

The logo for Prospiant, featuring the word "PROSPIANT" in a white, sans-serif font. The letter "O" is replaced by a stylized orange square with a white outline.

PROSPIANT



Deliver Cannabis to Market Faster with
PRE-ENGINEERED SOLUTIONS

WHITE PAPER BY

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SUMMARY

Timing and speed to market are crucial when starting a new cannabis project. The cannabis industry moves at a rapid pace. New cultivation businesses either keep up or get left behind. There is no time to lose once a new start-up receives its license. Wholesale prices go down as more start-ups become operational and have saleable product on the market. The first companies to enter a new market have the competitive advantage and typically earn higher revenues the first year in operation.

There are many variables that determine an operation's speed to market. Keeping build-out and outfitting of the facility on schedule is one of the largest hurdles new start-ups must overcome because individual states dictate operational lead times when releasing licenses. It is not unheard of for lead times to be as quick as six to nine months. Additionally, each state is driven by different standards that are subject to change at any moment. New operations must consider local requirements and zoning laws as well. Plus, the entire process from the design phase to growing is often riddled with time-consuming bottlenecks and inefficiencies that can setback project completion up to a year or more. All things considered; something needs to change to help new cannabis start-ups shave time off the design, build, integrate, operate process.

Realizing this need in the industry, the Prospiant team came up with a solution to address it using standardized cannabis cultivation models packed with everything a new start-up requires to get up and running quickly. These Pre-Engineered Solutions reduce time spent on consultation, design, and execution when compared to customized cultivation facilities, and start-ups don't have to navigate the complexities of outfitting a facility on their own. The time-savings gained by choosing this route gives new licensees a head start on stocking their product shelves sooner to gain a competitive edge.

In this exclusive whitepaper, we'll discuss design and strategy considerations for choosing a cannabis facility and cover the advantages gained from using Pre-Engineered Solutions to get to market faster than ever before.

What Are Pre-Engineered Solutions?

Prospiant believes in making the cannabis greenhouse set-up process less daunting and time-consuming. Pre-Engineered Solutions takes the best of Prospiant's popular, proven greenhouse models and packages each one with a streamlined design and construction process. This significantly accelerates and simplifies cultivation projects — without compromising on quality.

Three best-in-class cultivation models fall under Pre-Engineered Solutions – Sealed Venlo, Hybrid Vail, and Indoor Grow. These modules are packaged with everything a cultivator needs to start growing cannabis. Pre-Engineered solutions can accelerate time to market by three months or more, helping cannabis growers earn revenue faster while maximizing yield and operational efficiency.

Why Use Pre-Engineered Solutions?

There are inherent advantages that come with having a selection of standardized greenhouse packages to choose from that cater to a wide array of cultivation needs and strategies.

- **Accelerate Speed to Market.** By selecting a Pre-Engineered Solution for your cannabis cultivation project, you will be positioned to save three months or more on your project timeline. Lead times for these solutions include every aspect that goes into a project timeline; from earthwork and fencing to systems integrations and finally to handing over the keys to your fully finished facility. The upshot of the favorable lead times gained by using a Pre-Engineered Solution can result in your cannabis business generating revenue within a year of your initial investment.
- **Eliminate Scope Gap.** Scope creep is an ever-present threat to on-time and on-budget project delivery. When too many people are involved in a project, gaps in scheduling, missed deadlines, and unexpected delays that cost time and money are inevitable. It is just good business sense to go with one team that has a good overall view of a project and can manage all aspects of it from start to finish.
- **Generate Revenue Faster.** Customers can shave three months off the construction process using Pre-Engineered Solutions. The time savings gained means cultivators can harvest a complete crop turn before their competitors are up and running with plants in their facilities. This significantly impacts first-year revenues
- **Save Money.** Customers who select Prospiant's Pre-Engineered Solutions can save an average of \$135,405 per project. These savings occur due to the design costs associated with a custom project. Prospiant has already spent the resources to fully design and engineer its solutions, so the costs of design are passed down to the customer as savings.
- **Set-Up Hassle-Free.** The cannabis greenhouse construction process is complex. Pre-Engineered Solutions removes that complexity by reducing the time spent on consultation and design. The entire process from breaking ground to stepping into your fully finished facility is a seamless blend of 150+ years of horticulture expertise paired with the best project management and general contracting in the business.

- **Meet State Regulations.** State requirements sometimes dictate that plants need to be in the ground and growing within a certain timeframe, which is usually very tight. With Pre-Engineered Solutions, you can meet the deadline, without taking shortcuts.
- **Leverage Vertical Integration.** Pre-Engineered Solutions are backed by Prospiant's wide array of services, from materials only, to furnish and install, to true turnkey service. Prospiant has the capability to supply your facility with all required equipment for cultivation, the necessary installation of each individual system, and the general contracting aspect of a project. Our general contracting is a full-scale offering from site grading to putting the final touches on interior walls.
- **Eliminate Third-Party Suppliers.** Prospiant structures are 100% engineered, designed, and manufactured in-house. Issues that often come from doing business with third-party suppliers are eliminated. Owing to the manufacturing of our own structures, we can provide our customers with favorable lead times, clarity in the manufacturing phase, and knowledge regarding how to operate and cultivate cannabis with the supplied equipment.

Estimated Customer Revenue Created by Speed to Market

Eliminating three months of construction is the equivalent of money in your pocket. You can add the following numbers to your first-year revenues by being the first to move product in a new market.

Indoor Grow:	\$1,054,185	—	\$3,764,947
Sealed Venlo:	\$819,921	—	\$2,928,292
Hybrid Vail:	\$608,807	—	\$1,739,448

Breakout of Hours:

Prospiant has taken the time to Pre-Engineer and design its offerings, to allow its customers to achieve the quickest speed to market. By selecting the Pre-Engineered Solutions, the following breakdown of design hours is virtually eliminated from the process.

General Overhead Layouts and Concepts:	1 week
Structure Blueprints:	2 weeks
Systems (HVACD, Irrigation, Fertigation, Air Circulation):	2–3 weeks
MEP (Mechanical Electrical Plumbing):	2–3 weeks

NAVIGATING YOUR GREENHOUSE OPTIONS: DESIGN AND STRATEGY CONSIDERATIONS

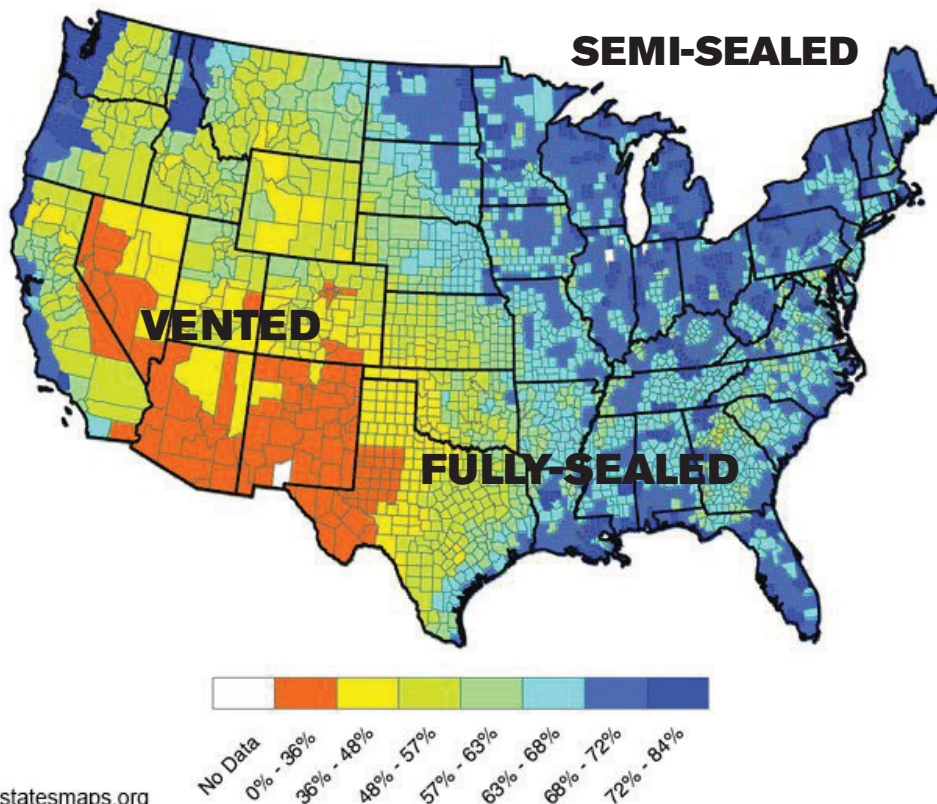
Part of your success depends on choosing the right greenhouse structure for optimal cannabis cultivation. Everything needs to be taken into careful consideration, from optimal design to structural components and systems, to ensure long-term success.

Match the Structure to the Location

A common mistake when starting a cannabis project is not taking specific climate conditions of your location into consideration during the planning phase. Cannabis is a finicky crop. Addressing location and environmental factors early on will ultimately lead to you producing a higher-quality product with a lot less hassle.

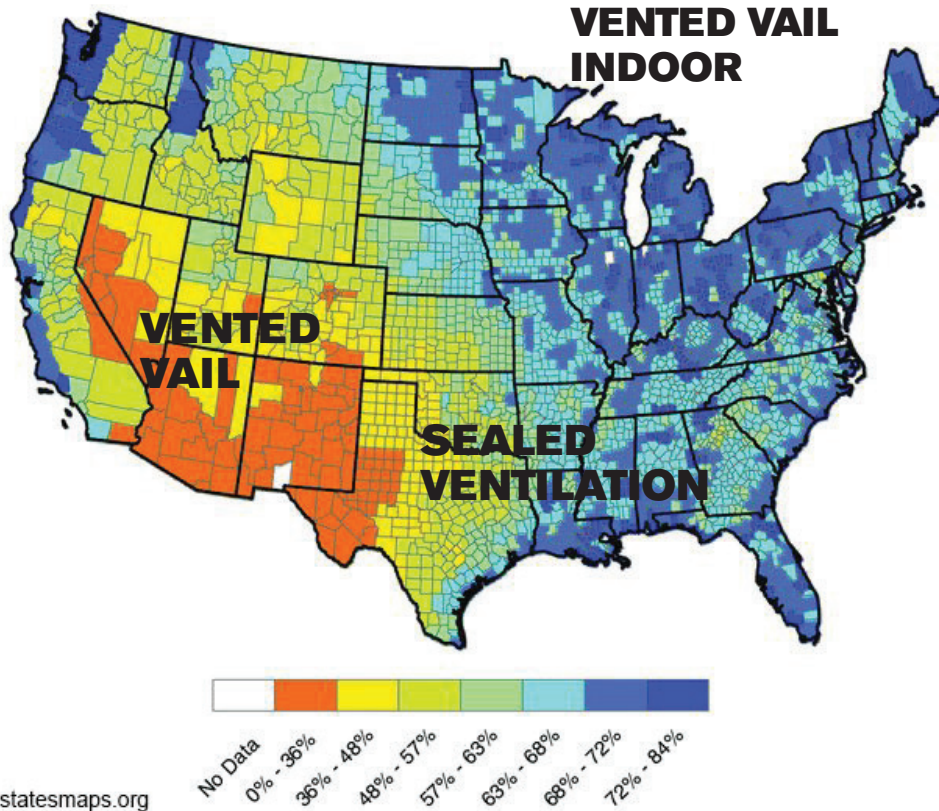
The greenhouse structure you choose must be strong enough to bear regional wind and snow loads and withstand extreme weather events. One of the top concerns for cannabis growers is controlling humidity levels in the greenhouse. Careful thought needs to go into selecting a structure that has the right type of ventilation for the location. What works in an area with high relative humidity and lower vapor pressure deficit (VPD) levels may not be the right choice for a more arid location where less water must be extracted from the environment. Pre-Engineered Solutions allows you to choose the best structure suited to your location for the best results.

Greenhouse Humidity Management Based on VPD



Term	Humidity Management Definition
Vented	Dehumidifies by exhausting air in the greenhouse and bringing in dry, filtered outside air with fans and shutters or mechanical vents.
Semi-Sealed	Dehumidifies using the venting method, when applicable. At night, the greenhouse seals and uses commercial dehumidifiers to remove water vapor.
Fully-Sealed	Dehumidifies by extracting water from the closed environment. This extraction occurs through water-chilled fan coils and desiccant systems.

Recommended Pre-Engineered Solution Based on Location



Optimize and Integrate Your Greenhouse Systems

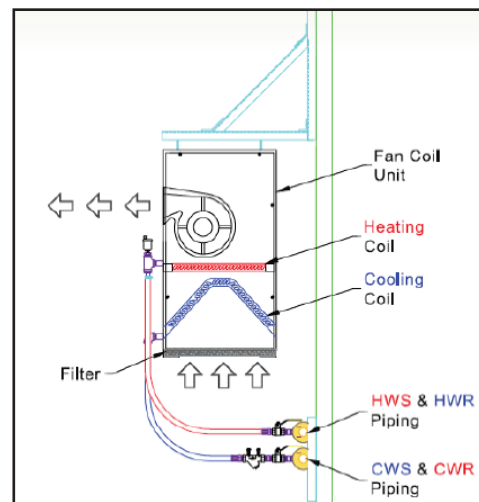
There's more to your cultivation facility than just the structure itself. The importance of equipping your greenhouse properly to create the ideal growing environment cannot be understated, and that includes making sure all systems are integrated and installed correctly.

Prospiant has pre-engineered every system required for premium cultivation. Every cannabis cultivator has different needs for their greenhouse structure, depending on their location and growing environment. Pre-Engineered Solutions makes it easy to adapt to these requirements with unique cultivation systems. Each of the three pre-engineered solutions comes equipped with industry-proven systems from heating and cooling, dehumidification, irrigation, fertigation and supplemental lighting. Prospiant makes certain every cultivation system is sized properly the first time, so you don't run into problems down the line.

Prospiant has leveraged knowledge gained from more than 150 years of experience and 200+ cannabis projects to ensure our Pre-Engineered Solutions are the perfect cultivation solution for our customers. For example, our HVACD designs range from a 4-Pipe fan coil system, desiccant outdoor air handlers, under bench and overhead fin-pipe heating systems, and nighttime cooling and dehumidification. With unmatched integration, we can implement any suggestion a grower may want in their cultivation facility.

Some of the systems already integrated into our Pre-Engineered Solutions include:

- Dissolved Oxygen systems
- Water Recirculation systems
- Liquid CO₂ systems
- Boiler Flue Gas CO₂ systems
- Micro dosing irrigation systems
- pH and EC monitoring systems
- High-Light Intensity systems
- Air sanitation, and more.



Example and schematic of overhead fan coil units

Healthy growing environments that produce consistent results and superior product result from understanding the science of cannabis cultivation and integrating systems accordingly. Overlooking just one variable when producing cannabis can negatively impact your entire grow. Prospiant understands that individual systems must operate in sync with each other to achieve the highest levels of control and efficiency. When one system is upgraded, all the other systems in the greenhouse must be programmed simultaneously. For example, when selecting high light intensity, Prospiant provides the necessary correspondence with the CO₂ and irrigation systems to gain the full benefit of the high light intensity system.

It is crucial to accurately account for your CO₂ concentrations when designing a high intensity light system. When cultivating in a room with no supplemental CO₂, the grow room will be at atmospheric CO₂ concentration (~420 ppm). Attempting to produce more yield by blasting a plant with 1250 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ will not work if one is not properly introducing CO₂ into the grow environment.

Growers who are looking to increase their yields with higher light levels should consider the following relationships before designing their associative systems. Cannabis yields will tend to increase near linearly when a ratio of 1 ppm of CO₂ to 1 μmol·m⁻²·s⁻¹ of light is used up till 1200 (e.g, 800 μmol·m⁻²·s⁻¹ with 800 ppm CO₂ or 1100 μmol·m⁻²·s⁻¹ with 1100 ppm CO₂). A ratio level of 1,200 up to 1,800 will still have positive returns, but the increase in yield will temper off with a slope of roughly 0.7 to 0.8. Any ratio greater than 1,800 has proven to still show signs of increased yields, but the economics associated with the correlation are not great. When designing high intensity light and CO₂ systems, Prospiant works with its customers to provide the best correlating system to reach their yield numbers, while staying operationally efficient.

As a company, Prospiant has designed, engineered, and implemented more than 350 cultivation systems into our projects, resulting in a higher quality product and more precise data collection for our customers.

KNOW YOUR OPTIONS

Prospiant has the know-how to engineer and design well-proven cannabis structures and systems that cater to your unique business needs. We help you succeed by using our knowledge and expertise to assist you along every step of the cultivation journey. Prospiant's Pre-Engineered Solutions include three packaged models – Sealed Venlo, Hybrid Vail, and Indoor Grow – to cover a wide array of cultivation needs and strategies.

SEALED VENLO PRE-ENGINEERED SOLUTION

The Sealed Venlo is the best climate-controlled solution out there for growing cannabis in a greenhouse. It offers complete environmental control regarding



humidity, temperature, and light intensity. With the greenhouse facility being completely sealed, the chances of outside pests and contaminants entering the grow zone is essentially eliminated.

Mechanical dehumidification via fan coil units or air handlers offers accurate and efficient control of the environment and is the best way to maintain actual environmental set points to improve plant health and turn out premium product.

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The Sealed Venlo has the capacity to be controlled and operated as if it was an indoor grow but saves the cultivator money in capital and operating expenses due to the benefits of natural sunlight and other factors associated with a glass house.

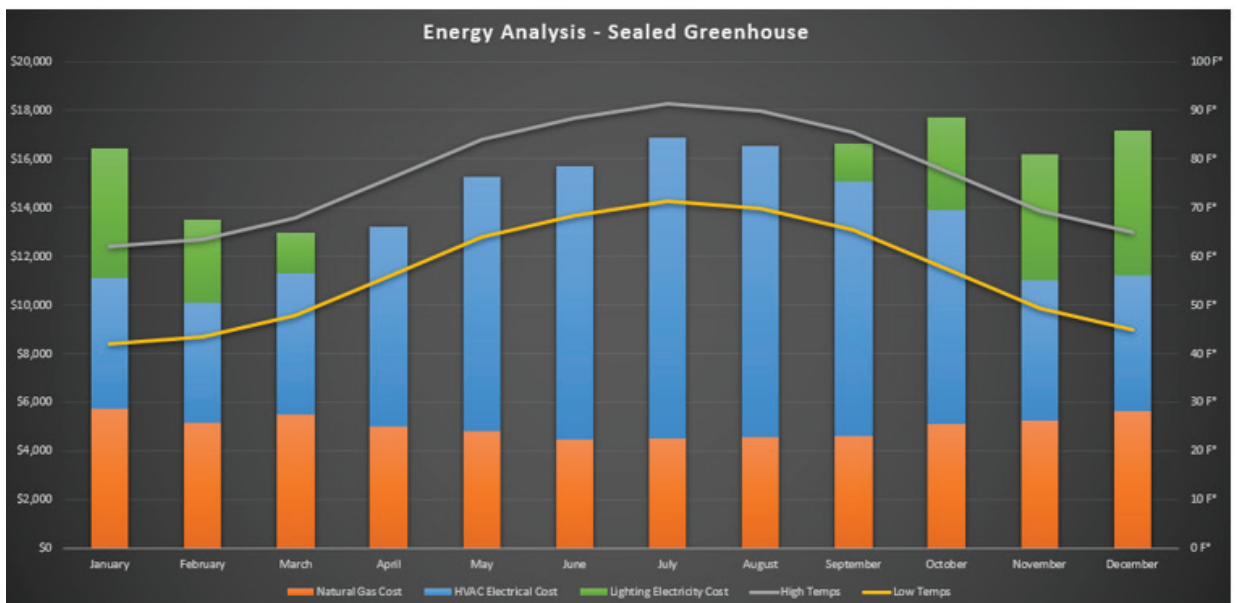
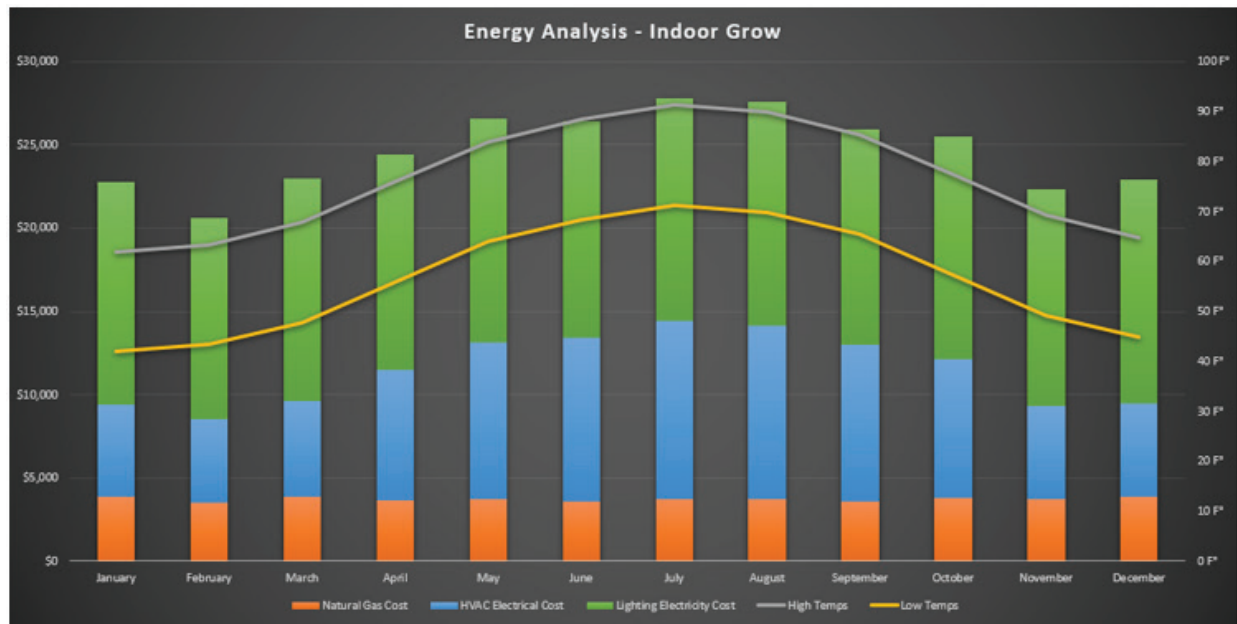
FEATURES

- **18-foot gutter height** allows warm air to rise higher in the grow zone, creating a more uniform temperature and humidity surrounding the canopy. The Venlo has the highest truss height of Prospiant's structure family.
- **Glass roof** for maximum light transmission to the plant canopy, decreasing the required amount of supplemental lighting fixtures needed to achieve optimal light intensities.
- **Standard four-peak design** in 31 ½ -foot width, allows for maximum control of cultivation systems.
- **HVACD** supplied mechanically. This means the Sealed Venlo can operate efficiently on its own, regardless of location or outside climate.
- **Top-of-the-line shade and blackout systems** provide cultivators with the ability to harvest year-round (five to six harvests a year).
- **Fan coil units and air handlers** designed specifically for the cultivation of cannabis offer next-level environmental control.

ADVANTAGES

- Increases plant yields and crop health.
- Reduces operating expenses. The operating expenses with a Sealed Venlo are much lower than that of an indoor grow, while still maintaining the environmental control and yield. Growers stay more competitive in their markets, while still producing quality flower throughout the entire year.
- Controls humidity and temperature in high humidity regions. In areas where growers cannot use outside air to cool their grow zone, the Sealed Venlo offers complete humidity and temperature control.
- Reduces risks of pests and contaminants.
- CO₂ concentrations can be increased and held at maximum levels.
- Requires less maintenance, due to height and glass roof, when compared to other standard structures.

Energy Analysis of an Indoor Grow versus a Sealed Greenhouse



Seen above in the two graphs is an operating cost analysis of an Indoor Grow versus a Sealed Greenhouse model. Comparing energy usage for lighting, the Sealed Greenhouse has significantly lower operating expenses for supplemental lighting due to the natural sunlight coming in through the roof, whereas the indoor grow must supply all of its light through lighting fixtures. The Indoor Grow does slightly better than the Sealed Greenhouse regarding operating expenses for heating and cooling, due to the Sealed Greenhouse experiencing solar heat gain through its glass roof. Natural gas usage and costs are nearly identical for both facilities throughout the year, but overall the Sealed Greenhouse has significantly lower operating costs than the Indoor Grow does. Comparing the two graphs above allows cultivators to assess their business models with accurate estimates for their operating expenses when deciding between a Sealed Greenhouse or an Indoor Grow.

HYBRID VAIL PRE-ENGINEERED SOLUTION

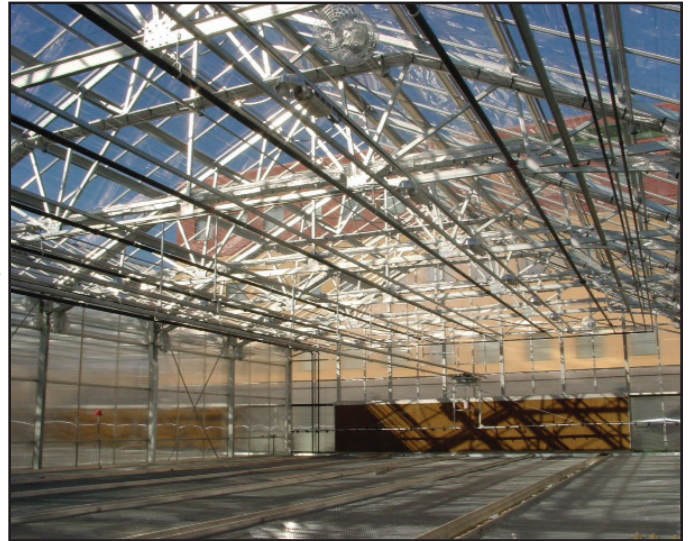
The Hybrid Vail offers flexibility to meet a customer's needs. Its traditional peak design is adaptable to different types of rigid roof coverings to optimize your growing environment. In low humidity climates, the Hybrid Vail offers cultivators an additional option to produce high-quality flower at attractive capital and operating cost levels.

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FEATURES

- **Pad and fall wall** permit cooling and dehumidification of the climate inside the grow zone. With air exchanges designed for one per minute, this greenhouse style allows for maximum air movement, eliminating micro-climates.
- **Rigid roof coverings** from corrugated or twin wall polycarbonate to glass are available.
- **One-piece factory welded trusses** are the strongest on the market and make for quicker construction times.
- **Peak style design and 30-foot-wide spans**
- **Supports additional equipment** such as nighttime dehumidification and supplemental lighting fixtures, to support a grower in maintaining setpoints during peak times and seasons.
- **Shade and blackout systems** to allow exact photoperiod and light intensity control.
- **Bug screens and air purification units** can keep harmful pests and diseases at bay, while also mitigating the risk of powdery mildew and mold entering the facility.
- **Vertical and horizontal circulating fans** maximize air circulation and balance temperature levels from floor to ceiling. Effective air movement can also help reduce heating and cooling costs.
- **Supplemental cooling and dehumidification** draw air from the greenhouse and cool it down for better humidity control, helping to prevent issues such as bud rot and powdery mildew.
- **Odor mitigation** keeps fragrant air contained, while still delivering precise environmental control and ample air movement.



ADVANTAGES

- The Hybrid Vail offers flexibility to meet the needs of different cultivation systems.
- Peak-style design allows for maximum snow shed and enhances interior condensate control.
- Roof design uses natural sunlight to reduce the amount of supplemental light needed, thus saving on capital and operational expenses.
- The Vail allows for year-round harvests (5 to 6 per year).
- Structure is engineered to meet regional snow and wind load requirements.

INDOOR GROW PRE-ENGINEERED SOLUTION

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Prospiant's Indoor structure removes all environmental factors and allows for 100% full control and precision management of environmental conditions, while still taking advantage of the Venlo structure design. The Indoor Pre-Engineered Solution maintains an interior greenhouse structure with all the advantages of a warehouse indoor grow, while still offering capital cost-savings to customers.



FEATURES

- **Fully covered and fully sealed** for complete environmental control and maintaining the best indoor environment for achieving maximum yields.
- **Heating, cooling, and dehumidification supplied mechanically**, so outside air never enters the facility.
- **Fan coil units and air handlers** engineered specifically for cannabis cultivation.
- **18-foot gutter height** allows warm air to rise higher in the root zone, creating a more uniform temperature and humidity surrounding the plant canopy.
- **Insulated metal roof** prohibits natural sunlight from entering the grow zone, allowing cultivators to have full control of lighting intensities without outside influences.
- **HVACD supplied mechanically** to allow facility to operate efficiently independently, regardless of location or outside climate.
- **Liquid CO₂ system** maintains CO₂ concentrations at maximum levels. While supplementing the CO₂ concentrations, a cultivator often will also increase their light intensity, which is incorporated in the Indoor Grow structure. By supplying light to your plant fully by light fixtures, there will never be fluxes in what level intensity your plants are receiving.



ADVANTAGES

- A completely sealed cultivation facility essentially eliminates the chances of outside pests and contaminants entering the grow zone.
- Full control of environmental parameters maximizes yields and plant genetics.
- Indoor Grow allows a cultivator to have confidence that their setpoints are maintained and plant performance doesn't vary, no matter the season.
- Every system, from light intensity to temperature and humidity set points, mimics the controllability of an enclosed warehouse, allowing cultivators to consistently repeat their harvests of increased larger yields, regardless of climate and location.

MEET THE EXPERTS



Johnny Burgoon is a solutions architect at Prospiant and has a Lean Six Sigma Black Belt certification. He uses that knowledge to provide solutions to customers and consultation to growers. He integrates operational excellence into cultivation facilities. Johnny has experience providing greenhouse systems, equipment integration, controls, and general contracting services for many sizes of facilities serving the cannabis, flower, and vegetable industries.

Mark Reich is a systems engineer at Prospiant. His responsibilities include taking conceptual cultivation ideas of the customer and turning them into designs for all environmental equipment outside of HVACD. The systems include lighting, CO₂, irrigation, benching, air flow, and water treatment. Mark is a graduate of University of Cincinnati, and he likes to solve complex issues for customers surrounding environmental controls and water treatment.



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