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Energy Impacts of Cannabis Cultivation
Workshop Report

I. Executive Summary

Cannabis is an energy-intensive crop when grown indoors. According to a 2012 study, conducted when medical cannabis was legal in California but recreational cannabis was still prohibited, indoor cannabis cultivation is responsible for about 3% of California’s electricity consumption, which is equivalent to the electricity consumption of one million California homes.¹

On November 9, 2016, California voters approved Proposition 64, which legalized the recreational use of cannabis by adults. Other states have experienced an increase in electricity demand after legalizing recreational cannabis; for example, half of load growth in Colorado is now attributable to new cannabis cultivation.² Given the electricity use attributable to cannabis cultivation, an increase in cannabis cultivation associated with recreational legalization may be a significant driver of electricity consumption in California.

On February 28, 2017, the California Public Utilities Commission (Commission) held a workshop designed to explore opportunities for ensuring that any load growth associated with cannabis cultivation in California is consistent with California’s clean energy goals. During the workshop, panelists from utility companies, cannabis growers and industry groups, regulators, and energy efficiency and standards-setting organizations discussed the cannabis-related energy impacts in states that have already legalized recreational cannabis, and the challenges and opportunities for making cannabis cultivation in California more energy efficient.

Key takeaways from the workshop include:

- States that have legalized recreational cannabis have not necessarily seen an increase in energy consumption attributable to cannabis cultivation;
- With respect to indoor cannabis cultivation, state building and/or energy codes sometimes result in cultivation operations that are less energy efficient than they could be, without any concomitant gains in safety;


What is energy efficient for one industry may not be energy efficient for another industry. For indoor cannabis cultivation, for example, insulation requirements may increase cooling needs, and HVAC economizers may increase the need for dehumidification and air filtration;

Indoor cultivation is generally accepted as the most energy intensive cultivation method, but is also potentially the most water-efficient method;

California’s cannabis exports exceed in-state consumption by a factor as high as four-to-one. The looming market uncertainty from a reversal in federal policy on prosecution may result in a market demand reduction and negatively impact in-state production as export falls; and

The cannabis industry has not benefitted from publicly funded agricultural research on how to best optimize production across a variety of cultivation methods, unlike other valuable agricultural commodities in the state.

Staff concludes that the available data are not sufficiently robust to support specific policy recommendations. However, staff recommends engagement with the cannabis industry, California regulators, utility companies, local jurisdictions, and other stakeholders to explore options for ensuring that California cannabis cultivation is energy efficient. Staff are assembling a Cannabis Working Group to consider policy responses, up to and including the possibility of a specific energy tariff for cannabis cultivation.

The workshop is summarized in additional detail below.

II. Introductory Remarks

Michael Picker, President, California Public Utilities Commission

This workshop is part of the Commission’s ongoing effort to understand new developments and consider changes as the world changes around us.

The fast growth in the cannabis industry presents a challenge and an opportunity to ensure that the choices made by the cannabis industry reflect California’s climate goals. Commission staff convened this workshop in order to help understand what steps the Commission should take in order to ensure that California cannabis is the greenest in the nation. Specific questions include:

Should the Commission institute a distinct set of higher energy rates for cannabis cultivation?
How can the Commission ensure the most effective use of energy efficiency in the cannabis industry, and avoid over-procurement?

How can the Commission help cities and counties where cannabis is grown meet their sustainability and clean energy goals?

III. Panel One: Energy Impacts in Other States after Recreational Legalization

Voters in Washington and Colorado legalized recreational cannabis in 2012, and Oregon voters legalized recreational cannabis in 2014. Stakeholders discussed the experience in their respective states concerning the increase in cannabis cultivation, the increase in electricity consumption associated with cannabis cultivation, and energy efficiency measures that have been proposed and adopted.

John C. Morris, Vice President for Market Development at D+R International, and Co-Founder and Board Secretary of the Resource Innovation Institute, spoke about the benefits of stakeholder cooperation and ongoing challenges concerning access to data in Oregon; Alex Cooley, Co-Founder of Solstice, and National Cannabis Industry Board Member, offered his perspective as a cannabis cultivator in Washington; David Montgomery, Consulting Energy Management Engineer at Puget Sound Energy, provided a utility perspective on the challenges and opportunities for making cannabis cultivation in Washington more energy efficient; Jacob Policzer, President of the Cannabis Conservancy in Colorado, discussed recent trends in energy consumption and cannabis cultivation in Colorado, as well as his experience with cannabis cultivation sustainability certification and standards development; and Adam D. White, P.E., Team Lead Energy Efficiency Engineer at Xcel Energy, provided a utility perspective concerning energy consumption and adoption of energy efficiency measures by cannabis cultivators in Colorado.

During the panel discussion, certain major themes emerged: limitations on available data concerning energy consumption; stakeholder cooperation; challenges concerning access to information; and existing energy efficiency measures. The Panel One discussion is summarized by major theme, below, and the audience Q&A is presented separately.

**Hard Data on Energy Usage Associated with Cannabis Cultivation**

According to John Morris, there are 449 permitted recreational cultivators in Oregon; the Oregon Liquor Control Commission does not distinguish between indoor and outdoor cultivation facilities when reporting the number of permitted facilities. In addition, there are no studies concerning energy consumption associated with cannabis cultivation in Oregon. The lack of baseline data reflecting energy consumption for indoor cannabis cultivation represents a
significant challenge to efforts to make the cannabis industry more energy efficient; as a consequence, California recreational cannabis licensing authorities should require energy and water forecasting and reporting by cannabis cultivators.

Alex Cooley reports that it is difficult to find data concerning cannabis cultivators’ energy usage in Washington. State agencies have some information, but cultivators and associations have had limited success getting data from state agencies. Agencies such as the Commission might have an easier time getting information from sister state agencies.

In Washington, of the entire licensed cannabis cultivation canopy, 60% is indoor, less than 10% is greenhouse, and the balance is outdoor cultivation. According to the latest public data, indoor cultivators operating year-round were consuming about 150 W/sq. ft. of active canopy, greenhouses operating 30%-50% of the year were consuming about 60 W/sq. ft. of active canopy, and greenhouses operating 15% of the year were consuming <5 W/sq. ft. of active canopy. Cooley believes it is fair to assume that California will see similar percentages of indoor, outdoor, and greenhouse cultivation. The largest cannabis cultivation operation Cooley ever toured was an outdoor cultivation in California.

According to David Montgomery, Washington’s Puget Sound Energy (PSE) is not tracking whether cannabis cultivation is affecting load growth, or how many cannabis cultivators there are. In addition, PSE has not seen a spike in demand attributable to recreational legalization. New cultivators have been coming on steadily and slowly for two years, starting small at 10,000 square feet of canopy and then expanding. PSE’s service territory is cool and cloudy, and most cultivation is indoors.

Jacob Policzer notes that quality data concerning the energy consumption associated with cannabis cultivation in Colorado are scarce. According to Xcel Energy, between 2012 and 2013, Denver’s electrical consumption increased by 1.2%, 50% of which is attributed to new cannabis cultivation. 2% of Denver’s electric consumption is due to cannabis cultivation. The majority of cultivation operations in Colorado are indoor, largely a function of local rules, and 60% of Colorado’s cannabis cultivation takes place in Denver.

In 2016, Colorado’s recreational cannabis market saw a large increase in demand for edibles, currently 75% of the recreational market. In addition, 57% of caregivers requested an increase in the number of cannabis plants permitted for residential cultivation. Per the Cannabis Conservancy’s research, daily/near daily users are those most likely to engage in home cultivation. In California, that amounts to about 265,000 individuals.

Xcel Energy’s Adam White has seen a wide range in the size and capacity of cannabis cultivation in Colorado, ranging in size from the square footage of a big box retailer, to as small as a conference room.
A large percentage of total service requests made by cannabis cultivators in Xcel’s territory have not come to fruition, and there is no clear explanation why. Many cultivators moved into one area of Denver, necessitating a new feeder in 2015, although some cultivators have succeeded in rotating their operations on 12 hour cycles. Of the requests that have been completed, cultivators tend to over-estimate their capacity needs. Among cannabis cultivators, Xcel has seen power load estimates of 200 W/sq. ft., and the actual is closer to 35 W/sq. ft. 68 W/sq. ft. is about the highest density of lighting they see, and that is for flower areas. Flower areas require more lighting than other cultivation areas, such as the veg and clone areas, so the average is 35 W/sq. ft.

**Stakeholder Cooperation**

John Morris reports that there are many organizations and agencies in Oregon that are actively pursuing efforts to increase the energy efficiency of the cannabis industry, including, e.g.:

- The Energy Trust of Oregon, which offers information and incentives for residential and commercial customers, including agriculture, and is actively recruiting cannabis cultivators;
- The Northwest Energy Efficiency Alliance, which tracks the cannabis sector but has no specific offerings to its members yet;
- The Northwest Power and Conservation Council, whose Seventh Power Plan accounts for the growth in indoor agriculture, and which conducts an annual cultivator survey to try to understand cultivators’ energy usage;
- Oregon DOE, which developed a lighting calculator to help cultivators forecast their electricity needs;
- Oregon Liquor and Control Board, the cannabis licensing authority, which requires cultivators to forecast their energy and water needs and file annual usage reports;
- The HB 3400 Task Force, convened to examine at environmental best practices for cannabis cultivators. Among its other recommendations, it supports a voluntary market based certification standard; and
- The Resource Innovation Institute, which endeavors to establish best practices for energy and water use in cannabis facilities, using an open source data-sharing approach and collaboration with cultivators, builders, agencies, and other stakeholders.

In contrast, the Bonneville Power Administration provides power to a number of utility companies in the Pacific Northwest, but, as a federal agency, will not provide incentives for cannabis cultivators because federal law prohibits the cultivation and consumption of cannabis.
Jacob Policzer has observed a limited amount of interagency cooperation in Colorado. The Denver Department of Environmental Health has a working group developing best practices for indoor cultivation; the Colorado Energy Office has sponsored a cannabis industry energy use report, the results of which are not yet public.

**Challenges and Opportunities Regarding Access to Information**

John Morris reports that Oregon cultivators are not familiar with utility hook up process, and may underestimate their energy and water needs in order to start growing as quickly and inexpensively as possible, or may overestimate their needs because they contemplate becoming the “Budweiser of cannabis.” Morris recommends that California utilities need to take a consistent approach to California cultivators, and both the energy efficiency and new connects departments need to coordinate their outreach to cultivators.

Alex Cooley states that the majority of cultivators in Washington care about energy efficiency, but their behaviors are inconsistent with environmental stewardship. Why? Because there is a steep learning curve for cultivators, and many cultivators are not aware that there are gaps in their knowledge, much less where to go for information. For example, cultivators might not be aware that they need to develop a working knowledge of Energy Code, or how to do so. In response, and in order to address the information deficit and help cultivators operate in a more energy efficient manner, it is crucial that utilities and other stakeholders meet the cultivators where they are. Hand out quick briefings on what cultivators need to know (e.g., permitting, code compliance) wherever the cultivators happen to be. Don’t just make information available; physically hand the information to the cultivators, emphasizing that this is something they need to know.

**Energy Efficiency Measures**

Alex Cooley observed that some energy efficiency measures are inappropriate for cannabis cultivators. One practical example air conditioning economizers, which reduce air conditioning load by drawing in cool outside air. Some cultivators weld the vents shut because they do not want the humidity and potential contaminants such as mold associated with outside air, although this decreases the energy efficiency of the air conditioning system. Cooley argues that rebates are key in order to encourage cultivators to adopt efficiency measures. Encourage rebates per fixture, and encourage solar providers to offer incentives and flexible payment plans to cannabis cultivators.

David Montgomery notes that there is tremendous variability in the design of cannabis cultivation operations in Washington, anything from a few lights in a barn to cultivation approaching clean room environments. PSE has done over 70 energy efficiency projects for cannabis cultivators so far, all focused on lighting. PSE does not have a special energy
efficiency program for cannabis; everything fits into PSE’s existing lighting/custom retrofit/new construction programs.

Most of PSE’s energy efficiency projects for cannabis cultivation are new construction rather than retrofits, as it is much more cost effective to install efficient lighting in the design phase rather than as a retrofit. PSE is still, however, struggling to understand what a baseline cannabis cultivation operation looks like from an HVAC standpoint. PSE asks cultivators for a baseline low cost design compliant with code, as well as a more efficient design; cultivators don’t have the money for more efficient designs up front, so all PSE’s incentives have been paid in lighting.

In the past 2+ years, PSE has completed about 70 energy efficiency projects with cannabis cultivators, which have saved between 35 and 40 million kWh, just from energy efficient lighting. When a cultivator installs more energy efficient lighting, the cultivator reduces the need for cooling and dehumidification. Despite the number of projects PSE has completed for the cannabis industry, Montgomery still meets cultivators who say they had no idea PSE could offer incentives.

Montgomery adds that cultivators have been reluctant to adopt LED lighting (especially in the flowering cycle) based on their experience with LEDs that were on the market ten years ago, but there have been advancements in LED technology. Cultivators report that they do lose some productivity with newer LEDs, but get higher THC concentrations in the finished crop.

Jacob Policzer points out that, in cannabis cultivation, upgrading to more energy efficient LEDs is not simply a case of swapping bulbs. The different bulbs require a different style of cultivation, which requires cultivator education and buy-in. Some Colorado cultivators are staggering grow rooms and trying to shift their usage to off peak hours, but these cultivators then experience labor issues, as it is more difficult to find labor at off peak hours.

Boulder County created an Energy Impact Offset Fund for cannabis cultivation, and assesses two cents per kWh. The fund pays for meter installation and analysis, and has the goal of ultimately supporting offset schemes. However, due to the lack of production data, it is not possible to evaluate how efficient these cultivation operations are.

Adam White reports that, in Colorado, upfront cost has been the main consideration of Xcel Energy’s cultivator customers. These customers want to begin growing as quickly as possible and want a two or three year payback on investments in energy efficiency measures, so energy efficiency rebates have been critical.

Concerning industry trends, LED manufacturers are meeting cultivator preferences with respect to wavelength of delivered lighting. In the past year, several Colorado cultivators have switched to LED even in the flowering cycle, because LED manufacturers are changing the wavelength provided during the flower cycle in response to customer demand. In addition,
some cannabis cultivators are going vertical: imagine a big box store style with stacked pallets, and “green walls” that can be moved back and forth with grow lights projected horizontally.

**Panel One Q&A**

**Question**: Does variation in cultivator size complicate the ability to provide them with the necessary information?

**Cooley**: Play to the lowest common denominator, and “help outlaws become compliant with building code.” Well capitalized cultivators have an easier time securing professionals to assist them with information and design, but people who started growing cannabis in their closets need information too. One way is via attention-getting fact sheets; simple, fun, engaging, one page per topic or a bound booklet, and physically hand the documents to the cultivators when they go to a government office or to a hydro shop.

**Policzer**: in California, many cultivator groups and collectives have formed, making it easier to meet them where they are. It is tougher to reach smaller cultivators, although cultivators are eager for the info. Go to cultivator groups and share information.

**Question**: Farmers still use pen and paper to collect data. What about metering and submetering for reliable data collection?

**Montgomery**: Very few cultivators have the money up front, making it difficult to get a baseline understanding. Some new cultivators are teachers growing in a shed behind their house, with no business plan.

**Policzer**: The Cannabis Conservancy requires metering and monitoring for their certification, energy and water audits are the first step. Because warehouses can vary widely in structure, many different types of meters are necessary. Getting cultivators to adopt monitoring can be challenging; they try not to make cultivators spend more than 15 minutes per day on energy data analysis.

**Question**: SMUD has experienced challenges getting the word out to cannabis cultivators about their incentive programs. Will that trend change?

**Cooley**: Cultivators have been breaking federal law. Be accommodating and understanding; the cultivators you are trying to reach have probably watched friends go to federal prison. Go to cultivator groups and ask for 5 minutes to speak about your programs. Go to the hydro store and to supply stores and say you want to offer incentives to their customers. Cultivators will be willing to talk about incentives if you meet them where they are.
**Morris:** Superbly well capitalized and sophisticated cultivators still don’t understand how utility programs work. Work through efficiency programs AND hookup programs.

**Montgomery:** Establish relationships via information sharing. Once a couple of cultivators and lighting contractors get on board, they will all want to participate.

**Policzer:** The cannabis industry is legitimate and legal on paper, but still often not treated with respect as business owners. Approach your efficiency programs as a partnership and word will get around.

**Question:** Please clarify what you mean when you say your customers are growing.

**White:** Business acumen is improving, facilities are getting larger, projects are getting larger.

**Policzer:** In Colorado, licenses are being consolidated by a handful of companies. Cultivation operations are getting bigger, with economies of scale and uniformity. In Colorado, there used to be a deadline by which cultivators had to have product on the shelves after licensing, so cultivators were in a rush, although this pressure is easing.

**Question:** Are cannabis cultivation operations candidates for real time or time of use pricing? We found that cultivators had zero interest in this, they wanted to be in charge of when the lights are on.

**Cooley:** There is some interest, because the industry is maturing and normalizing. It will take time. Without measurement, cultivators don’t see how significant the changes can be. Also, cultivators went from two month returns to two year returns, and the market price for cannabis is falling, increasing the interest in obtaining cost savings through energy efficiency.

**Morris:** In Washington, a small muni has a time of use rate for cannabis cultivators. They worked with their cultivators to help them understand the time of use rate, but there are no results available yet.

**Question:** Does hesitancy from federally chartered banks have any impact on program design or incentives?

**White:** Cannabis is legal in Colorado, we have a duty to serve our customers.

**Cooley:** Echo that with respect to Seattle utilities. The Seattle utility program is an indoor agriculture program, not a cannabis-specific program. The cannabis industry is seeing statements from federal agencies and programs, but not seeing engagement or enforcement per se.
Montgomery: Some public utilities have a problem because they get money from Bonneville Power Administration, so they create separate funds. This has not been a problem for PSE.

Question: Are there any building efficiency measures that work well in a general sense but pose a unique challenge for cannabis cultivators?

Cooley: Economizers pose a unique issue because indoor cultivators operate on a closed system, and economizers draw in outside air. In Washington’s rainy climate, drawing in damp air created dehumidification problems and so the economizer ended up not saving any energy overall. Helping people with water side economizers, on the other hand, is helpful. Washington state challenges include building code occupancy standards; some municipalities say all cannabis greenhouses are F1 (factory) when under the building code they should be classified as U (miscellaneous, including agricultural). Solstice has appealed this classification to Washington State Building Council. F1 classification requires, e.g., sprinklers and 3 hour firewalls, but “the plants aren’t flammable until after we dry them.” Look at occupancy load and hazard load.

Question: California building code operates on a 3 year cyclical update. What is the best way to encourage participation by cultivators?

Cooley: Engage them where they are. The only way code improves is with involvement, get engineers and cultivators involved the process of updating the code.

Morris: A Portland medical cultivator was trying to comply with city building code, but the insulation requirements in the walls ended up increasing the cultivator’s cooling needs. Sometimes when you think you’re getting efficiency, you aren’t.

White: Colorado is considering new lighting fixture baselines as part of its Energy Code; but the industry is already making these changes, and may get there before the Energy Code is updated.

Montgomery: Treat lighting like it is part of the growing process, not just as space lighting.

Policzer: Sometimes it is more energy efficient to design a system in a manner other than what the building code requires, and cultivators are seeking exemptions. When updating code, put proposals out there and seek input from cultivators.

Question: What incentive programs have worked to get cultivators to do the right thing?

White: The incentive for agriculture is part of the lighting program. Xcel tried a kWh per pound production efficiency approach, but it became too difficult and expensive to run because of too many variables -- strains, nutrients, water, and people -- to control. The
new incentive program is based on equivalent photosynthetic photon flux density, plant-food-light at the canopy. Micromoles per joule as a measurement does not work because it does not allow for the directional nature of light fixtures, and some lights are better at pointing light at the canopy. Xcel uses quantum sensors to measure light at the canopy, and that’s how they quantify the basis for the incentives they offer. Cultivators have not proven interested in hearing about HVAC incentives, because the payback period is too long.

**Montgomery:** We push new construction approach before they start installing less efficient lighting, using what they want to install as a baseline. 20 cents per annual kWh saved in new construction lighting is the incentive offered; PSE has not had any cultivator take non-lighting incentives, currently offered at 30 cents per annual kWh saved.

**Cooley:** Solstice took advantage of a mechanical watts-in, watts-out incentive, but very few cultivators do because it is very expensive and has a ten year return on investment. Consider rebates by fixture, not by kWh saved, because there can be less energy savings realized in different parts of a grow, i.e., flowering and veg and transitioning spaces.

**Question:** What tools do we need to give you to encourage compliance, participation in reporting, energy efficiency measures, and changes to rules and standards?

**Cooley:** If I’m bound by law I’m going to comply, but it would be even easier if someone could do it for me. Be cooperative, collaborative, and do the work for the cultivators by automating as much as possible.

**Morris:** Many cultivators are not willing to share energy data, they regard energy usage as part of their proprietary technique. Market transformation is rooted in education and outreach, every cultivator is different in their willingness and ability to engage.

**Policzer:** Not an easy process in Boulder, had to learn how to approach cultivators via stakeholder engagement. We have experts on our sustainability committee in Denver.

**Key Takeaways from Panel One Presentations and Q&A**

States that have legalized recreational cannabis have not necessarily seen an increase in energy consumption attributable to cannabis cultivation.

With respect to indoor cannabis cultivation, state building and/or energy codes sometimes result in cultivation operations that are less energy efficient than they could be, without any concomitant gains in safety.
What is energy efficient for one industry may not be energy efficient for another industry. For indoor cannabis cultivation, for example, insulation requirements may increase cooling needs, and HVAC economizers may increase the need for dehumidification and air filtration.

Market participants and third party organizations are already reducing the energy footprint of cannabis cultivation without government mandate. For example, in Colorado, utilities and cultivators have already adopted more efficient lighting technologies that are only currently being considered for inclusion in the Energy Code.

Information on the energy consumption associated with cannabis cultivation is scarce. The dearth of information creates difficulties for: cultivators trying to anticipate their energy needs and understand the benefits of conservation; utilities trying to plan for infrastructure and energy procurement needs associated with new cannabis cultivation; cities and towns trying to meet their sustainability and clean energy goals while accommodating cannabis cultivation; and regulators trying to ensure compliance with statewide climate goals.

To date, cannabis cultivators have been significantly more receptive to lighting efficiency incentives than HVAC efficiency incentives due to upfront cost and length of payback period.

For cannabis cultivation, adopting more efficient lighting such as LEDs necessitates a change in cultivation techniques, and therefore will require education and buy-in.

The wide variety in the size of cannabis cultivation operations and the sophistication of the cultivators will create challenges for education and outreach concerning energy efficiency measures, and for cultivator engagement with mandatory reporting and other forms of data sharing.

**IV. Panel Two: Cannabis Cultivation in California, Challenges and Opportunities**

California cannabis stakeholders have been working toward a statewide regulatory framework for many years. Since the passage of Proposition 215 in 1996, which legalized medical cannabis use, in-state cannabis stakeholders have worked toward the passage of the Medical Cannabis Regulation and Safety Act of 2014, and the Adult Use of Marijuana Act of 2016 (Proposition 64). Representatives of key stakeholder groups discussed their experience, insights, and tasks underway to meet new legislative requirements.

California panelists included Hezekiah Allen, the Executive Director for the California Cultivators Association; Kristin Nevedal, Program Director for Americans for Safe Access and Board Member of the California Cannabis Industry Association; Nick Caston of CannaCraft, a cannabis product manufacturer and distribution company; Amber Morris, Branch Chief of CalCannabis Cultivation Licensing at the California Department of Food and Agriculture; Cody
Coeckelenbergh, Director of Program Services at Lincus Energy, an energy efficiency service provider; and Jesse Emge, Supervisor of Evaluation, Measurement, and Verification at San Diego Gas and Electric.

The Q&A session of the second panel benefitted from participation from various individual cultivators, engineering consulting firms, representatives of key organizations such as Sacramento Municipal Utility District, Pacific Gas & Electric, California Energy Commission, energy policy professionals from the energy efficiency and renewable energy industry.

Panelists spoke to key California-specific attributes that set the state apart from Washington, Oregon, and Colorado. Because Panel Two was limited to an examination of the California experience, a number of major themes emerged during the panel discussion, and therefore the synopsis is presented by theme rather than by individual panelist.

**California Market Trends**

Cannabis is currently grown across California at varying levels of energy use for both in-state consumption and export, constituting a multi-billion market. Hezekiah Allen estimates California’s cannabis exports exceed in-state consumption by a factor as high as four-to-one. The looming market uncertainty from a reversal in federal policy on prosecution may result in a market demand reduction and negatively impact in-state production as export falls.

Kristin Nevedal and Hezekiah Allen both pointed out that from a horticultural perspective, cannabis can be grown in a variety of settings in California, ranging from open field, to greenhouses, to a completely indoor setting using a number of different irrigation methods (e.g., dry farming, drip irrigation, flood irrigation, and hydroponics). The combinations of different cultivation methods using varying lighting and irrigation techniques are numerous. When asked whether cultivators across the state have a preference for a particular style of cultivation, Hezekiah Allen responded by observing that whatever method of cultivation is currently preferred by an existing cultivator may likely be that cultivator’s preference in the future, but added the caveat that California’s higher electricity rates will pose a constraint on the expansion of indoor cultivation.

Kristin Nevedal pointed out that decades of prohibition have reinforced the adoption of indoor cultivation methods, where cultivators are forced to hide their cultivation, even when California’s natural climate is conducive for open field cultivation. Members of the audience highlighted that indoor cultivation practices also resulted from a preference for higher yield potential and industrialized quality control offered by indoor facilities. Nadia Sabeh, an agricultural facilities engineer from the audience, pointed out that unlike other high-value California crops such as almonds and wine grapes, the cannabis industry has not benefitted from publicly funded agricultural research on how to better optimize production in a variety of
cultivation settings. Other members of the audience affirmed that existing industry practice on energy and water use has emerged solely based on information sharing between cultivators.

**Metrics of Energy Intensity for Cannabis Cultivation**

There was no disagreement among panelists and the audience that indoor cultivation is indeed more energy intensive. However, Hezekiah Allen and Cody Coeckelenbergh stated that indoor cultivation is less water intensive. Indoor cultivation methods benefit from reduced evaporation that would otherwise occur in an outdoor environment. Using artificial lighting to support plant growth and HVAC equipment to control temperature, air flow, and humidity require a significant amount of electricity, and Cody Coeckelenbergh presented a breakdown of such indoor energy demand sourced from the 2012 Evan Mills study. Both Kristin Nevedal and Nick Caston spoke to the hybrid approach of using a mix of sunlight and artificial lighting in a greenhouse setting as an ideal environmentally sustainable middle ground to boost yield without sharply increasing electricity consumption.

Kristin Nevedal further elaborated that California’s agricultural environment, rich sun exposure, and temperate climate provide an ideal setting to shift toward less energy intensive open field or mixed-light cultivation. She also added, however, she had observed a higher sales volume of indoor cultivation equipment, as cultivators may be shifting from lower-yield outdoor cultivation to higher-yield indoor cultivation in order to increase revenue to either offset or avoid regulatory compliance costs.

There are differences of opinion on how exactly to measure the energy intensity of cannabis cultivation. Cody Coeckelenbergh presented a per-plant metric in his presentation based on the approach taken in the 2012 Evan Mills study. However, both Hezekiah Allen and Kristin Nevedal rebutted that the energy and water intensity for cultivation actually depends on plant size, plant density, and crop yield. High-density planting for any cultivation method would significantly change the energy or water intensity calculation. A more accurate metric for
energy or water intensity, Allen and Nevedal explain, would be one that measures yield per square footage per flowering cycle, similar to how other crop productions are measured.

According to an internal cost study based on 2016 data, Nick Caston estimated that the energy cost differential between indoor versus greenhouse versus outdoor cultivation to be 78 to 1 to 0.

**Status of State Regulatory Implementation**

The CalCannabis Cultivation Licensing Office (CalCannabis) at the Department of Food and Agriculture (CDFA) is currently developing regulations to license the cultivation of medical and adult-use recreational cannabis to comply with Proposition 64 and recent medical cannabis legislation. As Amber Morris explained, CalCannabis is developing a track-and-trace technology platform to prevent the comingling of legally-grown and illegally-grown cannabis products in the marketplace, such that legally-grown cannabis is not spread into the black market, and that illegally grown cannabis products will not be legally sold. Beginning January 1, 2018, CDFA will accept applications for cultivation licenses in three tiers differentiated by square footage and cultivation methods:

<table>
<thead>
<tr>
<th>California Cannabis License Tiers</th>
</tr>
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<tbody>
<tr>
<td><strong>Outdoor (no artificial light)</strong></td>
</tr>
<tr>
<td><strong>Special Cultivator</strong></td>
</tr>
<tr>
<td><strong>Small Cultivator</strong></td>
</tr>
<tr>
<td><strong>Medium Cultivator</strong></td>
</tr>
<tr>
<td><strong>Nursery</strong></td>
</tr>
</tbody>
</table>

Source: CalCannabis at California Department of Food & Agriculture

In August 2016, CalCannabis conducted a month-long statewide industry survey on the location and type of licenses cannabis cultivators plan to seek. The survey result is available by county, and reflects business development interest in cultivation across all counties of the state. Amber Morris summarizes that about 45 percent of respondents indicated preference for indoor cultivation.

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3 CalCannabis August 16 survey results available at [https://www.cdfa.ca.gov/is/mccp/news/36](https://www.cdfa.ca.gov/is/mccp/news/36)
Due to the correlation between license type and on-site energy use, the availability of indoor and mixed-light licenses across localities could provide utility planners with valuable information on load growth potentials attributable to commercial cannabis cultivation. Hezekiah Allen emphasized that, unlike other states that have legalized commercial cannabis cultivation, California utilities and regulators will have better data access to ascertain and respond to any potential energy impact of cannabis cultivation due to the inherent structure of the state’s regulatory framework. He further emphasized that the electricity demand spikes experienced by states such as Washington and Colorado are not likely to be replicated in California due to limited license availability and California’s higher electricity rates. “California is not a cheap electricity market. California is not going to cost competitive at a large scale with indoor cultivation only,” Allen said. “Impacts can be allocated based on the [cannabis] regulatory structure.”

Amber Morris explained that CalCannabis is currently conducting a statewide programmatic environmental impact report (PEIR) under California Environmental Quality Act (CEQA) to understand and mitigate the statewide effects of cannabis cultivation. The goal of CalCannabis is to certify this environmental review by the end of 2017, and the department is working in consultation with other state agencies tasked with other responsibilities under Proposition 64. This environmental assessment will differentiate the impact and potential mitigation by license type, thus setting a baseline for cultivation site-specific CEQA assessment. Local government will then determine whether the PIER analysis is sufficient for adopting local land-use policy or conducting site-specific CEQA review.

**Impacts of Local Land Use Policy**

Nick Caston points out that local land use decisions predominantly determine the method of cultivation within a municipal jurisdiction. Currently only a handful of California counties allow cannabis cultivation within unincorporated areas. Citing experience with Sonoma County, Nick Caston stated that local authorities often cite aesthetic concerns and ignore the environmental impact of indoor cultivation when passing local ordinances prohibiting outdoor and mixed-light commercial cultivation facilities.

Proposition 64 does not allow local government to ban cultivation for personal use, but local government may restrict the method by which these personal plants are cultivated. The City of Sacramento recently approved a city ordinance to allow only indoor cultivation for personal use. A representative from SMUD in the audience cited concerns with assessing and identifying the location and magnitude of residential energy load as a result of this local ordinance. Hezekiah Allen responded by stating there may already be existing load to grow cannabis indoors for personal use, so it may not be additive load. “Six plants are not going to be an obvious load to detect,” he said.
Most California cities and county governments have either prohibited cultivation, or are still in the process of developing land use requirements for cannabis. In agriculture-rich counties such as Sonoma, cannabis cultivation permits for both personal and commercial purposes are authorized on the condition that the cultivation is indoors. All three cannabis industry representatives on the panel expressed similar frustration on the lack of environmental consideration when local authorities prohibit outdoor or greenhouse cultivation outright. “Whose job is it to watchdog these local agencies?” asked Hezekiah Allen. In response, Nick Caston cited a precedent with state-level enforcement during Jerry Brown’s term as Attorney General in litigating against local authorities for noncompliance with SB 375 on sustainable land use.

Amber Morris, in discussions pertaining to the impact of land use policy, repeatedly stressed that current state legislation allows for local control in determining how cultivation sites are permitted. While CalCannabis will produce a CEQA analysis by license type, it is ultimately up to local government to determine the conditions by which local permits are granted.

**California Utility Experience and Energy Programs**

With regards to the variety of energy management incentive programs in California, Nick Caston stated that while incentives programs may work for the cannabis sector, the bigger barrier is the inability for the industry to obtain financing due to federal banking and lending constraints. Financing tools such as the Property Assessment Clean Energy (PACE) program would be a welcome approach.

Utility representatives of SDG&E, PG&E, and SMUD all echoed the common theme of the need for more data. Joe Horak from PG&E announced that PG&E is actively recruiting cannabis cultivators to sign up for the agricultural rate schedule, rather than the commercial rate schedule, through an informal customer working group. This announcement was met with positive response from cultivators in the audience. When inquired on the difference between cannabis and other agricultural energy use patterns, Joe Horak stated that PG&E currently does not have enough data to make that determination. Jesse Emge of SDG&E explained that while internal stakeholders within his company know the energy impacts of cannabis cultivation should not be ignored, there is simply not a lot of data to determine what to do next.

**Key Takeaways from Panel Two Presentations and Q&A**

California cannabis cultivators have developed diverging preferences on pursuing indoor, mixed-light versus outdoor cultivation. Optimizing between increased crop yield and increased energy costs is a business decision affected by revenue potential and other costs of doing business.
The cannabis industry has not benefitted from publicly funded agricultural research on how to best optimize production across a variety of cultivation methods, unlike other valuable agricultural commodities in the state.

Indoor cultivation is generally accepted as the most energy intensive cultivation method, but is also potentially the most water-efficient method.

California’s high energy rates may pose a constraint on the expansion of indoor cultivation.

When calculating the resource impact of cannabis cultivation, a per-plant metric does not account for planting density, yield potential, or growing cycle.

California’s statewide licensing tiers are differentiated by square footage and cultivation setting (indoor, outdoor mixed-light), leading to potentially easier access to locational data on where increased energy load might occur.

California Department of Food and Agriculture is conducting a statewide programmatic environmental impact review by license type. Local government entities will determine whether this assessment is sufficient for adopting local land-use policies or site-specific CEQA review.

Local land-use permits, when granted, often require a specific type of cultivation setting. Many local jurisdictions have banned outdoor or greenhouse commercial cultivation, or banned commercial cultivation completely. It is unclear whether local jurisdictions are aware of the energy consequences of mandating indoor cannabis cultivation.

Local government entities cannot prohibit cultivation for personal use under Proposition 64. They can, however, place restrictions on outdoor or greenhouse personal cultivation. Sacramento is one city which allows residents to grow cannabis for personal use, but only when grown indoors.

California’s cannabis exports exceed in-state consumption by a factor as high as four-to-one. The looming market uncertainty from a reversal in federal policy on prosecution may result in a market demand reduction and negatively impact in-state production as export falls.

California utilities do not currently have sufficient data to identify new load patterns attributable to cannabis cultivation.

V. Staff Recommendations

Staff concludes that the available data are not sufficiently robust to support recommending a special cannabis tariff. In the near term, staff recommends increased data collection.
Oregon requires licensed cannabis cultivators to forecast their energy needs before commencing operation, and to submit annual reports of energy usage. It may be helpful for the Commission to engage the CDFA in consultation with CEC and ARB concerning whether a similar reporting requirement would be beneficial in California.

Commission staff should consult with cultivators and other industry stakeholders concerning the availability and development of informational materials for cultivators.

Commission staff should facilitate constructive engagement between cannabis cultivators and the CEC concerning California’s Building Code and Energy Code in order to determine whether particular provisions enhance or diminish the energy efficiency and safety of cannabis cultivation.

Because some local jurisdictions require that cannabis cultivation take place indoors, it may be beneficial for the Commission to engage with local jurisdictions to share information on the energy intensity of different means of cannabis cultivation and to discuss means of balancing public safety, aesthetics, and climate policy.

Commission staff should conduct a review of available energy efficiency/demand-side management programs and make program information available to cultivators, CDFA, and other stakeholders.

Commission staff should study the most appropriate energy efficiency metrics applicable to cannabis cultivation. Should efficiency be measured by plant, by square foot of canopy, by annual kWh saved, or by some other measure?

Commission staff can work to make data concerning embedded carbon intensity of electricity more easily accessible by local government entities for the purpose of local CEQA review.

Commission staff should assemble a Cannabis Working Group to consider options for ensuring that California cannabis cultivation is energy efficient, up to and including the possibility of a specific energy tariff for cannabis cultivation.

After the release of this Staff Workshop Report, Commission staff should attend a cultivator’s association meeting and/or utility working group and discuss the results.