



Thank you for the opportunity to comment on the CPUC Horticultural Lighting ISP for cannabis cultivation operations. Resource Innovation Institute (RII) was invited by Southern California Edison and Willdan to review the study and analyzed the purpose, the conclusions drawn from the SBW interviews and web survey, and gathered key RII Technical Advisory Council members with significant engagement in California cannabis markets, efficiency programs, and energy codes. RII is an unbiased authority in this market as a non-profit organization representing diverse interests across CEA market segments like producers, governments, utilities and efficiency programs, certification organizations, and standards bodies. RII has advocated for cannabis grower support systems since 2016. Our responses to the proposed findings are below. We would be delighted to talk further to respond to any further questions.

Please gather more data. RII does not agree with the findings and strongly encourages a continuation of the study to better represent the current market comprehensively and accurately. The study doesn't seem to provide preponderance of evidence necessary to conclude that LED horticultural lighting is ISP for all indoor vertical cannabis farms and ISP for all grow architecture (greenhouse, single tier indoor, and vertical indoor) for propagation and vegetative phases of crop growth. The study's sample size should not be considered to provide a preponderance of evidence due to the limited grower response rate (36 out of 3,635, 1%) and small portion of the market represented by respondents. Respondents were also not an unbiased and random sample of the market (for example, none of the grower respondents had received incentives from efficiency programs). In our experience and that of our Technical Advisory Council members, sometimes ISP technology varies based on the grow architecture for propagation and vegetation phases. We also do not find that LED is conclusively ISP for indoor cannabis vertical farms, though it may have its advantages for that particular grow architecture. Grow architecture and lighting decisions are often 'chicken and egg'. It starts with the growers license permitting a certain sized grow and finding real estate that will accommodate such canopy area. If a grower needs XX,XXX sq ft of canopy, they can achieve that in a number of ways. This study should be revised to reflect that "grow architecture" decisions are fluid.

Due to the effects this determination would have on the state's entire population of cannabis growers, we suggest that the CPUC support the extension of this research to get more study participants and increase sample size so the findings are more representative of the full market. Figures 31 and 32 from RII's 2021 report titled "Cannabis H2O: Water Use & Sustainability in Cultivation" co-authored with New Frontier Data and the Berkeley Cannabis Research Center show that in the United States, the illicit market comprised 73% of cannabis sales volume in 2021. The illicit market supplies the majority of production that serves the California market yet their views were not captured in the study or featured in the ISP findings. To be representative, studies

of the California cannabis market should holistically include regulated and illicit operations of diverse sizes so the comprehensive grid impacts of technology choices are understood by the CPUC and so that efficiency programs implemented in the state of California support growers transitioning from the illicit to regulated cannabis market. Operators of illicit cannabis cultivation facilities are observed to use legacy HID lighting systems more predominantly than LED lighting systems, due to first cost barriers and historical distrust of utilities and programs. While our Technical Advisory Council members concur that LEDs are outselling HIDs in vegetative and propagation among certain segments of producers (e.g., large-scale, multi-state operators) in new construction and retrofit scenarios in "mature" markets like California, smaller operators are more likely to install more affordable fluorescent and HPS technology. Also, smaller regulated operations owned or operated by people of color often lack access to financing for emerging technology like LED horticultural lighting. Declaring LED ISP for cannabis cultivation may severely impact marginalized producers if efficiency program support like financial incentives for LED horticultural lighting are reduced or eliminated.

In conversations with members of RII's Technical Advisory Council, the current climate for efficiency program support for LED horticultural lighting for cannabis operations is already challenging for even seasoned rebate administrators to navigate. One member reports the financial incentive process taking over a year. These guidelines, if accepted as is, could make an already complex incentive process "even worse." This would lead to even less participation at a time we should be encouraging market transformation in the United States' oldest and largest regulated commercial cannabis market. It also would further burden legal cannabis cultivators with no adverse effect on the illicit market who will continue to go with the cheapest legacy technology solution.

We recommend not separating the indoor cultivation category further for separate "grow architecture" categories. California's Department of Cannabis Control does not distinguish further than "indoor". Delineating horticultural lighting by single/multi-tier for indoor does not make sense and only serves to penalize good space utilization (and thus resource utilization) within a facility. An unintended consequence of the findings of this study could be an incentive for growers to choose single-tier or greenhouse production over vertical production to access incentives for efficient horticultural lighting. Single-tier indoor and greenhouse cultivation facilities are less efficient with their use of space and can be less productive than vertical indoor facilities. Since 2017, RII's PowerScore resource benchmarking platform has quantified the efficiency and productivity of for controlled environment agriculture (CEA) crop production facilities. PowerScore represents the largest analysis of aggregate resource usage data on CEA environments. PowerScore is specified by the Massachusetts Cannabis Control Commission for compliance reporting (cannabispowerscore.org/ma) and funded by the USDA to benchmark greenhouse and indoor CEA facilities (resourceinnovation.org/powerscore). PowerScore's Ranked Data Set of cannabis greenhouses produce 115 grams per canopy square foot while indoor cannabis facilities can produce 199 grams per canopy square foot.

We recommend that further study be performed with the supply chain to determine percentage of sales going towards LED by fixture type from retailers. In conversations with members of RII's Technical Advisory Council, lighting distributor and manufacturer members can demonstrate that the proportion of sales going towards LED were not the majority of sales volume in 2021 and are not projected to be in 2022. LED lighting manufacturer members attest that legacy fixtures have the largest installed volume and do not see LED as having achieved enough market penetration to be considered Industry Standard Practice. In the study, only three lighting manufacturers were interviewed and all of them sell LED products, which can create an impression of bias against HPS in the findings.

RII's 2020 research for Commonwealth Edison in Illinois revealed that the entire controlled environment agriculture industry is coming to fully embrace LEDs due to a combination of factors: energy efficiency, productivity, choice, pricing, utility programs, regulations, and transparency. However, **the cannabis industry has unique and specific barriers to adopting LED horticultural lighting that should be quantified so the CPUC understands how these obstacles may be complicated by reduced efficiency program support.**

Regardless of installation trends, it should be emphasized that training and education are critical to realization of lighting system efficiency and energy savings. Smaller operators do not have as much access to capital and may depend more heavily on both access to education about the benefits of LED lighting and also technical support from utilities and efficiency programs.

We want to note that some data sources available on the market do not completely reflect ISP. While the results of the 2021 Cannabis Business Times "State of the Cannabis Lighting Market" corroborate the findings of this study, RII Technical Advisory Council members find issues with survey methodology. Responses to the 2021 survey assume if a grower uses LED in any instance, they are an LED grower for that stage of growth. Because of this assumption, the results cannot accurately convey market penetration. Results of this survey suggest an increased level of adoption of LED lighting but do not offer enough detail to support LED as Industry Standard Practice according to members of RII's Technical Advisory Council.

It is recommended that programs use PPE as companion to equipment baselines alongside fixture type. In RII's 2018-19 work in Massachusetts, 2021 work in Illinois, and recent work with the California CASE team, PPE was recommended as the parameter to use for determining baselines for regulations affecting cannabis cultivation operations.

PPE of LED fixtures can vary widely based on light recipe and fixture construction. Fixtures used for propagation and vegetation could use a lower PPE baseline due to a higher proportion of blue and white diodes. PPE for fixtures used in the flowering stage could use a higher baseline PPE due to a higher proportion of red diodes, which are more energy efficient.

As Title 24, Part 6 requirements for Controlled Environment Horticulture (CEH) are adopted in January 2023, the ISP PPE of horticultural lighting for indoor facilities and greenhouses should be the grow architecture's code minimum PPE requirement. It is worth noting that Title 24, Part

6 does not require specific light fixture types or delineate between single-tier or vertical indoor facilities. PPE minimums for both greenhouses and indoor facilities in Title 24, Part 6 for CEH can be achieved with LED, fluorescent, and HID fixtures.

While the PPE of horticultural LED lighting products available to be purchased in the California market may increase, we still recommend the ISP for cannabis cultivation facilities align with Title 24, Part 6. Efficiency program baseline PPE for indoor operations (single tier and vertical) should match (and be no greater than) the proposed 1.9 $\mu\text{mol/J}$ at the lamp level from Title 24, Part 6 requirements for sole-source horticultural lighting. Baseline PPE for greenhouses should likewise match (and be no greater than) the proposed 1.7 $\mu\text{mol/J}$ minimum PPE for supplemental horticultural lighting from the final CASE report. Both of these efficacy requirements allow for cannabis cultivators to employ double-ended HPS horticultural lighting solutions as these solutions can achieve 1.7 PPE.

The efficiency program baseline PPE should not reflect the minimum from DLC Technical Requirements for Horticultural Lighting. Equipment certification programs recognize performance beyond an efficiency baseline and should not be basis for ISP. Certified equipment is listed for its higher-than-average energy efficiency, and minimum required PPE for DLC listing is likely to be increased in the next version of DLC's Technical Requirements (V3), according to the DLC's representative member of RII's Technical Advisory Council.

This study erroneously noted that "most energy efficiency lighting programs require LED products to be DLC listed." RII Technical Advisory Council members confirm that this is not true for horticultural lighting, as the Horticultural Qualified Products Library (QPL) for Horticultural Lighting was only created in 2018 and until recently many efficiency programs maintained their own list of products eligible for incentives. A vast majority of programs in North America do not yet require it as part of their custom project process. Many other programs say that they would "like to have it" but do not yet. A minority firmly require DLC listing for horticultural lighting products.

When performing further study, the light intensities for cannabis cultivation by stage of growth should be updated. According to RII lighting manufacturer members, 800 PPFD in flower is lower than the industry average, and the same PPFD should not be applied in the vegetative stage as in the flowering stage. When programs are calculating energy savings for horticultural lighting, PPFD should not be kept constant between the baseline and new lighting, as it does not represent the required level of new service. Though this approach was accurate three years ago, the industry now has a collective understanding that a 1% increase in light translates to a 1% increase in yield. Increasing PPFD can often be a catalyst for a lighting retrofit project.

In summary, RII is concerned that the study does not provide a preponderance of evidence for ISP, and recommends additional study to best capture the reality of the market. We extend an invitation to the CPUC to coordinate RII members to participate in the respondents to future studies for an expanded sample group and improved response rate.

About Resource Innovation Institute

Resource Innovation Institute (RII) is an objective, data-driven non-profit organization whose mission is to accelerate resource efficiency among controlled environment agriculture producers. RII's funders include the US Dept. of Agriculture. RII's partners include ACEEE. RII's members include utilities, governments, technology manufacturers, producers and other market actors who join together on RII's Technical Advisory Council to advance peer-reviewed efficiency best practices. RII's PowerScore benchmarking platform represents the largest cannabis energy usage dataset in the world. In 2021 and 2022, RII has and will continue to train California cultivation operators and project partners on best practices, with funding and partnership by San Diego Gas & Electric, the Tri-County Regional Energy Network (3C-REN), and Southern California Edison. Among other contributors, the California Energy Commission has served as a member of RII's Emissions Working Group and Policy Working Group. Among other resources, RII has published a *Cannabis Energy & Environment Policy Primer* and a *Program Design & Market Engagement Primer for Energy Efficiency Utilities and Program Implementers Serving Cannabis Cultivators*.