EVERGREEN ECONOMICS

SDG&E Cannabis Agriculture Energy Demand Study

Final Report

Prepared for San Diego Gas & Electric Company

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Table of Contents

1 Executive Summary

Evergreen Economics conducted research for San Diego Gas & Electric Company (SDG&E) to inform its Business Plan development.

Research Objectives and Approach

This research addresses questions relating to the cannabis industry, its energy use, possible intervention strategies, and the implications for legalization of recreational production and use in SDG&E's service territory.

The research was conducted in June of 2016 and included three components:

- Literature review;
- In-depth interviews with utilities in states where recreational cannabis is legal (Washington, Oregon and Colorado); and
- In-depth interviews with trade organizations that work with the cannabis industry in states where recreational and/or medical cannabis is legal.

Summary of Results

Almost all utilities Evergreen spoke with have seen an increase in energy demand due to the legalization of recreational cannabis in their state and the subsequent increase in growing operations.

Electricity costs comprise between 20 and 50 percent of growers' operational costs. Sixty percent of this cost is estimated to be due to demand charges for time of use rates. Lighting is the biggest source of energy consumption, particularly in indoor and greenhouse operations. While some cannabis growers have chosen to install LEDs, there remains a preference for T5s due to the impression among growers that the cannabis yield with LEDs is lower (although this is not a universal belief), that LEDs are bulky, and because the upfront cost of LEDs is prohibitory, especially given all the other startup costs associated with building a new indoor grow facility.

There are many benefits associated with indoor growing, but these benefits come at the expense of increased energy usage compared to greenhouse and outdoor growing. This report focuses on indoor and greenhouse growing, as these facilities are most likely to have an impact on the grid. Greenhouses offer a middle ground between the greater environmental control of indoor grow operations and the lower energy demand of outdoor operations. Utilization of natural light causes the load shape of greenhouses to vary significantly from the load shape associated with indoor growing, where the load is constant and more predictable. Some growers in other states have utilized solar to offset their energy intensive growing practices.

The potential exists for utility interventions—other than lighting—including air conditioning systems, controls and conversion to drip irrigation. A few utilities have taken tailored approaches to these industries, with one offering a specific rate and others offering customized incentives. Growers can also take advantage of existing rebate programs. Some utilities hesitate to engage with commercial growers because they do not want to encourage growth in an energy-intensive market and have concerns about differences in federal, state and local laws. Utilities have had requests for infrastructure upgrades to meet the demand of new operations.

After legalization, utilities reported a slight lag of around six months in the development of growing operations, indicating there is a short window of time between legislative and industry changes for SDG&E to take action. As markets mature, it is possible that growers will shift their focus to keeping operating costs low in order to remain competitive. Cannabis producers may be inclined to work in areas where energy costs are lower in order to manage their operating costs.

Given the industry findings from states that have experienced growth of the cannabis market after legalization, Evergreen Economics recommends the following:

- Focus on infrastructure and accommodation as an initial strategy.
- Engage with cannabis producers and trade allies as soon as possible in order to influence purchase decisions for new facilities.
- Customize program literature to the needs of this specific industry.
- When advising growers on energy efficient options, take into account local building codes as they relate to indoor cannabis operations.
- Monitor local initiatives banning commercial growing that may make it more difficult to control load growth; such bans may lead to widespread residential growing.
- Monitor equipment choices as the local cannabis industry develops to gain an understanding of how San Diego's unique climate and drought conditions influence grower choices and energy usage after legalization.
- Work with trade organizations to provide information and tools for growers to compare the energy usage and yield for indoor and greenhouse operations.
- Consider encouraging integrated solutions that allow facilities to take advantage of wind and solar to help offset increased demand.
- Create an internal policy for dealing with the differences in federal, state and local cannabis laws.

2 Introduction

This report documents research that Evergreen Economics conducted for San Diego Gas & Electric Company (SDG&E) to inform its Business Plan development.

2.1 Research Objectives

The research conducted by Evergreen seeks to answer multiple questions regarding energy use in the cannabis industry and the potential for implementing energy efficiency measures. These research questions were addressed using information gathered from a literature review and in-depth interviews with cannabis trade organizations and both large and small utilities operating in states where cannabis production has been legalized (Washington, Oregon, Alaska and Colorado).

Specific research questions that Evergreen addressed are listed below.

Impacts

- What kinds of impacts have other utilities and trade organizations seen/observed/measured in terms of an increase in energy use due to cannabis legalization?
- What kinds of impacts have utilities seen/observed/measured beyond energy usage such as water usage or broader community impacts?
- What impacts does cannabis legalization have on the commercial and residential sectors (retail, distribution and residential growing) besides the agricultural impacts of cannabis growing?
- What kinds of energy end uses are used for cannabis growing?
- How are the impacts of legalized cannabis growing observed across different regions and community types, and what types of impacts could SDG&E's service territory anticipate observing if cannabis growing becomes legal in California?
- How long after legalizing cannabis growing have other utilities and trade organizations observed the impacts of increased energy usage?

Industry

- What experience do cannabis trade organizations have operating in California and what expectations are there for the California growing market if cannabis is legalized?
- Besides cannabis growing, what other types of commercial markets exist in the cannabis market such as retailers, distributors and others?
- What are the preferred growing conditions, including time of year, type of equipment and location, for cannabis growing? Are there different growing models for different types of growing structures and buildings? (E.g. greenhouses, other?)

- What is considered "indoor growing" and is cannabis grown indoors for any particular reason?

Intervention Strategies

- Are there any experimental "cannabis rates" which have been piloted or implemented in other states?
- What has been the primary intervention strategies deployed to address energy usage or other impacts and how successful have the efforts been to date? What intervention strategies have been deployed by those utilities that have been impacted by cannabis industry growth?
- What is the potential for energy efficiency upgrades in the cannabis growing industry and how do cannabis growers choose their equipment?
- What utility intervention strategies have been observed by cannabis trade organizations in states that have legalized cannabis growing?

2.2 Data Collection and Analysis Methods

We used two primary research methods to address the research questions outlined above.

- **A literature review** of previous studies and articles on energy impacts of legalized cannabis production and the potential for energy efficiency upgrades in the industry based on grower preferences. The review covered legalization status, growing techniques and preferences, energy impacts, community impacts, utility intervention strategies and implication for California.
- **Nine in-depth interviews with utility staff** in regions where cannabis production has been legalized.
- **Six in-depth interviews with trade organizations** that work within the cannabis industry.

Each of these research tasks is described separately in Sections 3, 4 and 5 of this report. In Section 6, we share findings across all research tasks and implications for SDG&E if cannabis production is legalized in California

Utility In-depth Interviews

We completed nine in-depth interviews with eleven staff members at utilities across Colorado, Washington and Oregon. Given the varying levels of interaction with the cannabis market among utilities in the Northwest, utility interviewees had differing backgrounds and responsibilities, ranging from account managers to engineering consultants. As shown in Table 1, the utility survey respondents covered a wide range of service territories including high-density metropolitan areas and rural Northwest communities.

Table 1: Utility Survey Respondents Overview[1]

State	Utility	Service Territory
WA	Mason County Public Utility District (PUD) #3	Northwest Washington; greater Olympia area
WA	Okanogan County PUD	Northern Washington
WA	Clallam County PUD	Northwest Washington
WA	Clark County PUD	Southern Washington; Vancouver
WA	Big Bend Electric Cooperative	Eastern Washington; Columbia Basin area
OR	Northern Wasco County PUD	North Oregon, greater Vancouver area
OR	Eugene Water & Electric Board	Greater Eugene area
OR	Emerald PUD	Greater Eugene area
CO	Xcel Energy	Denver; Colorado

Trade Organization In-depth Interviews

We completed six in-depth interviews with representatives from trade organizations. As shown in Table 2 below, the trade organization interview respondents had a wide variety of involvement in the cannabis industry, ranging from cannabis-specific advisors to national property developers.

[1] Big Bend Electric Cooperative provided responses via email.

Table 2: Trade Organization Interview Respondents

State	Trade Organization	Description
Colorado; National	iComply	Client services provider designed to specifically help cannabis operations build infrastructure and legitimize through compliance training and protocol design
National	Kalyx Development	Privately held leasing company that specializes in cannabis properties
California	LifeStyle Solar Inc.	Solar system provider for residential and commercial customers in California
Oregon	Oregon SunGrown Growers Guild	Largest membership driven non-profit advocacy group for growers in Oregon, including cannabis cultivation consulting
Oregon	Energy Trust of Oregon	Independent nonprofit organization dedicated to providing utility customers with low-cost, clean energy solutions
Oregon	Resource Innovation Institute	Nonprofit organization comprised of utilities, growers and technology experts aiming to provide "certification standards, technology reviews and a platform for best practices on resource conservation in the cannabis industry"

3 Literature Review

We reviewed dozens of articles and reports on the cannabis industry and the implications of legalization. In this section, Evergreen presents an overview of legalization, information about growing techniques and preferences, energy impacts, community impacts, utility intervention strategies and implications for California. A complete list of the literature referenced for this report is in Appendix A: Literature Review Sources.

3.1 Legalization Overview

Beginning with Colorado in 2012, four states, including Colorado, Washington, Oregon, and Alaska, along with Washington D.C., have passed legislation to legalize recreational cannabis production and consumption.[2] As shown in Table 3, while the legalization measures were similar across the four states and Washington D.C., each state passed unique legislation focused initially on recreational use and home cultivation with provisions to add commercial growing legislation at a later date.

Table 3: Recreational Cannabis Legislation by State

State	Ballot Measure	Year Passed	Summary
CO	Amendment 64	2012	Permits the possession of one ounce or less and the transfer of one ounce or less for no remuneration along with the cultivation of six plants or fewer
WA	Initiative 502	2012	Permits the possession of one ounce or less in private location with no residential cultivation allowed
OR	Measure 91	2014	Permits the possession of one ounce or less, or eight ounces or less if home grown, along with the cultivation of up to four plants
AK	Measure 2 (2014)	2014	Permits the possession of up to one ounce and the cultivation of up to six plants
DC	Initiative 71	2014	Permits the possession of up to two ounces of and the possession and cultivation of up to three marijuana plants

Additionally, each piece of statewide legislation included provisions that allow the appropriate statewide regulatory boards, such as the Oregon Liquor Control Commission and the Washington State Liquor Control Board, to regulate legal retail operations and approve licenses for commercial cultivation. In Colorado, the Colorado Department of Revenue is responsible for the regulation and licensing of recreational cannabis production.

[2] http://norml.org/laws

Currently, federal laws still prohibit the consumption and distribution of any quantity of marijuana. However, in 2013, the Obama Administration openly acknowledged that it would not challenge state laws legalizing cannabis consumption "as long as those states maintain strict rules involving the sale and distribution of the drug."[3]

However, at least five additional states, including California, will likely have cannabis legalization measures included on the November 2016 ballot, which may influence federal legislation.[4] Given the size of California's relative population and medical marijuana market, the potential California recreational cannabis market alone could be twice the size of the Colorado, Washington, Oregon and Alaska markets combined, and may generate enough tax revenue and retail sales to impact national opinion and subsequently, federal legislation.[5]

3.2 Growing Techniques and Preferences

Cannabis is grown outdoors, indoors and in greenhouses with varying levels of energy demand in each setting. Indoor growing requires the most energy due to lighting, cooling and ventilation needs. Across all growing applications, the ideal temperature for cannabis production is between 75 and 86 degrees Fahrenheit with 12 to 24 hours of lighting a day depending on the stage of the growth cycle. Greenhouse growers uses less energy by supplementing daytime lighting needs with natural light, but still need additional lighting in the mornings and evenings in addition to venting and air conditioning. Outdoor and greenhouse growing conditions are more variable and produce less predictable yields.

A 2014 report notes that 90 percent of cannabis production in California occurs outdoors[6]. This is higher than the percentage of outdoor growth in Oregon and may be due to differences in climate. Since the 2014 report, there has been a trend towards increased use of indoor cultivation facilities (generally converted warehouses) because they help reduce the production cycle time, can standardize ideal conditions with regards to temperature, irrigation and lighting, and are viewed as being more secure.[7] Instead of having to adhere to natural production cycles that last between 20 to 26 weeks (consisting of planting seedlings in the spring, with the vegetative stage beginning in early spring and summer

[3] https://www.washingtonpost.com/national/health-science/obama-administration-will-not-preempt-state-marijuana-laws--for-now/2013/08/29/b725bfd8-10bd-11e3-8cdd-bcdc09410972_story.html
[4] Other states with expected legalization measures on the November 2016 ballot include Nevada, Maine, Arizona, and Massachusetts
[5] http://www.bloomberg.com/politics/articles/2015-04-13/pot-legalization-across-u-s-may-hinge-on-2016-california-vote
[6] https://www.nwcouncil.org/media/7130334/p7.pdf
[7] https://www.nwcouncil.org/media/7130334/p7.pdf

and the flowering stage in mid to late summer), indoor cultivation facilities allow for year-round production with production cycles of between 14 and 18 weeks.[8]

However, while traditional outdoor growing operations typically require only sun and water irrigation systems, indoor cultivation facilities require a significant amount of additional equipment to help control growing conditions. Specifically, research conducted by E Source found that indoor facilities commonly require extensive lighting equipment, air conditioning systems, dehumidifiers and ventilation equipment. Additionally, facilities require water-management equipment and CO_2 injection equipment to help feed the plants.[9]

For lighting, indoor cultivation facilities generally include a variety of tubular fluorescent lamps, metal halide lamps and high-pressure sodium lamps depending on the stage of the cannabis plant. Given the amount of heat generated by the extensive use of artificial lighting, large indoor cultivation facilities generally use rooftop air conditioners (RTUs), while others rely on either mini-split heat pumps or even window air conditioning units. Additionally, to address the water vapor produced by the cannabis plants, indoor facilities also require dehumidifiers and venting equipment.

3.3 Energy Usage in Growing Operations

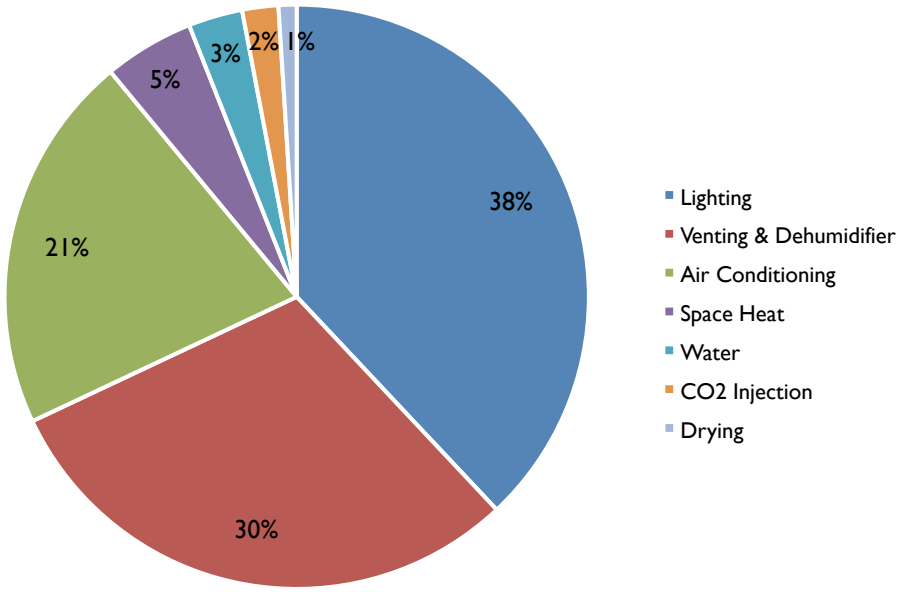
Commercial cultivation facilities currently consume a significant amount of electricity, primarily through the usage-intensive lighting and necessary cooling and venting equipment described above. In 2012, the Lawrence Berkeley National Laboratory (LBNL) reported that legal indoor cannabis facilities already accounted for approximately 1 percent of national energy usage.[10] This usage level will continue to increase as additional states legalize cannabis cultivation and begin issuing formal licenses for commercial growers. Research conducted by Bloomberg estimated that in 2014, more than 1,200 licensed grow facilities in Colorado accounted for "almost half of new demand for power" in Colorado in 2014, and consumed as much power as 35,000 households. Additional forecasts from Seattle City & Light estimated a 3 percent increase in demand on their overall system as a result of legal cannabis operations.[11],[12] Denver's largest utility, Xcel Energy, estimated that energy consumption associated with cannabis production was upwards of 200 million kWh a year across its service territory in 2013, an increase of over

[8] https://www.nwcouncil.org/media/7130334/p7.pdf
[9] https://www.esource.com/TAS-F-18/CannabisCultivation
[10] http://fortune.com/2015/12/21/marijuana-energy-consumption/
[11] http://www.bloomberg.com/news/articles/2015-12-21/as-pot-growing-expands-power-demands-tax-u-s-electricity-grids
[12] http://www.utilitydive.com/news/marijuana-grow-houses-may-cause-3-demand-spike-for-seattle-utility/409001/

40 percent from the previous year.[13] An additional study conducted in 2014 by the Northwest Power and Conservation Council estimated the energy demand for cannabis production across Washington, Oregon, Montana and Idaho to be approximately 112 average megawatts (MWa) in 2014 and could potentially increase to over 237 average MWa by 2035.[14] As a result of the high energy demand of cannabis cultivation facilities, utility companies have observed an increased amount of power outages as a result of cannabis production. For example, Pacific Power in Portland, Oregon reported at least seven power outages during the summer of 2015 due to cannabis production.[15]

As shown in Figure 1 below, the large amount of energy consumption from indoor cannabis production comes from a variety of sources, most notably lighting (38%), venting (30%) and air conditioning (21%). These measures, especially the lighting equipment, are generally very usage-intensive (about 360 kWh per 25 square feet).[16]

Figure 1: Cannabis Growing Energy Consumption By End Use[17]



[13] http://www.utilitydive.com/news/marijuana-grow-houses-boost-denver-power-demand-complicating-efficiency-pl/401751/
[14] https://www.nwcouncil.org/media/7130334/p7.pdf
[15] http://www.utilitydive.com/news/pot-power-how-utilities-and-regulators-are-dealing-with-the-budding-mariju/409172/
[16] http://www.utilitydive.com/news/marijuana-grow-houses-boost-denver-power-demand-complicating-efficiency-pl/401751/
[17] https://www.nwcouncil.org/media/7130334/p7.pdf

Overall, electricity usage accounts for between 20 to 50 percent of the total costs of a cannabis cultivation facility depending on the scale of the cannabis production.[18,19] Energy usage is especially high during the seedling and vegetative stages of the cultivation cycle, when growers commonly have tubular fluorescent lighting on 24 hours a day for the first two to four weeks followed by metal halide lamps of between 400 and 1,000 watts on for 18 hours a day for three to five weeks.[20] Furthermore, a survey conducted among Washington cannabis growers found that growers typically have separate rooms for plants in the seedling and vegetative stages versus the flowering stages. According to the survey results, a 1,000 watt metal halide lamp typically serves two to eight cannabis plants in the early stages of production, while a 1,000 watt high pressure sodium lamp typically serves two to three plants in the flowering stage of growth. The intensive lighting installations are specifically made for horticulture, providing the necessary heating and nutrients for the cannabis plants to grow quickly and yield the most amount of product. In addition to the lighting requirements, each room also included separate HVAC equipment with the equivalent of a mini-split heat pump for every 1,000 square feet of space, along with a larger central rooftop air conditioner.[21]

3.4 Utility Intervention Strategies

With energy forecasts indicating that energy usage from the cannabis production industry will continue to increase, utilities are beginning to incorporate intervention strategies to help curb energy usage. The two most common strategies include adopting specialized rates, such as time of use rates, and incentives for energy efficient upgrades such as LED lighting.

As previously discussed, cannabis indoor cultivation facilities generally have their lighting equipment operating between 12 and 24 hours a day depending on the stage of the plant growth cycle. As a result, the facilities generally are impacted by the time of use rates that utilities charge for usage during peak demand times, such as between 2 p.m. and 6 p.m, which can account for up to 60 percent of growers' energy bills.[22] Because of the massive energy demand from cannabis production, utilities such as Mason County PUD 3 in Washington created cannabis-specific time of use rates for cannabis industry customers. While most utilities currently still have cannabis producers on normal general service rates, Mason County PUD 3 has a cannabis-specific rate that is two cents higher per kWh, but also has a lower daily system charge and lower billing period demand rate than its

[18] https://www.theguardian.com/us-news/2016/feb/27/marijuana-industry-huge-energy-footprint
[19] http://www.bloomberg.com/news/articles/2015-12-21/as-pot-growing-expands-power-demands-tax-u-s-electricity-grids
[20] https://www.esource.com/TAS-F-18/CannabisCultivation
[21] https://www.nwcouncil.org/media/7130334/p7.pdf
[22] https://www.esource.com/TAS-F-18/CannabisCultivation

normal general service rate.[23] Other Washington and Oregon utilities have also explored the strategy of having growers pay for potential transformer upgrades or any current transformer damages caused by their energy demand increases.

Currently, the more common utility intervention strategies are energy efficiency rebates for lighting and HVAC equipment. In Oregon, utilities have started to work with Energy Trust of Oregon (ETO) to install custom LED lighting replacement projects in cannabis production facilities, with incentives ranging between $15,000 and $80,000. Additionally, other utilities in Washington and Colorado, such as Seattle City Light and Xcel Energy, offer traditional commercial energy efficiency rebates for LED lighting replacements that ease energy demand and can potentially save customers up to 50 percent on their energy usage.[24] However, some utilities are questioning the appropriateness of LEDs and associated rebate programs, as cannabis customers have noted that the LED lights require longer grow cycles and thus are not a viable option, especially as cannabis plants enter into the flowering stage of the growth cycle. Additionally, LED lighting units can cost between $1,300 and $2,500 for a single unit, with utility rebates generally only covering about 50 percent of those costs.[25]

As the cannabis production industry continues to develop, other possible utility intervention opportunities exist with regards to HVAC equipment. One option for the rooftop air conditioning equipment mentioned earlier in this report would be the addition of variable-frequency drives (VFDs) that slow the air supply when the cooling demand is lower than the capacity of the equipment. In other commercial buildings, VFDs have been shown to reduce cooling consumption by almost 50 percent, which could result in over $15,000 a year in energy savings for a cannabis producer with over 100 plants.[26] Other efficiency options exist for dehumidifiers, CO2 and ventilation systems, and water irrigation systems. For example, one Oregon study found that commercial facilities using a hand watering system were consuming up to 30,000 gallons of water per week. Providing incentives for cannabis producers to transition to drip irrigation systems could help producers lower their water use by 66 percent per week.[27]

3.5 Community Impacts

In addition to the explicit energy impacts that legal cannabis production has on the energy grid, several states that have passed legislation to legalize cannabis have also begun to observe broader community impacts such as on public safety, tax revenues and public

[23] http://www.pud3.org/service/billing-options/rates
[24] https://www.theguardian.com/us-news/2016/feb/27/marijuana-industry-huge-energy-footprint
[25] http://www.bizjournals.com/portland/blog/sbo/2015/11/how-oregon-marijuana-growers-plan-to-get-efficient.html
[26] https://www.esource.com/TAS-F-18/CannabisCultivation
[27] http://www.bizjournals.com/portland/blog/sbo/2015/11/how-oregon-marijuana-growers-plan-to-get-efficient.html

perception. For example, with regards to the broad impact on law enforcement, a report from the Colorado Association of Chiefs of Police in 2015 sites unforeseen issues derived from recreational cannabis use such as "how to determine when a driver is legally under the influence of marijuana" which is often times not clearly defined or easy to test for, causing regulatory confusion.[28] Additionally, the report acknowledges that the number of hospitalizations related to cannabis use increased over 200 percent between 2000 and 2013, resulting in a strain on local medical facilities.

Colorado also saw an initial increase in cannabis use among teenagers, leading to educational issues at the middle school and high school levels where school expulsions have increased since legalizing cannabis production. Homelessness has also spiked in Colorado over the last four years, especially in larger metropolitan areas such as Denver.[29]

To help combat these societal impacts, Colorado distributed over $6 million of the total cannabis revenues back to local governments over the course of 2014 and 2015.[30] The total tax revenue should continue to increase going forward as Colorado has now included a two cent/kWh tax for cannabis producers in an effort to offset green house emissions. However, several law enforcement officials argue that the current tax revenues may not cover the added expenses brought on by the increased law enforcement required to handle the community issues brought on by legalized cannabis production.[31]

3.6 Implications for California

In 2006, prior to recreational cannabis being legalized in some states, the federal government conducted a study that estimated that 42 percent of all cannabis produced in the United States as part of the medical marijuana market was produced in California.[32] Even in 2016, as recreational cannabis production has become established in states such as Washington and Colorado, the California medical production market remains the largest cannabis market in the United States, accounting for 9 percent of household electricity usage.[33]

Looking forward to November 2016, California will be one of at least five states with legalization ballot measures. While similar legislation failed in 2010, current polls indicate

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[28] http://www.nccpsafety.org/assets/files/library/Legalized_Marijuana_Practical_Guide_for_Law_Enforcement.pdf

[29] http://www.newsweek.com/unexpected-side-effects-legalizing-weed-339931

[30] http://www.newsweek.com/unexpected-side-effects-legalizing-weed-339931

[31] http://www.nccpsafety.org/assets/files/library/Legalized_Marijuana_Practical_Guide_for_Law_Enforcement.pdf

[32] https://www.nwcouncil.org/media/7130334/p7.pdf

[33] http://www.bloomberg.com/news/articles/2015-12-21/as-pot-growing-expands-power-demands-tax-u-s-electricity-grids

that 55 percent of California voters favor the legalization of cannabis production, with only 43 percent indicating they think cannabis should remain illegal.[34,35] With nearly 40 million residents in California, the potential recreational cannabis market would be more than double the size of the market in Colorado, Washington, Oregon and Alaska combined.

While the California ballot initiative will resemble the legalization measures passed in other states, some of the specifics for the proposed 2016 measure include:[36]

- A 15 percent sales tax;
- A $9.25 per ounce tax on flowers;
- A $2.75 per ounce tax on leaves;
- Provisions to restrict licenses for corporate or large-scale cannabis cultivation businesses until 2021.

Opponents still believe there is enough resistance, especially among law enforcement and education groups, to defeat the November bill. However, the market potential of the recreational market may prove too lucrative for voters to overlook considering the potential tax revenue benefits. According to research conducted by Arcview Market Research conducted in 2015, the Washington, Colorado, Oregon, Alaska and Washington D.C. markets alone could generate up to $5.5 billion in combined annual sales in 2020.[37] With California having the potential to generate up to twice that amount, potential sales tax revenue alone could be close to $1 billion by 2020 if not sooner.

[34] In California, ballot measures require over 50 percent voter approval to pass.
[35] http://www.bloomberg.com/news/articles/2015-12-21/as-pot-growing-expands-power-demands-tax-u-s-electricity-grids
[36] http://www.oag.ca.gov/system/files/initiatives/pdfs/15-0103%20%28Marijuana%29_1.pdf?
[37] http://static1.squarespace.com/static/526ec118e4b06297128d29a9/t/56f21ed59f7266ee27800d7b/1458708198877/Executive+Summary+-+The+State+of+Legal+Marijuana+Markets+-+4th+Edition.pdf

4 Utility In-depth Interviews

In-depth interviews conducted by Evergreen Economics with utility staff covered energy usage related to the cannabis industry, intervention strategies and community impacts outside of the energy sector.

The utilities Evergreen spoke with engaged with the cannabis industry on many levels. As recreational cannabis production was legalized across Washington, Colorado and Oregon, utility interviewees noted their primary responsibilities shifted to include predicting load growth, educating cannabis producing customers on potential energy efficiency options and engaging in customer outreach to discuss energy usage.

Eight out of nine respondents noted that they have engaged in some capacity with other public utilities or regional cannabis trade organizations to learn about how other market actors are responding to the legalization process in their state.

4.1 Energy Usage in Growing Operations

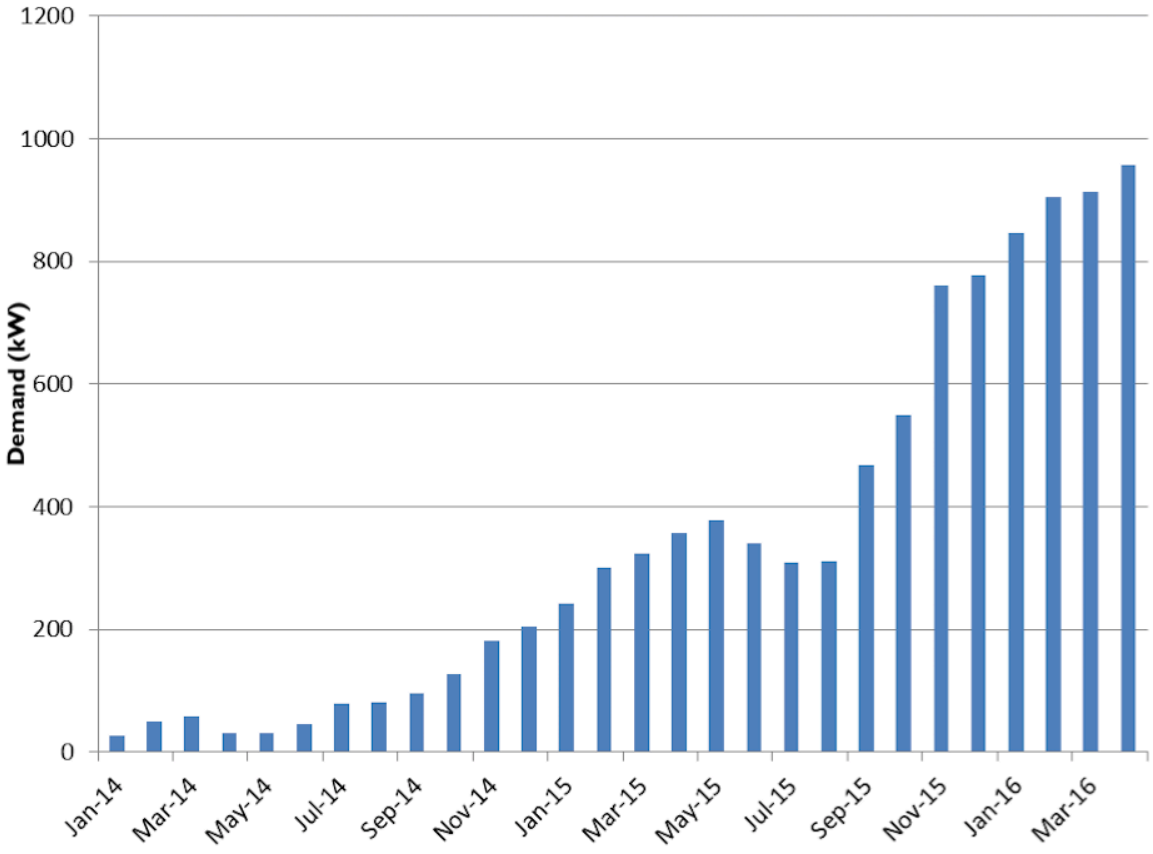
4.1.1 Energy Impacts

We asked utility staff about any increases in energy demand they saw from growing cannabis after legalization, along with the effects in other parts of the supply chain including residential use, distribution or retail sales. Interviewees were also asked to discuss how they identify industry usage and what types of load shapes are associated with growing cannabis.

Increased Demand in Energy from Growing Facilities

Seven out of nine utility respondents said they had observed at least some impacts on energy usage in their service territory since the legalization of cannabis. The majority of the utility interviewees noted they have seen an observable load growth in the commercial sector and attribute this growth to cannabis production facilities, the most impactful of which range from 0.5 to 6 MWs of usage per facility. Two Washington utilities said they have seen 40 to 50 percent growth in the energy usage from cannabis production facilities in the last year alone. As shown in Figure 2 below, one rural county PUD in Washington saw an even more dramatic increase in demand from cannabis producers, from less than 100 kW in 2014 to nearly 1,000 kW in 2016.

Figure 2: Demand Growth From Cannabis Growers: Washington Rural County



Source: Rural Washington Utility Records

Meanwhile, in Colorado, the most mature legalized cannabis producing market thus far, the utility interviewee estimated they have observed a total load growth of between 0.5 and 1 percent since 2013, consistent with the estimates reported in the literature review.

Increased Demand for Transformer Updates

In addition to increases in demand, three utility interviewees also reported seeing an increase in requests for 1,000 kWh and 1,500 kWh transformers as facilities prepare to increase their production.

Lag Between Passing of Legislation and Increase in Demand

While two Washington utilities and the one Colorado utility noted they observed the energy impacts immediately after cannabis legalization, most utilities (n=5) said there was a lag period of between 6 and 12 months before they observed direct energy impacts. These findings did not differ between more rural and more urban areas. The two utilities that had not seen any impacts thus far were both smaller utilities that have identified only a few growers in their territory.

Legislation Effects Generally Not Seen Outside of Growing Portion of Supply Chain

Two thirds of the interviewees reported that the energy impacts of cannabis legalization were not seen outside of growing (such as retail, residential production or distribution). The remaining utility interviewees reported seeing minor impacts in the residential sector, attributing this to the legislative restrictions on in-home growing.

While most utilities said they do not have any current estimates for the number of home growers in their service territory, one Oregon utility and one Washington utility estimated the number may increase to somewhere between 1 and 5 percent of homes.

Tracking Growers via Energy Usage and Statewide Databases

Currently, seven out of nine utilities said they are taking at least some steps to track the energy impacts directly related to cannabis production. Tracking is primarily done by observing facility energy demand. Two Washington utilities said they also reference a statewide database kept by state officials to identify cannabis producers in their service territory.[38]

Relatively Flat Load Shape

Seven out of nine utilities also mentioned that for the majority of cannabis operations, especially indoor growers, the load shape is relatively flat, as some lighting is constantly on throughout the day based on either a 12 hour on/12 hour off or an 18 hour on/6 hour off daily cycle. However, two Washington growers said the load shape differed between indoor and greenhouse growers given that indoor operations typically use their lighting 18 to 24 hours a day while greenhouse operations generally need to supplement natural lighting only in the early mornings and late evenings—when daylight is not readily available—with artificial lighting. They also noted observing peak loads for growers during the colder winter months, especially in greenhouse facilities that rely on supplemental lighting during the winter.

4.1.2 Energy Using Equipment

In general, utility interviewees were not familiar with the specific equipment types that cannabis producers used; however, all nine believe lighting accounts for the vast majority of energy usage, either directly or indirectly, through the subsequent cooling and ventilation systems that are required because of the heat-intensive metal halide, T5s and high-pressure sodium lamps commonly used in cannabis growing. Besides lighting, utility participants said other end uses in cannabis growing facilities include full-building HVAC cooling systems, ductless heat pumps, CO_2 pumps and ventilation systems.

[38] One of the Oregon utilities mentioned they had tried to access a similar statewide license database managed by the Oregon Liquor Control Commission (OLCC) but were unable to because the OLCC did not currently have the applications organized or transcribed electronically.

Similar to the findings from the background market research and literature review, seven out of nine utilities said LED lighting is currently the primary energy efficient end use option available for cannabis producers, although LEDs are not very common at growing operations at this time. However, as previous studies have reported, utilities report that a majority of cannabis producers are still wary of LED alternatives because they can be prohibitively expensive (over $1,000 a fixture), they may not produce the same yield as more intensive lighting options, and because the technology for LED cannabis lights has not been fully developed yet. As a result, the Colorado utility mentioned that the lack of efficiency adoption, combined with the rapid growth in cannabis production facilities, has made it difficult for utilities to meet their overarching sustainability goals.

Despite the potential long term energy savings associated with LED lighting options, utilities believe that the main factors for cannabis producers in choosing their equipment and setting up their facilities are their overall product quality and yield. The utility interviewees mentioned that they believe growers care about energy costs in their facilities as well but may not be able to prioritize efficiency initially as they attempt to get into the cannabis market quickly and affordably. As one Oregon utility pointed out:

> *"It's interesting now. I think the biggest thing now with the growers that work in our area is speed to market; they are trying to get up and going as fast as possible. I've heard from one grower that was a little bit interested in our LED program but did not have time to figure it all out and had to get going now and maybe look into a retrofit later on."*

All nine utilities also said they believe the necessity to expedite the facility set-up process is due to the fact that regional cannabis producers are generally new to the market and do not have existing infrastructure from other farming operations. As a result, cannabis producers have to find a warehouse or outdoor acreage for a greenhouse, customize the space for cannabis production, purchase equipment, and begin production to help generate revenue and allow them to scale up their operations.

4.2 Utility Intervention Strategies

Evergreen discussed two major utility intervention strategies with the utility interviewees. The first was specific rates, which are being used only at one utility. The main barrier to introducing cannabis rates expressed was related to the uncertainty of federal restrictions. The second intervention strategy discussed was standard measure incentives. Utility interviewees also reported concern for federal regulation in regards to incentives that are specific to the cannabis industry.

Specific Rates

Because utilities are still familiarizing themselves with the cannabis market, eight out of nine interviewees said they currently have cannabis producers on a general service rate, similar to any other type of non-residential customer. One Washington public utility does

currently have a special cannabis rate for customers, which includes a slightly higher usage rate per kWh with a lower demand charge compared to general service customers. While two other utilities expressed interest in proposed cannabis rates going forward, several Oregon and Washington utilities expressed concern in "singling out" certain customers, specifically cannabis customers that may be subjected to federal restrictions going forward. As one Oregon utility noted:

> *"[Cannabis rates] haven't really taken shape yet. Research has led us to think that there are opportunities for rate schedules out there in the U.S. for cannabis, and it's come up before but not a lot of traction so far. From our perspective it's tough to single out customers [by] end use and then apply specific rates to them…We actually shy away from it because the thought process is that if federal law does change, we don't want to have direct line to where customers are at."*

Measure Incentives

Utility interviewees reported that there are no additional measure incentives (not already offered through commercial and residential programs) given to cannabis growers. Over half of the utilities said they have completed LED rebate projects for cannabis producers in their service territory. One Washington utility used metering data from its LED retrofit projects at cannabis growing facilities to examine the potential load shape for the industry. The Colorado utility interviewee also added that while it does not have any cannabis-specific rebate programs, producers are eligible for programs "if they can find an existing demand-side management program that meets their needs, are approved and demonstrated they've reduced consumption."

One of the primary barriers for utilities operating in the current cannabis landscape is the disconnect between federal regulations and legalization legislation passed at the state level. Specifically among the Oregon and Washington utilities Evergreen interviewed, two thirds (six of nine) mentioned that they are wary of providing lighting or other incentives to cannabis customers because Bonneville Power Agency (BPA), a main supplier of power in the Northwest, is federally operated and will not fund any cannabis-related programs. As one Oregon utility acknowledged though, it remains somewhat of a grey area for certain utilities given the uncertainty as to how BPA will monitor and enforce the regulations:

> *"The BPA relationship is a barrier for sure. We take power from a federal wholesale provider and they have basically said that no money can go to cannabis activities that can be tied back to them. There's some grey area there in terms of where power is actually flowing to though so we've taken a line where we are agnostic and don't care what's behind the meter, and that's how we have done things historically."*

Over half of the participating utilities, including all those that referenced their relationship with BPA, echoed the sentiment of remaining "agnostic" when it came to cannabis

customers, emphasizing that their public responsibility is simply to provide power to customers in their service territory. Additionally, two utilities (one in Washington and one in Oregon) mentioned that some utilities might be hesitant to be involved proactively in the cannabis market if they receive federal power, because the increased demand could move them into higher Tier 2 rates.[39]

4.3 Community Impacts

As public acceptance for cannabis has increased in Colorado, Washington and Oregon, the utility interviewees noted that they have not observed very many impacts, adverse or otherwise, on their local communities outside of energy usage. However, one Oregon utility mentioned that because the indoor growing operations are commonly found near other businesses and industrial spaces, there has been some pushback on the locations of the facilities based on their odors and potential impact on local business. Additionally, one of the Washington utilities with a primarily agricultural service territory said they recently had a break-in reported at a local cannabis production facility resulting in thousands of dollars worth of damages and stolen goods.

[39] Beginning in 2012, BPA adopted a tiered rate schedule that offers utilities two price levels when purchasing power supply. Initially, utilities lock in a specific amount of power they wish to purchase from the existing federal system at a cost-based rate (Tier 1). Subsequently, Tier 2 rates are applied for any additional energy a utility obtains from BPA over the course of their contractual agreement. Currently, Tier 2 rates ($/MWh) are approximately 4 percent higher than Tier 1 rates.

5 Trade Organization In-depth Interviews

To broaden the scope of the investigation beyond utility perspectives, Evergreen Economics also completed six in-depth interviews with various types of trade organizations that have experience operating in the cannabis market. Respondents had varying levels of experience in the cannabis industry, ranging from three years to over 20 years of experience. Both the Oregon energy efficiency advocacy group and the Colorado compliance consultants Evergreen interviewed noted that recreational legalization has added a layer of legitimacy to the structure of their businesses, as their customers and clients are more forthcoming and professional about their operations.

Five out of six responding trade organizations indicated they also have experience working with regional utilities and other trade organizations on cannabis-related issues. Generally, these interactions include conferences and organized cannabis group meetings with discussions on marketing, advertising, cost strategies, advocacy campaigns, state legislation and potential utility strategies.

In this section, Evergreen presents findings from the interviews, covering the following topics:

- Energy usage in growing operations;
- Cannabis grower characteristics and preferences;
- Legislative barriers;
- Other cannabis industry operations;
- Utility interventions; and
- Community impacts.

5.1 Energy Usage in Growing Operations

5.1.1 Energy Impacts

Energy Is Half of Operating Costs for Indoor Growers

While none of the responding trade organizations were cannabis producers themselves, all had at least some knowledge of the potential energy impacts associated with cannabis production, including the implications of indoor and greenhouse cannabis operations that consume more electricity than outdoor growing operations. According to multiple trade organizations, and confirmed by partnering growers, energy costs account for between 45 and 48 percent of total operating costs for indoor cannabis operations.

Some indoor cannabis operations consume enough energy that they require upgrades to distribution facilities. For example, the regional certification group Evergreen interviewed said that one Oregon utility approached them regarding a proposed new indoor growing

facility in their service territory that would require a new substation being built to fulfill their load estimates.

As Markets Mature, Greenhouses Become More Popular, in Part Due to Lower Operating Costs

All five trade organizations operating in states with legalized recreational cannabis noted that there was a dramatic increase in the number of cannabis producers following legalization in Colorado, Oregon and Washington. Organizations across all states believe the dramatic increase will start to taper off as the markets mature and certain producers are able to differentiate themselves with better product and lower operating costs due to economies of scale. In the Colorado market, which is already more mature than the Washington or Oregon markets, the cannabis advisor said they observed several indoor production facilities quickly enter the market without anticipating the associated electrical and upkeep costs. As a result, the growth of the number of indoor cannabis facilities has slowed down in Colorado as some facilities went out of business while others converted to greenhouse operations.

Both the nonprofit energy efficiency group and the Oregon growers advocate also mentioned that greenhouses are becoming more popular in Oregon as well because of their reduced operating costs. As background research and the utility interviews suggested, indoor growing operations are generally comprised of multiple cycles of crops operating simultaneously on either 18-hour or 12-hour operating cycles with regards to lighting. Conversely, the trade organizations argued that greenhouse operations can cut electricity usage down to more efficient 12-hour on/12-hour off cycles that utilize daylight during the day and only draw power during the early mornings and late evenings. Despite the potential of greenhouses in lowering operating costs, traditional indoor growing facilities are still more common across Colorado, Washington and Oregon because of their level of control on production and output scalability capabilities.

5.1.2 Energy Using Equipment

Lighting Accounts for Large Electricity Demand

Similar to the utility interview respondents, all six trade organizations said that lighting accounts for a significant proportion of indoor cannabis producers' costs, including the initial purchase and set up. Specifically, the Oregon grower advocate added that production costs—notably from lighting—for indoor facilities can be between $800 and $1,000 per pound of yield compared to between $150 and $300 per pound for outdoor operations that do not rely on artificial lighting.

Grower concerns about product quality and yield lead most new growers to set up indoor facilities that can potentially yield higher quantities and qualities of product.

T5 Fluorescents Are The Lighting Technology of Choice Over LEDs Due to Purchase Cost and Growing Production

For indoor facilities, the Oregon energy efficiency advocate, the California solar provider, and the Colorado advisor all said that growers are choosing T5 fluorescents over LEDs and other technologies because they produce the greatest product yield and can be more energy efficient than T8 or other high-intensity lighting equipment. Similar to the utilities, trade organizations are wary of LED adoption in the cannabis market, primarily because current LED options are seen as less productive to growers and are more expensive than other lighting, according to the efficiency advocate. Additionally, as the Colorado advisor pointed out:

> *"People pay a good amount for lights that produce a 30 percent increase in yield, so you see a lot more T5 fluorescents now and high-lumen Gavita grow lights that help with yield despite the fact those are 1,000 W every 20 feet.[40] The industry hates LEDs as far as I know; they are ugly and bulky. Think [of them] as the solar industry from 10 years ago."*

However, according to the founder of the regional certification group interviewed by Evergreen, there are some large indoor cannabis producers currently using LED lights, especially as new technologies are introduced in the market that are specifically designed for horticulture and that may minimize the product concerns observed with previous generations of LEDs.

5.2 Cannabis Grower Characteristics and Preferences

Trade organizations reported similar preferences as utility interviewees did with regards to prioritization of energy efficiency.

According to all six trade organizations Evergreen spoke with, the vast majority of cannabis producers are entering the cannabis market as either new growers or as growers with past experience operating in the medical or illegal markets prior to legalization (rather than as growers of other crops).

Product Yield Trumps Energy Efficiency, Although Energy Efficiency is Becoming More of a Priority in More Established Markets

Specifically, the trade organizations, like the utilities, said that product quality and overall yield remain the most important considerations for cannabis growers. Additionally, five of the six trade organizations Evergreen interviewed noted that energy costs are important for cannabis growers but may not be prioritized over product quality and yield. In more established markets such as Colorado or the medical cannabis market in California, where competition plays a key role in differentiating producers, efficiency has started to become

[40] Gavita is a specialized horticulture lighting company in Holland that specializes in grow lights and fixtures that produce high-lumen counts that support higher yield for cannabis producers

a higher priority. However, trade organizations in both Colorado and Oregon noted that efficiency still lags behind the concern for overall yield. As the certification group founder noted:

> *"I've always said, energy efficiency is almost dead last when they have fundamental challenges like "Is my bank account going to get shut down?" Historically, producers have always paid their bills and the margins have been fine."*

However, more than half of the trade organizations said there is a potential for efficiency to become more important for growers down the road, especially if regulations and efficiency standards are established at the state and utility levels. Additionally, in markets like Colorado, established growers are starting to realize that keeping costs down through efficiency practices allows them to differentiate themselves in the market and increase their operating margins.

Water Consumption

The Colorado advisor Evergreen interviewed noted that water consumption is fairly comparable between indoor and outdoor facilities despite the assumption that outdoor operations face more issues with water evaporation during the warmer summer months. The nonprofit certification group Evergreen interviewed spoke with a regional grower, which said they used between five and seven gallons of water per plant per day. Additionally, there are concerns with pesticide runoff and the implications of using federal versus private water for their operations.

5.3 Legislative Barriers

The participating trade organizations echoed many of the utility interviewee comments on the implications of the differences between state and federal legislation. They added additional concerns, including:

- Banking restrictions; and
- Possible effects of pesticides in the environment.

In the past, federal restrictions have made it difficult for cannabis growers to utilize banks. The grower advocate interviewee reported they were unable to open an account at their credit union because of their involvement with cannabis growers, despite the fact that they do not grow cannabis themselves. Additionally, the Colorado compliance consultant added that pesticide certification has been an issue for growers because pesticides are covered by the Environmental Protection Agency (EPA) which has thus far not approved several critical cannabis pesticides.

5.4 Other Cannabis Industry Operations

In addition to cannabis production facilities, all responding trade organizations acknowledged that other cannabis operations exist, such as retail stores, distribution, processing and residential growing, and that these operations have become more established since cannabis was legalized. However, these other markets have significantly fewer energy implications than commercialized cannabis production itself, although they do contribute to overall operating costs for producers that also distribute and retail their own cannabis products.

Focusing specifically on residential growing operations, trade organizations mentioned it is somewhat unclear how prevalent residential growing is across Colorado, Washington and Oregon; however, the Colorado compliance consultant estimated the percentage could be as high as 2 percent of customers in some areas (similar to the estimates from utilities).

5.5 Utility Intervention Strategies

Three of the six trade organizations were familiar with utility intervention strategies. Interventions discussed included measure-based incentives and a desire to not actively pursue interactions with growing operations.

Specifically, two Oregon trade organizations discussed some of the larger LED incentive strategies that have allowed some cannabis customers to save thousands of dollars in operating costs. Other rebates include ventilation and HVAC system rebates that are available to some cannabis producers.

Additionally, one of the trade organizations added that utilities may have varying strategies for energy efficiency incentives depending on the increased demand associated with cannabis operations. In the Northwest, Oregon and Washington utilities cannot use federal incentives for cannabis operations despite purchasing their power from BPA. As a result, some utilities that see an increase in energy demand may self-fund conservation efforts to avoid paying higher Tier 2 rates when purchasing their power supply. Other utilities have excess power and lack the motivation to fund conservation efforts.

Energy Efficiency Advocate Connecting Growers to Existing Utility Services

An energy efficiency advocate Evergreen spoke with works with utilities in Oregon to help provide existing utility incentives to cannabis growers. This advocacy group also performs verification before and after projects, which they report to have total incentives of between $16,000 and $18,000 on average per project thus far.

Need for Additional Research

The energy efficiency advocate Evergreen spoke with noted that additional research is needed on the overall energy usage in cannabis operations to better understand how to provide efficiency options to cannabis producers. Another organization we spoke with

noted that they are working on creating a baseline of energy usage to help local utilities. One of the interviewee's goals is to work with a range of growers with different sized cannabis operations to better understand what their average lumen per gram or wattage per gram is across multiple sized operations. These numbers can then help to inform incentive programs.

Solar to Offset High Demand

Trade organizations across Colorado, Oregon and California all discussed the possibilities of solar options in cannabis production facilities. In Boulder County, Colorado, the compliance advisor noted that growers are required by the county to use some percentage of green energy, either through green energy credits or by installing solar. Growers that do not comply are subject to an additional tax of approximately two cents per kWh.[41] In Oregon, the certification group added that some of the largest Oregon cannabis producers are investing in solar (and LEDs), which helps to offset their total energy demand. One trade organization interviewee suggested that growers could look into micro-grid solutions with no utility usage, relying on solar, wind or storage to power the production facility.

The California solar provider added that the payback period for solar in cannabis production facilities is longer compared with other commercial solar applications; due to the need for grow facilities to use electricity for supplemental lighting. As a result, the solar provider noted that only between 10 and 15 percent of the cannabis producers they discuss solar strategies with end up installing solar options. The solar provider that Evergreen spoke with reported that they see battery storage as an important next step to supporting solar usage in this industry.

Shortfall in Utility Infrastructure to Accommodate New Cannabis Facilities

One participating trade organization familiar with regional growing operations noted that in Oregon specifically, certain utilities are unable to accommodate new power requests for cannabis growers in a timely manner. This causes delays of up to five to six months from the time of request and in some cases may require the producers to resort to diesel-powered generators that are very inefficient. The producers are typically looking to develop facilities in rural or more remote areas that previously did not have power supply, but are experiencing lengthy lag times because of the amount of total power requests in Oregon due to the state's population growth.

5.6 Community Impacts

Overall, the participating trade organizations said that thus far they have not observed very many adverse community impacts in the states that have legalized cannabis production. The Oregon trade organization specifically noted that because counties have

[41] http://www.bouldercounty.org/env/sustainability/pages/mjimpactoffset.aspx

the option to opt out of cannabis production, some flexibility with the legalization laws exist in areas where the public perception may not be in favor of recreational cannabis use. One adverse effect that was discussed by both the Colorado compliance advisor and the Oregon certification group founder Evergreen interviewed was that outdoor growing does have the potential to impact the local water supply with pesticide runoff or by cannabis producers diverting water from local rivers. Wildlife advocates stress the dangers both practices may have on local fish and wildlife, especially if the practices become more prevalent in the market.

Conversely, three out of five trade organizations asked about taxes said that the taxes raised by cannabis production and sales will actually have the most influence on the community and will potentially offset any adverse community impacts that regulators and city planners may fear. For example, the Colorado market had close to $75 million in tax revenues in 2015, while Oregon has seen close to $43 million thus far.[42] [43] As the certification group noted, these taxes could be extremely valuable to communities to help pay for educational outreach, law enforcement and potential city development.

The Oregon grower advocate also noted that there is some potential to increase tourism revenue and legitimize cannabis production jobs which also could have a ripple effect through local economies, especially in metropolitan areas. Additionally, advocates for keeping cannabis illegal often point to the potential adverse effects cannabis could have on minors. Despite initial reports of increased usage amongst minors, Colorado has actually cited a 2 to 3 percent decrease in teenage use since legalization, presumably because the black market has transitioned into the regulated market.

[42] https://www.colorado.gov/pacific/revenue/colorado-marijuana-tax-data
[43] http://www.oregonlive.com/marijuana/index.ssf/2016/05/oregon_collected_105_million_i.html

6 Findings and Recommendations

In this section, Evergreen Economics presents its findings from this research and where possible, contextualizes them in terms of what they may mean for the cannabis industry in SDG&E's service territory.

Electricity costs comprise between 20 and 50 percent of growers' operational costs. Sixty percent of this cost is estimated to be due to demand charges for time of use rates. Lighting is the biggest source of energy (38% of total energy consumption), followed by venting and dehumidification (30%), air conditioning (21%), heating (5%), water (3%), CO_2 injection (2%) and drying (1%). In indoor facilities, load shapes are relatively flat, with high energy consumption rates between 18 and 24 hours a day resulting in high demand charges.

Almost all utilities Evergreen spoke with for this research have seen an **increase in energy demand** due to the legalization of recreational cannabis in their state, and the subsequent increase in growing operations. Evergreen's research did not find awareness of or reports of increased energy use attributed to cannabis distribution, retail facilities and recreational growing.

There are **many benefits associated with indoor growing, but these benefits come at the cost of increased energy usage compared** to greenhouse and outdoor growing. This report focuses on indoor and greenhouse growing, as these facilities are most likely to have an impact on the grid. Indoor growing offers shorter grow cycles, more control over lighting and temperature, and predictable output.

In exchange for control, indoor growers have the added operating expense of running lighting, venting and dehumidification, air conditioning, heating, water, CO_2 injection and drying. **It is well known that lighting in indoor and greenhouse facilities is responsible for a large proportion of operating costs**.

It is unclear what type of growth (indoor, outdoor or greenhouse) will occur in SDG&E's service territory, but Evergreen has found that before legalization, California was more likely than other states to have outdoor growing, and knows from past research that greenhouses make up a significant proportion of agricultural sales in San Diego. Interviewees reported that the choice between indoor, outdoor or greenhouse growing is in part due to the type of facilities and land that is available. SDG&E has both rural and urban areas, which may mean that the territory sees a mix of indoor, outdoor and greenhouse operations**. In terms of energy demand, indoor and greenhouse operations are most relevant, and therefore are the focus of our findings**.

The trade organization representatives we spoke with were under the impression that many of the current growers in states where cannabis production is legal came from either

non-agricultural industries or had past cannabis growing experience. While they did not think that many growers came from other crop industries, this may differ in SDG&E's service territory because of the local focus on high value crops due to the comparably high cost of water. This finding also has implications for energy efficiency awareness of growers. Those who have grown cannabis in the past may be less open to energy efficient technologies due to their current strategies for producing high yields in a shorter time frame. Those who are newer to the industry may be more open to learning about new energy efficient growing practices.

Greenhouses offer a middle ground between the greater environmental control of indoor grow operations and the lower energy demand of outdoor operations. Greenhouses allow growers to utilize natural lighting in the daytime, but require additional lighting during the winter in the early morning and in the evening. **This causes the load shape of greenhouses to vary significantly from indoor growing, where the load is constant and more predictable**.

While some cannabis growers have chosen to install LEDs, there remains a preference for T5s due to the impression among growers that the cannabis yield with LEDs is lower (although this is not a universal belief), that LEDs are bulky, and because the upfront cost of LEDs is prohibitory, especially given all the other startup costs associated with building a new indoor grow facility. Some growers in other states have utilized solar to offset their energy intensive growing practices.

The opportunity exists for utility interventions—other than lighting—including air conditioning systems, controls and conversion to drip irrigation. A few utilities have taken tailored approaches in regards to these interventions, with one offering a specific rate and others offering customized incentives. Growers can also take advantage of existing rebate programs. Some utilities hesitate to engage with commercial growers because they do not want to encourage growth in an energy-intensive market and have concerns about differences in federal, state and local laws.

Utilities have had requests for infrastructure upgrades to meet the demand of new operations. Some have considered working with growers to fund new transformers and transformer upgrades, but no utilities reported doing this yet. One trade organization reported that increased infrastructure requirements have delayed further growth of the cannabis industry.

After legalization, utilities reported a slight lag of around six months in the development of growing operations, indicating there is a **short window of time between legislative and industry changes for SDG&E to take action**.

As markets mature, it is possible that growers will shift their focus to keeping operating costs low in order to remain competitive. In markets like Colorado, established growers

are starting to realize that keeping costs down through energy efficient practices and investments allows them to differentiate themselves in the market and increase their operating margins. Cannabis producers may be inclined to work in areas where energy costs are lower in order to manage their operating costs.

Given the industry findings from states that have experienced the growth of the cannabis market after legalization, Evergreen Economics recommends the following:

- **Focus on infrastructure and accommodation as an initial strategy.** While utilities and trade organizations report that efficiency will play a big role in the California cannabis market, the initial focus should revolve around ensuring SDG&E has the general resources to accommodate the rapid growth of cannabis producers. This includes ensuring that SDG&E has the engineering partners, line crews and other field employees in place to accommodate cannabis growers looking to enter the market very soon after legalization.
- **Engage with cannabis producers and trade allies** as soon as possible **in order to influence purchase decisions for new facilities.** Smaller scale growers are more likely to purchase lighting from box stores whereas established growers rely on traditional horticultural and cannabis grow shops.
- **Customize program literature to the needs of this specific industry,** as new growers will likely come from other industries or from cannabis-specific operations.
- **When advising growers on energy efficient options, take into account local building codes as they relate to indoor cannabis operations.** In Portland, Oregon, growers are finding that city code requires U-values that are too tight for cannabis production (but are generally more efficient overall). To offset insulation efficiency standards, growers are overcompensating with additional air conditioning, increasing their overall energy use.
- **Monitor local initiatives banning commercial growing that may make it more difficult to control load growth; such bans may lead to widespread residential growing.** A trade organization noted that Boulder County, Colorado, an area that is similar to San Diego in that it has a strong military presence, placed a moratorium on recreational and commercial facilities at one point because of the community's concerns with the potential impacts of commercial growing operations. This caused recreational cannabis growing to increase dramatically, putting an energy strain on Boulder that was more difficult to monitor than the potential energy usage from licensed commercial facilities.
- **Monitor equipment choices as the local cannabis industry develops to gain an understanding of how San Diego's unique climate and drought conditions influence grower choices and energy usage after legalization.** San Diego's climate may require additional cooling needs for indoor facilities compared to the Northwest. The high water costs may influence growers to select more efficient

watering options (such as drip irrigation). It will be important to balance observation with intervention as new facilities likely will not be ready to invest in more efficient equipment soon after purchasing new equipment for their operations.

- **Work with trade organizations to provide information and tools for growers to compare the energy usage and yield for indoor and greenhouse operations.** Greenhouses are able to utilize natural light during the day and thus minimize energy costs, while indoor facilities offer more control over the environment and are more costly to operate. A level of control may be lost from growing indoors instead of in a greenhouse.
- **Consider encouraging integrated solutions that allow facilities to take advantage of wind and solar to help offset increased demand.** Multiple cannabis facilities in Washington and Oregon have started to explore solar options with integrated storage.
- **Create an internal policy for dealing with the differences in federal, state and local cannabis laws**. Some utilities expressed concern about knowing where production occurs in case of federal intervention.

7 Appendix A – Literature Review Sources

- *Cannabis – A Big Issue Coming to a Utility Near You,* Jeff Ihnen, Michaels Energy, 2016, http://michaelsenergy.com/cannabis-a-big-issue-coming-to-a-utility-near-you/
- *Harvesting Energy Savings in Cannabis Cultivation Facilities: Quick Wins for Cultivators and Utilities,* David Podorson, 2015, https://www.esource.com/TAS-F-18/CannabisCultivation
- *Pot Power: How utilities and regulators are dealings with the budding marijuana industry,* Gavin Bade, 2015, http://www.utilitydive.com/news/pot-power-how-utilities-and-regulators-are-dealing-with-the-budding-mariju/409172/
- *Marijuana grow houses boost Denver power demand, complicating efficiency plans,* Robert Walton, 2015, http://www.utilitydive.com/news/marijuana-grow-houses-boost-denver-power-demand-complicating-efficiency-pl/401751/
- *Boulder levies extra electric charge on marijuana growers,* Robert Walton, 2014, http://www.utilitydive.com/news/boulder-levies-extra-electric-charge-on-marijuana-growers/332012/
- *The Booming Pot Industry Is Draining the U.S. Energy Supply*, Tom Huddleston, Jr., 2015, http://fortune.com/2015/12/21/marijuana-energy-consumption/
- *This is the grid. This is the grid on legalized marijuana. Any questions?*, Ethan Howland, 2014, http://www.utilitydive.com/news/this-is-the-grid-this-is-the-grid-on-legalized-*marijuana*-any-questions/233103/
- *As Pot-Growing Expands, Electricity Demands Tax U.S. Grids,* Jennifer Oldham, 2015, http://www.bloomberg.com/news/articles/2015-12-21/as-pot-growing-expands-power-demands-tax-u-s-electricity-grids
- *Pot is power hungry: why the marijuana industry's energy footprint is growing,* Melanie, Sevcenko, 2016, https://www.theguardian.com/us-news/2016/feb/27/marijuana-industry-huge-energy-footprint
- *Survey: Washington Cannabis Growers Would Like Help With Energy Efficiency*, John Harrison, 2015, https://www.nwcouncil.org/news/blog/cannabis-energy-use-update-august-2015/
- *Seventh Northwest Conservation and Electric Power Plan*, Northwest Power and Conservation Council, 2016, http://www.nwcouncil.org/media/7149940/7thplanfinal_allchapters.pdf
- *Electrical load impacts of indoor commercial cannabis production*, Northwest Power and Conservation Council, 2014
- *State Laws,* National Organization for the Reform of Marijuana Laws, 2016, http://norml.org/laws

- *Marijuana Legalization Across U.S. May Hinge on 2016 California Vote,* Alison Vekshin, 2015, http://www.bloomberg.com/politics/articles/2015-04-13/pot-legalization-across-u-s-may-hinge-on-2016-california-vote
- *Marijuana Data Discovery and Gap Analysis*, Jack Reed, Office of Marijuana Coordination, 2014, https://www.awcnet.org/portals/0/documents/legislative/MarijuanaDataDiscoveryGapAnalysisCO100714.pdf
- *The Unexpected Side Effects of Legalizing Weed*, Marjorie Haun, 2015, http://www.newsweek.com/unexpected-side-effects-legalizing-weed-339931
- *How Oregon marijuana growers plan to get efficient following $5,000 fines for power outages*, James Cronin, Portland Business Journal, 2015, http://www.bizjournals.com/portland/blog/sbo/2015/11/how-oregon-marijuana-growers-plan-to-get-efficient.html
- *California Control, Regulate and Tax Adult Use of Marijuana Initiative (2016)*, 2016, https://ballotpedia.org/California_Control,_Regulate_and_Tax_Adult_Use_of_Marijuana_Initiative_(2016)
- *Indoor marijuana grows cause headaches for Oregon Utilities,* James Cronin, Portland Business Journal, 2015, http://www.bizjournals.com/portland/blog/sbo/2015/11/indoor-marijuana-grows-cause-headaches-for-oregon.html
- *Obama administration will not block state marijuana laws is distribution is regulated*, Brady Dennis, 2013, https://www.washingtonpost.com/national/health-science/obama-administration-will-not-preempt-state-marijuana-laws--for-now/2013/08/29/b725bfd8-10bd-11e3-8cdd-bcdc09410972_story.html
- *Colorado's Legalization of Marijuana And The Impact On Public Safety*, Police Foundation and the Colorado Association of Chiefs of Police, 2015, http://www.nccpsafety.org/assets/files/library/Legalized_Marijuana_Practical_Guide_for_Law_Enforcement.pdf
- *Submission of Amendment to Statewide Initiative Measure – Control, Regulate and Tax Adult Use of Marijuana Act, NO. 15-0103*, Olson Hagel & Fishburn LLP, 2015, http://www.oag.ca.gov/system/files/initiatives/pdfs/15-0103%20%28Marijuana%29_1.pdf?
- *The State of Legal Marijuana Markets: 4th Edition*, Arcview Market Research, 2015, http://static1.squarespace.com/static/526ec118e4b06297128d29a9/t/56f21ed59f7266ee27800d7b/1458708198877/Executive+Summary+-+The+State+of+Legal+Marijuana+Markets+-+4th+Edition.pdf
- *Oregon on track to collect $43 million in pot taxes this year,* Noelle Crombie, The Oregonian/OregonLive, 2016, http://www.oregonlive.com/marijuana/index.ssf/2016/05/oregon_collected_105_million_i.html