CASTETTER
CANNABIS GROUP

EFFICIENTLY GROWN:

KEY RECOMMENDATIONS FOR AN ENERGY-RESPONSIBLE CANNABIS MARKET

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About the Authors

Castetter Cannabis Group

At CCG, we understand how difficult it can be to make decisions with regulations and compliance in constant flux. Lean on our experts to help guide your future plans with authentic insights from an unmatched understanding of New York's cannabis regulations.

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Kaelan has been in the New York hemp industry since 2015 as the founder of Sovereign Vines: America's Only Hemp Infused Wine, receiving the first issued hemp processor license in 2017. He was successful in arguing against federal rulings on the product.

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Kate is CCG's Lead Policy Analyst, focusing on helping small businesses, entrepreneurs, and priority applicants plan for the multi-billion dollar adult-use cannabis industry. With nearly eight years of combined experience in public policy research and analysis, legislative advocacy, report preparation, and professional writing to the policy analysis team. Her prior roles include Legislative Liaison for South Carolina Women and Leadership, Research Director of the South Carolina Senate's Family and Veterans' Services Committee, and education reporter for The Index-Journal, among others.

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Aldous is an expert in the genetic development and cultivation of cannabis. He has a lifetime of experience spearheading commercial growing operations throughout North America. His scientific knowledge combined with years of practical experience has honed his careful approach to the cultivation of industrial hemp. He has become a trusted source of information for hemp growers throughout the State looking for advice on facility design, pest management, fertilization plans, and more.

Executive Summary

Bringing a shadow economy into the light is never an easy proposition.

For New York's very recently illicit adult-use cannabis industry, where stealth was historically prized above all else, mainstream concerns like maintaining energy efficient operations often took a backseat to staying undetected. Thus, as the state's cannabis industry moves from an informal to formal market with the passage of the Marihuana Regulation and Taxation Act (MRTA) in March, best practices and industry standards will need to be developed on a variety of issues, including energy efficiency and environmental protection.

That said, cannabis cultivation is an inherently complex process that remains poorly understood from a policy and research standpoint because of its long existence in the shadows. Therefore, policymakers should seek to gather information and a comprehensive understanding of this process prior to enacting energy efficiency legislation or rules. Attempts to mandate specific technologies and efficiency thresholds in other states with burgeoning legal markets have been met with stakeholder resistance and, more importantly, have yet to manifest their stated goals of increasing efficiency and decreasing overall energy use.

This is because such restrictive statutory measures often do not correspond to cultivators' technical requirements,

discourage innovation, and generally fail to account for the intricate and integrated nature of cultivation, wherein all elements must be balanced to generate appropriate and, thus, efficiently produced yields. Statutorily specific mandates also limit flexibility and curtail cultivators' ability to adapt and evolve in nascent markets while disincentivizing or outright prohibiting the use of emergent technologies that develop organically in such markets.

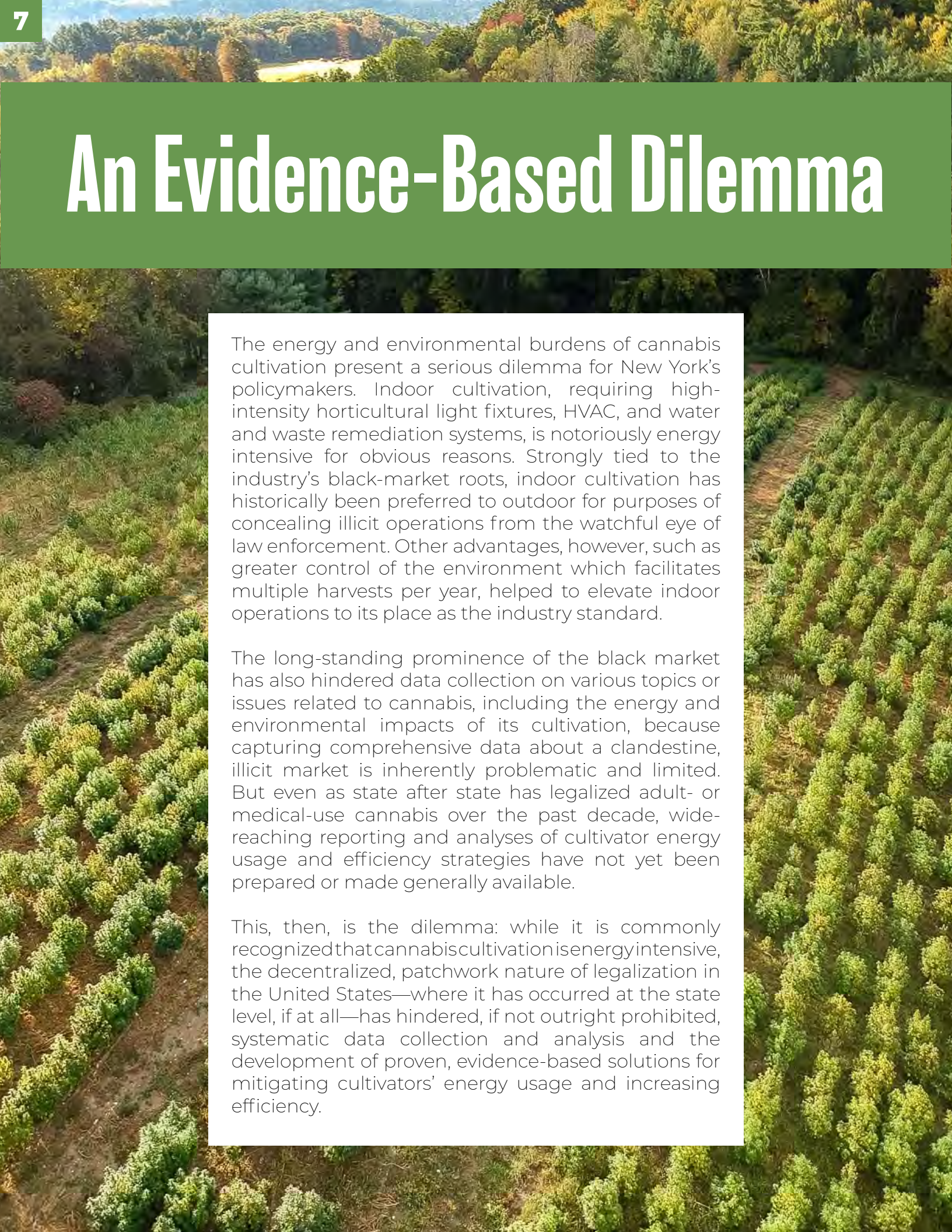
Key Recommendations

1. Development of a State created “Seal” that would signify a company’s cannabis meets certain efficiency and environmental standards. This education/certification program would qualify successful participants for THC potency tax reductions to help offset investments needed to produce sustainably grown cannabis products while serving to add more transparency to the supply chain and allowing consumers to make more informed buying decisions. The goal of offering a cultivation tax credit would be to help sustainably grown products be more cost competitive.

2. The Office of Cannabis Management should collect and analyze usage data from cultivation licensees. This data can then be published in reports and used to best inform policy makers.

3. Tax credits for meeting certain energy efficiency/usage thresholds in collaboration with utility companies.

An Evidence-Based Dilemma



The energy and environmental burdens of cannabis cultivation present a serious dilemma for New York's policymakers. Indoor cultivation, requiring high-intensity horticultural light fixtures, HVAC, and water and waste remediation systems, is notoriously energy intensive for obvious reasons. Strongly tied to the industry's black-market roots, indoor cultivation has historically been preferred to outdoor for purposes of concealing illicit operations from the watchful eye of law enforcement. Other advantages, however, such as greater control of the environment which facilitates multiple harvests per year, helped to elevate indoor operations to its place as the industry standard.

The long-standing prominence of the black market has also hindered data collection on various topics or issues related to cannabis, including the energy and environmental impacts of its cultivation, because capturing comprehensive data about a clandestine, illicit market is inherently problematic and limited. But even as state after state has legalized adult- or medical-use cannabis over the past decade, wide-reaching reporting and analyses of cultivator energy usage and efficiency strategies have not yet been prepared or made generally available.

This, then, is the dilemma: while it is commonly recognized that cannabis cultivation is energy intensive, the decentralized, patchwork nature of legalization in the United States—where it has occurred at the state level, if at all—has hindered, if not outright prohibited, systematic data collection and analysis and the development of proven, evidence-based solutions for mitigating cultivators' energy usage and increasing efficiency.

Proposed Policy Solutions

NYS Environmental Standards Seal and Tax Credit

- We recommend the state develop a voluntary program to educate and certify cultivators who can demonstrate energy efficient and environmentally responsible operations. Successful completion of the program would qualify participants for a reduction in the weight-based THC tax assessed at wholesale. The seal would also be displayed on retail packaging and allowed for use in marketing.
- The tax credit would serve two purposes:

> Offsetting the capital costs associated in building a cultivation facility that utilizes efficient lighting and HVAC technologies, remediates waste water, and generates or uses renewable energy.

> Helping to achieve price parity on the shelf for products that are sustainably produced.

As demonstrated within this report, environmentally friendly cannabis production in controlled environment facilities is possible, but costly. New efficient technologies can be up to double the cost and operating expenses to maintain sustainable practices are significantly higher. The tax credit would account for externalized costs to society associated with fossil fuel use and nutrient-rich water runoff which would allow consumers to make sustainable choices without having to pay more.

In implementing this “green seal,” New York would be a leader in not only reducing the environmental impact of cannabis cultivation, but also in consumer education. We feel that small and craft cultivators have the most to gain from this proposed tax credit as they will be able to more effectively compete with larger operations who may forgo meeting the sustainability standards.

Energy Usage Study

Additionally, we recommend that the state initiate a study to give policymakers a baseline understanding of industry energy needs, methods, and dynamics prior to adopting formal policy mandates for cannabis cultivator energy efficiency. Analysis of the collected information should precede any permanent legislative or regulatory action. To our knowledge, no state has yet attempted a comprehensive, statewide energy efficiency analysis of its cultivation market. Instead, states like Illinois have instituted prescriptive requirements lacking data or evidence that do not conform to industry needs with disastrous results.

According to a 2021 Resource Innovation Institute report:

> "This approach to mandate specific equipment types has led to stakeholder feedback that these system types are not appropriate for the needs of cultivation facilities and this means that the industry is moving towards solutions that may meet the needs of growers, though may not comply with the state statute."[1]

1 "Cannabis Energy & Environmental Policy Primer." Resource Innovation Institute, 2021. Page 29.

Furthermore, a 2020 National Cannabis Industry Association (NCIA) report on environmental sustainability in the industry emphasized that more data is needed to determine appropriate energy efficiency criteria and measures that can be taken by individual cultivators:

> "Data collection is the first step in identifying and implementing methods for reducing fossil fuel consumption (from energy production) and optimizing an individual facility's energy efficiency."

A successful study to inform future policymaking would avoid such pitfalls and position New York as a leader in realm of cannabis governance. Luckily, the MRTA, provides for such data collection, mandating that a report on various issues related to New York's legal cannabis market be prepared by the Cannabis Control Board (CCB), in collaboration with various other state agencies and offices, and submitted to state officials as well as being posted on the state's Cannabis Management website. The first report is to be submitted by January 1, 2023, and then on an annual basis thereafter.[2]

2. Marihuana Regulation and Taxation Act. New York State, 2021. Page 12.

Tax Credits

Studies, however, take time to execute, as researchers work to collect and analyze information, and prepare associated reports for policymakers (our above solution recommends at least a year of information gathering alone).

To prevent potential abuses and environmentally irresponsible operations in the interim period, we recommend the state collaborate with utility providers to develop financial incentives that could be available to cultivators on day one of licensure, including tax credits for cultivators that meet certain energy efficiency thresholds.

The above measures encourage energy efficient best practices while allowing for the development of emergent technologies and innovative strategies that evolve organically in a burgeoning market. The immediate adoption of the above recommendations gives lawmakers time to secure the information necessary for thorough, sage decision-making on a complex issue that could make or break a fledging market.

We provide these recommendations as an alternative to those included in recently proposed state legislation, SB6243, and discussed below.

New York's Senate Bill

As we have already indicated above, New York's SB6243, introduced by New York State Senator Michelle Hinchey, was modeled entirely after the Illinois law. The law prescribed specific equipment that did not conform to industry needs and is now being met with stakeholder resistance and attempts to work around the law.

New York's legislation is in its preliminary phase and was referred to the Senate's Agriculture Committee on April 19, 2021. The bill mirrors the Illinois law almost verbatim and seeks to amend the agriculture and markets law to require energy efficiency plans be submitted concurrently with an adult-use or medical-use cannabis cultivator's application for licensure and establishes energy efficiency criteria for such cultivators. During a Senate Agriculture Committee hearing on April 26, 2021, the legislation was tabled and did not receive a vote.

The bill includes the following requirements:

Cannabis Grower Energy Efficiency Plans (§531-1)

The bill requires all applicants for adult-use or medical use cultivator licenses submit an energy efficiency plan that addresses the following:

Expected Energy Needs:

Including monthly electricity and gas usage projections, estimated energy to be procured from local utilities/on-site generation, and whether a sustainable or energy conservation policy will be implemented by the applicant.

Expected Water Needs:

Including projected water draw and whether a sustainable water use or conservation policy will be implemented by the applicant.

Expected waste management needs:

Including whether a waste reduction policy will be implemented by the applicant.

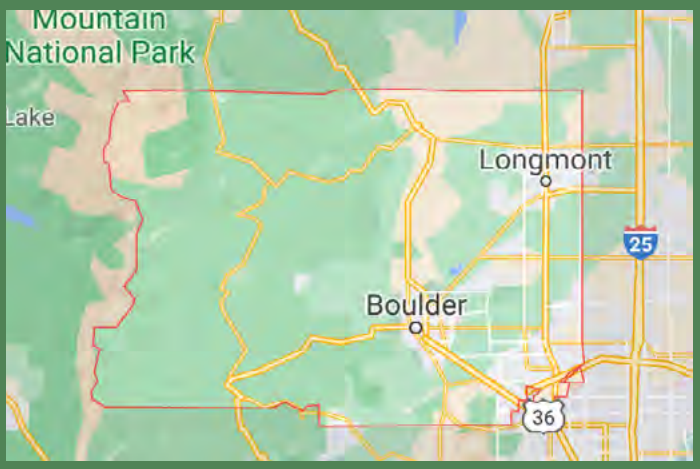
Applicants must also include a description of how they intend to comply with the resource efficiency requirements of the legislation.

Resource Efficiency Requirements (§531-2)

The bill also lays out the operating energy efficiency requirements for cannabis growers once licensed as follows:

- Lighting Power Density (LPD) capped at an average of 36W/in^2 (this is likely a mistake in the bill text and meant to read 36W/ft^2)
- Photosynthetic Photon Efficacy (PPE) minimum of 2.2 µmol/J per lighting fixture
- Aforementioned lighting fixtures must also be found on the Design Lights Consortium Horticultural Specification Qualified Products List
- Cultivators operating in a space of less than 6,000ft^2 must use high-efficiency ductless split HVAC units
- Cultivators operating in a space of 6,000ft^2 or more must use variable refrigerant flow HVAC units
- All cultivators must use automated watering systems to irrigate cannabis
- Water runoff from each watering event must be measured and growers must maintain an average of less than 20% runoff from each such event
- HVAC condensate, dehumidification water, excess water runoff from watering events, and wastewater produced during cultivation must be captured and filtered to a standard so that it can be reused in subsequent watering events

While the goals of the above-described legislation are noble, the bill, in its current form, fails to account fully for industry needs and trends in connection with energy efficiency. In the technical discussion that follows this section, we will attempt to demonstrate why such specific legislation is destined to fail.



Specifically, the Lighting Power Density requirement of 36W/ft^2, is inconsistent with what is needed for economical and effective growth as well as what is practiced by cultivators in more mature markets. For instance, Boulder County, Colorado, where recreational marijuana has been legal since 2012, commissioned a report assessing Cannabis Cultivator Energy Efficiency which was published in April of 2020. The report suggested the range of average annual LPD for all cultivators in the county to be between 30W/ft^2 and 80W/ft^2 with only one operation averaging under 40W/ft^2. [3]

Additionally, all cultivators in the county as of the publication of the report were using HID bulbs as opposed to LEDs for the flowering phase because of the effectiveness of the technology. While LEDs appear to be comparable in efficacy on paper, their effectiveness in practice has yet to be proven and is dubious at best for this stage of the cultivation process. Moreover, the mandate that cultivators only buy lighting fixtures listed on Design Light Consortium's list of Qualified Products is, quite frankly, not evidenced in the least by facts on the ground in the industry, nor does DLC possess reputational clout in the larger cultivator community.

3. "Summary Report of Cannabis Cultivator Energy Efficiency Assessments." Energy & Resource Solutions, Inc. Boulder County Colorado, 2020. Page 13: https://assets.bouldercounty.org/wp-content/uploads/2020/05/EIOF-BC-Cultivation-Assessment-Summary-Report_Final-5_4_20.pdf

A highlight of the Illinois law, however, that we wholeheartedly endorse as reflected in our own policy recommendations, is the requirement that cultivators collect and periodically submit energy data to the state.[4]

To provide insight into the complex process of cannabis cultivation, the following "Exploring Cultivation" sections on the growth cycle, lighting, HVAC, and water and waste management, examine its technical aspects—which, in turn, dictate industry needs—interwoven with our related analyses and equipment recommendations.

4. "Illinois Marijuana Growers Will Face Energy Efficiency and Reporting Rules." Energy News Network. September 16, 2019. https://energynews.us/2019/09/16/illinois-marijuana-growers-will-face-energy-efficiency-and-reporting-rules/

Exploring Cultivation: The Growth Cycle

Cannabis has historically been considered an annual plant that grows in the spring and summer and flowers in the fall.[5] This was the standard, however, when cultivation primarily occurred outdoors. The rise of indoor cultivation for commercial growing in modern markets has enabled growers to reduce the amount of time needed to produce a quality, mature crop from the traditional year to approximately 90 days from clone (clones are clippings of a mother plant that are subsequently rooted to form plants) to harvest.[6]

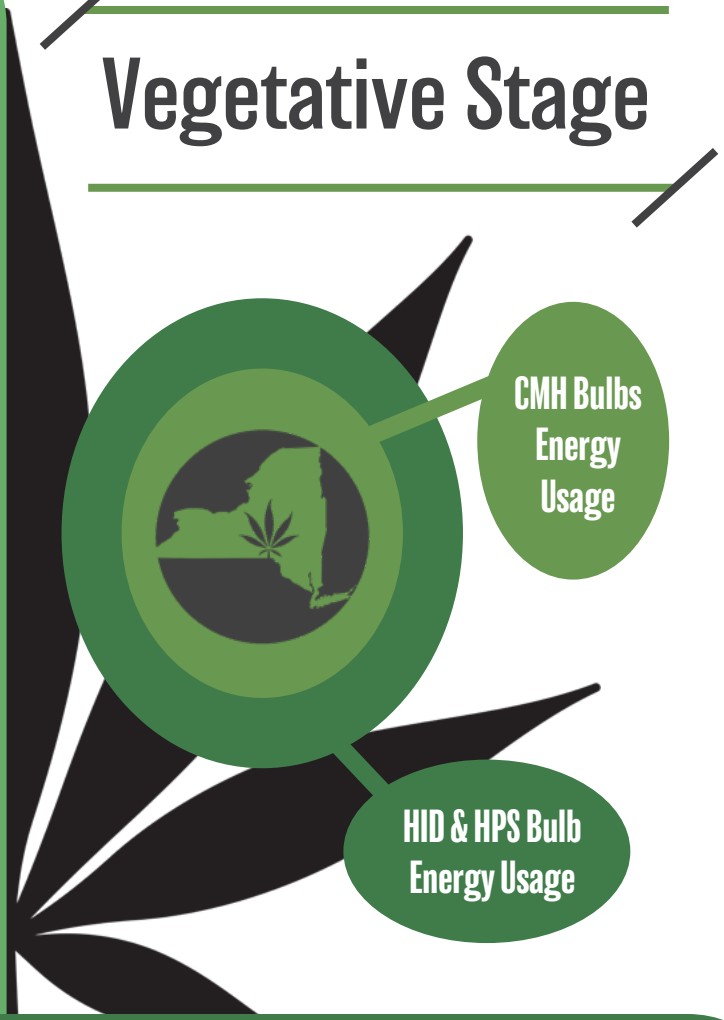
According to a 2020 National Cannabis Industry Association report, 63% of commercial cannabis cultivation occurs indoors, with an additional 20% occurring in hybrid facilities, such as greenhouses[7]. As such, cultivators are now able to realize several harvests per year (up to six, with four as the average) as opposed to one, with the expedited and more frequent yields creating a financial incentive for growers to invest in primarily indoor operations. This more rapid, indoor growth is generally achieved through tightly controlling indoor environmental conditions, including lighting intensity and timing, corresponding HVAC, dehumidification, and irrigation systems, as well as nutrient and CO_2 supplementation.

The stages of the cycle are broadly as follows: germination, seedling, vegetative, and the flowering or "bloom" phase, wherein the cannabis plant flowers and after which the crop is harvested[8]. When it comes to energy use, the two main stages of concern are the vegetative stage and the flowering stage. Each has different lighting and environmental requirements to realize quality, efficient growth.

5. Cervantes, Jorge. Marijuana Horticulture: The Indoor/Outdoor Growers Bible. Van Patten Publishing, 2006. Page 3.
6. Ibid. p. 29.
7. "Environmental Sustainability in the Cannabis Industry." National Cannabis Industry Association, 2020. Page 7: https://thecannabisindustry.org/wp-content/uploads/2020/11/NCIA-Environmental-Policy-BMP-October-17-final.pdf
8. "4 Stages of Marijuana Plant Growth." Leafly. https://www.leafly.com/learn/growing/marijuana-growth-stages

Vegetative Stage

Vegetative/clone rooms are generally a quarter to one-third of the size of rooms used for flowering and thus use less electricity. Plants in the vegetative stage can flourish using LED lighting, optimal for this stage of growth. Ceramic Metal Halide (CMH) bulbs have also shown to be promising for energy efficiency purposes as they can use up to 30% less energy than the traditional **High Intensity Discharge (HID)** and **High-Pressure Sodium (HPS)** bulbs.[9]



Regarding CMH technology, 250W or 315W bulbs are the best wattage to use. The 315 CMH also works best when compared to a 400W Metal Halide (MH) or 1,000W MH, and can easily illuminate vegetative plants and clones that would then fill a flowering room lit by 600W HPS bulbs or 1,000W DE HPS or LED. Such a lighting situation provides a Lighting Power Density (LPD) of 37.5W/ft^2 on average, with 60+W/ft^2 requiring CO_2 supplementation and professional expertise to utilize correctly and efficiently. Additionally, T-5 and T-8 fluorescent and compact fluorescent lamps are economical and work well to root clones and propagate seedlings. The timing of the lighting cycle is also different in the vegetative phase, which requires light for 18-24 hours per day with 18 hours per days being the ideal, industry standard as some plant processes require a dark cycle once a certain growth point is reached.

9. “Ceramic Metal Halide Lights: What They Are and How to Use Them.” Epic Gardening, 2019. https://www.epicgardening.com/cmh-grow-lights/

Flowering Stage

HID or HPS lighting are the dominant types of lighting employed in the flowering stage.

In order to promote flowering in indoor cultivation operations, the lighting cycle must be decreased in time and increased in intensity to simulate an impending seasonal change to signal to the plant that its annual life cycle is coming to an end and the time to flower has arrived.[10] This is because cannabis is photoperiodic-reactive, meaning that the light and dark cycle dictate flowering. Lighting in this phase is thus controlled at 12 hours of light, 12 hours of darkness per every 24 hours, traditionally using 1,000W HID or HPS bulbs. HPS bulbs provide the far-red spectrum of light energy needed for bud development. It is important to note that as the plant moves through these phases of growth, with phase-dependent light fixtures facilitating that growth, other elements of growth (CO_2, nutrients, and water) must be correspondingly balanced for the plant to reach its full potential.

Clearly, each stage of the growth cycle is unique, and, therefore, a one-size fits all solution to lighting energy efficiency fails to account for the particular needs of each phase. Because of the high intensity lighting inherent to the flowering phase in indoor cultivation, lighting energy efficiency measures such as the installation or retrofitting of a facility with LED light fixtures, might be most effectively implemented (and more palatable to growers) in the vegetative stage of the cycle, wherein the duration of daily lighting necessary to an efficacious operation is longer but the lighting intensity necessary for growth is considerably less and, thus, actually feasible through the use of LED fixtures.

10. Cervantes, Jorge. Marijuana Horticulture: The Indoor/Outdoor Growers Bible. Van Patten Publishing, 2006. Page 8.

Exploring Cultivation: Lighting

As suggested by the above discussion of the growth cycle, much of the energy efficiency standards and incentives related to cannabis cultivation concern lighting. This is because the use of HID indoor lighting fixtures constitutes the majority of cultivation energy use and, in practice, comprises a significant amount of market share energy usage.

Indoor lighting technology is dominated by LEDs and HIDs, as they are the most effective and provide light in the correct spectrum that allows for plant growth. Each also comes with its own technical considerations.

Technical Considerations

The primary consideration related to HID light sources is the conversion factor. That is, the amount of usable light in the correct spectrum being created via the amount of electricity input. For example, a **600W HPS bulb puts out 90,000 lumens (lm)** which equates to a factor of 150 (90,000lm / 600W= 150). **This would sufficiently cover a 4ft x 4ft area of 16ft²** and is capable of yielding **one to two pounds of flower** if CO_2 and additional supplemental lighting from the defined growing area lighting layout (i.e., multiple lights in same space) are applied.

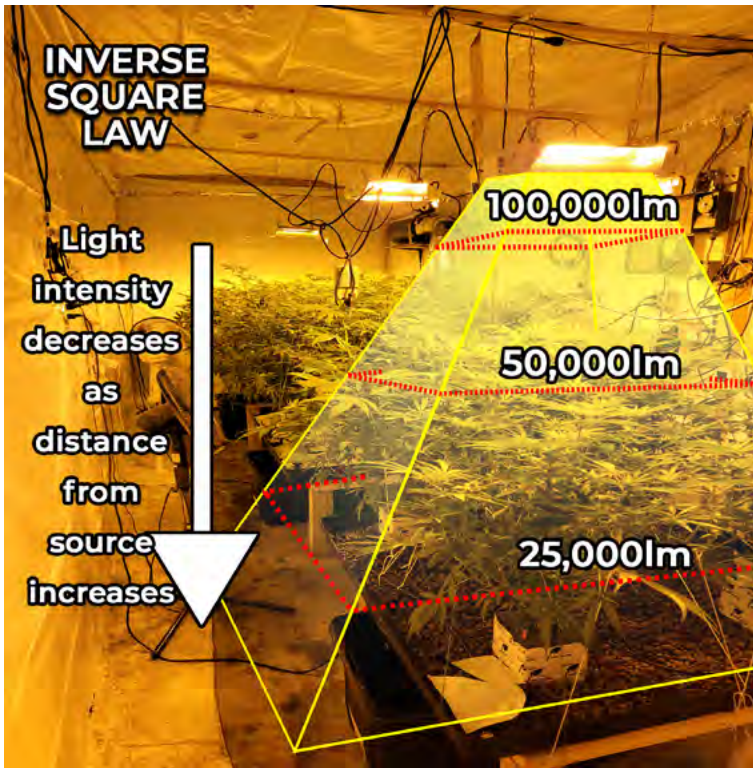
Naturally, adequate light energy per square footage of the defined growing area is required to facilitate vigorous growth.

Among experience growers, **30W/ft²** is generally considered the **lowest possible LPD value** necessary to achieve growth. **Thirty-seven and a half watts per square foot is a good compromise,** but still on the low end of the normal range employed by cultivators operating in legal markets across the country[11]. Such a value equates to a **600W HPS bulb hung 18 inches** above the canopy over a 16ft² growing area (typically a 4ft x 4ft table). **Sixty or more watts per square foot** requires CO_2 atmospheric injection as well as contemplation of the **Vapor Pressure Differential (VPD)** as such factors contribute to fully functioning photosynthesis processes. Successful growing is thus a finely tuned balancing act wherein it is important to remember that all plant biological processes are based on survival strategies that evolve or emerge due to the particulars of their unique environment and climate. Consequently, if too much light is applied and the plants are not supplemented with CO_2, they will stop growing and regress into survival mode to reserve moisture and protect themselves from environmental damage. The ability to balance such factors to ensure efficient and effective growth is, therefore, a highly important skill that often corresponds to cultivator experience.

11. "Cannabis Cultivator Energy Efficiency Assessments." Boulder County, CO. Prepared by Energy & Resource Solutions, Inc., 2020. https://assets.bouldercounty.org/wp-content/uploads/2020/05/EIOF-BC-Cultivation-Assessment-Summary-Report_Final-5_4_20.pdf

Further complicating strategy is the fact that one must also consider the distance of the light from the plant canopy. Light emitted from a LED or HID follows the **Inverse Square Law**. According to the University of Calgary, this law says that:

> ...INTENSITY EQUALS THE INVERSE OF THE SQUARE OF THE DISTANCE FROM THE SOURCE. FOR EXAMPLE, THE RADIATION EXPOSURE FROM A POINT SOURCE (WITH NO SHIELDING) GETS SMALLER THE FARTHER AWAY IT IS. IF THE SOURCE IS 2X AS FAR AWAY, IT'S ¼ AS MUCH EXPOSURE. IF IT'S 10X FARTHER AWAY, THE RADIATION EXPOSURE IS 100X LESS.[12]



Thus, the further away the light source the less energy or photons that fall on the canopy.

Experience of the cultivator is key to ascertaining the most effective distance from the light source at which to place the plants. According to Cervantes: "Artificial light diminishes to the square of the distance, which means that foliage four feet away from the bulb receives one fourteenth as much light as if it were one foot away."[13]

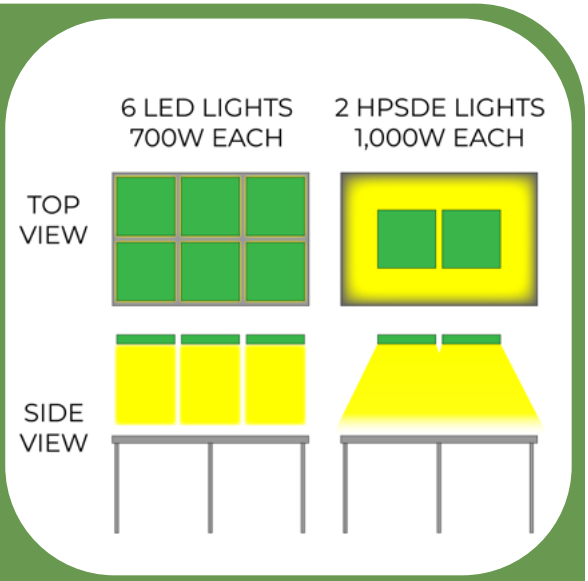
As suggested above, it is helpful to think of photons as particles of sand being emitted from the light source such as a LED or HID fixture; in other words, it is the number of particles per second being created that translates into canopy penetration (that is, light making its way through the entirety of the plant canopy instead of just having an effect on the top surface). LEDs and HIDs both have their advantages and disadvantages as discussed below.

12. "Inverse Square Law." Energy Education. University of Calgary, 2017. https://energyeducation.ca/encyclopedia/Inverse_square_law
13. Cervantes, Jorge. Marijuana Horticulture: The Indoor/Outdoor Growers Bible. Van Patten Publishing, 2006. Page 30.

LEDs vs. HIDs

Since their introduction into the market, LED light fixtures have matured into an attractive option for indoor cultivation.

As with most equipment, the use of LED fixtures has its advantages and disadvantages. The primary benefits of LEDs are that they **produce less heat**, heat that then must be mitigated by an HVAC system. Additionally, they have longer bulb lives, passive cooled fixtures, tunable spectrums, and the ability to be placed closer to the plant canopy. However, in order to be effective, high-powered LEDS also require the **maintenance of specific environmental atmospheric conditions**, making their usefulness more suited to the professional grower. Such conditions include calibrating CO_2 levels to match the increase in output energy intensity from LEDs as well as the **Vapor Pressure Differential (VPD)** that is primarily responsible for the effective utilization of LEDs. LEDs also cover a smaller area per fixture then their HIDs counterparts as shown to the right.



HID lamps have been the gold standard of indoor cannabis propagation for decades.

There have been recent advancements in their energy efficiencies, as well as that of full spectrum or spectrum-specific bulbs that allow flexibility in the grow space. The primary drawbacks of HIDs are their heat production, energy consumption, bulb life and disposal of used bulbs. The benefits of HIDs, however, tend to out weight the costs, from a commercial perspective. When HIDs are spaced and hung correctly, they offer overall **better efficiency then LEDs** due to the fact that **less fixtures are needed to illuminate the same space**, which is contingent on the sheer density of light photons emitted and reflector design. These technologies are competitive when it comes to potential capabilities. However, reaching this potential is primarily a result of the individual grower's professional experience and knowledge of atmospheric parameters.

In the modern market, both LEDs and HIDs **generally include dimmer features**, meaning they have the ability to run at various fractions of their rated wattage (e.g., 50%, 75%, or 100%). Such features can be employed to **realize energy savings**. For example, in a run of 10 light fixtures, three in the center could be set to run at 75% and still maintain a 37.5W/ft^2 average LPD value. HID fixtures are generally recognized in the industry as best practice for the flowering stage until new technology emerges with the adult-use market.

Exploring Cultivation:

HVAC

Lighting necessarily generates heat. In order to maintain ideal conditions for growth, this heat must be removed immediately through the use of **HVAC equipment**. HVAC equipment can be a costly investment for cultivators and traditional systems are known for their significant energy use. Creative, environmentally friendly strategies for mitigating HVAC energy use and increasing efficiency include the installation of **passive heat or geothermal systems.**

While such innovative methods exist, efficiency standards that mandate precisely the equipment to be used, such as the **"ductless split HVAC units"** required for growing in a certain sized space per New York's proposed legislation, miss the point in that they focus on equipment as opposed to the performance of the equipment. The focus should be more on the equipment's efficiency and cooling capacity as opposed to the type of equipment employed.

Furthermore, the **Resource Innovation Institute (RII)** suggests that more effective alternatives are those which focus on comprehensive strategies, including **planning** and **performance measurement**. Such policies would require that regulated entities submit an energy efficiency plan specifying equipment to be employed along with the periodic submission of energy usage data:

"...if productivity based standards are considered there will likely have to be a reporting mechanism set up to verify that the specified equipment is installed alongside data regarding energy use and production."[14]

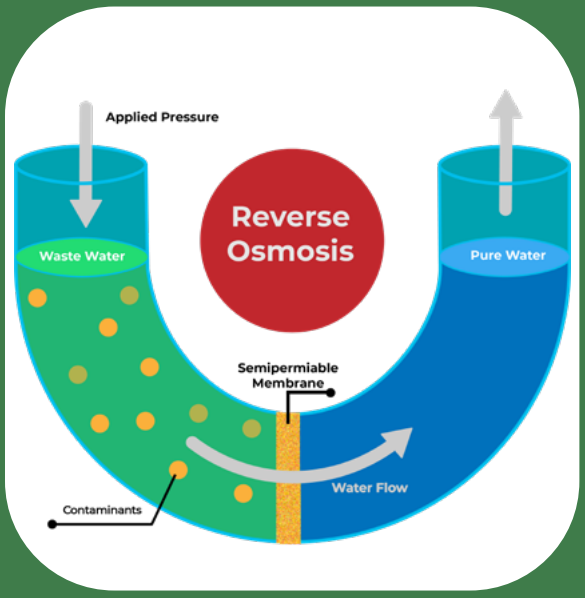
Such policies are holistic in their approach and allow for the evaluation of an entire system's performance to ensure that energy usage goals are actually met in practice, rather than merely mandating specific equipment:

"Productivity based regulations, particularly on a whole building basis, could allow for producers to consider an array of technologies...when developing their systems. However, the consensus among stakeholders is that there is not sufficient data at this time for this type of compliance path."[15]

14. Cannabis Energy & Environmental Policy Primer" Resource Innovation Institute, 2021. Page 30.
15. Ibid.

Exploring Cultivation: Water & Waste Management

Water remediation and waste management are issues of immense concern as runoff of untreated or nutrient rich water into aqueducts or freshwater estuaries threaten significant environmental harm. We support required monitoring and treatment of water to mitigate potentially negative impacts, and recommend pumping runoff, waste, and brown water into a holding tank, then to a reverse osmosis (RO) system with different holding tanks to re-use water. Regular, periodic cleanings of the first holding tank to remove accumulated residue are essential.



Such processes are also inherently easier to control and effectuate in indoor cultivation environments as opposed to outdoor where nutrients infused directly into the soil could immediately and adversely affect ground water.

We recommend the state study the methodologies used for cannabis irrigation as well as the remediation and disposal of nutrient residue, before mandating irrigation policy or waste management policies.

Efficiency Measures in Other States' Adult-Use Cannabis Markets

Colorado

Colorado addresses cultivator energy efficiency through regulations and best practices. The **Colorado Cultivators Energy Management program**,[16] for instance, helps businesses understand best practices and provides resources from the **Colorado Department of Public Health and Environment**.

Municipalities also play a huge role ensuring energy efficiency. For instance, the **City of Denver department of Public Health and Environment** led a working group in 2016 which led to the city's government amending building codes regarding lighting and cooling and humidification. Regarding lighting:

"the city requires that 80% of total watts of lighting used for plant growth to be provided by lighting fixtures/luminaires meeting efficacy of **1.6µmol/J** or **bulbs/lamps** that meet 1.9µmol/J with efficacy verified by either listing on the Design Light Consortium's Horticultural Qualified Products List or third-party verification. This code will allow the use of double ended HPS lighting and is in line with a proposal in the 2021 International Energy Conservation Code."[17]

However, the µmol/J PPE measurement is hardly used in cannabis cultivation.

Illinois

The **Illinois Cannabis Regulation and Taxation Act**[18] mandates energy efficiency standards which New York's legislature has copied word for word, literally (410 ILCS 705/30-10, Sec. 30-10 "Application"). The mandates, according to Sam Milton, a consultant at Climate Resources Group, are some of the **"strictest in the nation."**[19]

However, the Illinois energy service, ComEd, has an **Energy Efficiency Program** which includes agricultural incentives, as laid out in an **"Agricultural Initiative Worksheet[20],"** and the "Agricultural **Pre-Approval and Final Application[21]"** sheets. A business must prove it is in line with the initiatives as laid out to receive incentive cash from the state, but is unlikely that **indoor** grow operations can even access this program. According to ComEd:

"Under the **Future Energy Jobs Act**, customers who had an account with a load of **10MW or higher** during the 12 months ending December, 2021, may not be qualified to contribute to, nor participate in, the ComEd Energy Efficiency Program. Notwithstanding any prior approval of an application for the program."

According to the **National Conference of State Legislators**[22], the average electricity usage of indoor growth facilities in Boulder, Colorado, was **41,808 kilowatt hours (or 41.808 MegaWatts) per month**, so it is unrealistic that any comparable grow operations could take part in such an incentive scheme.

16. "Colorado Cultivators Energy Management Pilot Program." https://energyoffice.colorado.gov/clean-energy-programs/colorado-cultivators-energy-management-pilot-program
17. Cannabis Energy & Environmental Policy Primer" Resource Innovation Institute, 2021. Page 15.
18. Illinois "Cannabis Regulation and Tax Act." https://www.ilga.gov/legislation/ilcs/ilcs3.asp?ChapterID=35&ActID=3992
19. "Illinois Sets Strict Energy Efficiency Rules for Cannabis Growers." St Louis Public Radio. 2019. https://news.stlpublicradio.org/health-science-environment/2019-09-02/illinois-sets-strict-energy-efficiency-rules-for-cannabis-growers
20. "Agricultural Incentive Worksheet." ComEd Energy Efficiency Program. 2021. https://www.comed.com/WaysToSave/ForYourBusiness/Documents/AgricultureIncentiveWorksheet.pdf
21. "Agricultural Pre-Approval and Final Application." ComEd Energy Efficiency Program. 2021. https://www.comed.com/WaysToSave/ForYourBusiness/Documents/AgriculturalApplication.pdf
22. "Electricity Use in Marijuana Production." National Conference of State Legislatures. 2016. https://www.ncsl.org/research/energy/electricity-use-in-marijuana-production.aspx

Maine

Cultivators operating the state of Maine can access energy efficiency incentives provided by **Enlighten Your Grow**, a project of the **Climate Resources Group**. Provided through **"Efficiency Maine,"** these include **Custom Inventive Programs** based on the scope of the efficiency project and site-specific engineering analyses.[23] Maximum project funding is capped at **$1,000,000 per customer**. The program also includes free scoping audits to provide customers with access to professional expertise on specific energy efficiency upgrades to existing facilities, as well as providing ongoing technical assistance to customers during the timeline of the energy efficiency project.

Massachusetts

Massachusetts takes a **hybrid** approach to tackling energy efficiency in cannabis cultivation. This approach includes both **regulatory mandates** and **financial incentives**. The regulatory prong of this hybrid approach includes mandated energy efficiency criteria and environmental best practices built into the licensing process. Applicants for licensure must include a summary of their written standard operating procedures as they relate to efficiency and conservation. According to guidance issued by the commission, an applicant is to engage in:

1. Identification of potential energy-use reduction opportunities (such as natural lighting and energy efficiency measures), and a plan for implementation of such opportunities;
2. Consideration of opportunities for renewable energy generation, including, where applicable, submission 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;
3. Strategies to reduce electric demand (such as lighting schedules, active load management, and energy storage; and
4. Engagement with energy efficiency programs offered...or through municipal lighting plants[24]

An architectural review is also conducted as part of the licensure of a cultivation facility, as Growers can take advantage of **financial incentives** provided by their local utility via the **"Mass Save" program.**[25]

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23. "Commercial and Industrial Custom Program." Efficiency Maine. https://www.efficiencymaine.com/at-work/commercial-industrial-custom-program/
24. "Energy and Environment Compiled Guidance." Massachusetts Cannabis Control Commission, 2020.
25. "Basic Energy Efficiency Practices & Reporting." Massachusetts Cannabis Control Commission. https://masscannabiscontrol.com/efficiency-sustainability/energy-efficiency/#energy-efficiency-programs

Oregon

Cultivators in Oregon are encouraged to employ efficiencies in their operations through economic energy efficiency incentives offered by applicable utilities for indoor grow facilities.[26] Such incentives include those pertaining to horticultural lighting, irrigation systems and upgrades, greenhouse upgrades, heating and cooling systems, and dehumidifiers. **The Energy Trust of Oregon** compiles information on available incentives.

Incentives for horticultural lighting are available through **Portland General Electric and Pacific Power** as lighting technology overwhelmingly dominates overall energy use for indoor grow facilities.[27] Operators must work with a **"Business Lighting trade ally"** on lighting upgrades and controls in order to establish eligibility for a customized lighting incentives. Additionally, incentives are only available after upgrades or efficiency controls are already installed, rather than available on the front end to facilitate the capital incentives.[28]

For dehumidification upgrades, cash incentives are available for growers operating in specific utility service areas for replacing old equipment with an **energy-efficient dehumidifier**. For instance, growers operating in Portland General Electric's service area can apply for a **$7 per pint, per day** for replacing existing equipment in existing facilities with energy efficient equipment and **$5 per pint per day** for installing energy efficient dehumidifier equipment in a new facility. Such incentives are limited to a total of **$10,000-14,000 per facility** and growers may only apply for the incentive for one dehumidifier per facility site.

Through the Energy Trust, cultivators are also eligible for custom incentives for larger, more comprehensive renovations to their facilities. The Energy Trust also offers practical, energy efficiency training for operators through individualized technical assistance.

26. "Incentives – Cannabis and Hemp Grow Operations." Energy Trust of Oregon, 2021. https://www.energytrust.org/incentives/agriculture-indoor-grow-facilities/#:~:text=Energy%20Trust%20of%20Oregon%20offers,outdoor%20and%20greenhouse%20grow%20operations.
27. "Cannabis Cultivator Energy Efficiency Assessments." Boulder County, CO. Prepared by Energy & Resource Solutions, Inc., 2020. https://assets.bouldercounty.org/wp-content/uploads/2020/05/EIOF-BC-Cultivation-Assessment-Summary-Report_Final-5_4_20.pdf
28. "Incentives – Horticultural Lighting." Energy Trust of Oregon, 2021. https://www.energytrust.org/incentives/horticultural-lighting/

Moving Forward

Energy efficiency and environmental conservation are crucial in a world hurtling towards the disastrous consequences of fossil fuel usage and unmitigated climate change. The newly legal state cannabis industry offers New York a new avenue in which to innovate when it comes to environmentally responsible cultivation.

The Empire State's large and diverse population and economy, combined with its varied topography and agricultural potential almost guarantee a thriving cannabis marketplace—almost. These unique dynamics could help to position New York State as a leader in the cannabis industry both on a national and international scale. Imposing overly burdensome, ill-conceived, and ineffective efficiency mandates on such a nascent market, however, imperil the success of legalization and may serve to jeopardize the new and significant revenue stream that the MRTA's embedded tax structure was included to create. Conversely, while experienced cultivators are naturally inclined to be efficient as such efficiency ultimately results in operational cost savings, energy efficiency goals are a must in this electricity-intensive industry. To foster both innovation and efficiency, we recommend the metaphorical carrot as opposed to the stick and recommend the above-described innovative strategies to promote energy efficiency in New York's novel market.