

NAVIGATING THE BUILDING DESIGN PROCESS FOR GROW ROOMS





The environment for growing cannabis is central to the economics of every operation. In addition to essential building systems, what is your light source? Do you need an HVAC system, and if so, what type?

Facilities for growing cannabis vary from pure greenhouse to mixed-light to fully enclosed and include new construction, retrofit, or conversion. Geography and climate, capital budget, speed to market, and licensing requirements determine the best choices.

Each combination of facility type and location is unique for creating the ideal growing environment.

Designing and implementing the appropriate solution for your operation requires careful consideration. The decisions you make will significantly influence every harvest you produce in your facility. Crop quality, volume, and consistency must be optimal to exceed the operating cost of capital, energy consumption, and maintenance.

For efficiency, a good strategy is to start with a smaller facility and expand over time, given license requirements in some areas.

WHAT TYPE OF FACILITY TO CHOOSE?

In North America, there are four operation types for growing cannabis at a commercial scale, with the viability of each one determined by geographic location:



**NO ENCLOSURE
(OUTDOOR GROW)**



**GREENHOUSE
WITHOUT ARTIFICIAL
LIGHTING**



















**MIXED-LIGHT
GREENHOUSE**



**WAREHOUSE
WITHOUT SUNLIGHT**

COMPARING GROW ROOMS





	COST	CONTROL	LIGHTING	HVAC NEEDS
NO ENCLOSURE				
GREENHOUSE WITHOUT ARTIFICIAL LIGHTING				
MIXED-LIGHT GREENHOUSE				
WAREHOUSE WITHOUT SUNLIGHT				

GROWING




The United States has the most diverse climate from coast to coast of any country on the globe. Each zone has unique attributes that dramatically affect the way you approach cannabis cultivation. Some strains are best grown outside, while in other areas, greenhouses are the ideal choice. Elsewhere, you will require a fully enclosed indoor environment to provide the right conditions for growth.



CLIMATE ZONE VARIABLES

-  Dew point (absolute humidity) influences relative humidity and the risk of mold on plants, and also affects vapor pressure differential, a significant influencer on growth.
-  Average temperatures: Sativa plants need the warmest temperatures, while Indica, with its dense leaves, can handle cooler temperatures. Cool temperatures limit growth. High temperatures cause damaging heat stress, stunting the crop, and creating foxtails.
-  Rainfall: Some areas are wetter than others.
-  Hail, early frost, tornadoes, or hurricanes can destroy a crop.

GEOGRAPHICAL CONSIDERATIONS

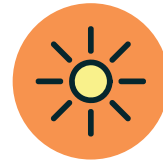
-  Elevation influences temperature and humidity. For every 3,280 ft additional altitude, the temperature is about 43.7°F lower. Higher elevations are drier, and the air is thinner, meaning less CO₂ is available.
-  Photoperiod: Length of day varies drastically. In the south, photoperiod is consistent throughout the year, while in the north, it fluctuates and is shorter during winter.
-  Winds, especially high-speed winds, can affect transpiration.

NO ENCLOSURE/ OUTDOOR GROW

Growing cannabis in the outdoors, considered authentic and natural, has zero electricity cost for lights or HVAC. Even with the watering system, staff payroll, and pesticides, the operating expenses of an outdoor grow can be lower than other options. Outdoor growing is viable in the milder climates of California, Florida, Oregon, British Columbia, and Southern Ontario.



Outdoor growing, with lower cost and larger plants, offsets the grower's lack of control over the environmental factors. The crop quality and quantity are likely to be inconsistent. For producing a medical product, outdoor growing is not viable, given the stringent regulations and requirements.



UPSIDES

- + No building structure or electricity cost for lights and HVAC
- + Outdoor crops often larger than comparable plants grown indoors
- + Plants stretch their roots and absorb more sunlight through larger leaves

DOWNSIDERS

- Grow cycles are longer; dependent on seasons and seasonal workers
- Unpredictable amount of sunlight and water levels (rain/watering)
- Uncontrolled relative humidity can result in moldy, stunted plants

GREENHOUSE WITHOUT ARTIFICIAL LIGHTING

You can harness the sun's power to significantly reduce operating costs and, at the same time, protect your crop from the most significant risks of outdoor grows. Greenhouses were initially used for medical grows and are now expanding for more products.



Greenhouses without artificial lighting are only viable in areas where sunlight is relatively stable throughout the year.

Even with savings on lighting and HVAC for choosing a greenhouse, the highest cost for a new building is in constructing the first floor. Therefore, it is practical to build a multi-story enclosed structure that uses less land than a big greenhouse that spans a large area of land. It follows that a warehouse may be preferable for a very large grow.



UPSIDES

- + Quick and easy to acquire and operate
- + Affordable to convert from other crops to cannabis
- + No requirement for lighting, HVAC systems less common
- + Significant savings on electricity with the sun for light
- + Curtains or covers used to block out excess light

DOWNSIDES

- The greenhouse is one level; a warehouse offers sunlight to all levels
- Larger crop quantity requires a larger plot of land
- More cost for the same yield as grown in a multi-story warehouse
- Only control of interior heat and humidity is opening windows

MIXED-LIGHT GREENHOUSE

Many mixed-light greenhouses are purpose-built for growing cannabis, incorporating the latest technologies to create ideal growing conditions. Growing in the north in a greenhouse is now possible with a mixed-light facility.



A cost analysis for a 100,000 ft² greenhouse starts with the initial light installation of \$5.6 million (\$56 per ft²). In the north, greenhouses are affected by insufficient sunlight during the winter. This light shortfall is covered by supplemental lighting for roughly 25% of six months (1,095 hours) with HPS lights using 1 kW per 20 ft² for approximately \$491,381.25 per year. Lights use 5,475 MWh per year, at a rate of \$89.75 per MWh.

While mixed-light facilities are worth considering, the grower needs to carefully model the costs to determine if this method would offer a better return on investment (ROI) than a fully enclosed warehouse.



UPSIDES

- + Artificial lighting complements sunlight in the northern U.S. and Canada
- + Electricity savings for lighting during the summer
- + Modify the intensity of light when not quite enough sunlight

DOWNSIDES

- Cold winters in the north with heat from lights only when on
- Heat loss through windows, so heating system required

WAREHOUSE WITHOUT SUNLIGHT

In the fully enclosed indoor environment, all of the typically limiting factors of plant growth—light levels, CO₂ levels, water, temperature, and humidity—are entirely under the control of the grow master with the right equipment and controls.



Cannabis requires specific humidity levels that vary depending on the type of plant and its stage in the growing cycle.

The right dehumidification equipment increases yield, allowing for more money-making potential.

In this controlled environment, the grower has a competitive edge by minimizing product loss while maximizing quality and productivity. A few percentages of increase in yield can have a considerable impact on a facility's revenue projections.



UPSIDES

- + Ability to control environment, including light intensity
- + Faster grow cycles, more yield
- + Higher THC content; engineering facilitated
- + Minimal loss from disease and stunting
- + Lower labor costs with automated operations
- + Improved human productivity
- + Efficient work environment
- + Solution for a northern location

DOWNSIDERS

- Costs are higher for building construction, maintenance, operations
- Additional cost due to energy consumption of supporting equipment

NEW OR RETROFIT?

The construction of purpose-built cannabis facilities is increasing, and while it is preferable, the cost is unquestionably higher. Converting existing warehouses or greenhouses to cannabis production is popular and economical.

The goal is to create as large and continuous a space as possible that can be subdivided into multiple rooms so the grower can produce a variety of plant strains separated by grow stage. Multiple rooms reduce the risk of total crop contamination in the case of infestation.

For both new and retrofitted buildings, subdividing rooms is done effectively by using structural steel insulated panels (SIPs), which the cold storage industry uses to construct walk-in freezers. The grower can do a full washdown of the floors, walls, ducts, and HVAC units between grow cycles.

Using fabric ducts means you can easily take them down for laundering.

BENEFITS OF STRUCTURAL INSULATED PANELS

- + Affordable, modular construction materials are airtight and straight-forward to install
- + Fabricated offsite in pieces and trucked to the site, fastened together to create rooms
- + The build-time is very quick and there is no drywall dust
- + Fully washable to keep the facility sanitized, and protect against cross-contamination
- + The panels improve efficiency by providing good insulation





UPSIDES

- + Retrofitting is quickly done compared to building a new facility
- + Renovations may need less involvement from architects and professional engineers
- + The land zoning may already allow for cannabis production, depending on the municipality
- + Get set up for grow operation almost immediately

DOWNSIDES

- The building design is not ready to grow cannabis at commercial scale
- Significant upgrades to electrical systems for power-intensive lighting
- The HVAC system in place would likely require upgrading
- Could be a challenge to add large HVAC equipment and airflow capacity redesign
- Might not have the right size of doors in right locations
- Roof load weight restrictions
- Restricted hallway access
- Windows may need to be covered or removed
- Insufficient space for equipment for 4 to 8 times more than traditional building loads

UPSIDES

- + The designed structure can be highly customized for excellent growing conditions

DOWNSIDES

- Expensive to design and construct a new facility
- If the grower holds land where a building already exists, demolition is required
- Waiting for the municipality to grant a building permit on top of re-zoning, if applicable
- Time to build the structure before the first grow

INCORPORATING REDUNDANCY, SCALABILITY

You can design your facility to reduce the risk of losing significant amounts of crop. Key measures include the choice of building material (SIPs, as noted), the quality of the HVAC system (and its air filters), as well as how much the grow environment is exposed to the outdoors. Another way you can reduce risk is by building redundancy into the building itself.

Consider limiting the total canopy area per room to limit exposure if one of the rooms is contaminated. Sealing the rooms with airtight building materials and separated HVAC systems is also helpful and could potentially reduce your insurance premiums.

Subdividing the facility into multiple rooms is a standard practice because the grower can then rotate crops and put plants in a specific room depending on the grow cycle. Managing the environment of these different rooms usually requires independent HVAC systems.

The room setup is as follows: mother room, cloning, veg, flowering, drying.



MOTHER ROOM

78–80°F & 60% RELATIVE HUMIDITY

Commercial cannabis plants originate from a “mother” plant, rather than seeds, which enables their growth to remain pure from a specific strain and eliminate mutations. According to Aurora Cannabis, a mother plant is a healthy, adult, female cannabis plant used for creating clones from cuttings. The grower selects mother plants based on the characteristics they have, such as an ideal level of THC or CBD or for being particularly resilient. Mother plants live for a long time, and cloning continues for months or years. Cloning is a process known as vegetative propagation.



CLONING ROOM

75–85°F & 80% HIGH HUMIDITY

The cuts removed from mother plants are transplanted into the soil where they are allowed to grow under continuous light. The high heat and humidity in this space make HVAC particularly challenging. Cuttings can take a week, or up to a month, to take root.



VEGETATIVE (VEG) ROOM

**71° TO 82°F DURING LIGHTS-ON
RH STARTS NEAR 70%, DOWN 5% PER WEEK**

The clones, now maturing, are potted and moved to the Veg Room, where they spend 2 to 8 weeks proliferating. Like a teenaged human, these maturing plants need large amounts of energy, requiring constant exposure to light to photosynthesize. Between 12 to 18 hours of light is essential, on the lower end if using sunlight and closer to 18 hours if using artificial light. Roots are continually stretching and absorbing water. The plant transpires in this stage, so the room must have proper vapor pressure differential controls with enough airflow to slightly bristle the leaves. Due to evaporative cooling off the leaves, temperatures are kept higher. The grower manipulates the light cycle to either keep plants in vegetation longer, thus allowing them to grow more, or to enter the next stage. Providing 12 hours of continuous darkness will mimic the fall season to the plants, thus sending them into the next stage of growth.



FLOWERING ROOM

**68° AND 79°F LOWERING AS PLANT MATURES &
40% RH TOWARD THE END OF THE CYCLE**

When the plant has developed sufficiently, it is ready for flowering in the flowering room where they are kept in the dark for 12 uninterrupted hours, causing them to enter the flowering stage. Then they are given light, 12 hours on 12 hours off. The plants produce buds at this stage, which can last 6–8 weeks. Maintain low humidity to prevent mold on the bud, generally starting higher and dropping toward the end of the cycle.



DRYING ROOM

When the grower is satisfied, the product can be harvested and processed according to the application. If processing is done on-site, there will be drying rooms and curing rooms. The temperature, humidity, and volume of airflow vary considerably, depending on the quantity of the product and the desired rate of drying.

Many smaller rooms are preferred to allow for a wider variety of crop strains, stages of growth, and customized conditions rather than a few more substantial rooms.

CONCLUSION

In summary, the economics of growing cannabis in North America depends on many factors, beginning with the environment. Understand the pros and cons before choosing the most viable facility for your grow:

1. No enclosure/outdoor grow
2. Greenhouse without artificial lighting
3. Mixed-light greenhouse
4. Warehouse without sunlight



This report was made from elements of *Getting Grow Rooms Right*, an industry-first publication on HVAC design, specification, selection, installation and operation. This is the go-to guide on setting up a profitable grow room.

Order your complimentary copy at QuestClimate.com/Book



Each of these facilities has benefits and downsides, so picking the right one for your operation is a business decision based on the best investment.

The cost of growing tends to scale upward in concert with the level of control you have over the environment, from the simplicity of outdoor growing (with inherent risks) right up to a fully enclosed warehouse structure (with higher yield volumes and consistent quality).

For the choice of a building, retrofitting is generally less expensive and can enable a quicker start-up. Retrofitting does bring many challenges caused by shoehorning a cannabis operation into a facility not designed to accommodate such activity. Purpose-built facilities include more of the design ideas that can lead to better outcomes for both crop quality and the bottom line.

Incorporating scalability and redundancy into your facility, by reducing risks and making it easier to scale-up in the short and long term, is a vital part of business success.