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Solving the Biggest HVAC Challenges of Modern Grow Rooms

Part I: The challenge of understanding the process of HVAC system design, selection and installation

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, nor is there a magic formula yet to maximize return on invested capital. Plus, growing at scale is a new frontier for most licensed producers and it's been referred to by many as the Wild West because of the hectic pace of growth and perpetual innovation in a hyper-competitive landscape.

There are countless vendors and consultants vying for your business, but do they really have all the answers? Are they truly experts? How do you know their solutions actually are the best ones? It's not easy. There are no cookie-cutter answers, and better solutions are evolving constantly for virtually every aspect of the cannabis industry.

This three-part series will address some of the biggest challenges and common mistakes being made by growers in selecting the best HVAC solution for their needs.

Challenge: Understanding the Process

Getting the right equipment designed and installed for a project is far more complex than most growers would expect, and the process itself often sets the stage for conflicting interests when choosing between lowest initial cost and smartest long-term value — a critical issue for business owners.

Because there are so many participants in the process with differing levels of HVAC design knowledge and potentially competing interests, the design, specification and equipment selection process can be very convoluted. There are many decision points, which don't always serve the owner's best interests. There are no hard and fast rules, but for new construction, and oftentimes for designing and renovating cannabis production facilities, the process looks like this:

- The owner selects an architect to design or retrofit a building.
- The architect hires an engineering firm to manage all facets of engineering.
- The engineering firm may hire an HVAC specialist to design the heating and cooling requirements.
- The engineering firm/HVAC specialist invites vendor reps to recommend HVAC solutions and propose equipment options.

- Reps propose assorted solutions and price points and may require manufacturer support (few reps are experts in all equipment lines they represent).
- The engineer accepts a proposed solution and uses that solution to create their "basis of design" — the specifications for the bidding process.
- The general contractor is hired by the business owner, architect or engineering firm to build the project — typically through a price-sensitive bidding process.
- The winning general contractor solicits bids from sub-contractors specializing in various aspects of the job (another price-sensitive process).
- The 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; sub-contractors typically choose the lowest cost in order to maximize their profits.)
- The winning sub-contractor typically only has to support issues with the installed equipment for one year after startup.

Although there are often variances, the 10 steps outlined above are a pretty common process. Even when there's deviation from this process, the key takeaway is that unless the architect, owner, engineer or general contractor direct the HVAC sub-contractor to purchase a specific brand of equipment, or utilize a particularly prudent technology, the final equipment selection takes place at the end of the process — at which time the contractor makes a profit-motivated decision where typically the lowest-cost vendor wins.

Why? Because the contactor has already bid and won the job based on their predetermined price. That means any additional savings they can extract will add to the contractor's profits from the project, thus they are typically looking to meet the specifications of the job with the cheapest equipment they can find.

We want to be clear that we are in no way suggesting any participant in the design, engineering or construction process has less than full commitment to the success of the project. However, what we are suggesting is that some of the traditional industry biases, processes and protocols are not always aligned for optimal equipment selection in the highly specialized cultivation industry.

Low Cost is Usually Very Expensive

Specifications rarely include energy consumption criteria and operating, maintenance or service costs, nor do they factor reliability or equipment life — all of which have a huge impact on the most important long-term value considerations. Unless a non-traditional, extended warranty is called for, facility managers are saddled with the long-term outcome of the equipment choices. This should be a big concern to owners.

Owners need to be aware of exactly what equipment has been specified by the engineer and which vendor/brand will provide it. If it's premium quality equipment, will the contractor be allowed to provide alternates or substitutions? Specifications must be extremely tight with key competitive features clearly defined in the documentation.

This is one of the biggest challenges business owners face in getting a premium quality solution to their HVAC needs. In our estimation, the lowest "first cost" or lowest cost on

Ensuring your plants produce the best buds possible means understanding every aspect of the grow room's design, including the HVAC system.

"contractor bid day" is typically not the smartest money or the best way to ensure long-term value and performance.

Solution

It's highly recommended that business owners have a clear understanding of the entire HVAC decision process from design to installation. Ask lots of questions, understand what the options are and why specific recommendations have been made. Get all the facts.

Of note, a well-informed owner, architect or engineer can predetermine 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 the bigger picture equipment value factors. As the owner, you will be well-advised to understand and participate in the decision process of specifying and selecting the equipment for such a critical aspect of your business.Part II: Getting the design parameters right

Designing commercial-scale cannabis grow rooms is still a new frontier, and technologies are changing constantly. There's also a considerable level of secrecy and competitive confidentiality relating to what works, what the secret sauce is and how not to let hard-won industry expertise become common knowledge with competitors.

Careful cost-benefit modeling

Clearly, there's a lot of pioneering work being done that is not setting industry standards. This is very different than the traditional construction industry where the American Society of Heating and Refrigeration Engineers (ASHRAE) sets standards. General construction is not a competitive business with trade secrets guarded in the same way as growing cannabis. So far, ASHRAE has no engineering standards or best practices published about how to design HVAC systems for grow rooms.

That means that even the technically qualified firms have to guess at a considerable amount of the science and mechanics behind creating optimal grow environments. Their jobs are extremely complex and involve dozens more variables than designing traditional HVAC systems for commercial buildings.

Getting grow room specification right requires careful modeling of grow cycles, transpiration rates, temperature and humidity specifications, lighting loads and irrigation loads, just to name a few components. 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.

All of those factors must be carefully modeled to ensure the HVAC engineering specifications can be met, but there's another critical piece of modeling that should be included in the business decision: the cost-benefit analysis of extreme-condition management capability. What latitude of temperature and humidity ranges could be acceptable on the most extreme hot and humid days or cold and dry days? And what's the cost of designing a facility for that range of temperatures versus designing for optimal temperatures 90% or 95% of the time and allowing the remainder of the year — the most extreme days — to be slightly warmer or cooler? That can make a significant difference in the capital cost of equipment as well as the operating costs of handling those extreme days.

Solution

Work closely with your HVAC design engineers to discuss and incorporate all factors that will affect temperature and humidity loads into your ideal specifications. 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.

Then model those conditions and the equipment capacities required to meet them on the most extreme days, considering how much latitude of temperature and humidity you can accept during those outlier days relative to the costs of maintaining perfect conditions. The cost-benefit analysis will inform your decision about how much you really need to spend on HVAC equipment. You may find that allowing a few degrees of latitude in temperature and humidity on those extreme days can save a lot of money and not have much impact on your yield or quality.

Part III: Getting the right HVAC solution design

Commercial cannabis is an evolving industry that presents a number of unique challenges for business owners. The past two issues of Marijuana Venture addressed the importance of properly evaluating the true needs of a space in order to make the best decision about HVAC equipment sizing, but how can growers be sure they're getting the right solution design?

There are different approaches and contrasting technologies that can be applied to achieve the desired grow room conditions. But what approach is the best? What type of equipment will give the best result? What manufacturers will deliver the best solution? What's the smart money decision?

There is a natural "solution bias" in the engineering community toward traditional HVAC solutions, a tendency to use familiar models that have been applied successfully in the past. But are they truly the best solutions for a grow room application?

Growers may find themselves with oversized electricity bills due to the power requirements of their HVAC systems.

When Does a Central Plant Makes Sense?

Most projects requiring 1,000 tons or more of installed refrigeration capacity — roughly 80,000 to 100,000 square feet of facility — have typically utilized a central plant for heating and cooling. This would apply to a typical college campus, hospital complex or data center; for these facilities, it would be unfathomable to use smaller unitary air conditioners.

Because a large grow room can require a similar amount of refrigeration, many engineers naturally want to apply the same central plant approach. And they do so because they are familiar with that approach and don't consider contemporary, "purpose-built equipment" for grow rooms.

What's the difference? Why should they consider purpose-built equipment instead of traditional and more familiar solutions? The reason is that grow rooms really are different. They have a much higher latent load (moisture/dehumidification load) than almost any other large-scale environment. Latent load refers to the actual moisture or dehumidification load as opposed to air conditioning (cooling) load for a similar capacity requirement.

For a comparison, consider a computer data center. It has a similar raw cooling power requirement for a given room size as a grow room, but typically no need to dehumidify — in fact, most data centers add humidity to ensure they don't have any static electricity buildup. This means they're able to use chilled-water air handlers to effectively cool the space, with no need for reheat or auxiliary heat. Thus, a two-pipe system that's relatively easy to install and equipment that's reasonably priced makes perfect sense. You'd have a hard time arguing that it wasn't the right solution for that space.

Traditional thinking (or solution bias) would say to apply the same approach to grow room spaces, which also have large, sensible cooling requirements.

However, the issue with a grow space is the humidity. To properly control the conditions and dehumidify effectively, the air needs to be cooled much more in order to condense the humidity off the cooling coil. That means the chilled water temperature needs to be much colder than is traditional, which turns out to be very inefficient when using the typical chilled-water air handlers and chillers mentioned previously. Furthermore, in lights-out mode, growers need to be able to not just dry the air but then to reheat it, to avoid overcooling the grow room. That reheat could use free energy captured from the dehumidification process to accomplish that with the right system. If you don't, add that to your operating costs.

Simple Gets Complicated

This type of setup means growers now need to add a boiler for reheat capability, along with another set of pipes and a more complicated and expensive installation, instead of just a simple chiller-based central plant.

The inexpensive two-pipe system now becomes a much more costly and complicated four-pipe system. A chiller would also need to be run well below its most efficient operating point; you then have to add heat from a boiler and sophisticated systems to control it all, as well as redundancy to your chiller, pumps and boiler so that no single point of failure can affect your entire complex.

Electrical Power Consumption

Another often-overlooked complication is that most grow facilities are painfully underserviced by electrical utility capacity. A single, large plant is going to have a much higher single point load, which your electrical engineer and local permit officials aren't going to appreciate.

The other obvious challenge with central plant design is that many growers want scalable production capacity with the ability to expand their facilities as their business grows. Knowing this, how do you size your central plant? Do you size, spend and build for current needs or oversize it now and hope expansion absorbs excess capacity? Scaling central plants and the supporting infrastructure is a complicated and expensive process. Central plants are by design not scalable.

The Purpose-Built System

Unitary, purpose-built grow room dehumidification and climate control systems can solve all these challenges and more. By utilizing a unitary compressorized system, you can cool and dehumidify effectively and intelligently reject heat out of your building when needed. You can easily size the equipment to match the room and create built-in redundancy in a number of ways. Expansion is 100% manageable with relatively short equipment lead times. Installation is simple and heat rejection is even simpler with low-risk, scalable, redundant dry coolers. Additional rooms can easily be added at will — entirely independent of the rest of the facility.

The other benefit of purpose-built, unitary systems is that the right ones are far more energy efficient than having separate dehumidification, cooling and heating components. Using separate components, that in some respects actually fight each other, requires careful control systems to minimize wasted energy. On the other hand, purpose-built unitary solutions leverage the latent heat of evaporation to recycle energy with high efficiency and tightly integrated controls.

Solution

It's essential to have a solid understanding of your HVAC options as well as the costs, limitations and advantages of different design scenarios. You want to also 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 available to you and which might be most suitable for any given facility.

Conclusion

Business owners need to be more deeply involved in their mission-critical HVAC and dehumidification decisions. There are too many potential areas where third-party specifications and purchase decisions can underserve the bottom line and the long-term interests of shareholders. HVAC equipment decisions must be carefully evaluated against important ROI considerations that have significant impact on budgets well beyond the initial purchase and one-year warranty period.

Business owners also should be thoughtful, diligent and explicit in setting out temperature, humidity and air-change specifications for every stage of growth and every type of potential crop in order to get load calculations done correctly. They should also ask for specific details about HVAC design criteria, why certain solutions are being recommended, what alternatives are available and what the pros and cons of each solution are. Once they are clear and comfortable with the solution design, they should carefully evaluate vendor recommendations and brand decisions based on important considerations that often don't show up on mere technical specifications.

Equipment selection should be based on the merits of the equipment and evaluated using all of the facts in a straight-up comparison of all value factors over a multi-year ownership cycle, not merely lowest cost to meet specifications on contractor bid day.

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For additional information about Agronomic IQ's purpose-built, unitary grow room humidity and temperature control solutions, visit AgronomicIQ.com, or contact the company at ContactUs@AgronomicIQ.com.

This article is a three-part series on the biggest HVAC challenges of modern grow rooms. Parts I and II of the series were published in the February and March issues of Marijuana Venture, respectively. They can be found at www.MarijuanaVenture.com.