Cannabis Energy Use and Building Energy Codes

Introduction

The majority of medicinal and recreational marijuana in the United States is grown in controlled indoor agricultural facilities. Cannabis is the plant from which marijuana is derived. To date, 15 states, two territories, and Washington D.C. have legalized recreational marijuana, and 34 states have legalized medicinal marijuana. Growing cannabis indoors is extremely energy-intensive because it requires cooling, dehumidifying, ventilating, and specialized lighting fixtures that are used constantly throughout a plant's life. Most of the necessary equipment in marijuana operations are available in energy efficient options for growers. In some states, like Massachusetts, more energy efficient equipment is required. Even if these regulations exist, however, they are not always enforced. The lack of enforcement for existing regulations or regulations in general for commercial cannabis operations leads to large amounts of energy usage.

The purpose of this policy brief is to provide insight into:

- How much energy an indoor cannabis operation uses;
- Some of the challenges of regulating horticulture lighting and other necessary growing equipment from a building codes perspective;
- How some states are increasing cannabis operations energy efficiency; and
- Recommendations on how states can decrease the energy use of indoor grow facilities using building codes and standards.

IECC and Horticulture Lighting Requirements

The 2018 and 2021 International Energy Conservation Codes (IECC) do not include indoor horticultural lighting requirements. As of December 2021, the draft 2024 IECC also does not include horticultural lighting requirements. This lack of regulations is an important omission from the IECC considering the growing cannabis industry and the increase of indoor agricultural operations around the United States, which is now estimated to account for 1% of the U.S.'s total electricity consumption.

Indoor Cannabis Operation Energy Use

Cannabis is the most energy-intensive agricultural process in the United States and one of the most energy-intensive industrial processes in general. Lawrence Berkeley National Labs states that legalized growing operations use one percent of total electricity use in the U.S., which is estimated to cost $6 billion dollars per year. Additionally, growing operations generate an estimated 15 million tons of greenhouse gas emissions, or the equivalent of 3 million cars. States report that their most significant load increase is for electricity used to power cannabis facilities, including Denver reporting a 45 percent load increase. Utilities have also reported that cannabis production facilities coming online contributed to blackouts. Finally, according to the Northeast Sustainable Cannabis Project, indoor cannabis cultivation facilities in Massachusetts are consuming about 10 percent of all industrial electricity

consumption in the state.

Grow spaces in cannabis facilities can vary in size, but many facilities have multiple grow rooms that contain hundreds of individual plants. In addition to maximizing usable space, growers also want to produce high-quality cannabis, which requires the grow room(s) to have constant temperatures of 70-85 degrees Fahrenheit, at least 40 percent relative humidity levels, and depending on the stage of the growth cycle, at least 12 hours of lighting per day.[1] Equipment for indoor cannabis growers requires substantial energy, which is why most cannabis operational energy costs account for 20-40 percent of their total operating cost per year.

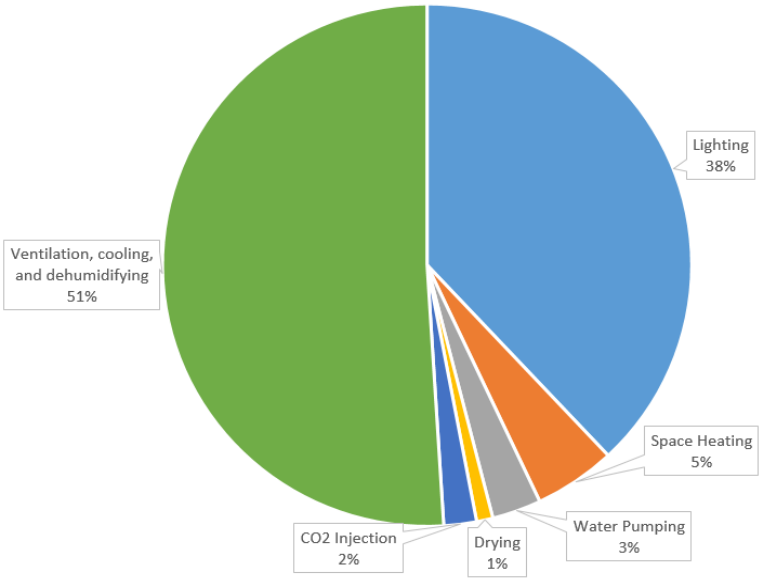
Since Colorado was one of the first states to legalize cannabis, it has had more time to understand grow processes and overall energy consumption from cannabis facilities. In Colorado, most cannabis plants are grown indoors due to the state's unpredictable weather, precipitation, and humidity levels throughout the year. According to the Colorado Department of Public Health and Environment, the cannabis sector currently accounts for about four percent of Denver's total electricity consumption per year. In addition to electricity use, it is also estimated that growing one kilogram (kg) of marijuana flower produces up to 2900 kg of carbon dioxide (CO_2) over the plant's lifecycle.[2]

Since growing cannabis, like other agricultural products, is focused on maximizing yields, more operations around the country are expected to be indoors. As more states legalize marijuana consumption, it can also be expected that electricity usage will follow Colorado's trend. Figure 1, which follows, explains the typical energy use breakdown for an indoor cannabis growth facility.

[1] Knowley, N. (2017), Southwest Energy Efficiency Project, "A Budding Opportunity: Energy Efficiency Best Practices for Cannabis Grow Operations".

[2] Sacirbey, O. (2021). "Powerful Friends: Marijuana companies partner with utilities and solar gardens to offset electricity costs" MJBiz Magazine, Volume 8, issue 7, page 50-51. Retrieved from: August 2021 - MJBizDaily

Figure 1. Energy Use Breakdown for Indoor Cannabis Growth Facility Equipment



Source: Collins, N. and Remillard, J. *Trends and Observations of Energy Use in the Cannabis Industry.* ACEEE Summer Study on Energy Efficiency in Industry. Retrieved from: Trends and Observations of Energy Use in the Cannabis Industry (aceee.org)

Indoor commercial cannabis operations use large amounts of energy because growers want to maximize production per square foot of growing space since these operations are usually run within existing buildings, which limits an operation's expansion. Figure 1 shows that the indoor lighting fixtures required to grow cannabis alone account for nearly 40 percent of the operation's total energy use.

Cannabis and Carbon. Currently, it is estimated that growing two pounds of cannabis emits 2-5 tons of carbon emissions, depending on the growing region. The Northeast has more renewable energy generation; therefore, emissions may be on the lower end. However, the cannabis industry is expected to grow by 16 percent annually, and emissions from cannabis production are a growing concern in meeting state and regional greenhouse gas emission reductions. The above energy use and emissions numbers in Figure 1 capture only the indoor growing part of energy usage and associated emissions with growing cannabis. Processing, storage, water, pesticides, transportation, and other ancillary factors associated with cannabis sales are not factored into the above numbers. Additionally, unregulated and illicit cannabis production and homegrown cannabis are not included in the above energy use and carbon numbers.

Challenges of Regulation the Cannabis Industry

Although the energy-intensive process of growing cannabis has been studied, there are numerous challenges to regulating the necessary indoor equipment through model building energy codes. One of the main challenges of developing and implementing these building codes is that marijuana is still illegal on the federal level and in some states. Since the U.S. Department of Energy (U.S. DOE) has not developed any regulations or federal guidance to make indoor cannabis facilities more energy efficient through codes, states and marijuana companies must create efficiency standards, which takes money and time to research, develop, and implement. This also means that, depending on the state's legalization status, there are few direct energy efficiency incentives or technical assistance offered to states and little-to-no engagement or investment by utilities and states for growing operations.

High Times and High Emissions

The Massachusetts Cannabis Commission has authorized the development of 1.1 million square feet of indoor cannabis production in the state. A blog by NEEP explains how these facilities have the potential to derail the state's climate goals.

There are other challenges to making indoor lighting and the other cannabis growing equipment more energy efficient, including the proprietary processes, a culture of secrecy regarding equipment development, and the fast-paced industry changes that outpace state building code adoption cycles. These issues limit a state's ability to develop energy efficiency standards through building codes that can adequately regulate cannabis industry energy usage. The culture of secrecy also impacts the amount of research on emissions or other environmental factors related to indoor grow facilities, which has created a lack of consistent energy data from existing grow facilities that regulators could use on which to base codes and standards and energy saving initiatives.

New Indoor Agricultural Operations for Food Growth

Local food movements in cities are driving increased demand for fresh high-quality produce. More restaurants are interested in sourcing ingredients directly from the producer, and in dense urban areas, a growing number of new indoor agriculture operations have begun to meet this demand. This movement could drive a significant expansion in indoor agriculture in cities around the country, which will further increase energy use in states that have already legalized medicinal/recreational marijuana.

Finally, many cannabis grow houses are built within existing buildings, which would require retrofit upgrade solutions to meet any efficiency codes or standards. Many of these buildings are grandfathered and are therefore required to operate on older and less energy efficient codes. A state that has legalized marijuana must address existing indoor operations in new building codes and standards to decrease the energy use and CO_2 emissions from industrial cannabis operations.

Current State Work Increasing Cannabis Operation Energy Efficiency

Some states are currently working on making the cannabis industry more energy efficient, specifically its electricity usage, without model building code guidance from the federal government. Currently, only two states in the country have efficiency regulations addressing indoor cannabis grow facilities – Illinois and Massachusetts. California is also expected to be the first state to promulgate cannabis production requirements in its energy codes during the next building code adoption cycle in 2024.

In Denver, Xcel Energy, Colorado's largest electric utility, has partnered with numerous marijuana companies and consulting firms in the state to offer rebates to companies that replace energy-intensive equipment and lighting with more efficient solutions and/or create building automation systems that control HVAC, dehumidifying, and lighting systems to maximize energy use.[3] Massachusetts addresses efficiency regulations through the Cannabis Control Commission (CCC) efficiency requirements, which were published in 2020. New cannabis facilities must follow these requirements in order to be licensed by the state. Although the CCC collects cannabis operations energy use data through reporting requirements, the data is not shared with utilities, so utilities can't offer incentives to cannabis facilities directly like Xcel Energy does in Colorado.

In addition to promoting the use of more efficient equipment, states with established marijuana companies, like Colorado and Oregon, have begun working with these companies to research and develop custom-built micro grids. These micro grids utilize on-site renewable energy sources, storage equipment, and distribution lines to allow companies to power their cannabis grow facilities with renewable electricity generated on-site.

Another way states are looking to decrease CO_2 emissions from cannabis operations is by promoting outdoor cannabis growing. Growing outdoors drastically decreases the amount of energy needed to grow cannabis and also promotes carbon sequestration. Outdoor growing, however, can only be accomplished in certain climates and traditionally yields less usable plants. States are exploring the use of greenhouses and other technologies to incentivize companies to grow more cannabis outdoors.

[3] Sacirbey, O. (2021). "Powerful Friends: Marijuana companies partner with utilities and solar gardens to offset electricity costs" MJBiz Magazine, Volume 8, issue 7, page 50-51. Retrieved from: August 2021 - MJBizDaily

NEEP Recommendations

The first proposed recommendation is for states with legalized marijuana to remove the loopholes in horticultural lighting requirements in model energy codes by requiring the majority of lighting used for cannabis plant growth or maintenance to meet an efficiency metric. A proposed efficacy requirement of 1.6 micromole per Joule (µmol/J) for fixtures and 1.9 µmol/J for lamps could be adopted. Other technologies used to grow cannabis must also be required to be more efficient. States must require indoor cannabis facilities to use efficient technologies such as: combined heat and power cogeneration units, solar photovoltaics, evaporative chillers, and fluid-free coolers to reduce energy use. States like Massachusetts must also ensure that existing regulations are enforced in new operations as well as implemented for cannabis facilities operating prior to 2020.

Indoor Agriculture Lighting

The efficiency metric of photosynthetic photon efficacy (PPE) was explicitly developed for lighting used in plant growth. PPE measures the number of photosynthetically active photons emitted from the lamp or fixture per Joule of energy consumed. The PPE of lamps or entire fixtures, including the ballast and reflectors, can be measured using accepted measurement standards developed in collaboration with the horticulture industry.

A second proposed recommendation is for states to focus on collecting and analyzing indoor cannabis facility energy use data. This data is essential for states to know the impact of their existing facilities as well as to anticipate how future operations will increase electricity usage. States can collect and analyze energy use data through programs that audit facilities to identify potential energy and water savings and/or by establishing voluntary or mandated cannabis facility benchmarking. States like Massachusetts must also consider sharing collected data with utilities, so they can create savings and rebate programs for cannabis operations like Xcel Energy has for Colorado facilities. Creating effective and lasting building codes and standards regulations requires accurate energy use data and states must focus on closing existing data gaps.

In addition to creating new regulations and requirements, states must incentivize existing and new cannabis facilities to reduce their energy usage. This can be done through increased education and training programs for cannabis industry professionals that focus on decreasing an operation's electricity usage and how to reduce carbon emissions. Some examples of education and training programs states might offer to those in the cannabis industry can address:

- Strategic energy management;
- Regenerative farming methodologies that use closed-loop systems to reduce carbon; and
- How cannabis operations can participate in carbon offset programs, both in their state and nationwide.

Finally, since most marijuana operations operate within legacy facilities, which are difficult and expensive to retrofit, states must research and invest in planning how cannabis grow systems can be more efficient in buildings before those buildings are constructed in order to maximize energy efficiency. Once a state has documented processes to make new grow facilities more energy efficient, these measures can be applied to existing facilities

in older buildings. To ensure operations are more efficient, states can also consider creating a regulation that requires new cannabis operations in existing facilities to follow the state's current iteration of building energy code.

Conclusion

The expanding cannabis industry impacts building energy use now and will in the future due to the large amounts of energy, especially electricity, needed to grow marijuana indoors. Governments must begin to address this energy-intensive sector in order to further cut building energy use and carbon emissions. Since indoor agricultural lighting and other necessary equipment remains unregulated in model energy codes, states must develop and implement their own codes and standards solutions to decrease the cannabis industry's growing carbon emissions and energy use. While this brief did not address water usage in the cannabis sector, water efficiency measures must also be taken into account when discussing environmental impacts of indoor operations because indoor cannabis operations require large amount of water as well. Energy efficiency, and water efficiency measures, are necessary for states to adopt and implement in order to decrease the energy use and carbon emissions of the cannabis industry as it continues to grow.

Resources

Energy Trust of Oregon. Energy Trust of Oregon offers licensed cannabis growers and hemp growers free technical services and cash incentives for the installation of energy-efficient equipment at new and existing grow operations. Incentives are available for indoor, outdoor and greenhouse grow operations. More information on this program can be found here.

Cannabis PowerScore. Cannabis PowerScore is the free resource benchmarking and reporting platform provided by the non-profit organization, Resource Innovation Institute. PowerScore enables cultivation operations to easily report their energy and water usage as specified by their governments. PowerScore also enables cultivation operations to benchmark their operational efficiency and productivity relative to industry-standard key performance indicators on energy, emissions, water and waste.

Design Lights Consortium. The DLC is a non-profit organization improving energy efficiency, lighting quality, and the human experience in the built environment, including information and policies related to horticultural technical requirements for lighting. More information can be found here.

Climate Resources Group. This group works directly with facility developers and operators to improve the resource-efficiency of indoor horticulture facilities. More information can be found here.

Massachusetts Cannabis Control Commission (CCC). The CCC has published guidance for new cannabis operations on basic energy efficiency practices & reporting for marijuana establishments. More information can be found here.