticulture utilizes electric (also known as artificial) lighting systems that have the ability to generate specific and tunable wavelengths to generate plant growth and development.

This document utilizes a **Photosynthetic Photon Flux Density (PPFD) calculation methodology** and provides guidance on measure policy and requirements for indoor horticultural lighting energy savings eligibility. This document is not a guarantee of project acceptance or incentive approval.

Indoor Horticultural Lighting Measure Eligibility Requirements:

The following are eligibility requirements for horticultural lighting products:

- This is a process-only measure where lighting is utilized in the production (growth) of the crop
- Products that are lamps, light engines, or identified as retrofit kits intended to replace the light sources or other structures within an existing fixture are not eligible
- Fixtures that incorporate light sources other than LED, whether as sole-source or as LED-hybrid fixtures, are not eligible
- Incentive applications for LEDs in vertical farming of leafy greens will no longer be eligible for custom projects that submit Project Applications on or after January 1, 2020. As part of SCE's 3rd Low Rigor ISP Study, SCE will further evaluate the definition of vertical farming applications and identify the status of the use of LED grow lights for all farming applications.

Once the Design Lights Consortium (DLC) completes a special-purpose Horticultural Lighting Qualified Product List (QPL):

- Qualifying products must be on the DLC QPL
- A minimum efficacy threshold for Photon efficacy is 1.8 µmol/J

All projects must be developed and run through SCE's Savings by Design engineers (for New Construction projects) or BCD Field Engineering (for Customized projects).

All projects must meet SCE's Project Influence requirements.

- The Energy Efficiency Program Influence Job Aid is located on the Manuals and Guides tab on the SCE Online Application Tool.

All Customized projects and must meet the program's Simple Payback Incentive Cap.

- A project's Effective Useful Life (EUL) must be equal to or greater than its simple payback
- Please review the Calculated Incentives EUL-Simple Payback Tool located on the Forms tab on the SCE Online Application Tool

Calculation Approach:

The baseline and measure horticultural lighting systems shall provide a comparable level of service and the energy use of the baseline solution must be adjusted to provide a comparable service as the EE measures. SCE will use PPFD as a quantitative measurement of light output and a metric to evaluate a level of service and PPFD shall be held constant between the baseline and proposed horticultural lighting systems to calculate the energy savings. This calculation approach aligns with the ISP review report issued on 01.03.19. This report outlines that PPFD and PPF are two metrics that have emerged as industry-accepted measurements of horticulture lighting output.

Documentation & Source Information:

New Construction (NEW) Installation Type:

- Obtain fixture wattages, PPF, and photon efficacy for the proposed baseline unit(s) from a manufacturer's specification sheet or use 1.74 µmol/J (PPF/W)
- Obtain fixture wattages, PPF, and photon efficacy for the proposed unit(s) from a manufacturer's specification sheet or use 1.8 µmol/J (PPF/W)

Normal Replacement (NR) Installation Type:

- Obtain fixture wattages, PPF, and photon efficacy for the existing unit(s) from a manufacturer's specification sheet or use 1.74 µmol/J (PPF/W)
- Obtain fixture wattages, PPF, and photon efficacy for the proposed unit(s) from a manufacturer's specification sheet or use 1.8 µmol/J (PPF/W)

PPFD Calculation Methodology:

Output: PPFD (µmol/s/m^2)

Baseline - ISP:

For vegetative stage: Metal Halide (MH) or High Pressure Sodium (HPS)
For flowering stage: HPS

Hours of Use:

Since this is a process lighting measure, the following methodology is acceptable:

Apply to projects with savings < 250,000 kWh

- Describe Monday thru Sunday operation & any maintenance or seasonal impacts

Apply to projects with savings ≥ 250,000 kWh

- Describe Monday thru Sunday operation & any maintenance or seasonal impacts
- Short Term (7 days) System On/Off Status Measurements

According to the ISP report, the following assumptions are considered normal industry estimates for each stage:

- For the vegetative stage, 16 ~ 22 hours a day
- For the flowering stage, 12 hours a day

Energy Savings

The calculation methodology uses the proposed LED system to determine an equivalent sized baseline system. PPFD is held constant between the baseline and proposed systems.

The following equations are used to establish proposed energy usage calculation and system PPFD:

Equation 1: Proposed Annual kWh = $QTY_{proposed}$ x $FW_{proposed}$ x OPHR
Equation 2: Proposed Demand kW = $QTY_{proposed}$ x $FW_{proposed}$
Equation 3: System $PPFD_{proposed}$ (µmol/m^2/s) = $QTY_{proposed}$ x $PPF_{proposed}$ (µmol/s) / Canopy Growing Area (m^2)
The following equations are used to establish baseline energy usage calculation:

Equation 4: $QTY_{baseline}$ = System $PPFD_{proposed}$ (µmol/m^2/s) x Canopy Growing Area / $PPF_{baseline}$ (µmol/s)
Equation 5: Baseline Annual kWh = $QTY_{baseline}$ x $FW_{baseline}$ x OPHR
Equation 6: Baseline Demand kW = $QTY_{baseline}$ x $FW_{baseline}$

The following equations are used to calculate the energy savings:

Equation 7: **Energy Savings (kWh) = Baseline Annual kWh - Proposed Annual kWh**
Equation 8: **Demand Savings (kW) = Baseline Demand kW - Proposed Demand kW**

Interactive Effects

Photosynthetic Photon Flux Density (PPFD) methodology outlined in the reference attachment is a reliable method and HVAC interactive effects can be calculated using an approved tool such as eQuest or Energy Pro as long as site specific parameters (e.g. HVAC system, building envelope, interactive sensible and latent internal loads, schedule, and climate zone) are used.

Acronyms

- QTY = number of fixtures
- FW (kW) = fixture kW
- OPHR (hours) = annual hours of operation
- PPF (µmol/s) = Photosynthetic Photon Flux (PPF) of fixture
- Canopy Growing Area (m^2) = Canopy Growing Area
- System $PPFD_{proposed}$ (µmol/m^2/s) = System Photosynthetic Photon Flux Density (PPFD), level of output for horticultural lighting system

Next Steps:

1. Review and update (if necessary) the low-rigor ISP study every 6 months and sunset the measure once LED is ISP, with 2 months of transition timeline for projects in pipeline.

Definitions:

Photosynthetic Photon Flux (PPF) is the total amount of photosynthetic active radiation (PAR) that is produced by a light source each second (µmol/s). This metric is an indicator of how efficient a lighting system is at creating PAR, however, it does not relate to how many PAR particles actually land on the plant.

Photosynthetic Photon Flux Density (PPFD) is the total amount of photosynthetic active radiation particles that fall on an area each second (µmol/m^2/s). This measurement is dependent upon the distance of the light source

from the specific area measured. Further, multiple measurements must be made of the specific area in order to accurately determine the amount of PAR particles reaching the area.

Photon efficacy is the measure of how efficient a lighting system is at converting electrical energy to PAR photons. Knowing the PPF of a fixture, along with the input wattage, the efficacy of a horticultural lighting system can be determined. The units for photon efficacy are micromoles per Joule (µmol/J). The higher this ratio, the more efficient the lighting system is at converting electrical energy to photosynthetic active radiation.