SPECIAL REPORT

2023 STATE OF THE CANNABIS LIGHTING MARKET

THE EIGHTH ANNUAL DEEP DIVE INTO LIGHTING TRENDS AMONG COMMERCIAL CULTIVATORS.

IN PARTNERSHIP WITH

FLUENCE

CANNABIS BUSINESS TIMES

A FOCUS ON QUALITY

IT'S STILL TOUGH OUT THERE. The past several years have been marked by supply chain issues, product surpluses, inflation, rising energy prices and complex regulations. But the cannabis industry continues to weather the storm with dogged determination. This spirit resonates strongly with us at Fluence. From our inception, Fluence has been committed to innovating alongside growers to maximize their success at every stage of production.

This year's "State of the Cannabis Lighting Market" report, produced by *Cannabis Business Times* and made possible with support from Fluence, highlights the industry's adaptability in the broader context of oversupply, consolidation, and the rapidly increasing importance of operational efficiency. For the second year in a row, at least 70% of study participants used LEDs in vegetation and/or flowering. Last year's research showed 74% of participants used LEDs in propagation. During the past eight years that *CBT* has conducted this study, LED usage has grown steadily across the board, suggesting that LEDs have become a permanent fixture during each stage of commercial cannabis production.

And while quantity *always* is important, quality is king. Sixty-two percent of respondents ranked "crop quality" as the most important factor for using LEDs in cannabis production. Compared to "yield" at 16% and "energy efficiency" at 12%, the importance of quality has never been greater.

This year's respondents cited energy costs, consistency of lighting, and lighting's impact on plant growth as their top three challenges in 2023. And less than half of respondents reported exploring utility rebates and incentives despite these programs being offered in multiple states. With so many different factors to consider, working with a trusted, knowledgeable and quality partner has never been more important. That's why Fluence has teams of horticultural scientists, rebate specialists and field application engineers to provide growers unparalleled guidance and support in every facet of their operation.

This year's report, and the industry-leading research performed by Fluence's global team of horticulture experts, affirm the critical role of lighting in an ever-changing landscape. Being led by science means we're dedicated to delivering technology, data and support that improves the interaction between light and life and to help our cultivation partners drive operational efficiencies in every growth cycle.

To helping the world grow smarter, together,

STEVE GRAVES
Senior Vice President, Strategy & Business Development, Fluence

PHOTO COURTESY OF FLUENCE

62%

OF RESPONDENTS RANKED "CROP QUALITY" AS THE MOST IMPORTANT FACTOR FOR USING LEDs IN CANNABIS PRODUCTION.

‘DRAMATIC CHANGES’ IN CANNABIS LIGHTING TRENDS

BY **JOLENE HANSEN**

THIS YEAR’S *CANNABIS BUSINESS TIMES* “STATE OF THE CANNABIS LIGHTING MARKET” report represents *CBT*’s eighth annual deep dive into lighting trends among commercial cultivators. Since this exclusive industry research first published in 2016, the lighting market and the cannabis industry have undergone dramatic changes. Technological advances in lighting, pushed forward by ardent growers, product manufacturers and researchers, have been tempered by challenges, old and new.

Cultivators, in their quest for increased profitability, have faced price compression, rising energy costs and shifting consumer patterns as new markets and competitors enter the fray. Once considered unproven and unaffordable, energy-saving light-emitting diodes (LEDs) have become integral cost-saving components of controlled growing environments for many commercial cultivators.

This 2023 “State of the Cannabis Lighting Market” report was conducted on behalf of *Cannabis Business Times* by third-party research organization Readex Research, with support from Fluence. The results reported here provide an in-depth look at cannabis lighting trends and the practices of cultivation operators. This essential *CBT* research enables valuable comparisons as the cannabis lighting market matures.

Jolene Hansen is a freelance writer specializing in the cannabis, horticulture and CEA industries.

MEDIAN CANOPY SIZE FOR COMMERCIAL GROWERS*

2023	2022
19,370 SQ. FT.	14,770 SQ. FT.

TAKING WORK HOME:

40%

OF COMMERCIAL GROWERS ALSO GROW AS A HOBBY OR FOR PERSONAL USE.*

**Base: Participants who grow cannabis commercially in an indoor facility or a greenhouse, with or without supplemental lighting: 91. Turn to p. S8 for more details.*

LEDs LEAD DIVERSE LIGHTING CHOICES

Last year, for the first time in this report's history, more than 70% of research participants from commercial indoor and greenhouse cultivation operations with supplemental lighting reported using "light-emitting diodes" (LEDs) in every growth stage. That represented a 55-percentage-point jump, on average, from 2016. While LEDs continue to dominate lighting choices for commercial cultivators for veg and flowering in 2023, study results show some growers seek other solutions.

Vegetation: 76% of 2023 research participants reported using "light-emitting diodes" (LEDs) for vegetation, up 59 percentage points since 2016. Nearly a third (29%) of participants reported using "fluorescent lights (compact, T5, other HO fluorescents)," but use of the technology has declined among participants by 8 percentage points when compared to 2016. At 15%, the number of participants using "high-pressure sodium (HPS) lights" decreased 16 percentage points from 2016.

In 2016, "metal halide (MH) lights" took the top spot for veg lighting, used by 43% of growers that year. For 2023, only 16% of commercial grower participants used metal halides for the vegetative stage—27 percentage points less than 2016.

Flowering: The vast majority (73%) of 2023 study participants indicated they use LEDs in flower, up 2 percentage points from last year and 58 percentage points since 2016.

Nearly a third (31%) of commercial grower participants reported using HPS lights this year—reflecting about a 50% decline since the first year this study was conducted (2016), when 62% of research participants cultivating commercial grows indoors or in greenhouses, with or without supplemental lighting, reported using HPS lights in flower.

Future plans signal more shifts for those cultivators *not* using LED lighting or using no supplemental lighting: 38% of those participants indicate their operation plans to use LEDs in the cannabis flower cycle within the coming year, and another 23% are considering using LEDs.

TYPES OF LIGHTING USED

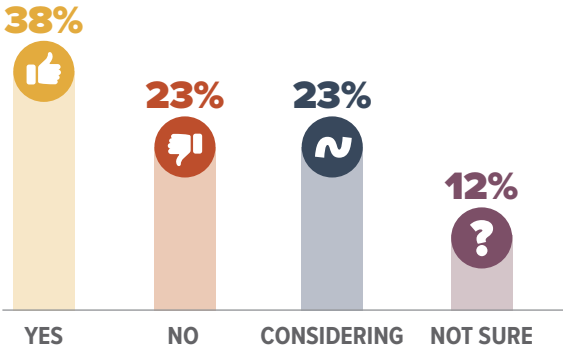
	VEGETATION			FLOWER		
	2016	2023	% pt. change	2016	2023	% pt. change
LIGHT EMITTING DIODES (LEDS)	17%	76%	↑ 59% pts.	15%	73%	↑ 58% pts.
FLUORESCENT LIGHTS (COMPACT, T5, OTHER HO FLUORESCENTS)*	37%	29%	↓ 8% pts.	8%	6%	↓ 2% pts.
HIGH-PRESSURE SODIUM (HPS) LIGHTS	31%	15%	↓ 16% pts.	62%	31%	↓ 31% pts.
METAL HALIDE (MH) LIGHTS**	43%	16%	↓ 27% pts.	12%	2%	↓ 3% pts.
OTHER	8%	5%	↓ 3% pts.	5%	1%	↓ 4% pts.

*Total may exceed 100% because participants could select all that apply. Base: Participants who indicated they work for a commercial operation that grows cannabis indoors or in greenhouses: 91; *In 2016, "compact flourescent lights" was a separate category; in 2023, "compact flourescent lights" was combined under "flourescent lights," so 2016 data reflects the total of what was previously two separate categories. **In 2016, metal halide (MH) lights was separated into two categories, "ceramic" and "quartz." In 2023, those categories were combined, so for comparison, 2016 data reflects the total of what was previously two separate categories.*

TOP 3 LIGHTING TYPES

VEGETATIVE	FLOWER
#1 LED	#1 LED
#2 FLUORESCENT (compact T5, other HO fluorescents)	#2 HPS
#3 METAL HALIDE	#3 FLUORESCENT (compact T5, other HO fluorescents)

Is your operation planning to use LED lights in the cannabis flower cycle within the next 12 months?



Base: Those who own or work for a commercial operation that grows cannabis indoors and/ or greenhouse and does not use LED lights (26). No response: 3%

FACTORS DRIVING **LIGHTING DECISIONS**

In last year's study, "light intensity" led the list of the top five factors influencing lighting fixture purchases for flowering. But this year's research saw a shift. "Energy efficiency," cited by 48% of research participants in 2023 and 2022, was the most-cited, top-five purchasing factor among study participants growing commercially in an indoor facility or greenhouse in this year's research.

"Price" was a top-five factor for 47% of 2023 participants, down 5 percentage points from last year. Next up was "light spectrum" for 46% of 2023 participants, followed by "must be LED" at 43%. "Light intensity" finished out the top-five most important purchasing factors for flowering at 42% of 2023 participants, down 11 percentage points from 2022.

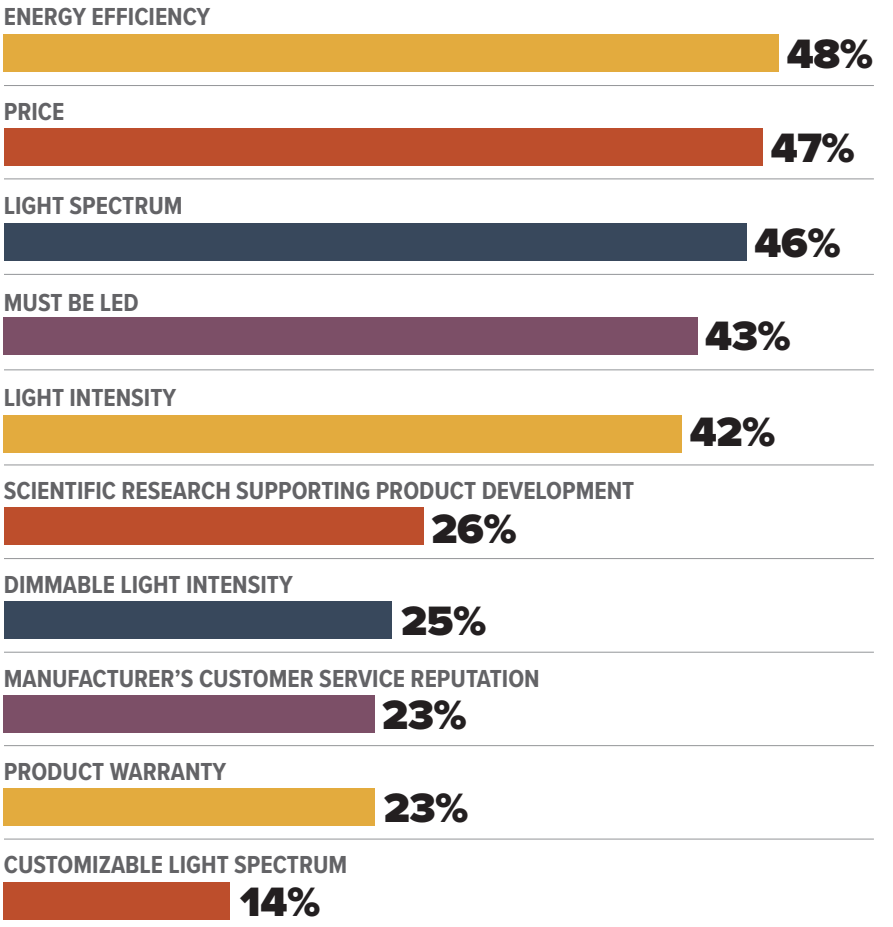
On a related note, interest in dimmable light intensity diminished among this year's study participants. When asked about the importance of dimming as it relates to controlling light intensity and enhancing lighting flexibility, 38% of commercial growers cultivating indoors or in greenhouses said dimming was "very important," down from 47% of participants last year. Fifteen percent of 2023 participants reported dimming was "not at all important," compared to 8% in 2022.

When asked more broadly, "What are the top three considerations, ranked in order of importance to you, for current or future LED use in your cannabis cultivation operation for 2024?" the top-selected answers differed slightly, with 62% of participants ranking "crop quality" as their top choice, followed by "yield" (16%) and "energy efficiency" (12%).

62%

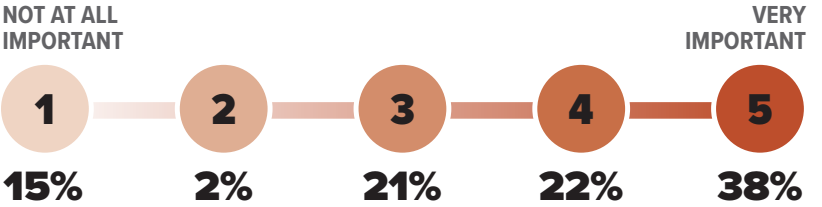
OF PARTICIPANTS SAID **CROP QUALITY WAS A TOP CONSIDERATION** WHEN EXAMINING IMPORTANT CONSIDERATIONS FOR CURRENT OR FUTURE LED USE.

When purchasing a lighting fixture for the cannabis flowering phase, which factors are among the top five most important to you? *(Top 10 in order below)*



Total exceeds 100% because participants could select up to five. Base: Participants who grow cannabis commercially in an indoor facility or a greenhouse, with or without supplemental lighting: 91

How important to your operation is dimming with regard to controlling light intensity and allowing for greater lighting flexibility in your garden?



Base: Participants who grow cannabis commercially in an indoor facility or a greenhouse, with or without supplemental lighting: 91

LIGHTING CHALLENGES + LED ANSWERS

In many ways, cannabis cultivation has grown easier thanks to advanced growing technologies, including lighting. But economic and legislative landscapes continue complicating the path to profitability. The top lighting challenges reported by commercial cultivators in this year's research reflect those hurdles.

For the third year running, "managing energy costs" was named the single greatest lighting-related challenge among commercial cultivation operators using supplemental lighting in an indoor facility or greenhouse—cited by 21% of participants, compared to 22% last year.

Seventeen percent named "ensuring consistent/even lighting across the crops" as their greatest lighting challenge. "Lighting's impact on plant growth (yield, internodal spacing, etc.)" (16%) and "managing heat load" (12%) rounded out 2023's top four.

Among commercial cultivation operations growing indoors or in greenhouses, perceived benefits of LED lighting promise solutions. Four out of five research participants (80%) named "energy efficiency" as a top-three benefit of LED lighting. Three out of five (60%) cited "low heat" as a leading LED benefit. "Lifetime of product" took third place at 27%, a 12-percentage-point increase compared to 2022.

TOP LIGHTING CHALLENGE

2023
MANAGING ENERGY COSTS

2022
MANAGING ENERGY COSTS

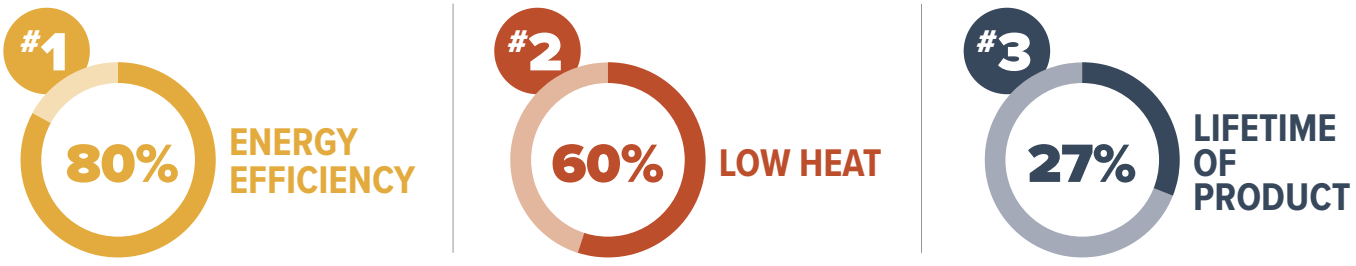
2021
MANAGING ENERGY COSTS

What is your cannabis cultivation operation's ***greatest*** **challenge** when it comes to lighting?

TOP CHALLENGES IN 2022		TOP CHALLENGES IN 2023	
MANAGING ENERGY COSTS	22%	MANAGING ENERGY COSTS	21%
MANAGING HEAT LOAD	15%	ENSURING CONSISTENT/EVEN LIGHTING ACROSS THE CROPS	17%
ENSURING CONSISTENT/EVEN LIGHTING ACROSS THE CROPS	13%	LIGHTING'S IMPACT ON PLANT GROWTH (YIELD, INTERNODAL SPACING, ETC.)	16%
ADJUSTING LIGHT DISTANCE TO CANOPY	10%	MANAGING HEAT LOAD	12%
LIGHTING'S IMPACT ON PLANT GROWTH (YIELD, INTERNODAL SPACING, ETC.)	10%	ADJUSTING LIGHT DISTANCE TO CANOPY	6%

Base: Participants who grow cannabis commercially in an indoor facility or a greenhouse, with supplemental lighting: 90

What are the top three benefits of using LED lighting?
(Participants could select up to three answers; top three answers out of 10 options listed below.)



Base: Participants who grow cannabis commercially in an indoor facility or a greenhouse, with or without supplemental lighting: 91

REBATE ACQUISITION & AWARENESS

Cost is often cited as a barrier to LED adoption. Research participants who don't plan to use LEDs in flowering in the next year named "payback/ROI too long" and "challenges in securing funding/capital for LED lighting" as top reasons preventing them from leveraging this technology. For many LED users, utility rebates and incentives provided crucial boosts, but rebate awareness remains low.

For 2023, 44% of commercial indoor and/or greenhouse research participants reported they "explored utility rebate incentives to subsidize the cost of LED solutions." Nearly one-fourth (23%) have "submitted and received rebates," compared to 18% in 2022. Another 5% "submitted but did not receive rebates," while 15% explored options, "but have not submitted for a rebate yet."

However, 56% of 2023 participants haven't explored rebates at all, showing little change from 2022. Of those, about one-fourth (24%) said they are "aware of these rebates but haven't explored," and nearly one-third (32%) were "not aware of these rebates."

What is preventing your operation from introducing LEDs in the flower cycle within the next 12 months?

25% PAYBACK/ROI IS TOO LONG

17% CHALLENGES IN SECURING FUNDING/ CAPITAL FOR LED LIGHTING

Base: Those whose cannabis operation does not plan to use LEDs in the flowering cycle in the next 12 months: 12

Has your operation explored utility rebates and incentives?

YES | **44%**

- **23%** YES, SUBMITTED AND RECEIVED REBATES
- **5%** YES, SUBMITTED BUT DID NOT RECEIVE REBATES
- **15%** YES, BUT HAVE NOT SUBMITTED FOR A REBATE YET

NO | **56%**

- **24%** NO, AWARE OF THESE REBATES BUT HAVEN'T EXPLORED
- **32%** NO, WAS NOT AWARE OF THESE REBATES

Base: Participants who grow cannabis commercially in an indoor facility or a greenhouse, with or without supplemental lighting: 91

AVERAGE YIELDS AND LIGHTING TYPES

For many commercial cultivators in the cannabis industry, interest in spectra, light intensities and lighting technologies often boils down to yields. As demonstrated by this 2023 research, when examining average yields per square foot of flower canopy across all genetics, progress was clear.

Last year, more than half (55%) of research participants operating commercial indoor or greenhouse grows reported average yields exceeding 50 grams per square foot of canopy. For 2023, two-thirds (66%) of commercial growers fell within that 50-plus gram range.

This year's research also offered a new category within that upper echelon: "80 grams per square foot or more." Fourteen percent of commercial operations reported average yields in that top range in 2023. According to participants, not all operations track this metric, as 12% said their company "doesn't measure" this. Another 8% reported "operation measures but I don't know."

As growers pursue optimal yields, interest in augmenting overhead lighting grew slightly. Among study participants growing cannabis commercially in an indoor facility or greenhouse with supplemental lighting or those without lighting but considering greenhouse lighting within the next 12 months, more than 34% reported interest in exploring "side lighting," compared to 30% last year. Interest in "intercanopy" and "sub canopy" lighting held relatively steady at 22% and 21%, respectively.

On average, how many grams per square foot does your operation achieve across all genetics?

- **14%** 80 GRAMS PER SQ. FT. OR MORE
- **18%** 70-79 GRAMS PER SQ. FT.
- **18%** 60 – 69 GRAMS PER SQ. FT
- **16%** 50 – 59 GRAMS PER SQ. FT.
- **7%** 40 – 49 GRAMS PER SQ. FT.
- **4%** LESS THAN 40 GRAMS PER SQ. FT.

Base: Participants who grow cannabis commercially in an indoor facility or a greenhouse, with or without supplemental lighting: 91 "Operation measures but I don't know:" 8%. "Operation doesn't measure:" 12% No answer: 3%

CANOPIES, FACILITIES & TIERS

Last year, this report acknowledged that averages can mislead when data contains extremes—case in point, commercial canopy footage. Instead of the average canopy size, the 2022 report shared the median value for total plant canopy among commercial participants: 10,000 square feet. This year's report again offers the middle value of all reported canopy sizes, where half of participants fall above and half below. Once again, median total plant canopy was 10,000 square feet for 2023. But filter out the 40% of commercial growers who also operate hobby or personal-use grows, and the commercial median total plant canopy increases to 19,370 square feet, compared to 14,770 square feet last year. For 2023, 26% of commercial growers operating indoor or greenhouse facilities cultivate 50,000 square feet or more of plant canopy. Sixteen percent operate a plant canopy of less than 1,000 square feet.

Forty percent of 2023 research participants who grow commercially in an indoor facility or greenhouse with supplemental lighting use vertical racks for vegetation, up 9 percentage points from the first time this report asked that question in 2017. Of those using vertical racks for veg, 50% use two tiers. Less than one-fourth (22%) of commercial cultivators growing under supplemental lighting report using vertical racks for flowering—9 percentage points higher than 2017. Of those using vertical racks for flowering, 65% stick to two tiers. This year's study again confirmed many commercial cultivators operate multiple facility types. More than three-fourths of commercial growers (76%) grow indoors, down from 88% last year. Meanwhile, 39% of commercial participants cultivate greenhouse grows with supplemental lighting, up from 28% in 2022.

CULTIVATION FACILITY TYPES

In what **type of facility** does your operation grow cannabis?*

76% INDOOR FACILITY**

23% OUTDOORS***

39% GREENHOUSE WITH SUPPLEMENTAL LIGHTING**

7% GREENHOUSE WITHOUT SUPPLEMENTAL LIGHTING

**Total may exceed 100% because participants could select all that apply. **To examine lighting trends among cultivators specifically, CBT's research looked at the responses of the 91 participants who grow commercially indoors and/or in greenhouses. ***Responses from participants who grow outdoors only were excluded from the final report.*

ABOUT THE RESEARCH & PARTICIPANTS

Readex Research conducted the study and compiled the data for this 2023 "State of the Cannabis Lighting Market" report. During July and August 2023, the research questionnaire went out to all emailable, active, qualified subscribers to Cannabis Business Times magazine located in the United States or Canada.

To provide information most pertinent to commercial cannabis cultivators, research results focused on the 126 research participants who own or work for an operation that grows cannabis in an indoor facility and/or greenhouse. Data was then refined to exclude non-commercial operations. Unless otherwise indicated, the results found within this report represent participants who cultivate cannabis commercially indoors and/or in greenhouses, with or without supplemental lighting.

The margin of error for percentages based on the 126 participants who reported they own or work for an operation that grows cannabis in an indoor facility and/or greenhouse, with or without supplemental lights, is ±8.7 percentage points at the 95% confidence level.

What is the area of your operation's cannabis crop production (total plant canopy)?

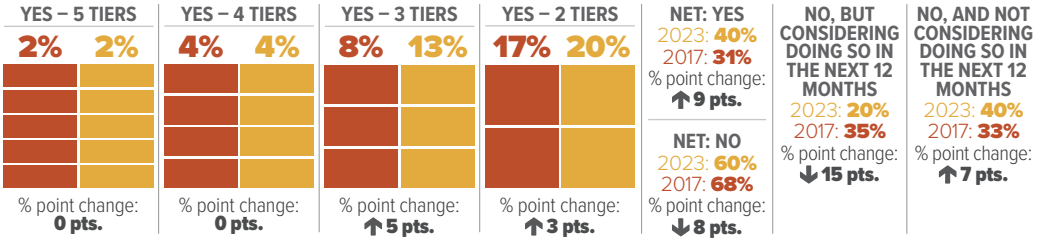
250,000 sq. ft. or more	7%	25,000 - 49,999 sq. ft.	9%
150,000 - 249,999 sq. ft.	4%	10,000 - 24,999 sq. ft.	15%
100,000 - 149,999 sq. ft.	8%	5,000 - 9,999 sq. ft.	14%
80,000 - 99,999 sq. ft.	2%	less than 5,000 sq. ft.	35%
50,000 - 79,999 sq. ft.	5%		

Base: Participants who grow cannabis for a commercial operation in an indoor facility or greenhouse with or without supplemental lighting: 91

VERTICAL FARMING – VEGETATION & FLOWERING

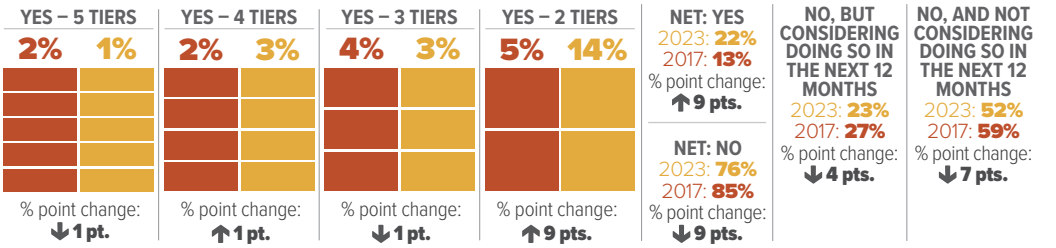
2017 2023

Does your operation **use vertical rack systems** for cannabis *vegetation*?



Base: Participants who grow cannabis for a commercial operation in an indoor facility or greenhouse with supplemental lighting: 90

Does your operation **use vertical rack systems** for cannabis *flowering*?



Base: Participants who grow cannabis for a commercial operation in an indoor facility or greenhouse with supplemental lighting: 90 No answer: 2%

All Jushi Holdings Inc. cultivation facilities are equipped with LEDs.

PHOTO COURTESY OF JUSHI HOLDINGS INC.

8 TIPS TO REAP THE LED REBATE

Utility incentive programs vary by state, but horticultural lighting programs are becoming more common and can cover significant portions of the investment.

BY **MICHELLE SIMAKIS**

When it comes to LED rebates, many growers may be leaving money on the table.

According to *Cannabis Business Times* 2023 State of the Cannabis Lighting Market research, more than half (56%) of participants have not explored light-emitting diode (LED) rebates. A quarter (24%) of those participants said they are aware but haven't investigated the utility savings, while nearly a third (32%) said they weren't aware of these rebates at all.

Cannabis cultivators who are in the know and companies that do take advantage of these state-based programs have the opportunity to save hundreds of thousands of dollars—

and sometimes more—in LED retrofits and installations.

"Awareness is the first barrier," says Jeannie Sikora, senior energy engineer for CLEAResult, which works with utility companies to implement energy efficiency rebate programs. "If I were a grower, I would first check with my local utility company. Rather than trying to navigate the web page—if you don't immediately see agricultural rebates through your local utility company—pick up the phone and call and talk to somebody."

Because utility rebates are often state-mandated programs, the offers and structure can be very different depending on where you operate, Sikora says. But horticultural lighting rebates have become more common during the past few years, and it would be worthwhile for cannabis cultivators to explore what their local electric (and also gas) companies offer.

Once you've established that your utility offers energy efficiency rebates for horticultural lighting, here are steps you can take to obtain and maximize your rebate.

1. Determine the type of rebate incentives available.

Generally, there are two primary types of incentives available for horticultural lighting: prescriptive and custom. Prescriptive incentives offer money toward purchasing more energy-efficient equipment, whereas custom incentives do the same, but may require measurement and verification of the energy saved before they are awarded. Preapproval is almost always required before purchase.

Travis Higginbotham, vice president of cultivation for StateHouse, a cannabis cultivation company based in Salinas, Calif., said his team was able to secure a significant rebate that covered the entire cost of retrofitting the company's greenhouses from HPS lighting to LED. And they didn't have to seek or use capital to invest in the equipment.

"The California market has obviously been challenging now for quite a while, and 2022 was an incredibly difficult year," Higginbotham says, noting that millions of square feet of cannabis production have gone offline in the past 18 months. According to an article published in April in SFGATE, the state lost more than 1,760 cultivation licenses since January 2022, which represented about a quarter of legal canopy or 19 million square feet. "With the price of flower coming down due to the saturation of product on the market, we decided to go into 2022 a little bit more aggressive and focused on being more cost effective, and then at the same time trying to optimize our square footage to produce more in less space," Higginbotham says.

Their solution was to "play with their total square footage," as Higginbotham describes it, rearranging the stages of production among the company's five greenhouses to dedicate less space to flower and more to veg within the 205,000 square feet of space.

"One reason was to make sure that we did everything possible to prevent Hop Latent Viroid, and two, it was in an effort to give our plants a little bit more space during veg and a little bit longer veg time to reduce our plant count going into flower and reduce direct costs," Higginbotham says. "And, at the same time, to potentially take advantage of plant sales."

A key part of the equation to optimize space was increasing yield without expansion. With the rebate and other strategic infrastructure improvements, the company was able to boost light intensity in a smaller footprint. The whole process was quick and relatively easy, Higginbotham says. The lights were compatible with the HPS outlets, so it only took about a month from finalizing the rebate and purchase to converting the facility.

2. Work with suppliers who offer resources and support for rebates.

One of the reasons the

PHOTO COURTESY OF JUSHI HOLDINGS INC.

> **ONE OF THE BIGGEST BARRIERS TO GETTING REBATES IS THE TIME AND ENERGY INVOLVED."**
>
> **– JOSH MALMAN,** VICE PRESIDENT OF CULTIVATION OPERATIONS, JUSHI

A rebate covered 26% of the LED equipment investment in Jushi's Scranton, Pa., facility.

rebate for the LED retrofit was so easy for Higginbotham is because the LED supplier handled the entire process—from application to working with Pacific Gas & Electric (PG&E) and the utility consultant to get approval and receive the maximum benefit possible.

Jushi's Holdings Inc.'s LED supplier also offered the same support and made a LED rebate for the buildout of their 123,000-square-foot Scranton, Pa., facility possible, says Josh Malman, vice president of cultivation operations.

"One of the biggest barriers to getting rebates is the time and energy involved," Malman says. The timeline for Jushi's rebate, which covered 26% of the LED fixture cost, took about a year. His LED supplier worked with them from the very beginning when their Scranton facility was designed, helping to complete the application and calculate comparisons of what the energy usage load of legacy equipment would be compared to LED technology. "I think [cultivators] should be aware that rebates are out there and work with partners that will work alongside you. Not all companies have someone on the team that can run the rebate process."

3. Check that your supplier is DLC certified.

Before moving forward with a lighting investment, Sikora suggests checking with the utility company to ensure that the LED supplier is eligible. Most of the time, utility companies require that products are on DesignLights Consortium (DLC)'s qualified products list.

4. Start exploring rebates as early as possible.

The team at Jushi Holdings Inc. knew before purchasing LEDs that the utility company, PPL Electric Utilities, would cover 5% to 26% of the total cost to outfit their indoor facility, which includes double and triple tiers.

"Capital costs for LEDs is a barrier; but there's enough research out there now and visibility around LED companies that have the right technology that bury legacy lighting for indoor growing," Malman says, noting the energy efficiency combined with the savings in HVAC costs (because LEDs produce less heat) make LEDs an obvious choice.

Two months after the lights were installed, Jushi Holdings Inc. received the rebate for the LED investment, a relatively fast turnaround and feasible because the company had started during the facility design stage.

5. Understand the full range of benefits available, and ask questions.

Most utility companies offer a range of prescriptive and custom incentives, Sikora says. Once you connect with a utility company, ask about other incentives that are available.

In addition to lighting fixtures, the ways that companies operate the equipment can result in savings, too, Sikora says.

StateHouse received a rebate that covered the company's supplemental greenhouse lighting conversion to LEDs.

"If they're using dimming controls, for example, that could also be something that would qualify for additional rebates if your utility company allows custom incentives," she says. "It helps if you have growing automation software that can report information and data because a lot of these programs, we have to measure and verify energy savings."

Malman said that in addition to the rebate for the LED installation, they received rebates for airflow fans that were within the vertical rack systems because they were more energy efficient, something that was an unexpected surprise.

And when building out facilities, as Malman says, "Every cent counts."

6. Document everything: Save purchase documents and calculate energy usage from current versus new equipment.

Most rebate programs require invoices to prove that the equipment was purchased, and a representative will visit to verify it was installed. Some utility programs require monitoring after installation to determine energy usage and the rebate amount.

Facilities that have sophisticated controls can more easily generate this data to provide the current energy usage, but if not, metering equipment can be installed and removed once data is collected, generally for about eight weeks, Sikora says.

"The more data that you can provide, the easier it becomes to prove that you're saving energy over a typical baseline or an industry standard practice," she says.

For Higginbotham at StateHouse, the equipment they use that requires electricity—such as fans, shade cloths and HVAC systems—was connected to separate meters, which made determining the energy used from lights alone seamless. This is crucial to get a full understanding of savings from LEDs and approval for rebates in a retrofit.

For Malman, these load calculations were provided by his LED supplier and the utility program implementer.

7. Measure the results.

After just one growth cycle at StateHouse, Higginbotham and his team have been impressed with the results of supplementing the greenhouse sunlight with LEDs. Despite being one of the most ideal places for agriculture, Salinas experienced record rainfall earlier this year, which impacted light levels, and thus the photosynthetic active radiation (PAR) plants were receiving, which can be a detriment to light intensity, thus yield and quality. Photosynthetic flux photon density (PPFD), which measures how much usable light, or PAR, the plant actually receives, and a way to track light intensity, doubled with the supplemental LEDs, Higginbotham says.

"We were close to 200 to 230 micromoles of light intensity with our artificial lighting before we were able to take advantage of the rebate," Higginbotham says, not including intensity from the sun. "Now with new and more lights, we are hitting as high as 500 micromoles now of just artificial, supplemental lighting. So we were able in 1 acre to increase light levels by double. And we're seeing yield follow the same trend where we've almost doubled."

8. Don't assume rebates will always be available.

Although rebate programs have become more common for horticultural lighting, that might not always be the case, Sikora says. If you're interested in converting to LED technology and rebates are available in your state, act now.

"Don't wait. Take advantage of incentives while they are here," Sikora says. "The purpose of utility efficiency programs is to influence buyers to select higher efficiency equipment and systems. When that higher efficiency equipment starts becoming the norm, programs will reduce or eliminate incentives because they are no longer perceived as having influence on buying decisions."

As Malman puts it, "LED is the future of cannabis lighting," and the future is now.

MICHELLE SIMAKIS
is editor-in-chief for *Cannabis Business Times*.

PHOTO COURTESY OF STATEHOUSE| SIMAKIS PORTRAIT: KEN BLAZE

NEXT-MOVER ADVANTAGE

A combination of experience, experimentation and the latest technology has allowed Root & Bloom to establish its brand and respond to consumer trends during its first year of sales in Massachusetts's cannabis market.

BY **MICHELLE SIMAKIS**

After spending seven years commuting between his home in Massachusetts and his job in Colorado, Tom Regan wasn't necessarily looking to get back into the cannabis industry full time.

He had been one of the leaders of MiNDFUL, a Denver-based dispensary chain with origins in the state's medical market, serving as president of the retail arm, as well as the vertically integrated company's other brands, TR Concentrates and Link Brands.

In early 2021, he finalized an acquisition deal with LivWell, and after selling the company, he moved back East.

Once the year-plus process was complete, Regan says, "I was exhausted." He took a break as he assessed his next step, imagining that he'd eventually launch a cannabis consultancy. In the meantime, he connected with Brad Kutcher and George Haseltine, commercial and residential developers who were building out a new grow, extraction and manufacturing facility to serve Massachusetts's three-year-old, adult-use cannabis market. He started offering some advice and eventually signed on to be a consultant for Root & Bloom, a cultivation, extraction, manufacturing and distribution company based in Salisbury, Mass.

"Over the next year or so, [Kutcher and Haseltine] would come to me to ask questions or if I knew folks that could help. And a lot of the Colorado team and folks I knew in Massachusetts were becoming available," Regan says. "So, I started to channel the best folks I knew over to the Root & Bloom side, and then finally in 2022, Brad and George asked me to join [as CEO], and it was just an incredible opportunity."

Root & Bloom's products debuted in October 2022.

One of the growers Regan helped recruit to Root & Bloom from Denver

was William Windham, VP of Cultivation, who was one of the first people Regan met at MiNDFUL.

"He joined [MiNDFUL] as a trimmer. He came from the restaurant industry and joined our company in probably one of the most entry-level jobs, and he worked his way through our organization and became the head cultivator," Regan says, adding that other people he worked with had also signed on to the new company. "Once I met the team, I'm like, this is it. You don't always get to choose who you get to work with. But the team was just so cool and down to earth and confident."

With four-plus decades of cannabis experience among the veterans on the team, Regan says they were ready to take on the challenges of a new market.

Root & Bloom first launched with seven cultivars.

A COMPETITIVE EDGE

In cannabis, a lot of experts will note first-mover advantage. As state markets come online, the competition for licenses is fierce as prospective business owners do anything they can to stand out among often crowded applicant pools and complicated requirements. People gamble, making significant investments in the hopes of getting on the ground floor of an emerging, lucrative market, when prices are at their highest.

The Massachusetts Cannabis Control Commission approved Root & Bloom's license in July 2020. By the time Root & Bloom's products hit the Massachusetts market in October 2022, average wholesale cannabis prices were about $2,270 per pound versus the roughly $3,530 average cultivators were getting the year before, according to an August 2022 report from Cannabis Benchmarks. By January 2023, prices had dropped to $1,400, though they have since rebounded.

But Regan says there's a lot of opportunity in the Massachusetts market. With its limited licensing model (each cultivation company can only operate up to three dispensaries, for example,) there's room for smaller players, he says. There are now just over 120 approved, operational cultivation licenses in Massachusetts, a state with a population of nearly 7 million people that saw more than $1 billion in medical and adult-use sales in both 2021 and 2022. On Aug. 31, 2023, the program hit $5 billion in sales since the first adult-use dispensaries opened their doors in November 2018.

And Regan and Windham were used to the ups and downs of the industry. Colorado has experienced the most dramatic price compression of any adult-use state, and, despite the dip in the East Coast market, it had been years since cannabis had commanded the kind of prices Massachusetts companies were getting. This understanding of the price fluctuations that happen as a market matures, coupled with a state-of-the-art, custom-built cultivation and manufacturing facility, meant they could produce high-quality flower, vapes, prerolls and edibles for partners as well as its house brand efficiently and compete right away.

"We're able to partner with folks to get brands out to the market that maybe wouldn't be able to otherwise since they don't have a facility and a license and a team like we do," Windham says. At its launch, the company was in 40 dispensaries in Massachusetts; now they have surpassed 150. "We're excited to be able to offer some pretty unique products and get into a lot of stores really, really quickly."

ILLUMINATING THE GROW

The indoor cultivation facility helps the team of 75 veterans and "hungry" newcomers achieve these goals and avoid some of the growing pains of pioneering companies. The facility is split among two floors, with one clone room, one mother room, two veg rooms and four flower rooms on each level, with separate irrigation, HVAC, ductwork and other required systems for every single room. Systems are automated. Producing a high-quality, craft product is the priority, and preventing any pest or disease outbreaks that would get in the way of that was top of mind for the founders. Redundancies are built in—including a generator *and* a backup generator—to protect the crop.

After watching the evolution of horticultural lighting play out in Colorado, it was important to Regan and Windham that the entire facility be outfitted with top-of-the-line, energy-efficient light-emitting

PHOTOS COURTESY OF ROOT & BLOOM

diodes (LEDs). Each of the eight 1,900-square-foot flower rooms is equipped with 99 fixtures.

By using LEDs and having separate veg rooms, Windham can give the crops more time in flower without cutting into efficiencies of the operation, which harvests about 150 pounds a week.

"We're able to change the light cycle in veg into that 12/12 cycle to induce flowering. We can do that before we move our plants into a flower room because of the number of rooms and size of rooms we have here," Windham says of the 20,000-square-foot canopy. "In other facilities where I've worked, we've had massive veg rooms, and we couldn't put that room into 12 hours of darkness without impacting some other crops that also were in there."

With one crop per veg room, growers are able to flip the room into flower weeks earlier, speeding up the time it takes to get cultivars to harvest, giving them flexibility and the ability to respond to the market more quickly.

Root & Bloom's 20,000-square-foot canopy is outfitted entirely with LEDs.

They're also able to work with genetics that can take longer to finish, some that other commercial growers may have discontinued because they need about 70 days to mature. They also have the ability to finish cultivars sooner if necessary, as the lights they are working with can push maturity up to 38 to 42 days. But quality, not speed, is the focus for Windham.

"That's not how we use them, but the LEDs are definitely helping us achieve our goals of having the most beautiful, well-expressed flower that we can produce," Windham says. "The bud structure, the color, the trichome coverage and maturity."

It's one of the reasons Windham pushed for additional lighting during the buildout, which initially called for 85 lights in each flower room.

"I don't think you can have too much light available," Windham says. "I would probably increase that by 50% if I could. One of the things that we learned early on is that we haven't found the upper limit of how much light we can deliver to these plants yet."

Regan says that by boosting intensity, yields have climbed.

"It's been awesome and obviously that helps with the brand launch to be able to have high yields consistently," Regan says. "It's everything. A lot of times when you build a big facility like this, your costs are fixed. So if your yields go up, your cost per pound goes down, which makes you more competitive, gives you a bigger margin and it gives you the opportunity to pass those savings on to the customer. It's a huge competitive advantage."

When asked about what intensity Root & Bloom generally prefers and the company's average yields, Windham says it varies by growth stage and cultivar, but they're continuing to increase intensity even in early veg.

"I'll say that the most important factor that I have found so far is getting that light intensity up as quickly as you can," he says. "If we delay in that ramping, then the plant seems to have a hard time taking on that same intensity later in life. But if we can get the plant to take [intensity] early on in its life, then it seems to continue to be hungry for more and more, and we're able to increase that."

LOOKING AHEAD

One of the limitations of today's lighting—though Windham emphasizes how impressed he is with the speed of advancement and innovation of the past decade—is that cleaning fixtures isn't simple.

Mitigating and preventing pests and diseases is crucial for any grow, and ideally, the Root & Bloom team would welcome new innovations to sanitize their lights between growth cycles, just like they do with their benches, floors and walls.

When Windham hires people, Regan says, "he tells them the job here is cleanliness, consistency and quality."

An item on Regan's wish list is more integration between the environmental control systems and LEDs and more information sharing between growers about target parameters that have worked best for them. But he has been impressed with how sophisticated the still relatively young adult-use Massachusetts market is.

"The most surprising thing about Massachusetts has been the speed at which the early industry has stepped forward. Things that took seven years in Colorado, I'm seeing happen here in two-and-a-half or three years," Regan says. "It seems like a lot of the learnings from these prior states have been transported to Massachusetts."

What drew Regan to the industry initially was that it felt like a technology startup, similar to what he was used to during his days at Cisco. And in many ways, it still is.

Windham says in order to thrive in this unpredictable space, it's important to keep experimenting and improving best practices.

"We were able to bring a lot of lessons [from Colorado] here," Windham says. "Hiring folks who are hungry and want to learn and have a student mindset and just genuinely enjoy or get fulfillment out of hard work is really important to us."

MICHELLE SIMAKIS
is editor-in-chief for *Cannabis Business Times*.

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