Energy and Equity in Cannabis Cultivation

GENEVIEVE BYRNE

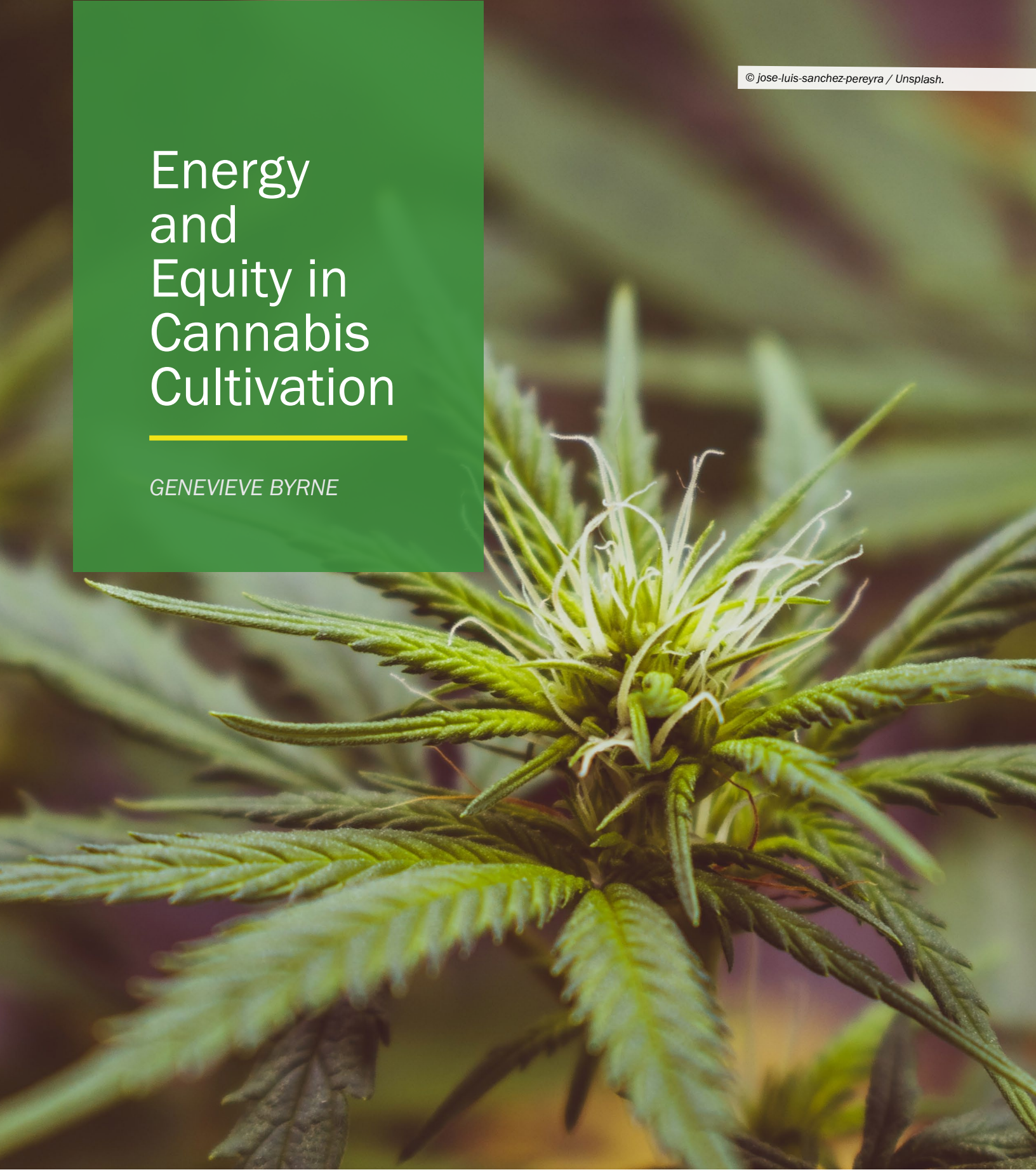

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Table of Contents

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About the Farm and Energy Initiative

The Farm and Energy Initiative (FEI) is a collaboration between the Institute for Energy and the Environment and the Center for Agriculture and Food Systems at Vermont Law and Graduate School and supported by funding from the National Agricultural Library at the United States Department of Agriculture. FEI seeks to lead research and create open access resources to farmers, researchers and public citizens alike, to promote the future sustainability of the agricultural industry. Our projects examine legal and practical issues at the intersection of energy and agriculture with the goal of improving agricultural energy management nationwide. Learn more about our work at farmandenergyinitiative.org.

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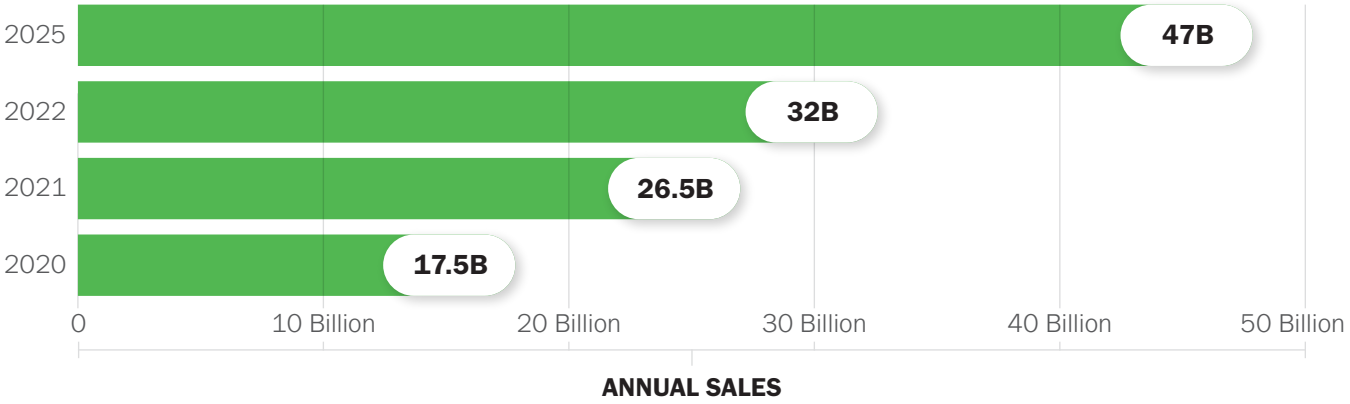
I. Introduction

The continuing trend toward state legalization of high-THC[1] cannabis[2] for medicinal and adult recreational use has rapidly changed the cannabis cultivation industry.* In August 2016, 4 states permitted adult recreational use of cannabis.[3] By 2022, that number had increased to 19 (including the District of Columbia), with 39 allowing medicinal use.[4] These legal changes have resulted in a boom in cannabis commerce, as 248 million Americans (around 74 percent of the US population) now live in a state with some legal access to cannabis.[5] In 2020, state-legal sales of medicinal and recreational cannabis totaled a record $17.5 billion dollars, a nearly 50 percent increase over the prior year.[6] In 2021, annual sales in the US grew to $26.5 billion dollars and are projected to reach at least $32 billion in 2022 and $47 billion in 2025.[7] To meet consumer demand, cannabis legalization has led to a significant increase in commercial cannabis production. Legal cannabis is now arguably the sixth largest cash crop in the US by wholesale harvest value.[8] The burgeoning cannabis industry comes with numerous environmental impacts, including increased demand for electricity to power commercial operations.[9]

STATE-LEGAL SALES OF MEDICINAL AND RECREATIONAL CANNABIS



**There is presently significant criticism of use of the words "marijuana" and "marihuana" as default references to recreational cannabis given that they were adopted as part of an explicit attempt to associate the drug with Latinx criminality.[10] This report only uses the words "marijuana" and "marihuana" when quoting federal, state, or local legal standards that use those terms.*

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"MARIJUANA" IS CONSIDERED A SCHEDULE 1 SUBSTANCE under the Controlled Substances Act, making it illegal at the federal level (21 U.S.C. ch. 13 sec. 801). "Hemp" and high-THC cannabis both come from the cannabis sativa plant. Under the 2018 Farm Bill, cannabis sativa "with a THC content of less than 0.3% was removed from the federal controlled substance definition of 'marijuana' and was classified as 'hemp.'"[11] When using the term "cannabis," this report is referring to the higher-THC cannabis intended for medicinal and lifestyle use. Hemp is not included.

This report focuses on the social equity and energy equity impacts of regulating energy consumption in the cannabis industry. It discusses the high levels of electricity consumed by indoor cannabis cultivators, explains how energy management requirements are being integrated into the specialized state licensing processes for cannabis businesses, and introduces some of the social equity and energy equity issues arising in the cannabis industry. Illustrative examples of state and local energy regulations are organized into four categories, including (A) legal status of outdoor or greenhouse cultivation; (B) requirements for energy planning, reporting, and benchmarking; (C) energy efficiency standards; and (D) requirements for renewable energy consumption. This report considers each category of regulation in the context of social equity, including potential barriers to entry to the cannabis market, and energy equity, including how grid management costs are allocated between cultivators and other ratepayers.

There are many legal and policy options available to state and local regulators seeking to make the cannabis cultivation industry more sustainable. This report aims to help policymakers, community leaders, advocates, researchers, and others better understand the equity concerns that arise in regulating the electricity consumption of indoor cannabis cultivators and to prompt law and policy solutions that better balance equity and sustainability.

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II. Energy and Equity Considerations

A. How Much Energy Does Cannabis Cultivation Consume?

All cannabis products in a regulated market must be grown in the state where they are sold because federal law continues to ban interstate cannabis sales.[12] Most regulated cannabis is grown indoors. Growing indoors is not always a choice for cultivators; some states ban commercial outdoor and greenhouse production based on security concerns while others leave it up to individual cities and towns to determine what forms of cultivation are permissible. Where choice is available, cultivators may prefer to grow indoors to better control the quality of their crop and the security of their facility. Outdoor growth is more energy efficient but can also result in a lower quality product because outdoor cultivators have less control over environmental conditions. A 2021 survey of 127 commercial cannabis cultivation operations found that 54 percent of respondents grew exclusively indoors, an increase of 12 percent over the prior year.[13] Another 13 percent supplemented indoor cultivation with either outdoor or greenhouse growth.[14] Only 11 percent of respondents cultivated entirely outdoors, while 4 percent cultivated exclusively in greenhouses.[15]

Growing market-quality cannabis indoors requires intensive production conditions supported by a continuous input of electricity. Indoor cannabis cultivation requires climate management to produce optimal growing conditions, including specialized lighting, water management, and HVAC systems.[16] These indoor environmental controls prevent crop loss and optimize yield, but often demand large amounts of electricity. A 2021 study estimated at least 80 percent of the greenhouse gas emissions from indoor cannabis cultivation are "caused by practices directly linked to indoor cultivation methods," including specifically "indoor environmental control, high-intensity grow lights and the supply of CO_2 for increased plant growth."[17] Their results suggest that if Colorado were to fully convert all of its indoor cannabis cultivation to outdoor production, the state's total annual emissions would be reduced by more than 1.3 percent, a result comparable to eliminating the state's coal mining industry (1.8 percent of annual state emissions).[18]

A MEGAWATT-HOUR indicates the usage of 1,000 kilowatts or 1,000,000 watts of energy capacity in one hour. Your toaster or blender might have a 1,000-watt rating. Because 1,000 watts equals one kilowatt, you would need to run your toaster for 1,000 hours, or almost 42 days, without ever turning it off to consume one megawatt-hour of energy.

Estimates vary regarding just how much electricity indoor cultivation operations need. A report by New Frontier Data, a cannabis industry market research firm, estimated that regulated cultivators used 1.1 million megawatt-hours (MWh) of electricity in 2017, with 60 percent consumed by indoor production and 37 percent by greenhouse production.[19] This represents the same amount of electricity to power "92,500 homes for a year."[20] The same report estimated that if unregulated cultivation is also considered, the figure increases to 4.2 million MWh.[21] In 2017, US total retail sales of electricity to all sectors totaled 3.72 billion MWh.[22] When these numbers are tallied, cannabis cultivation consumed approximately 0.11 percent of all electricity used in the US in 2017, while regulated cultivators used 0.03 percent. However, actual electricity consumption by cannabis cultivators may be much higher—up to and potentially exceeding 1 percent of total US electricity consumption, putting cultivators on par with other large electricity intensive uses, like data storage centers.

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A 2021 REVIEW OF RESEARCH INTO THIS TOPIC BY EVAN MILLS AND SCOTT ZERAMBY FOUND A RANGE OF CONCLUSIONS ABOUT ENERGY USAGE IN INDOOR CANNABIS CULTIVATION:

ESTIMATED ELECTRICITY CONSUMPTION BY ALL INDOOR CULTIVATION FACILITIES[23]

Author	year	GEOGRAPHIC AREA	PERCENTAGE OF TOTAL CONSUMPTION IN THE NAMED GEOGRAPHIC AREA
Easton	2004	British Columbia	1%
Mills	2012	California	3%
Mills	2012	US	1%
Jourabchi	2014	Washington	1%
Remillard and Collins	2017	Washington	3%
Remillard and Collins	2017	Colorado	0.5–1%
New Frontier Data (as calculated in this report)	2017	US—all cultivation US—regulated cultivation	0.11% 0.03%
Hood	2018	Denver, CO	4%
Hood	2018	Colorado	0.6%

While the estimates and data sets differ (see chart, above), relevant studies collectively conclude that electricity consumption by cultivation facilities is quite high. Unless facilities are powered exclusively by clean energy, they are a new major source of fossil fuel consumption and resulting greenhouse gas emissions.

The more recent estimates from states with established regulated markets are likely the most reliable, as more years of data are available and organized data collection may be required by state law. Even the lower consumption numbers estimated by New Frontier Data (4.2 million MWh or 0.11 percent of total US consumption) indicate that national cannabis cultivation is approaching the annual electric demand of an entire state. In comparison, all sectors within the state of Vermont used a total of 5.4 million MWh in 2017.[24]

Some cannabis cultivators have been incredibly innovative in managing their electricity consumption. The Solar Cannabis Company in Somerset, Massachusetts, is an example. It is an energy independent cannabis

Unless facilities are powered exclusively by clean energy, they are a new major source of fossil fuel consumption and resulting greenhouse gas emissions.

cultivation and dispensary facility that is also registered as a power plant.[25] The uniquely designed facility uses LED lighting and other efficiency measures to maintain a low energy profile and hosts 67,000 square feet of solar panels on the facility and adjacent fields.[26] They generate approximately 5 megawatts of energy that feed a "microgrid," or small independent electric grid, which has helped to reduce emissions by nearly 60 percent.[27] These innovations were funded in part by more than $1 million in total rebates from local utility companies.[28] While the Solar Cannabis Company has worked to ensure it is powered by clean energy and has little impact on the surrounding electric grid, the same is not true of or possible for many cultivators. Energy investments are expensive and significant capital is required up front to take advantage of million-dollar rebates. For cultivators without access to capital, access to clean energy and energy efficient technology can be very difficult to obtain.

ENERGY EFFICIENCY UPGRADES in a cannabis cultivation facility can cost tens to hundreds of thousands of dollars, depending on the size of the business and the scope of the improvements. A seemingly simple improvement, like installing more efficient lightbulbs, can cost upwards of $30,000 in a commercial facility's vegetative room when swapping 1,200 fluorescent lamps for tubular LEDs.[29]

Utilities that manage the electric grids hosting indoor commercial cannabis cultivation facilities have drawn attention to electric grid failures potentially caused by cultivation operations.[30] Utilities serving areas with known cultivation facilities report higher incidents of blackouts and equipment failure.[31] One utility reported seven blackouts resulting from indoor cannabis cultivators.[32] Another utility pointed to indoor cultivators when it needed to replace 10 percent of its transformers due to overheating.[33] Whether each reported blackout is reliably or solely attributable to cannabis cultivators is unknown, but adding numerous large electric customers certainly increases the burden on electric distribution grid infrastructure and can add to energy procurement costs for utilities, and ultimately, ratepayers.

Across the United States, energy consumption by indoor commercial cultivation is an increasingly frequent target for enhanced regulatory oversight. Consequently, state and local lawmakers have begun to seek and test policy solutions to improve energy management in the cannabis industry. For example, cultivators may be subject to requirements for energy planning and benchmarking, energy efficient equipment, or renewable energy procurement, and may be eligible for special incentive programs aimed at improving the sustainability of cannabis operations. However, these requirements are not always supported by financial and technical assistance for cultivators and can prevent market entry for cultivators without access to significant capital.

B. Who Gets to Grow? State Licenses for Legal Cannabis Cultivation

State laws vary widely regarding legal cannabis cultivation and consumption.[34,35] Some states have "decriminalized" cannabis, while others have enacted laws allowing adults to possess, buy, grow, or consume cannabis for medical or recreational purposes. Several states have established entirely new regulatory schemes to oversee the commercial cultivation and retail sale of cannabis, including administrative processes to license, regulate, and tax certain market participants.[36]

States control who and how big commercial cannabis cultivators are, and how many enter the market, by issuing cultivation licenses.[37] Businesses cannot lawfully cultivate cannabis without a license.[38] The licensing process for commercial cannabis cultivation generally begins with an application to the regulatory board, commission, or agency designated by the state to be the entity tasked with oversight of cultivators. This may be a new regulatory authority or an existing state agency.[39] States may also limit the total number of commercial cultivator licenses available and impose a wide variety of operational requirements on those approved for a license. The licensing process provides a regulatory hook for requiring cultivators to minimize their environmental impact, including consumption of electricity. In addition to any conditions imposed by the state licensing process, cannabis cultivators are typically subject to environmental or energy requirements included in local zoning or permitting regulations.

C. Social Equity and Restorative Justice

"Those creating legalization regimes get to choose the type or class of organization that can supply cannabis. It could be home producers, co-ops, nonprofits, government entities, or, as has been passed in eighteen states, for-profit companies. That creates opportunities for lucky or smart entrepreneurs to get rich and so raises the question of who will get those licenses."

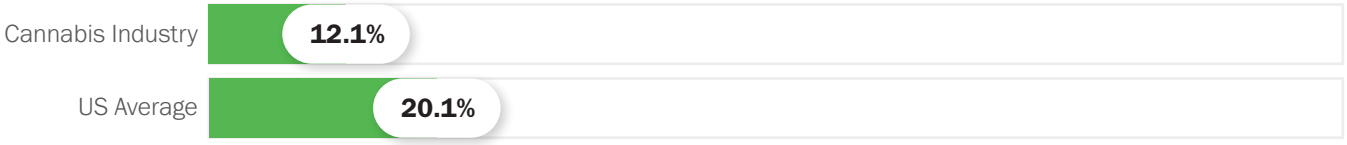
Beau Kilmer, et al. 2021[40]

The people empowered to make decisions about legal cannabis, including state and local lawmakers and cannabis regulatory boards, determine who may participate in the burgeoning cannabis industry and how. Decision-makers should consider both social equity and restorative justice in creating and implementing regulatory schemes for the cannabis industry.

I. SOCIAL EQUITY

While the cannabis industry offers significant financial opportunities for those licensed to participate, a vast majority of the individuals who enjoy those opportunities are white.[41;42] Only 12.1 percent of executives in the cannabis industry in 2022 were non-white, a one percent reduction from 2021 and below the national average of 20.1 percent for all US businesses. The number of non-white executives has declined even though several states try to facilitate non-white participation in the cannabis industry.[43] Social equity in the context of cannabis legalization and regulation means that the opportunities and benefits of the industry should be shared, and that decision-makers should consider historic and systemic racism when designing regulatory regimes.

NON-WHITE INDUSTRY EXECUTIVES - 2022



The financial barriers to cannabis business ownership are a significant factor contributing to the scarcity of cannabis industry stakeholders of color.[44] Because cannabis is still federally criminalized, most banks are unwilling to lend money to potential cannabis entrepreneurs, which means that hopeful entrepreneurs usually need to have the capital start-up costs up front.[45] Some state regulatory programs have created additional barriers to entry into the cannabis market by restricting individuals with felony possession of cannabis convictions from obtaining licenses.[46] Cannabis prohibition has disproportionately impacted Black, Indigenous, and People of Color (BIPOC) and contributed to historic and persistent social inequities, including the increased likelihood of arrest and conviction for cannabis-related offenses and the subsequent challenges presented by having a criminal record.[47] Some states are working toward social equity by creating special licenses or programs that give preferential treatment to "social equity applicants" or people from communities that have been "disproportionately affected" by cannabis prohibition (see definitions in the box on pages 12-13).[48] Others have taken actions to reduce barriers for these individuals by offering free training opportunities, legal support, and financial support in the form of fee waivers, loans, grants, or other access to financing.[49]

II. RESTORATIVE JUSTICE

While social equity initiatives aim to create future opportunities for BIPOC participation in the cannabis industry, restorative justice initiatives attempt to compensate disproportionately affected communities for past inequities. President Biden recently granted a pardon to all US citizens and lawful permanent residents convicted of "simple possession of marijuana in violation of the Controlled Substances Act."[50] At the state level, efforts at restorative justice include the expungement of cannabis-related offenses and the release of people incarcerated for activities that are no longer considered criminal offenses.[51] Other initiatives include directing funds generated by the state taxation of licensed cannabis businesses toward programs that benefit communities particularly affected by cannabis prohibition.[52]

State and local lawmakers should be aware that energy regulations designed to mitigate the environmental impact of commercial cannabis may create additional barriers to market entry by imposing increased costs on license applicants. To equitably regulate energy, lawmakers should consider relaxed requirements for defined applicants or the provision of legal, financial, consulting, or other support in complying with energy standards. For example, Illinois established a Cannabis Business Development Fund that provides low-interest loans and grants to "qualified social equity applicants" to help pay for "ordinary and necessary expenses to start and operate a cannabis business."[53] The fund also assists with "job training and technical assistance for residents in Disproportionately Impacted Areas," as defined by the state.[54] Support systems like these are necessary tools to increase equity in the cannabis industry, especially as compliance with restrictive energy regulations becomes more complicated and expensive.

D. Energy Equity and Cost

"Studies show that communities of color, which are heavily burdened by the harms of fossil fuel generation and sky-high energy costs, have less access to new solar energy technologies. We urge Congress to prioritize these communities for local clean energy developments and opportunities to own clean energy assets, like solar panels, wind and water turbines and batteries."

Alice Kaswan and Shalanda H. Baker, 2021[55]

Many of the same people who are and have historically been harmed by the criminalization of cannabis are also underserved by clean energy and energy efficiency programs.[56] They are already more likely to experience financial burdens from clean energy policies and are less able to take advantage of economic opportunities.[57]

NET-METERING PROGRAMS allow eligible electric customers to offset their electric bills with any excess energy generated by that customer's solar array.[58]

Social equity applicants for a cannabis cultivation license are likely to need additional support in negotiating electric interconnection processes, obtaining capital to pay for necessary grid upgrades, and shopping for a utility and available rate-class that best serves them (where choices are available). For example, individuals without credit, real estate, capital, and significant tax liability (to take advantage of federal tax incentives) face real challenges in owning a net-metered solar array.[59] Instead, these individuals may experience increased electric rates and an increased energy burden[60] due to a clean energy policy that mostly benefits wealthier ratepayers. This can happen for two reasons: first, customers generating excess energy in traditional net-metering programs are often compensated at the retail electricity rate, which means the utility is paying more for that energy than its usual wholesale cost.[61] Because the difference is collected in electric rates, this increases the energy burden of customers who are not able to participate

in net-metering.[62] Second, when net-metered customers are allowed to "zero-out" their electric bill through the sale of excess generation, they avoid paying any of the overhead costs of grid maintenance and electricity delivery. These costs are shifted onto other ratepayers, again increasing their energy burden.[63]

"ENERGY BURDEN" is the percentage of household income that goes toward energy costs. Earning less money or paying higher electric bills increase a household's energy burden. Black, Hispanic, and Native American households all face a higher than average energy burden.[64]

This is not to say that clean energy programs like net-metering should not exist, as they have been instrumental in expanding distributed renewable energy generation and bringing down the overall cost of renewable energy technology. Many states are addressing inequities in their net-metering programs by imposing mandatory minimum costs on net-metered customers, adjusting net-metering rates, and providing specific opportunities for low-income participation.[65] When designing energy standards and regulations for the cannabis industry, lawmakers should strive to create more equitable clean energy policies that do not cause further harm to historically harmed communities.

EXAMPLES OF STATE DEFINITIONS FOR "SOCIAL EQUITY APPLICANT"

Illinois

410 Ill. Comp. Stat. Ann. 705/1-10 (West 2019)

"Social Equity Applicant" means an applicant that is an Illinois resident that meets one of the following criteria:

(1) an applicant with at least 51% ownership and control by one or more individuals who have resided for at least 5 of the preceding 10 years in a Disproportionately Impacted Area;

(2) an applicant with at least 51% ownership and control by one or more individuals who:

  i. have been arrested for, convicted of, or adjudicated delinquent for any offense that is eligible for expungement under this Act; or

  ii. is a member of an impacted family;

(3) for applicants with a minimum of 10 full-time employees, an applicant with at least 51% of current employees who:

  i. currently reside in a Disproportionately Impacted Area; or

  ii. have been arrested for, convicted of, or adjudicated delinquent for any offense that is eligible for expungement under this Act or member of an impacted family.

Washington

Wash. Rev. Code Ann. § 69.50.335 (West 2022)

(b) "Social equity applicant" means:

i. An applicant who has at least fifty-one percent ownership and control by one or more individuals who have resided in a disproportionately impacted area for a period of time defined in rule by the board after consultation with the commission on African American affairs and other commissions, agencies, and community members as determined by the board;

ii. An applicant who has at least fifty-one percent ownership and control by at least one individual who has been convicted of a cannabis offense, a drug offense, or is a family member of such an individual; or

iii. An applicant who meets criteria defined in rule by the board after consultation with the commission on African American affairs and other commissions, agencies, and community members as determined by the board.

EXAMPLES OF STATE DEFINITIONS FOR "DISPROPORTIONATELY IMPACTED AREA"

Illinois

410 Ill. Comp. Stat. Ann. 705/1-10 (West 2019)

"Disproportionately Impacted Area" means a census tract or comparable geographic area that satisfies the following criteria as determined by the Department of Commerce and Economic Opportunity, that:

(1) meets at least one of the following criteria:

(A) the area has a poverty rate of at least 20% according to the latest federal decennial census; or

(B) 75% or more of the children in the area participate in the federal free lunch program according to reported statistics from the State Board of Education; or

(C) at least 20% of the households in the area receive assistance under the Supplemental Nutrition Assistance Program; or

(D) the area has an average unemployment rate, as determined by the Illinois Department of Employment Security, that is more than 120% of the national unemployment average, as determined by the United States Department of Labor, for a period of at least 2 consecutive calendar years preceding the date of the application; and

(2) has high rates of arrest, conviction, and incarceration related to the sale, possession, use, cultivation, manufacture, or transport of cannabis.

Washington

Wash. Rev. Code Ann. § 69.50.335 (West 2022)

(a) "Disproportionately impacted area" means a census tract or comparable geographic area that satisfies the following criteria, which may be further defined in rule by the board after consultation with the commission on African American affairs and other agencies, commissions, and community members as determined by the board:

(i) The area has a high poverty rate;

(ii) The area has a high rate of participation in income-based federal or state programs;

(iii) The area has a high rate of unemployment; and

(iv) The area has a high rate of arrest, conviction, or incarceration related to the sale, possession, use, cultivation, manufacture, or transport of cannabis.

This report uses the term "social equity applicants" to refer generally to cannabis industry license applicants who are the intended beneficiaries of social equity and restorative justice measures.

Lawmakers should strive to create more equitable clean energy policies that do not cause further harm to historically harmed communities.

In addition to supporting historically harmed individuals, energy regulation for cannabis cultivation should strive for an equitable division of costs and benefits between the cultivation facility that is drawing power from the grid and the utility's other customers in the same service area. The high energy needs of indoor commercial cannabis cultivation can raise both interconnection costs and energy supply costs for growers. There is also a risk that electric demand from new cultivation facilities will increase the utility's coincident peak load, or the maximum demand for electricity from all users on the grid system, which is likely to increase prices for all ratepayers.[66] Commercial and industrial electric customers are often required to pay demand charges—additional costs based on their individual peak load, or highest demand for electricity over a specified time period.[67] While these demand charges improve the equity of allocating the costs of a utility's coincident peak load, smart energy policy can reduce the impact of commercial indoor cannabis cultivation facilities on the coincident peak load by targeting these facilities with time-of-use rates and other demand management programs.

It is also possible to shift the timing of an indoor cultivation facility's energy demand, which reduces the overall cost to the utility of obtaining electricity to meet demand.[68] When a new customer signs up for electric service, the electric utility evaluates whether connecting the new customer will require modifications or upgrades to the distribution grid to provide service. The higher the new customer's electric demand, the more likely that upgrades will be needed. Electric utilities generally have a policy for line extensions and new connections that establish and explain the division of costs between the utility and the new customer.[69] Each utility line extension or grid upgrade may solely benefit the new cultivation facility, or it may serve and benefit a large number of ratepayers in the service area. Generally, an equitable division of costs requires the avoidance of "cross-subsidization" between electric customers;[70] investments benefitting only the cultivation facility should be paid by the cultivation facility, while investments benefiting ratepayers should be appropriately socialized and allocated by the utility across their customer base. Subsidies and access to financing can help support social equity applicants in the cannabis industry while maintaining equitable allocation of electric distribution costs among ratepayers.

Further, equitable energy policy should treat cultivation facilities in the same manner as other new interconnecting customers in their class. Generally, state public utility commissions are tasked with ensuring that regulated electric utility rates are both "just and reasonable" (fair to both the utility and the ratepayers) and "not unduly discriminatory" (instead, that they treat similarly situated customers similarly).[71] If state law requires cannabis cultivation facilities to be treated differently from other high-demand electric customers in their class, it could trigger constitutional issues, such as state takings[72] limitations or even equal protection challenges.[73]

STATES HAVE A LEGITIMATE INTEREST IN REDUCING GREENHOUSE GAS EMISSIONS FROM THE ELECTRIC SECTOR, BUT SINGLING OUT CANNABIS CULTIVATION FOR IMPROVEMENTS NOT REQUIRED OF OTHER INDOOR CULTIVATORS OR OTHER HIGH-DEMAND ELECTRIC CONSUMERS MAY INVITE CONSTITUTIONAL CHALLENGES.

1. EQUAL PROTECTION

The 14th Amendment to the US Constitution prohibits states from creating legal distinctions between persons based solely on differences that are not rationally related to a legitimate government objective. Some cannabis licensing regulations single out cannabis cultivators for electricity management obligations that are not required for similar cultivators of other indoor agricultural crops or of similar electric customers in the same customer class.[74]

2. REGULATORY TAKINGS

The Supreme Court has found that "monetary exactions" in local permit conditions may be a regulatory taking if the government cannot demonstrate an "essential nexus" with a legitimate state interest or if the permit condition is not roughly proportional to the impact of the proposed development.[75] It may constitute a regulatory taking if cannabis licensing regulations do not fairly or proportionally allocate the burden of emissions reductions among contributing electric consumers.

Ultimately, equitable energy policy for cannabis cultivation should support social equity applicants in navigating and complying with energy regulations and meeting required costs. Utilities should establish and offer energy efficiency incentives, demand-side management programs, and time-of-use rates directed at cultivators. Additionally, utilities should analyze whether energy or cost savings would result from creating a new customer class to better target regulated cultivators. Electric service costs imposed on cultivators should be limited to the incremental increased cost to the utility and should not subsidize the cost of service to other customers, and requirements for cultivators should be similar to those that apply to other high-demand customers in their class.[76] Ensuring these considerations are accounted for in cannabis energy policy requires a difficult balancing of regulatory burdens and benefits across the cultivation industry. While beyond the scope of this research, it is likely that the most equitable way to regulate energy consumption in the cannabis cultivation industry is to regulate all similar high-demand electricity consumers similarly, rather than singling out cannabis cultivation for improvements not required of other commercial or industrial facilities.

AT LEAST ONE JURISDICTION—the Mason County Public Utility District 3 in Washington—has created a special energy rate for cannabis cultivation that falls between the district's small commercial and large commercial rates.[77]

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III. Exploring State and Local Regulation of Energy in Commercial Cannabis Cultivation

A. Indoor, Outdoor, and Greenhouse Growth

"Outdoor cultivation—which has sufficed for millennia—is the most technologically elegant, sustainable, ethical, and economically viable approach for minimizing the rising energy and environmental burden of cannabis production."

Evan Mills and Scott Zeramby, 2021[78]

Cannabis is principally grown in one of three ways: indoors, outdoors, and in greenhouses.[79] Outdoor cultivation is traditional agricultural crop cultivation using tracts of land.[80] Greenhouses, which are sometimes classified as mixed-light facilities, may utilize tarps or other forms of sun cover to manipulate light exposure and control the lifecycle of the crop.[81] In indoor facilities, cultivators can use equipment to control lighting, temperature, and humidity to reproduce optimal growing conditions.[82] The controlled indoor environment often allows cultivators to create a product that is more appealing to consumers at a higher per-plant and per-square foot yield.[83] However, in addition to high energy requirements, indoor cultivation environments can create significant solid and hazardous wastes.[84] They can also be particularly susceptible to mold growth that can devastate an entire crop.[85] When poorly managed, indoor cultivation environments may produce high levels of carbon dioxide and volatile organic compounds that negatively impact human health.[86] Indoor, outdoor, and greenhouse growth also incur significantly different electricity costs per gram of flower produced. While outdoor cultivators incur approximately $0.01/gram in electricity costs, greenhouse cultivator's costs are $0.21/gram and indoor cultivators pay $0.24/gram.[87] Further, outdoor cultivators may be able to offset declines in product quality due to the less controlled outdoor environment by taking advantage of the market for processed cannabis goods, like edibles and concentrates.[88] The increased consumer enthusiasm for processed goods may help to steer new cultivators toward outdoor cultivation because it lowers the risk that a crop will be unmarketable.

The most effective way to reduce electricity consumption from indoor cannabis cultivation is to cultivate less cannabis indoors. While indoor cultivation is most prevalent in the regulated cannabis industry, outdoor cultivation consumes significantly less power and is significantly less carbon intensive than indoor or greenhouse cultivation.[89] Energy efficiency improvements and renewable energy consumption can reduce the environmental impact of indoor cultivation facilities, but are also likely insufficient to counteract the environmental impact of continued increases in demand for electricity from new indoor cultivators.[90]

While consumer preferences for flower or processed goods may inform a cultivator's choice of set-up, regulatory barriers to outdoor growth may leave cultivators with no choice but to grow indoors. State laws often make it difficult or impossible to cultivate commercial cannabis outdoors. For example, Illinois has banned outdoor growth statewide and only permits indoor commercial cannabis cultivation.[91] Other states impose significant restrictions on outdoor and greenhouse growth, and some leave the decision up to local governments.[92] Where it is allowed, restrictions on outdoor growth usually impose requirements for specific security measures or limit the canopy size of the cannabis crop.[93]

While the majority of outdoor cultivation regulations focus on addressing security concerns, other legal issues are arising as the cannabis industry expands. For example, cross-pollination between male and female plants can cause "seed production, lower crop yields, and altered THC or CBD content of the flowers that are produced."[94] This is particularly devastating for hemp cultivators, who must destroy crops that exceed the 0.3 percent THC concentration threshold allowed under federal law.[95] Allegations of cross-pollination have already led to litigation between cannabis and hemp cultivators claiming millions of dollars in lost crop value.[96]

If state and local lawmakers want to minimize the overall electricity consumption of cannabis cultivation, the first step is to not only remove barriers to outdoor growth, but to encourage and facilitate outdoor production.

Some work is underway to help solve these emerging outdoor cultivation challenges. In 2021, Colorado established a working group to investigate minimizing cross-pollination between cannabis plants and instructed the state licensing authority to create rules allowing contingency plans for outdoor cultivators to mitigate crop loss due to adverse weather.[97] USDA-funded research at Virginia Tech is using mathematical models and drone imagery to better understand the transportation of pollen from hemp.[98] This kind of targeted research is important to help regulators identify and solve the problems that outdoor cultivators operating in each regulated market face.

If state and local lawmakers want to minimize the overall electricity consumption of cannabis cultivation, the first step is to not only remove barriers to outdoor growth, but to encourage and facilitate outdoor production. For example, Massachusetts expedites the applications of "Outdoor Marijuana Cultivators" by reviewing them ahead of most indoor applications.[99] Further, outdoor cultivators are often unable to take advantage of the grants, tax credits, and energy rebates offered to indoor cultivators for decreasing their energy consumption. Regulators should ensure that sustainability incentives do not inadvertently discourage outdoor cultivation instead of encouraging it. Ultimately, strong support for outdoor cultivation is necessary to improve the energy footprint of the cannabis industry.

SOME STATES BAN OUTDOOR CULTIVATION:

Illinois[100]

Illinois bans outdoor cultivation by requiring that all commercial cannabis cultivation occur in an "enclosed, locked facility." Access to the facility is limited by law to agents working at the cultivation center (that is, employees), regulatory inspectors, necessary contractors, and emergency personnel. An "enclosed, locked space" can include a "closet, room, greenhouse, building, or other enclosed area equipped with locks or other security devices that permit access only by authorized individuals."

OTHER STATES LEAVE DECISIONS ABOUT INDOOR AND OUTDOOR CULTIVATION UP TO LOCAL GOVERNMENTS:

Michigan[101]

Municipalities in Michigan "may completely prohibit or limit the number of marihuana establishments within its boundaries. Individuals may petition to initiate an ordinance to provide for the number of marihuana establishments allowed within a municipality or to completely prohibit marihuana establishments within a municipality, and such ordinance shall be submitted to the electors of the municipality at the next regular election.

Alaska[102]

Local governments in Alaska "may prohibit the operation of marijuana cultivation facilities, marijuana product manufacturing facilities, marijuana testing facilities, or retail marijuana stores through the enactment of an ordinance or by a voter initiative."

SEVERAL STATES HAVE CREATED SPECIAL LICENSES FOR OUTDOOR CULTIVATION, AND MAY EXPEDITE OR REDUCE FEES FOR OUTDOOR APPLICATIONS:

California[103]

California has multiple licenses available for outdoor cultivation. Commercial cannabis cultivators must obtain a license under one of 14 different designations, which differ by a combination of size (in square feet), location (indoor, outdoor, greenhouse), and lighting (artificial light, natural light, mixed light).

Vermont[104]

Like California, Vermont has several cultivation licensing tiers which differ depending on the maximum square footage of the total plant canopy. Notably, Vermont introduced a "mixed-use" license (indoor/outdoor) in consultation with the local energy efficiency utility, Efficiency Vermont, to incentivize outdoor cultivation despite the state's short outdoor growing season.

Massachusetts[105]

Massachusetts has established 14 licensing tiers based on total canopy size, available for either indoor or outdoor cultivation. The state expedites review of applications for outdoor cultivation and offers reduced licensing fees for outdoor cultivators.

MOST STATES IMPOSE SECURITY RESTRICTIONS ON OUTDOOR CULTIVATORS:

Vermont[106]

Licensed outdoor and mixed-use growers must follow "Outdoor Security Management Practices" including proper fencing, unobstructed video surveillance, alarm systems, photographic surveillance, motion-activated floor lights, and controlled points of access. Any crops in an outdoor growing facility must be shielded from public roadways behind a physical barrier. The board retains the right to inspect physical sites to determine security risks or violations and may require additional security management practices should the inspection results fall short of regulations.

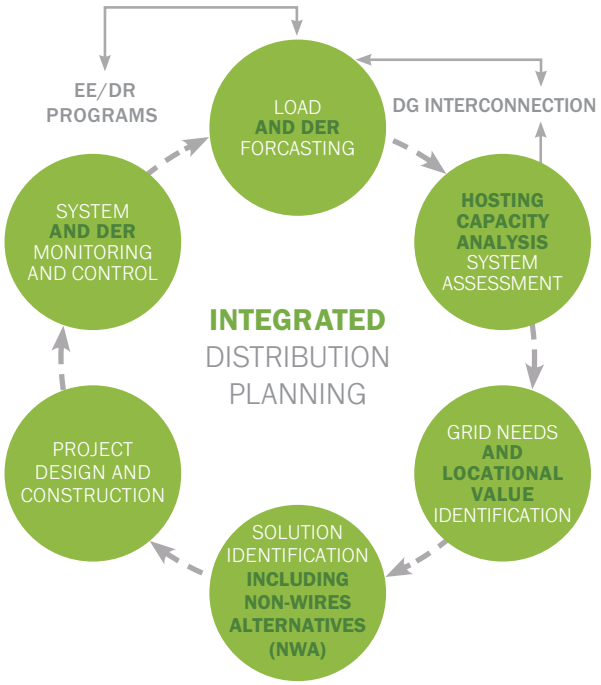
Alaska[107]

When not otherwise specified, facilities are generally limited to fully enclosed, secure indoor facilities or greenhouses with rigid walls, roofs, and doors. Additionally, all growing facilities must have full video surveillance on the premises. Where not prohibited by local law, cultivation may take place outdoors in a non-rigid greenhouse or similar structure, or in an open area of ground completely enclosed by an opaque physical barrier at least six feet high. Regardless of the location or type of facility, all cultivation facilities must ensure that no odor is detectable by the public.

B. Planning, Reporting, and Benchmarking

"The legalization of cannabis has caused a substantial increase in commercial production, yet the magnitude of the industry's environmental impact has not been fully quantified."

– Hailey M. Summers, 2021[108]



TRANSITIONING TO INTEGRATED DISTRIBUTION PLANNING

Figure comes from Curt Volkmann, Integrated Distribution Planning: A Path Forward, GridLab, 2019 p.8, IDPWhitepaper_GridLab-1.pdf.

Several states and local governments require indoor cannabis cultivation facilities to submit planning and reporting documentation to regulators regarding their energy consumption. Energy is one of the largest controllable costs of cannabis cultivation.[109] Planning and reporting requirements can help business owners and regulators better understand an individual cultivation facility's energy consumption, as well as the energy used by the industry overall. Collecting data on a facility's energy use enables facility owners to identify what areas to target for energy efficiency improvements and to document the resulting reduction in energy usage and associated costs. Benchmarking requirements go a step further, requiring that a facility track and review its resource use over time to better understand its resource consumption in relation to other similar facilities as well as its own prior performance.[110] Proactive energy planning and management can also improve community support for cultivation facilities.[111]

In addition, energy planning and reporting requirements allow utilities to better predict how much energy a facility will require in the future. Preparing for increased energy demand in advance can help utilities operate a more efficient grid and ensure reliable service at a lower cost to ratepayers.[112] Forecasting the expected load on the electric grid is an important part of utility planning. Utilities need to ensure that adequate resources are available to provide uninterrupted service, and unexpected increases in demand for electricity can leave utilities paying steep prices for additional supply.[113] Energy planning is even more important when cultivation facilities are required or encouraged to use on-site renewable energy. Distributed energy resources like solar arrays and battery storage systems are playing an increasingly important role in "providing grid services when and where they are needed most."[114] Surprisingly, distribution grid models used in utility planning and load forecasts may not include any details about installed or planned distributed energy resources, even though better integration of these resources could avoid significant capital investments.[115]

EXAMPLES OF DISTRIBUTED ENERGY RESOURCES[116]

- ENERGY EFFICIENCY
- DEMAND RESPONSE
- COMBINED HEAT AND POWER SYSTEMS
- DISTRIBUTED GENERATION, SUCH AS SOLAR OR WIND
- BATTERY OR OTHER ENERGY STORAGE SYSTEMS
- ELECTRIC VEHICLES
- MICROGRIDS

When energy planning and reporting is a component of cannabis cultivation licensing, it allows utilities time to prepare for large new electric loads being added to the grid system and analyze how the cost of any needed energy infrastructure upgrades should be allocated between utilities and cultivation facilities. These costs can include primary or secondary utility lines and their supporting structures, transformers, labor, and equipment. Accurate and up-to-date data can also assist policymakers with balancing public safety, environmental impact, and economic growth as they design and assess the efficacy of regulations.[117]

Benchmarking energy consumption by cultivators can use several different metrics, including production per unit of electricity (in grams per kilowatt-hour, also known as "electricity productivity"), electricity intensity (in kilowatt-hour per square foot), production intensity (in grams per square foot), electricity cost (in dollars spent per gram produced), and carbon intensity (pounds of carbon dioxide equivalent, or CO_2e, produced per gram).[118] Electricity productivity may be the most useful metric in comparing the overall energy efficiency of different cultivators and cultivation methods, as it simply compares electricity input to cannabis output.[119] Because many of the benchmarking factors identified above are based on state-specific parameters (sources of electricity generation, cost of electricity), cultivators within a single state can be compared more easily than cultivators located in different states.[120]

State and local lawmakers should recognize that compliance with regulatory requirements for energy planning, reporting, and benchmarking takes time, labor, and expertise. While these energy management requirements are less burdensome than those discussed later in this report, they still represent an additional barrier to entry into the cannabis industry. Regulators should consider impacts to social equity applicants and ensure that legal, financial, consulting, and technical support is available for compliance with energy planning and reporting regulations.

Ultimately, planning, reporting, and benchmarking regulations are an important tool in decarbonizing the electric grid because they help electric customers, utilities, and regulators better understand where present and future electric demand comes from and how it can be best met with low-cost and low-carbon resources. The benefits of these regulations from an environmental perspective are not limited to the cannabis industry; indeed, they may provide a model for collecting information about energy consumption and benchmarking improved energy management in nearly any business sector.

MANY STATES AND LOCAL GOVERNMENTS REQUIRE CULTIVATORS TO PLAN AND REPORT ON ENERGY CONSUMPTION:

Illinois[121]

Applicants for a cultivation license must submit a plan to the Illinois Department of Agriculture addressing "energy needs, including estimates of monthly electricity . . . usage, to what extent [the cultivation facility] will procure energy from a local utility or from on-site generation, and if it has or will adopt a sustainable energy use and energy conservation policy." Illinois also requires that cultivation facilities commit to certain technological standards for efficient use of resources, as well as report on energy use and efficiency.[122]

Banning, California[123]

Local government requires licensed cannabis cultivation facilities to submit an operating plan to obtain a Cannabis Conditional Use Permit. As part of this plan, applicants must report projected energy demand as well as an energy efficiency plan that addresses illumination, heating, cooling, and ventilation. Applicants must also provide a letter from the Banning Municipal Electric Company stating that the company can meet the expected electricity demand of the new facility.

CULTIVATORS MAY BE REQUIRED TO REPORT GREENHOUSE GAS EMISSIONS ASSOCIATED WITH THEIR CONSUMPTION OF ELECTRICITY:

Oregon[124]

Oregon requires new cultivator applicants to submit a report describing the estimated electricity usage of the facility for the following year. License renewal applicants must describe their actual electricity consumption. Oregon's required records include the following components:

(a) the total electricity and greenhouse gas emissions intensity per kilowatt-hour supplied by all local utility providers,

(b) the total electricity supplied by a zero net energy renewable source,

(c) the total electricity and greenhouse gas emissions intensity supplied from other sources (such as generators), and

(d) the average weighted greenhouse gas emissions intensity from all electricity sources.

SOMETIMES, AN ONLINE PLATFORM IS AVAILABLE TO HELP STREAMLINE COMPLIANCE:

Massachusetts[125]

Massachusetts requires licensed cannabis cultivators to adopt minimum energy efficiency standards established by the Massachusetts Cannabis Control Commission. Cultivators must report their energy consumption to the commission anytime that the commission requests it. An additional report of the cultivator's energy usage over a 12-month period is required for license renewal. Massachusetts allows regulated cultivators to use a tool called the Cannabis PowerScore to demonstrate regulatory compliance.[126] The Cannabis PowerScore is a free online platform that tracks energy and water consumption, as well as greenhouse gas emissions.[127]

REQUIREMENTS MAY DIFFER BETWEEN LOCALITIES IN THE SAME STATE:

Grand Rapids, Michigan[128]

Grand Rapids requires cultivation license applicants to create and submit an analysis of predictive energy load, including design energy use intensity, to the city's Office of Sustainability, as well as to energy utilities serving the applicant. They must also submit an environmental sustainability plan to that office, including estimated greenhouse gas emissions for the coming year, and report on the past year's emissions. The city also requires the applicant to submit a whole-building energy audit meeting or exceeding the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)[129] Level II guidelines to the city's Office of Sustainability within 16 months after operations commence. In addition, cannabis facilities must report energy efficiency performance data through an Energy Star[130] Portfolio.[131] Facilities must begin reporting no later than sixteen months after becoming operational and must continue to report annually.

Bay City, Michigan[132]

Bay City requires cannabis cultivation applicants to submit electrical plans for review to the applicable municipal utility provider. Applicants may be required to prepay all costs associated with building new energy infrastructure necessary to meet the applicant's anticipated load. This can include primary or secondary utility lines and their supporting structures, transformers, labor, and equipment. The city allows the utility the right to deny electric service to any applicant based on failure to meet load acceptance review or load requirements.

C. Energy Efficiency Requirements

"The Northwest Power and Conservation Council (NPCC) which develops regional power and environmental management plans in Oregon, Washington, Montana and Idaho, expects electricity use by marijuana producers to increase from 130 megawatts in 2015 to 237 megawatts in 2035, at which point the industry will consume approximately 3 percent of the state's projected demand growth."

– John Kagia, 2016[133]

While outdoor growth may be the most energy efficient, most cannabis cultivators operate either partially or entirely indoors.[134] In 2021, 54 percent of licensed cultivators grew cannabis exclusively indoors, an increase of 12 percent over the year before.[135] Only 11 percent cultivated exclusively outdoors, a 1 percent reduction from the prior year.[136] Given the current policy barriers to outdoor growth and the uncertainty of policy change, it is worth managing and minimizing the energy consumption of indoor facilities while simultaneously working to remove barriers and improve incentives for the expansion of outdoor cultivation operations.

State and local requirements for energy efficiency in cultivation facilities can mitigate both the greenhouse gas and energy reliability externalities of commercial indoor cannabis production. Incentivizing commercial indoor growers to implement energy-saving measures helps limit carbon emissions from fossil fuel-based energy sources.[137] For states and municipalities that have set carbon reduction targets, reducing cannabis facility emissions could be critical to staying on track to meet these goals.[138] Increasing electrical efficiency also allows cannabis producers to reduce their electric demand, which reduces production costs, mitigates grid vulnerability, and may help protect or improve reliability for other energy consumers.[139] Although efficiency measures may have a higher upfront cost, they can cut energy costs over time and in the long term.[140] Since efficiency measures are most cost effective when implemented from the start of operation rather than when replacing existing equipment, regulators should move to put in place energy efficiency standards as early as possible. However, compliance with energy efficiency regulations can be complicated and expensive. Compliance assistance should be made available to all applicants, with a particular focus on mitigating the regulatory burden on social equity applicants.[141]

Lighting and HVAC systems have been common targets for state and local energy efficiency requirements. Lighting is one of the most energy-intensive aspects of cannabis cultivation, contributing an estimated 20 to 50 percent of total operating costs for cultivators.[142] Lighting requirements change during the cannabis plant's growth phases. Cannabis plants require additional light as they grow larger during their vegetative phase, and then need a carefully controlled 12-hour cycle of light and darkness to trigger their flowering phase. A commercial cultivation facility is likely to maintain multiple separate rooms with lighting conditions conducive to each stage of growth.[143] High Intensity Discharge (HID) lights, including High Pressure Sodium (HPS) or metal halide lights, are commonly used in flowering areas.[144] HID lights generally produce more heat than can be used for plant cultivation.[145] This heat becomes humidity when combined with plant transpiration, which may result in a need for dehumidification, usually powered by additional electricity.[146]

Regulators should move to put in place energy efficiency standards as early as possible, [and] compliance assistance should be made available to all applicants, with a particular focus on mitigating the regulatory burden on social equity applicants.

There is a distinct energy advantage to prioritizing light emitting diode (LED) lights over HPS or metal halide lights in an indoor cultivation setting.[147] LEDs are the most efficient commercially

feasible lighting option for cultivating cannabis at scale, often providing beneficial light conditions while producing less heat than other light fixtures, which reduces electric demand for cooling.[148] Cannabis cultivation facilities using LED lights in vegetative rooms can reduce energy consumption up to 50 percent compared to conventional lighting.[149] Additionally, LEDs can be calibrated to provide an optimum spectral composition for cannabis plants, and their lower heat output may allow cultivators to grow more plants in the same space or to rely less on their HVAC system for cooling.[150] However, cultivators must be careful to analyze their existing systems: some cultivators rely on the waste heat from high pressure sodium lights to help heat their facility, so switching to LEDs would cause significant heat loss that must be replaced at some energy cost.[151] Cultivators and regulators benefit from outcome-focused standards that consider the energy consumption and efficiency of a facility as a whole, rather than mandating specific technology investments for all cultivators.

ONE COMMON MEASUREMENT FOR LIGHTING EFFICIENCY is *Lighting Power Density* (LPD), which measures the total watts of horticultural lighting equipment per total square footage of horticultural growing space. Another is Photosynthetic Photon Efficacy (PPE), which measures "micromoles of photon output per second, per watt of input power," a comparison of energy that the plant can use to the total power drawn.[152]

The amount of electricity used by the HVAC system of an indoor cannabis cultivation facility varies widely based on the facility's specific activities and geographic location, as well as the time of year.[153] A facility's HVAC system typically contributes 25 to 50 percent of total electricity consumption.[154] HVAC systems are also one of the largest capital expenses when building a new cultivation facility.[155] While HVAC systems consume a significant amount of energy, they can be made more efficient through proper sizing, effective insulation, and efficient equipment.[156] Maintaining precise control of temperature, relative humidity, and ventilation is critical to managing plant health, and thus quality and yield, in an indoor environment.[157] Poorly designed systems "can increase energy consumption by up to 50 percent."[158] Thus, it is necessary to carefully consider individual facility conditions to optimize efficiency.[159] Cannabis cultivation facilities should determine what scale of HVAC system is necessary for their growing operation and ensure that the system can adjust to the changing climate needs of plants throughout their growing cycle.[160] Ensuring that a growing space is well insulated and not leaking air prevents wasting energy on heating, cooling, and humidity management to maintain an optimal climate.[161] An HVAC system's efficiency may be measured using its Integrated Energy Factor (IEF), which compares "the amount of water in liters the dehumidifier can remove with a given energy input in kilowatt-hours under specific conditions."[162]

State and local governments have started to require indoor cultivation facilities to meet certain energy efficiency standards for lighting and HVAC systems. While energy efficient equipment can reduce cultivators' operating expenses over the long term, energy efficiency requirements can also significantly increase the startup costs for a new cultivation facility. Without increased technical and financial support, energy efficiency regulations can represent an additional barrier to entry into the cannabis cultivation industry. Lawmakers should pair requirements for reduced electricity consumption with compliance support, including providing subsidies and negotiating lower cost opportunities for equipment purchase for all licensees. Particular attention should be paid to the impact of proposed regulations on social equity applicants and whether there are reasonable sources of financing available.

A few states, like Oregon and Vermont, benefit from the existence of local energy efficiency utilities that can provide specialized support to the cannabis industry. Energy efficiency utilities are utilities that save energy rather than sell energy. Their business model is built on reducing load on the electric grid by reducing the electricity consumption of residents and businesses. They provide industry-specific recommendations, organize savings on bulk purchases of specialized equipment, consult with regulators and licensees, and assist with energy data collection and analysis. For example, the Energy Trust of Oregon is an efficiency utility that offers licensed indoor, outdoor, and greenhouse cannabis cultivators free technical services and cash incentives for the installation of energy-efficient equipment at new and existing operations.[163] The cost savings are significant, reducing project costs by as much as 50 percent.[164]

THE ENERGY EFFICIENCY UTILITY Energy Trust of Oregon highlighted its work with one licensed indoor cultivation facility, Yerba Buena:[165]

"Yerba Buena's vegetative room has 1,270 tubular LED lamps that operate 6,570 hours a year. The company was able to replace each 59-watt fluorescent lamp with a 28-watt tubular LED while still using the same fixtures and ballasts, saving over 258,600 kilowatt hours annually. The project cost was $29,900, and Yerba Buena received a $15,000 cash incentive from Energy Trust, bringing the company's payback to approximately nine months."

Efficiency utilities are often funded by fees collected on customers' electric bills statewide. These utilities are also able to "sell" their verified electric load reductions. Efficiency utilities are generally active bidders in the forward capacity markets[166] that grid operators use to determine which energy resources electric distribution utilities will consume to meet future demand for electricity at the lowest cost. In these markets, a megawatt of power from a natural gas plant and a megawatt of reduced electricity demand from an efficiency utility are essentially treated the same. Thus, efficiency utilities have a direct financial interest in ensuring efficiency improvements are measurable and effective—more energy savings means more efficiency capacity to sell into the market. However, because some energy efficiency programs are funded through fees on customers' electric bills, regulators should be careful to assure that the benefits of these programs are equitably allocated across different classes of electric customers being charged.[167]

SOME AREAS OF THE US have created regional "***forward capacity markets***," which are reverse auctions in which participants bid for the opportunity to provide future electric capacity. Some bids come from sources of electricity generation, such as wind turbines and natural gas plants. It is also possible to submit a bid based on energy efficiency, or a promise to reduce future electric demand through energy efficiency improvements.[168]

Ultimately, energy efficiency utilities can simplify compliance with strict energy regulations—or any energy regulations—when they are tapped as a centralized and dedicated source for education, technical assistance, and incentive implementation. The expertise of these dedicated entities helps reduce the technical and financial burdens of regulatory compliance on individual cultivators and enables them to make smart and successful efficiency investments. Very few states have dedicated energy efficiency utilities like those that exist in Oregon and Vermont, and not every state participates in a regional forward capacity market where efficiency savings can be sold to utilities. However, any regulatory program requiring compliance with energy efficiency standards should consider the benefits of organizing robust and centralized support for cultivators in finding and financing energy efficiency improvements.

A few states, like Oregon and Vermont, benefit from the existence of local energy efficiency utilities that can provide specialized support to the cannabis industry.

Finally, it is worth addressing the issue of cannabis overcultivation and waste, as every kilowatt of electricity used to cultivate cannabis is wasted if the product is produced and not sold or consumed. As previously noted, interstate sales of cannabis are not legal, which means that all cannabis produced in any given state must be consumed in that state. The Oregon legislature directed the Oregon Liquor Control Commission (which is also tasked with cannabis oversight) to study biannually whether supply is commensurate with demand in the state's regulated cannabis market.[169] Their 2021 Supply & Demand report found that only 65 percent of the cannabis produced in the state was purchased by consumers.[170] This is an improvement over 2019, when only 50 percent of cannabis products were purchased.[171] The report notes that the state saw significantly increased demand for cannabis during 2021, in part due to altered social behavior during COVID-19 restrictions, and expressed uncertainty about continued growth in consumer demand.[172] Oregon has placed a statutory moratorium on new cultivation licenses until March 31, 2024.[173] Oversupply of cannabis is not limited to Oregon; Washington,[174] Michigan,[175] California,[176] and other regulated markets have also seen supply outpace demand. Further north, Canada destroyed over 425 million grams of unpackaged dried cannabis flower in 2021, a quarter of their domestic cannabis crop.[177] In addition to the wasted flower product, "more than 140 million grams of unpackaged extracts (17%), edibles (4%), and topicals were destroyed (4%) . . . [and] more than 7 million packaged products were also destroyed (on average, 3% of the total). The percent of the crop destroyed has gone up every year that Health Canada has data available."[178] Unsold cannabis products represent an enormous waste of resources, including electricity consumed during cultivation.

Unsalable cannabis flower and plant waste from cultivation and processing create an even larger environmental problem due to disposal. The specific jurisdictional rules for cannabis waste disposal are beyond the scope of this report, but the plant material is often considered hazardous by law with disposal requirements that render the plant waste unusable.[179] For example, until 2020, Colorado required that cannabis waste must be mixed 50 percent with non-consumable waste before disposal.[180] With the intent of improving industry sustainability, Colorado updated those rules to allow exemptions for on-site composting, anaerobic digestion, pyrolyzing into biochar, and biomass gasification.[181] As regulators, cultivators, and consumers consider the environmental effects of cannabis production, it is equally important to consider the effects of cannabis waste and disposal. Regulators concerned about energy efficiency should strive to create a market in which the supply is reasonably commensurate with demand. They should also enable, incentivize, and subsidize alternative management solutions that take advantage of cannabis waste as a reusable (and potentially energy generating) resource to improve industry sustainability.

STATES ARE TARGETING INDOOR LIGHTING AND HVAC SYSTEMS FOR ENERGY EFFICIENCY REGULATIONS:

Illinois[182]

Cultivators may choose between two options for lighting energy efficiency: (1) limit LPD for cultivation space to less than 36 watts per gross square foot, or (2) use lighting fixtures from a qualified products list maintained by the Design Lights Consortium,[183] which currently requires PPE of 2.2. If the Design Lights Consortium increases its minimum efficiency standard, that PPE shall become the new standard for Illinois licensees.

All HVAC units for cultivators with less than 6,000 square feet of canopy must be high-efficiency ductless split units, or more energy efficient equipment. All HVAC units for cultivators with 6,000 square feet of canopy or more must be variable refrigerant flow HVAC units, or more energy efficient equipment.

Massachusetts[184]

Cultivators may choose to comply with any of three energy efficiency requirements for lighting: (1) ensure their horticultural LPD is below 36 watts per square foot (or 50 watts for Tier 1 and Tier 2 facilities); (2) deploy horticultural lighting that is listed on the Design Lights Consortium Solid-State Horticultural Lighting Qualified Products List or other approved list and which has a lighting PPE that is at least 15 percent above the minimum threshold for products on the list; or (3) seek a waiver, which may be granted upon documentation of third-party certification of energy efficiency features of the cultivator's chosen lighting system.

A licensed mechanical engineer must certify that HVAC and dehumidification systems meet building codes and are sized for the anticipated loads of the facility.

ENERGY EFFICIENCY REQUIREMENTS MAY INCLUDE STANDARDS FOR GREENHOUSES IN ADDITION TO INDOOR CULTIVATION:

Vermont[185]

Indoor commercial cannabis cultivation facilities must meet Vermont's existing Commercial Building Energy Standards (CBES) regarding building envelope insulation, non-cultivation lighting, ventilation, and HVAC systems (except that HVAC systems do not need economizers or heat recapture). Greenhouses must meet the CBES for HVAC equipment efficiency, without a requirement for economizers or heat recapture. Indoor HVAC systems must comply with one of four different energy efficiency standards within one year of licensure. Any fans and clean water pumps in indoor facilities must comply with the most recent energy efficiency standards adopted by the Federal Department of Energy.

All indoor cannabis cultivation facilities have one year from the date of licensure to achieve a minimum of 1.9 PPE for lighting, while supplemental greenhouse lighting must meet a minimum PPE of 1.7. Greenhouses using less than 40 kilowatts in grid-powered lighting capacity are exempt from this requirement.

CULTIVATORS MAY NEED TO CONSULT WITH LOCAL ENERGY EFFICIENCY PROGRAMS TO EVALUATE POTENTIAL OPPORTUNITIES FOR ENERGY REDUCTION, INCLUDING ENERGY STORAGE AND DEMAND RESPONSE:

Massachusetts[186]

Cannabis cultivation applicants in Massachusetts are required to (1) identify potential energy-use reduction opportunities and a plan to implement such opportunities, (2) consider opportunities for on-site renewable energy generation, (3) adopt and use best management strategies to reduce electric demand, and (4) engage with state energy efficiency programs.[187]

Vermont[188]

Vermont requires cultivation license holders to report energy efficiency benchmarks to the Cannabis Control Board as a condition of annual license renewal. Licensees must submit "written operating procedures regarding equipment maintenance, calibration and proper operation, for all major energy equipment, including, but not limited to, horticultural lighting, HVAC systems, and dehumidification systems." They are also required to annually assess and report on opportunities for energy reduction, including:

i. the "identification of potential energy use reduction opportunities (such as natural lighting and energy efficiency measures), and a plan for implementation of such opportunities;

ii. consideration of opportunities for renewable energy generation, including, where applicable, identification of building plans showing where energy generators could be placed on the site, and an explanation of why the identified opportunities were not pursued, if applicable;

iii. strategies to reduce electric demand (such as lighting schedules, active load management, and energy storage); and

iv. engagement with energy efficiency programs offered by Efficiency Vermont, Burlington Electric Department, or Vermont Gas Systems."

D. Renewable Energy Consumption

"A renewables-based energy transition is the most realistic avenue to avoid the worst effects of climate change. And that same avenue promises greater energy security, national resilience, and a more inclusive, equitable and climate-proof global economy."

- Francesco La Camera, Director-General, IRENA[189]

The majority of the states,[190] as well as many local governments, have established clean energy standards mandating reductions in fossil fuel use and expansion of renewable energy consumption in order to reduce greenhouse gas emissions that contribute to climate change. Cannabis cultivation licensees are an increasingly frequent target for regulators who require that their operations be powered by renewable energy, generated either on- or off-site.[191] Some regulations take an aggressive approach, requiring that cultivation facilities use 100 percent renewable power. Others reflect a more moderate approach, allowing for a mix of renewable and nonrenewable energy to power the cultivation facility. In some cases, cultivation facilities are sanctioned for using too much nonrenewable power, or for failing to fully comply with regulations.

Earlier in this report, based on New Frontier Data's estimates, we calculated that regulated commercial cannabis cultivation accounted for 0.03 percent of electricity consumed in the US in 2017. That consumption "generated an estimated 472,000 tons of electricity-based carbon equivalent emissions," comparable to the emissions from 92,660 cars in a year or the production of 35,351 tons of beef.[192]

Climate change has been recognized by law- and policymakers as a genuine threat, which requires effective management and reductions in new major sources of greenhouse gas emissions.[193] Requiring indoor cannabis cultivation facilities to meet some portion of their electric demand with renewable energy is an effective method to reduce their electricity-based carbon footprint. Transitioning to renewable energy reduces electricity generation from fossil fuel sources and can ease the financial burdens of powering a cultivation facility by reducing electric bills.[194] In addition, when cultivation facilities produce renewable energy on-site, it can lower the overall burden on the electric grid and help support state and local sustainability goals.[195] However, investing in an on-site renewable energy system is expensive.[196] While a net-metered solar array may bring down a facility's electric bills, it takes years for those savings to offset the cost of installing the system. If a cultivation facility purchases renewable electricity rather than investing in its own generating system, the upfront costs of purchasing or leasing that system are avoided.[197] However, it will pay a premium per kilowatt-hour for electricity instead, without ever seeing the reduced electric bills enjoyed by system owners.

THE AVERAGE CONSTRUCTION COST for a solar array in 2020 was $1,655 per kilowatt (kW) of installed capacity. In 2021, the size of an average residential solar arrays was 7 kW, while an average commercial array was 255 kW.[198] The average payback period for going solar in the US is just above 8 years.[199]

State and local governments are using the cannabis licensing process to require cultivation facilities to manage or reduce their electricity consumption. However, other similar business types, including the indoor cultivation of federally legal vegetative crops, may consume as much electricity as cannabis cultivators without becoming subject to a regulatory requirement for energy management because they generally do not need a special license to operate. USDA reported that all indoor horticultural installations (including greenhouses) consumed about 5.9 million megawatt-hours of electricity in 2017.[200] As noted earlier, regulated cannabis cultivators consumed nearly 1.1 million megawatt-hours of electricity in 2017 (or about 18 percent of the electricity used by all indoor horticulture). If regulated cannabis cultivation is the only sector targeted for mandatory reductions in electricity consumption, that leaves out over 80 percent of the electricity used by indoor horticulture.

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It is very unusual for state or local governments to impose energy regulations on individual consumers of electricity. Most state energy reduction requirements are imposed on electric utilities, or "load-serving entities," who reduce consumption or increase renewable generation within an entire service territory. Electric utilities may offer special rates or other incentives to specific customer classes (industrial, agricultural, residential, and so on) to encourage beneficial energy management, but the electricity consumption of individual businesses is rarely regulated. If electricity is available for purchase from the utility and can be delivered on the grid, businesses are not generally told they may be fined for using this local grid mix instead of renewable energy.

While electricity-based greenhouse gas emissions from indoor commercial cannabis operations are considerable, there are other industries with a high emissions intensity that are not subject to mandates regarding renewable energy consumption. For example, "data centers require a tremendous amount of energy to operate, accounting for around 1.8 percent of electricity use in the United States" and responsible for 0.05 percent of all US emissions.[201] There have certainly been energy efficiency programs in the US targeted at data centers,[202] and the European Union has set a goal for climate-neutral data centers by 2030.[203] However, the data processing industry has not been subject to state and local regulation of electricity consumption or requirements for renewable energy procurement. It is extremely unusual for states and local governments to regulate the electricity consumption of individual business sectors.

When considering equity in the context of energy regulation in the cannabis industry, it appears that cannabis cultivators are held to stricter standards than other businesses with a similar or higher electric demand, particularly when it comes to requirements for renewable energy consumption. Using renewable energy to power cultivation facilities helps to reduce emissions, but significantly increases costs for regulated cultivators and imposes a greater burden than is expected of other business sectors. This burden creates additional barriers to entry into the cannabis market when not paired with sufficient technical, legal, and financial assistance.

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STATES ARE BEGINNING TO REQUIRE CULTIVATORS TO USE ELECTRICITY FROM RENEWABLE SOURCES:

California[204]

As of January 1, 2023, California requires all indoor, tier 2 mixed-light licensees and similar nursery licensees to ensure that electrical power used for commercial cannabis activity meets an average electricity greenhouse gas emissions intensity standard required by their local utility pursuant to the California Renewable Portfolio Standard Program, which sets an overall goal of 60 percent renewable electricity by 2030. If a cultivator's average weighted greenhouse gas emissions intensity is greater than the standard, the cultivator must purchase carbon offsets from one of three identified carbon registries to cover excess emissions.

Massachusetts[205]

Cultivators in Massachusetts are excused from a lighting energy efficiency standard if the cultivator generates 80 percent or more of their total annual on-site energy use from an on-site clean or renewable source, or renewable thermal generation. Such cultivators must also document that they have purchased renewable or alternative energy credits for the portion of energy that is not generated on-site from renewable sources.

LOCAL GOVERNMENTS ARE ALSO IMPOSING A RANGE OF REQUIREMENTS FOR RENEWABLE ENERGY CONSUMPTION:

Ann Arbor, MI[206]

Ann Arbor requires cannabis cultivation licensees to generate a minimum of 10 percent of their electricity from on-site solar panels.

Riverside County, CA[207]

Riverside County requires their licensed commercial cannabis cultivation facilities to generate renewable energy on-site with systems capable of producing energy equal to or greater than 20 percent of the projected energy demand of the facility.

SOME LOCAL GOVERNMENTS ARE REQUIRING 100 PERCENT RENEWABLE OR CARBON FREE ELECTRICITY FOR CULTIVATORS:

Berkeley, CA[208]

Berkeley cultivators "must mitigate the carbon dioxide emissions caused by the generation of electrical energy delivered to its Facility by participating in East Bay Community Energy's 100 percent renewable content option for electricity or equivalent. Alternatively, the offset can be achieved through purchase of renewable energy certificates certified by the Center for Resource Solutions." In other words, they must demonstrate that 100 percent of their electricity is derived from renewable or carbon free sources.

El Dorado County, CA[209]

In El Dorado County the power for all indoor commercial cultivation facilities must be entirely provided by (a) on-grid power from a renewable energy source, (b) on-site zero net energy renewable sources, or (c) purchasing off-site carbon offsets for any energy from nonrenewable sources.

Boulder City, CO[210]

Boulder City requires 100 percent of the electricity consumed by a licensed commercial cannabis cultivation facility to be offset via one of the options provided: (a) a Community Solar Garden subscription, which allows customers to buy off-site solar energy and receive utility bill credits in return, (b) renewable energy generated on-site, or (c) a licensee-proposed alternative option, subject to approval by the city.

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IV. Social Equity and Subsidizing Sustainability

"Even more than past environmental challenges, decarbonizing will not be a narrow, technical undertaking. We need a holistic, justice-centered perspective to shape our vision for a green economy and meet the pervasive environmental and socioeconomic challenges and opportunities ahead."

- Alice Kaswan and Shalanda H. Baker, 2021[211]

While many states now include some form of specialized support for social equity applicants within their cannabis regulatory programs, this support is not usually specific to helping social equity applicants manage and reduce their energy consumption or comply with state or local energy regulations. Further, where programs do offer technical and financial assistance in improving energy efficiency, the support is not necessarily directed toward social equity applicants. Generous subsidies for efficient lights and equipment exist in some regulated markets. However, taking advantage of these subsidies still requires substantial up-front investment. Regulators should ensure energy regulations do not represent an insurmountable barrier by providing free technical assistance, grants, and no- or low-cost financing for sustainable energy investments.

Equitable regulation of energy in cannabis cultivation requires not only the relaxation of requirements or waiving of fees for social equity applicants, but also the establishment of accessible legal, financial, consulting, and other proactive support for compliance with energy standards. For example, Illinois established and directed millions of dollars toward a Cannabis Business Development Fund that provides low-interest loans and grants to "qualified social equity applicants" to help pay for "ordinary and necessary expenses to start and operate a cannabis business."[212] The fund also assists with "job training and technical assistance for residents in Disproportionately Impacted Areas," as defined by the state.[213] Support systems like the Cannabis Business Development Fund are necessary tools for increased equity in the cannabis industry, especially as compliance with restrictive energy regulations becomes more complicated and expensive.

Similarly, Vermont's Cannabis Business Development Fund was established to provide low-interest loans and grants to social equity applicants for the purpose of paying for expenses associated with starting and operating a licensed cannabis establishment.[214] It is only open to social equity applicants and provides both technical assistance and grant funding. Vermont also provides significant efficiency investment incentives through Efficiency Vermont and other efficiency utilities funded by a charge on every Vermonter's electric bill.[215] Incentives often come in the form of rebates on energy efficient equipment, meaning that financing for the up-front capital costs can be vital for social equity applicants. Efficiency Vermont meets this need by offering low-interest loans for up to 100 percent of the cost of energy efficiency improvements on farms and at agricultural operations.[216] Without grants or low-cost loans, some cultivators may not have the capital to invest in energy efficient equipment in the first place, even if significant rebates or savings on that equipment are available.

One particularly problematic mismatch of energy standards and compliance support appears in strict local energy regulations in Michigan. Ann Arbor requires that 10 percent of a cultivation facility's energy consumption must come from on-site solar. In Bay City, applicants may be required to prepay all costs associated with energy infrastructure needed to meet their anticipated load. In Grand Rapids,[217] cultivators must complete a whole-building energy audit and meet specific lighting efficiency standards, with proof of compliance due at the time of municipal licensing.[218] While Michigan offers fee reductions[219] to qualifying social equity applicants under state law, it does not have a fund to help cultivators comply with these local energy standards or a dedicated efficiency utility or other program offering significant incentives to cultivators across the state. The "social equity all-star program" established in Michigan "encourages licensees to be proactive in their diversity, equity, and inclusion initiatives" and publicly recognizes licensees meeting certain criteria.[220] Unfortunately, this model puts the onus of creating social equity opportunities on licensees, rather than supporting social equity applicants directly. When intensive and expensive energy regulations are placed on cannabis cultivators without technical and financial support for compliance, only those with existing resources can participate in the industry. This is not an equitable result.

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V. Conclusion

"Once indoor cultivation is endorsed (or mandated), it becomes incumbent on policymakers to ensure that the resultant energy use is not excessive. Virtually all building types and the equipment in them are subject to energy codes and standards in the United States, yet comprehensive ones appropriate for cannabis cultivation facilities have not been promulgated and the supporting research essential for standards analysis has not been conducted."

– Mills and Zeramby, 2021[221]

As state governments continue to legalize production and recreational use of cannabis, the demand for commercial-scale cannabis cultivation will grow, along with the demand for electricity to power it. Indoor cannabis cultivation facilities represent a relatively new energy-intensive business sector. While indoor cultivation was already widespread within the unregulated market, legalized opportunities have both multiplied the number of indoor cultivators and improved data collection on their total electricity consumption. There is no question that indoor cultivation uses an enormous amount of electricity—potentially enough to undermine the attainment of clean energy, climate, and sustainability goals. For example, Massachusetts "determined that a single (massive) indoor cultivation facility could result in an increase in lighting demand equal to the energy saved over many years by the state's effort to convert over 130,000 streetlights from conventional high intensity lamps to LEDs."[222] While indoor cultivation is not the only business sector to use a lot of electricity, state cannabis licensing processes create an opportunity to impose energy-reduction obligations on cultivators that are not required of other businesses, even those that are very similar. This point is not made to argue that cannabis facilities should be entirely unfettered by energy-reduction obligations. Rather, creating an equitable and effective model for decarbonization within the cannabis industry may provide a model for reducing electricity usage in business sectors that are not burdened by obligations to engage in energy planning, meet energy efficiency standards, or consume renewable energy. Where they are imposed on the cannabis industry, it is crucial that these policies include legal, technical, and financial support for social equity applicants, as well as strategies for reducing compliance costs for all licensees.

State and local lawmakers must think beyond the cannabis cultivation sector to reduce emissions and improve electric grid reliability. If energy planning, reporting, benchmarking, and efficiency requirements were widespread in the agricultural, commercial, and industrial sectors, the result would not just be fewer electricity-based greenhouse gas emissions; there would also be more people thinking about, inventing, and deploying affordable solutions to energy management problems of all kinds. While some solutions will be industry-specific, other innovations could apply across diverse industries.

Within the regulated commercial cannabis industry, policymakers should also look beyond cultivation when evaluating energy and environmental impacts. Energy is consumed throughout the post-cultivation cannabis supply chain, including the processing of cannabis flowers, manufacturing of value-added products, and transportation of products to the distributor and consumer. Designing effective and equitable obligations, incentives, and subsidies for energy management throughout the supply chain would improve the sustainability of not just cannabis, but nearly any industry targeted for improvement.

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