# SOLVING THE 3 BIGGEST HVAC CHALLENGES OF COMMERCIAL GROW FACILITIES

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# INTRODUCTION

Designing, building and operating the ideal cannabis growing facility and getting every aspect of it right is no small task. There are countless decisions to be made and no obvious road map to create the perfect facility, and no magic formula yet to maximum return on invested capital. Growing at scale is a new frontier for most licensed producers. It's been referred to by many as the Wild West with a hectic pace of growth, perpetual innovation and changing technologies.

We first issued this report in 2018, to highlight what we identified were the 3 biggest HVAC challenges facing commercial growers. Since then, many elements of the industry have evolved and we have re-evaluated the main challenges. This report has newly expanded breakdowns of each challenge that include learnings from the years in this market.

**More reading on these topics can be found in our book *Getting Grow Rooms Right*, available at *QuestClimate.com/book***

## The ROI of Smart HVAC Decisions

Indoor air quality is one of the critical components to a successful yield. The big question in the overall consideration of HVAC purchase decisions is what the smartest financial decision will be. How do you balance capital cost of equipment, installation costs, maintenance and operating costs to get the best return on investment? Another factor is your risk tolerance with regard to equipment failure, because not all equipment is created equal and some decisions can carry a higher risk of failure.

Given the exceptional financial impact that optimal yield and quality has on the cannabis industry, creating the right indoor climate with the right HVAC solution delivers a significant ROI.

Benefits of the right HVAC solution include:

- Improving yield quality and volume by 10–15%.
- Elimination of mold to prevent crop failure.
- Built-in redundancy to remove the risk of downtime causing crop loss.
- Annual energy savings of 15–30%.
- Significantly improved equipment lifetime with lower maintenance costs.

The economics of cannabis growing are strongly in favour of making prudent HVAC decisions and choosing proven, reliable, long-lasting equipment that conserves energy in the process.

## So, What Are the Three Biggest Challenges?

We've discussed the critical importance of getting the right HVAC solution in place and its impact on your bottom line, so the question now is how do you make that happen? We now present what our experience has shown to be the 3 major challenges that cultivators face in getting that accomplished.

To be clear, we have a bias in the content that follows. Fortunately, that bias is toward delivering exactly the economics we discussed previously: the optimal balance of capital cost of equipment, installation costs, and maintenance and operating costs to deliver your best ROI. We also have a bias toward the longest lasting equipment that will deliver the lowest total cost of ownership over the long haul as well.

## Crunching the Numbers

The following spreadsheet illustrates some of the ROI calculations to be considered when evaluating the smart equipment decisions. The additional cost of superior equipment can often be recovered in the first year (the example below illustrates just over a year). Over a 10- or 15-year period the return on a superior grow room equipment decision can be hundreds of thousands of dollars.

### INFERIOR LOW BUDGET EQUIPMENT

| | $ | 1-Yr Impact | 5-Yr Impact | 10-Yr Impact | 15-Yr Impact |
|---|---|---|---|---|---|
| Initial Purchase | 62,500 | (62,500) | – | – | – |
| Installation | 25,625 | (25,625) | – | – | – |
| Energy Consumption | 25,465 | (25,465) | (127,327) | (254,653) | (381,980) |
| Annual Maintenance | 4,500 | (4,500) | (22,500) | (45,000) | (67,500) |
| 0% Yield/Quality Improvement | 987,500 | 987,500 | 4,937,500 | 9,875,000 | 14,812,500 |
| Repurchase | 78,125 | – | – | (78,125) | – |
| Reinstall | 32,031 | – | – | (32,031) | – |
| **Net Rev Less HVAC Costs** | – | 869,410 | 4,787,673 | 9,465,191 | 14,363,020 |

### SUPERIOR EQUIPMENT – SMART MONEY

| | $ | 1-Yr Impact | 5-Yr Impact | 10-Yr Impact | 15-Yr Impact |
|---|---|---|---|---|---|
| Initial Purchase | 90,625 | (90,625) | – | – | – |
| Installation | 25,625 | (25,625) | – | – | – |
| Energy Consumption | 20,045 | (20,045) | (100,225) | (200,450) | (300,676) |
| Annual Maintenance | – | (3,000) | (15,000) | (30,000) | (45,000) |
| 2% Yield/Quality Improvement | – | 1,007,250 | 5,036,250 | 10,072,500 | 15,108,750 |
| Repurchase | – | – | – | – | – |
| Reinstall | – | – | – | – | – |
| **Net Rev Less HVAC Costs** | – | 867,955 | 4,921,025 | 9,842,049 | 14,763,074 |
| **Superior Equipment Profit Increase** | – | (1,455) | 133,351 | 376,859 | 400,054 |

### ASSUMPTIONS

| | |
|---|---|
| Low cost option, standard vertical split DX, $/ton | $2,000 |
| Agronomic IQ option, $/ton | $2,900 |
| 2,500 sq. ft. room, 80 sq. ft./ton | 31.25 |
| Installation, $10k fixed + $500/ton | $25,625 |
| Dry cooler install, deduct | 20% |
| Compressor runtime, 100% lights on, 35% lights off, for flower | $5,913 |
| Compressor avg power, kW | 27 |
| Economizer cooling runtime reduction | 25% |

| | |
|---|---|
| Blower power, kW | 6 |
| ECM fan energy deduct | 10% |
| Electrical cost, $/kWh | $0.12 |
| Yield/sq. ft. grams | $39.50 |
| Bulk sell per gram, $ | $2.50 |
| Crops/yr | 4 |
| Baseline revenue | $987,500 |
| Yield/quality improvement | 2% |

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CHALLENGE #1:

# UNDERSTANDING THE HVAC DESIGN, SPECIFICATION, SELECTION & INSTALLATION PROCESS

Getting the right equipment designed and installed into a project is far more complex than most cultivators are aware of. It also has many decision points that don't always serve the cultivator's best interests. There are no hard and fast rules, but for new construction and often for substantial renovations in existing facilities, the process looks like this.

1. **Cultivator:** selects an architect to design the building.
2. **Architect:** hires engineering firm to manage all facets of engineering.
3. **Engineering firm:** may hire an HVAC specialist to design HVAC requirements.
4. **Engineering firm/HVAC specialist:** invites rep firm vendors to recommend HVAC solutions and propose equipment options.
5. **Rep firms:** propose assorted solutions, price points and may require manufacturer support (few rep firms are experts in all equipment lines they represent).
6. **Engineer:** accepts a proposed solution and uses that solution to create their "basis of design" specification for the bidding process.
7. **General contractor:** a general contractor is hired by the cultivator, architect or engineering firm to build the project — typically through a price-sensitive bidding process.
8. **Winning general contractor:** solicits bids from sub-contractors specializing in various aspects of the job (another price-sensitive process).
9. **Winning sub-contractor:** typically gets the job based on best price to supply and install the HVAC equipment that "meets the specifications" set out by the engineer. (Of note, there can be several vendors and several levels of quality that will technically meet specifications; the sub-contractor typically will choose the lowest cost in order to maximize their profits).
10. **Winning sub-contractor:** Typically, must only support issues with the installed equipment for one year after start-up.

Although there are often variances from this process, the 10-step process outlined above is pretty common. Even when there's deviation from this process, the key take-away is that unless the grower, architect, engineer or general contractor direct the HVAC sub-contractor to purchase a specific brand of equipment or utilize a particularly prudent technology or HVAC design, the final equipment selection comes down to the end of the line where the contractor makes a profit-based, low-cost vendor decision.

An important consideration with this process is that all the experts involved walk away after the job is done and typically have no more than one year of care or concern afterwards. It's the cultivator and facility managers that are saddled with the outcome of the engineering and equipment choices.

We see this as one of the biggest challenges cultivators face in getting a premium quality solution to their HVAC needs. Lowest "first cost" is typically not the smartest value or the best choice.

**SOLUTION:**

We highly recommend that cultivators have a clear understanding of the entire HVAC decision process from design to installation. Ask lots of questions, including what the options are and why recommendations are what they are.

A well-informed cultivator or engineer can pre-determine the brand of HVAC equipment they prefer or the type of HVAC design they feel strongly about. It makes no sense that the final decision should come down to the lowest cost without consideration of equipment value factors, and that the grower should not participate in such a critical equipment decision.

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CHALLENGE #2:

# GETTING THE RIGHT HVAC SOLUTION

There are countless manufacturers of a wide variety of different types of equipment, such as VRF, split systems, unitary systems, rooftop air conditioners and even industrial design firms that create fully-custom air handlers with central plants. How does the cultivator ensure they get the right system for their facility? Selecting the right HVAC system type is crucial for the success of the crop. Adequate control over environmental conditions affects not only the health of the crop, but also energy consumption, and operating and maintenance costs. Plus, certain types of systems will cost the grower more to own and operate, which reduces the equipment's overall value and the grower's return on investment.

To us, equipment value means a product that maximizes ROI by providing the best performance and the lowest overall cost (including purchase cost but also the costs of installation, operation, maintenance, and equipment longevity). Equipment value also arises out of whether your selection delivers expected performance when it is operating.

There are different categories of costs and their distinction is important. For example, sometimes purchase (capital/first) costs can be higher, but these are offset by a lower installation cost. As noted previously in this report, there is often a tendency to select equipment that provides the lowest first cost. This choice may certainly save money at the front end, but may end up costing even more to install and operate. For instance, it may be far more expensive to install comfort cooling with supplemental dehumidifiers, despite their capital cost being lower. Instead, the priority should be on the kind of equipment that will lead to lower operating costs. Choose energy-efficient solutions that will cost less to run in energy bills. Another important consideration is the kind of maintenance that will be required to keep the system in good operation for the long term. Certain kinds of equipment are easier and thus less expensive to maintain than others.

One bonus in this area is to see if your chosen equipment can be connected to the internet to enable remote logging of operating statistics. If so, you can get a wealth of information about your system that is useful for maintaining optimal performance and troubleshooting if an issue happens to arise. This especially pays off when receiving factory support, as technicians could access your unit remotely to diagnose much more quickly and cheaply than if they had to visit it in person.

By looking at all the costs and factors that are related to a specific piece of equipment — and especially the HVAC system — you can determine an overall cost of ownership. Factors include the purchase price and installation cost of the equipment, as well as the long-term cost of owning it, a period that could last 15–20 years for quality equipment. Only by reviewing the overall cost of ownership can you truly determine whether a specific piece of equipment provides good value.

## Factors to Consider in Selecting an HVAC System

The health of the crop depends on having good control over environmental conditions, but there are also ramifications for energy consumption and capital, operating, and maintenance costs depending on the system that is chosen. All factors must be considered when selecting the HVAC system.

Here is a brief description of some essential criteria to consider when selecting equipment.

### COST

- **Installed cost** — The comparative cost to hire a qualified firm to design, purchase equipment, properly install and commission the system.
- **Operating cost** — The comparative cost to operate the system to desired space conditions. This primarily consists of energy costs but should also consider hiring/training operators, any consumable components, and monitoring the equipment.
- **Maintenance cost** — The comparative costs to perform routine and annual preventative maintenance, as well as the anticipated costs of repair.

### EFFICIENCY

- **Cooling** — Ability of the system to adequately address the sensible cooling needs of the space in an energy-efficient manner.
- **Dehumidification** — Ability of the system to adequately address the latent cooling (dehumidification) needs of the space in an energy-efficient manner without the need for supplemental dehumidification.
- **Precision** — Ability of the system to hold a tight tolerance of the desired temperature/relative humidity conditions delivered to the room. (e.g. holding ± 1°F instead of ± 5°F).

### DESIGN

- **Complexity** — The level of complexity involved in the design, installation, and operation of this system. The higher the level of complexity, the more expensive it will be to hire the appropriate personnel to execute.
- **Scalability** — Ability to easily and cost-effectively upgrade and expand the system as the facility grows to increase production.
- **Redundancy** — The tendency for the system type to have redundant features, such as multiple cooling components, to provide back-up cooling if one component fails.

### PRODUCTION/SAFETY

- **Operational flexibility** — Ability of the system to satisfy a wide range of operational setpoints often required throughout the plant's lifetime. (e.g. 80°F/75% down to 60°F/40%) .
- **Reliability** — As typically installed, a combination of the expected lifetime and replacement costs for the HVAC system's components.
- **Plant safety** — Ability of the system to protect the plants from pathogens brought in from outside, pathogens recirculated within the facility, and other airborne risks, as well as potential system-related leaks in or around the grow rooms.

### SUPPLEMENTAL DEHUMIDIFICATION

- Some cooling technologies require supplementary dehumidification to meet the latent load. Standalone dehumidifiers hung in the space are an example of technology used in this case.

All factors must be considered when selecting the HVAC system.

## SOLUTION:

Clearly, there are many key factors to consider when it comes to deciding on what type of HVAC equipment is best for a grow room. Not every factor deserves equal weight; some factors will be more important than others in a specific project. However, some system types do offer clear advantages over others. For example, unitary equipment can offer full, effective dehumidification, air conditioning and heating in one piece of equipment and is generally a more scalable and redundant design orientation than one that uses a central refrigeration or chilled water plant. It is important to have a solid understanding of your HVAC options as well as the costs, limitations and advantages of different approaches. You also need to weigh the advantages of a more modular, scalable and redundant approach to HVAC control for your facility relative to traditional central plant considerations. Good vendors will be happy to have an open and honest conversation about the options, and which might be most suitable for any given facility.

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CHALLENGE #3:

# GETTING THE HVAC DESIGN PARAMETERS RIGHT

Given the many variables at play in grow rooms, significantly more than in standard environments, and considering most engineers are unfamiliar with this specific application, sizing calculations for grow room HVAC has been a very challenging task. This is largely due to misinformation and a lack of knowledge among those involved in the facility design industry. There are no standards set in this area, and the secrecy among industry players regarding best practices often leaves designers without a leg to stand on in their projects.

As a result, even the most technically-qualified engineering firms have had to guess at a considerable amount of the science and mechanics behind creating optimal grow environments. Getting grow room specifications right requires careful modeling of grow cycles, transpiration rates, temperature and humidity specifications, lighting loads, and irrigation loads, just to name a few. It also requires careful modeling of external factors, including annual temperature and humidity ranges, type of building structure, solar impacts of mixed-light sources, etc. Some of these factors may vary by type of plant and strain, which only further complicates the matter.

Few engineers specialize in this area, which makes accurate HVAC sizing more challenging. The best course of action is to (assuming a competent one has been selected) leave the sizing calculations to your HVAC equipment manufacturer. HVAC manufacturers know their equipment and would be best suited to advise on its application.

Each manufacturer may have their own form to fill out with key variables. Here are some examples:

- Room dimensions
- Purpose (mother, clone, etc.)
- Building material
- Temperature and RH at beginning and end of grow
- Lighting type and wattage per square foot of active grow
- Active grow area (as a percentage of room volume)
- Number of plants or plant density
- Watering rate per plant per day
- Type of watering system

As a grower, it would benefit you to know all of these factors before beginning your HVAC equipment buying process. You should be able to provide this information, openly and honestly, to your manufacturer so that they can provide the best solution for your needs.

The secrecy mentioned previously contributes to this challenge, as it causes growers to be wary in sharing the necessary details with their manufacturer. This impedes the process and can potentially prevent the grower from getting the right design. It's alright to ask any company you deal with to sign a nondisclosure agreement first to keep your business protected; any company that wishes to work with you will be willing to sign one.

**SOLUTION:**

The best way to get HVAC equipment designed for your grow room is to work directly with a competent equipment manufacturer. They are typically best suited to advise on equipment application and should be able to generate correct sizing based on certain details about your grow room, the parameters of which may be proprietary to the manufacturer. Be certain that they have the expertise to properly model the dozens of load factors and variations that your plants and your grow cycles will require. It's critical to ensure you get equipment that was sized correctly.