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

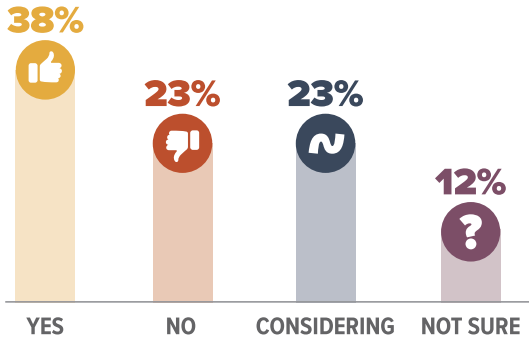
	VEGETATION			FLOWER		
	2016	2023	% pt. change	2016	2023	% pt. change
LIGHT EMITTING DIODES (LEDS)	17%	76%	↑ 59% pts.	15%	73%	↑ 58% pts.
FLUORESCENT LIGHTS (COMPACT, T5, OTHER HO FLUORESCENTS)*	37%	29%	↓ 8% pts.	8%	6%	↓ 2% pts.
HIGH-PRESSURE SODIUM (HPS) LIGHTS	31%	15%	↓ 16% pts.	62%	31%	↓ 31% pts.
METAL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

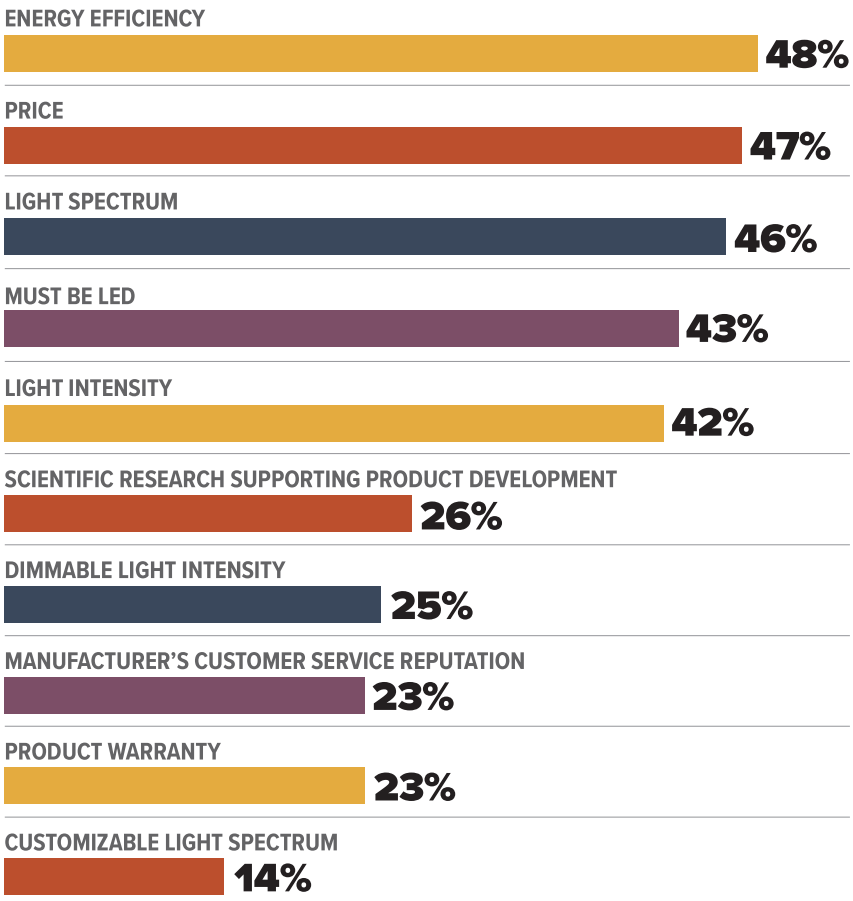
On a related note, interest in dimmable light intensity diminished among this year's study participants. When asked about the importance of dimming as it relates to controlling light intensity and enhancing lighting flexibility, 38% of commercial growers cultivating indoors or in greenhouses said dimming 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%

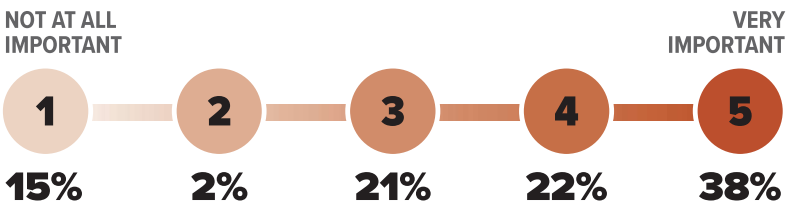
OF PARTICIPANTS SAID **CROP QUALITY WAS A TOP CONSIDERATION** WHEN EXAMINING IMPORTANT CONSIDERATIONS FOR CURRENT OR FUTURE LED USE.

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

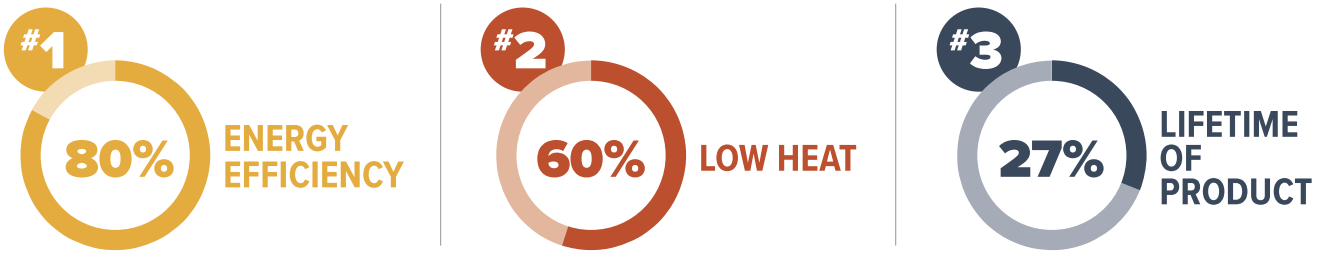
2021 MANAGING ENERGY COSTS

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.

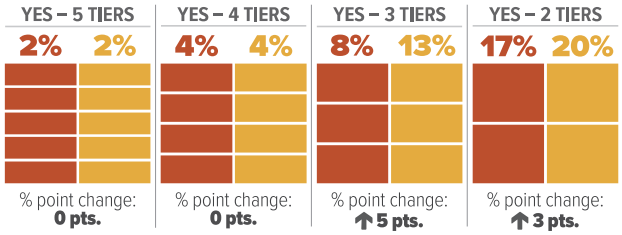
What is the area of your operation's cannabis crop production (total plant canopy)?

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

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*?



NET: YES
2023: **40%**
2017: **31%**
% point change: **↑9 pts.**

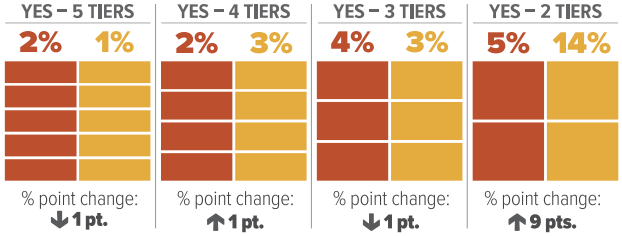
NET: NO
2023: **60%**
2017: **68%**
% point change: **↓8 pts.**

NO, BUT CONSIDERING DOING SO IN THE NEXT 12 MONTHS
2023: **20%**
2017: **35%**
% point change: **↓15 pts.**

NO, AND NOT CONSIDERING DOING SO IN THE NEXT 12 MONTHS
2023: **40%**
2017: **33%**
% point change: **↑7 pts.**

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*?



NET: YES
2023: **22%**
2017: **13%**
% point change: **↑9 pts.**

NET: NO
2023: **76%**
2017: **85%**
% point change: **↓9 pts.**

NO, BUT CONSIDERING DOING SO IN THE NEXT 12 MONTHS
2023: **23%**
2017: **27%**
% point change: **↓4 pts.**

NO, AND NOT CONSIDERING DOING SO IN THE NEXT 12 MONTHS
2023: **52%**
2017: **59%**
% point change: **↓7 pts.**

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