

LESSONS LEARNED FROM
A DECADE
IN CEA **PART 1-2**

BY ANDERS PETERSON

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MEET THE **AUTHOR**

Anders, Director of Horticulture at Pipp Horticulture, is a seasoned professional with over a decade of experience in the cannabis industry. Armed with a degree in cell and molecular biology, Anders has emerged as a leader in indoor cultivation facility design and operation. His expertise lies in integrating cutting-edge technology, data analytics, and precision agriculture techniques to optimize plant performance and product quality. In his current role at Pipp Horticulture, Anders collaborates directly with growers, owners, and construction professionals and has contributed to the designs of over 200 indoor cultivation facilities.

PART ONE

In the mid-20th century, **NASA** embarked on ambitious projects to grow plants in space to provide astronauts with a sustainable food source during prolonged missions. These experiments led to significant advancements in indoor lighting and hydroponic systems, technologies that would later revolutionize agriculture in controlled environments on Earth.

Interestingly enough, it wasn't the food or floriculture markets that first picked up on these advancements, but rather illicit cannabis growers. Cannabis prohibition forced innovative cultivators to move their operations indoors to avoid detection. With legalization in states like Colorado, Oregon, and Washington, the industry emerged from the shadows, bringing a wealth of expertise in **controlled growing environments**.



Making the Connection

Early on, high cannabis prices meant growers could not lose money (barring a catastrophic crop failure). Data from Cannabis Benchmarks pegged average wholesale prices for a pound of cannabis flower at **\$1,789 in 2016**, with average highs as much as \$2,100. During this Green Rush, investment dollars flowed into purpose-built facility construction and retrofitting projects.

At the same time, **indoor agriculture technology** experienced a boom not seen since the Space Race. The advancements in LED lighting, mechanical cooling, environmental control and monitoring, and vertical growing technologies over the past decade can nearly all be tied to the growing cannabis market.

Wholesale prices have since cooled (in 2023, the average wholesale price for flower was **\$1,019**), yet cannabis remains a cash crop where innovation abounds.

In the decade that I've been involved in the cannabis and broader **controlled environment agriculture (CEA)** space, I've found that there is a misconception that these markets share few parallels. The cannabis cultivation market and the food/floriculture industries are mostly two sides of the same CEA coin, and there are insights and lessons that crop and flower producers can learn from cannabis growers.



Bridging the Gap Between Cannabis & the Broader CEA Market

My experience as both a cannabis grower and **Director of Horticulture** at Pipp Horticulture has led me to develop a nuanced understanding of the CEA landscape and how cannabis fits within it as the outlier. To appreciate this, we should first zoom out and define what we mean by CEA and indoor farming.

Controlled environment agriculture is a technology-based approach to crop production that involves the control of most (if not all) plant growth variables. This includes lighting, temperature, humidity, irrigation, fertigation, airflow, CO2 supplementation, and more.



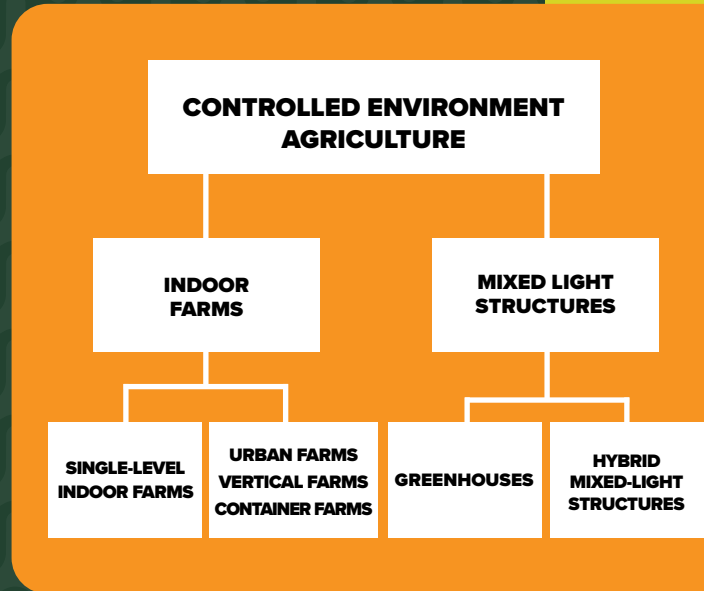
Painting the Picture

CEA can broadly be divided into two categories: **indoor farms**, and **mixed-light structures**. Mixed-light structures utilize both natural sunlight and artificial lighting to optimize plant growth. These facilities provide the benefits of natural light while allowing for environmental control through supplemental artificial lighting.

Greenhouses are one form of mixed-light facility. These are structures with walls and roofs made chiefly of transparent material such as glass or plastic in which plants requiring regulated climatic conditions are grown. Greenhouses can range from small, simple structures to large, high-tech installations, and they can be leveraged with or without supplemental lighting.

Hybrid mixed-light structures have a glass roof allowing sunlight to penetrate and insulated walls to better control the environment. These facilities combine the benefits of natural sunlight with enhanced climate control to optimize plant growth.

As opposed to mixed-light structures, indoor farms rely solely on **artificial lighting**. These are sometimes referred to as urban farms, vertical farms, and container farms.





Taking It to the Max

While approaches to cannabis cultivation are broadly similar to food and floriculture production in mixed-light structures, cannabis indoor farms are unique in that they often are at the **extreme of plant production levels**. From lighting, CO₂ supplementation, nutrient uptake, irrigation, and latent heat load management, these structures can be extremely energy- and resource-intensive. Some indoor cannabis growers operate their lights at intensities as high as **1,800 PPFD**, which increases transpiration rates, latent loads, and nutrient delivery needs.

The cannabis plant's ability to thrive in these environments and the dollar value crops can generate justify these large inputs.

Produce or cut flower indoor farms are generally less energy-intensive than cannabis farms due to economic and crop limits (i.e. plant stress would negatively impact yield and quality in those conditions).

For these reasons, cannabis growers have been viewed as “lucky” to be able to make mistakes that would otherwise bankrupt an indoor food production business. Conversely, indoor farmers growing crops other than cannabis have been told for years that their methods aren't feasible without the benefit of a cash crop. There may be some truth to both sentiments, but the fact that these industries continue to **evolve in parallel** remains true.

#1

Budget for Consultants & SMEs

In my time as a cannabis grower, I was fortunate to have the opportunity to design my own indoor farm. Due to the extensive licensing process, I had a lot of lead time to build my knowledge on the subject. Through my research, I discovered **innovative indoor farming principles** in both academic studies and online cannabis message boards. I studied cutting-edge technologies such as LED lights and environmental controllers. I drafted plans, scrapped them, and drafted some more.

Additionally, following my career as a cultivator, my time at Inspire (my previous employer) and Pipp Horticulture granted me the opportunity to impact the designs of **hundreds of facilities**. These experiences taught me that you shouldn't let your head grower be your design-build expert.

Lessons from the Cannabis Industry for Other Indoor Farmers



Lesson 1: Continued

In the early legalization days, private investors looking to tap into the **Green Rush**, none the wiser, would sometimes give full design control to growers who presented a “fake it ‘til you make it” attitude. Even architects and systems designers, who had no experience with cannabis, deferred crucial decisions to these “experts,” sometimes leading to millions of dollars in losses due to design-build errors and missed opportunity costs.

To be fair, few technologies were purposely designed to address the needs and realities of commercial indoor cannabis environments, and little knowledge was available about growing the plant at such scales. **High-intensity discharge (HID) lights** such as high-pressure sodium (HPS) fixtures were the industry standard. These systems emit significant amounts of heat, increasing cooling costs, and preventing growers from leveraging vertical racks to maximize their floorspace. HVAC systems were not yet optimized for a cannabis grow’s latent load, either, leading to plant health issues and forcing growers to

rely on multiple technologies to manage humidity. Indoor farms today have the benefit of being able to learn from the cannabis industry’s growing pains. Many **design-build experts** and consultants with hands-on indoor farming experience can inform your decisions, as it is often easier to dial back systems and controls from the extremes present in cannabis cultivation environments.

High-efficiency LED fixtures have drastically cut the sensible heat load compared to their HID predecessors. High-efficiency, specialized HVAC units able to manage both latent and sensible heat loads have become widely available. Even vertical racking units designed for cannabis grows (such as **Pipp’s Vertical Grow Systems**) have evolved from simple mobile shelving to sophisticated units that integrate in-rack airflow technology. When designing an indoor farm, make sure to budget for industry consultants and subject matter experts, no matter the crop you intend to grow.



#2

Purpose-Built is Easier than Retrofitting

In my time with Pipp, I've had the opportunity to help design countless facilities. Thanks to that experience, I can confidently say that building a **purpose-built facility** from scratch is much easier than retrofitting a space designed for another industry. Something as simple as column placement and spacing can greatly reduce your ability to leverage mobile vertical racks, cause airflow issues, and make it more difficult for employees to work with crops.

It's important not to get enamored and purchase a location until you have a clear plan of what you want to build. For example, a site close to cheap utilities and a growing customer base may be rendered useless by the lack of outside or rooftop space for the HVAC equipment you will need to maintain your crop's ideal climate. Similarly, an urban location may not have the parking space to accommodate staff adequately. While a seemingly silly reason to turn down an otherwise acceptable facility, keeping employees happy and safe will greatly **reduce turnover**. Designing a bespoke facility on a lot that meets your operational and employee needs can help avoid headaches when you're up and running.

Lesson 2: Continued

Additionally, older facilities may not have the necessary utilities (water, power, and/or natural gas) to support an indoor farm, and the costs to increase the amount of those utilities delivered on-site may exceed those for setting up new purpose-built connections. It's important to engage with **utility companies** and **city building departments** as early as possible to identify existing and upcoming sites that are suitable for your grow at the scale you wish to build.

Side Note

Some sustainability-minded operators may think that lack of electricity may be easily supplemented by solar panels. However, it's important to consider that every **8,000-10,000 square feet** of cannabis canopy needs approximately an **acre of solar power arrays**.





#3

Build a Realistic Business Plan

Produce and floriculture growers already know how tight their margins are. Running an indoor farm that can't reduce costs by relying on the most abundant source of natural light (the Sun) will be difficult in the best of circumstances. That's why it's important to adopt a **“buy once, cry once”** mentality when designing a facility and weighing which systems to adopt. Many early commercial cannabis growers made that mistake.

Trying to balance out the volatility risks of **changing regulations** and **price drops**, several cannabis operations value-engineered their builds by under-sizing HVAC units, opting for less efficient light fixtures, or selecting fixed vertical racking systems that didn't allow them to maximize their floor canopy. The low CapEx investment led to higher OpEx costs and product quality issues, making them unable to compete with businesses that made larger CapEx expenditures and had lower operating expenses.

Lesson 3: Continued

Due to the even tighter margins that exist outside of cannabis, indoor farmers have to go all-in by opting for the best systems they can afford. If budget constraints force you to make value-engineering decisions, aim to save money in areas that are easiest to retrofit, such as lighting fixtures. Many utilities will **offer incentives** for growers to adopt higher efficiency systems, making the most advanced systems more affordable when you're ready to make the jump. However these programs usually expire, so growers cannot wait forever to make those upgrades.

HVAC systems and floor planning, on the other hand, must be done right the first time as those are harder, if not impossible, to change after the fact. An undersized HVAC system will constantly operate at near capacity, **increasing energy costs and wear**. Meanwhile, floor plan changes usually require facilities to shut down all or part of their operations to make the necessary fixes.



We're Just Getting Started...

The lessons and similarities between the cannabis and broader CEA industry don't end here. In **part 2** of this series, we will explore lessons that cannabis operators can learn from their food and floriculture cousins. As these industries continue to co-mingle, CEA as a whole can achieve its potential to maximize efficiency, increase profits, and build a better food, pharmaceutical, and floriculture supply chain.





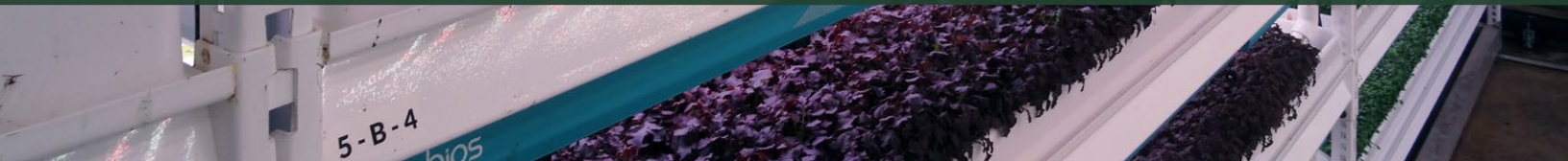
PART TWO

With more than a decade in the controlled environment agriculture industry, I've had the opportunity to work with a wide array of growers cultivating vastly different crops. More often than not, the economics of those crops are as widespread as the geography in which they are grown.

Considering how poinsettias have penny-per-plant margins, lettuce heads average over \$43 per 100 pounds (according to the June 2024 USDA National Agricultural Statistics Service Agricultural Prices report), and single pounds of cannabis sometimes sell for thousands of dollars, it's fair to say that **not all CEA operators** live the same experience.

In **Part 1**, I highlighted the misconception that every crop, especially cannabis, is different and needs to be treated as such. But as we discussed in that blog, this notion couldn't be further from the truth as there are a lot of lessons the traditional markets could learn from the innovative cannabis industry (and why that was the case). **The inverse is also true.**

Here, I share some of the **lessons I have learned** from the food and floriculture side of the CEA industry that cannabis growers can (and potentially should) explore in their operations.



Focused **Business Planning**

Vertical growers can thank the cannabis industry for helping to fund much of the **research & development** into indoor farming. Cannabis growers, due to the value of their crops, could afford to take risks and/or allocate space to R & D projects, something that traditional crop growers would be hard-pressed to do given the thinner margins they must contend with.

The necessity to build **lean operations** and **purpose-designed facilities** makes most non-cannabis vertical farmers better agricultural economists. Most of these companies have clear and targeted business plans, with crop production tailored to their final customer's needs. For some, that's a general grocery retailer like Kroger or Whole Foods. For others, it's specialty food retailers or independent grocers. Some farmers only grow products for restaurants. Most only grow a handful of products at best, while some only cultivate one lettuce or strawberry variety.

LESSON 1



Photo: EE Berger



LESSON 1

Whatever crop and market these vertical farmers serve, they can meet customer quality and consistency expectations. By delivering products to spec, they've built solid **business relationships** to sustain their operations for years. Cannabis growers have had the opportunity to dabble in multiple retail and medical products: some grow both branded and white-label products, as well as make extracts, edibles, tinctures, and topicals in-house.

Many of these businesses found early success thanks in large part to their **cultivation capacity**, but as competition has ramped up in many North American markets and consumers identify brands they most resonate with, several of these companies have found themselves overextended, unable to meet **quality expectations** or achieve consistency across batches.

LESSON 1

Take for example **Canopy Growth**, which once upon a time boasted having the largest cannabis canopy footprint in the world. After years of producing more cannabis than it could sell, the company divested from all of its cultivation assets. Now, it exists only as a house of brands, relying on other, more specialized producers to make its branded products.

Taking a page from the traditional agriculture market, cannabis growers should consider **retooling their business plans** and production goals to go from jacks-of-all-trades to masters of some. It's incredibly difficult to get everything right all the time, but it's much easier to get one or two things consistently perfect. By finding their niche and focusing their efforts on deepening their expertise in that market, cannabis growers will be much better positioned for the **commoditization movement** we're already seeing play out, which will only get worse in the U.S. with full federal legalization.



Photo: EE Berger

LESSON #2



Develop a **Commodity Mindset**

It's a foregone conclusion that not all cannabis brands are going to make it. Even with dedicated retail space, if you're unable to grow a good quality product at a fair price, you simply are running a fundamentally unsound business, and no quantity of marketing and branding will be able to save you (at least not beyond the short term).

Take for example **MedMen**, one of the first vertically integrated U.S. cannabis brands. Its approach to building both cultivation and retail footprints garnered both local and national media attention. However, the company's over-reliance on its appeal as the "Apple Store of weed," coupled with its poor growing practices with high cost of goods sold (COGS), led the California company to declare bankruptcy with \$410 million in debts, per Law360.

If there's one thing food producers have learned, it's that their asset value is not in a brand—it's the fact that their facility is a plant factory. This is why it's crucial for cannabis growers, especially vertical growers, to **avoid overspending** on building a brand early in its development, and instead focus on their facility.



LESSON #2

Proper facility design will go a long way in building that asset value. This includes maximizing floor space via **mobile vertical racks**, optimizing canopy airflow via **in-rack airflow systems**, leveraging advanced automated controls, as well as using energy-efficient HVAC, lighting, and watering systems.

A cannabis business, especially a cannabis cultivation business, should not be viewed as a short-term tech play, where founders aim to flip the company for huge profits to a multi-state operator (MSO) within 5 years of launching.

It's a farming business that takes years to build. How many farmers do you know that only farm for 5 years?

But the good news is that if you do this well, you won't need a brand to help you sell your business when you're ready to do so. By building up that asset—your **facility and operations**—the higher your value for acquisitions will be. You will be able to enter with a stronger position in partnerships, or with more leverage in negotiations.

Data Collection, Research, & Collaboration

As we talked about in Part 1, **Prohibition** forced cannabis growers to go indoors and not reveal their activities to the outside world. Growers started finding their own lighting and nutrient recipes that turned their crops into “gas.” These findings were closely guarded secrets, never to be shared lest a copycat “steal your work.”

While this attitude might have been justified at one point in time, it’s no longer a viable way to operate in a legalized market. Food and floriculture growers have benefited incredibly from collaborating with one another, government agencies, and academics. Thanks to that **collaboration**, vertical farmers growing traditional crops know crop data more intimately than their cannabis-growing counterparts.

While cannabis growers still can’t collaborate with the USDA to create massive data reports like the agency produces for food and floriculture crops, cannabis growers would be well served to use their facilities to collect data and share that data broadly. A growing number of universities are either launching cannabis-specific degrees and/or expanding horticulture programs to include cannabis and hemp. Partnerships with academia can help growers develop best practices for designing and building these vertical farms, and create **standardized cultivation protocols.**

LESSON #3

While individual cultivars may require slightly different approaches, the variance across genetics is not as vast as some cannabis growers seem to believe. Look at it this way: how many ways are there to grow a strawberry, an apple, or a head of lettuce?

Even if cannabis growers are hesitant to share data at the risk of revealing proprietary information to the public, companies operating multiple facilities can still benefit from data collection and sharing across sites. By doing so, MSOs can **standardize their operations** across state markets, bringing consistency to their products across state lines and enabling consumers to trust what they are going to purchase whether it's bought in Oklahoma, California, or Ohio.

Eventually, the goal should be to be able to **share data with government agencies** to be able to create extensive reports as it does with traditional crops—although federal agencies will also need to build trust with the very same growers they maligned for decades. But without building the infrastructure to collect, synthesize, and analyze data, growers are choosing to remain in the dark when the cannabis industry is rearing to break into the light.



CONCLUSION

The cannabis industry will continue to undergo massive changes as federal rules evolve, but the path forward for companies looking at long-term sustainability has always been the same: **adapt and learn** from the broader agricultural community to not only survive but thrive.

Contact **Pipp Horticulture's** experienced team of indoor cannabis operators and designers to take the first step towards your vertical farming future!



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