

The Future of Floriculture

# Greenhouse GROWER<sup>®</sup>



## Trends Shaping the Greenhouse Structures and Components Market

In this report, suppliers and manufacturers weigh in on the biggest factors influencing greenhouse construction today — from rising energy costs to shifting tariffs and smarter automation.



From the editors of Greenhouse Grower

Photos: GGS, Bailey Nurseries, Atlas, Wadsworth Controls, Prospiant

# Why Disconnects Between Design and Reality Can Hinder Greenhouse Projects

By Brian D. Sparks

**G**reenhouse manufacturers and component suppliers are navigating many of the same pressures as growers. From tighter margins and energy costs to shifting expectations around automation and integration, the forces shaping plant production are shipping the structures and systems behind it.

To better understand where the market is headed, Greenhouse Grower surveyed members of the National Greenhouse Manufacturers Association (NGMA), whose products range from greenhouse structures and coverings to controls and lighting systems. In this article, we cover where manufacturers see the biggest disconnect between design and real-world operation.

## Where do you see the biggest disconnect between design and real-world operation?

- “The biggest disconnect lies in what the estimated cost will be for a project.”
- “Multimillion-dollar investments are ultimately bypassed or operated manually because the human and mechanical infrastructure cannot sustain the design’s original complexity.”
- “The realistic time needed to complete projects.”
- “Design is tending to overcomplicate things.”
- “The biggest disconnect is often between theoretical performance and operational reality. Designs tend to optimize for ideal conditions, but they don’t always account for variability in climate, labor, or long-term wear. This can

lead to inefficiencies once the system is in use. We focus on closing that gap by emphasizing practical performance, durability, and application-specific solutions, rather than just design specifications.”

- “In our experience, the disconnect usually comes from a lack of operator input during the design phase. Institutional projects are often overdesigned and budgets are heavily weighted toward consulting and design, which can leave end users with systems that are more complex than necessary but missing practical features. In commercial projects, cost constraints sometimes result in eliminating items like irrigation or automation that would actually provide quick ROI and improve day-to-day operations.”
- “Electrical design and layout.”
- “Growers not utilizing the full capability of equipment.”
- “The biggest gap is between the sale and the harvest. Many companies sell innovation but then disappear, leaving growers with complex tools they cannot fully use. We bridge this by staying in the trenches with our customers, providing ongoing support to ensure they actually realize the value and ROI of what they bought.”
- “Some greenhouse builders are blind to the actual climate in the U.S and how it varies by region and season. “Naturally ventilated” seem to end up in my contact list or those of our distribution channels requesting help with mechanical for when nature fails them. It’s a great concept for saving energy costs, but not always practical in application.”

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# Underrated (And Overrated) Trends in Greenhouse Design, and Future Market Shifts

By Brian D. Sparks

In this article, we look at underrated and overrated trends in greenhouse technology, and where suppliers predict future market shifts.

## What is the most underrated or overrated trend in controlled environment agriculture right now?

- “Wireless sensors are overrated. What is underrated might be climate trend analysis, which should be used more to determine yield information, health/volume/quality, etc.”
- “Building greenhouses that match crop requirements to the climate is a trend that deserves more attention. Vertical farms are the most overrated trend.”
- “For me, it’s certain technologies or terminologies like VPD or crop steering. These are things that have been used for years but are being touted as new.”
- “I think the most overrated trend is the assumption that scaling technology automatically guarantees profitability. The most underrated aspect is operational efficiency at the structural level — how materials, design, and environmental control systems work together. That’s where long-term gains are really made.”
- “One overrated trend has been the idea that highly complex, fully automated facilities are always the best solution. In many cases, simpler, well-designed greenhouse systems with good environmental control and irrigation automation provide a better return on investment. Data collection is also increasing rapidly, but many growers are still figuring out how to use that data effectively. There is growing interest in AI to help interpret data and optimize growing, but that approach works best in large monoculture operations with consistent crops and growing conditions. Many smaller growers produce a wide variety of crops, which makes standardized crop models and AI optimization more difficult.”
- “The most underrated would probably be fertigation and irrigation.”
- “AI is the most overrated; it’s just based on factual information that the systems adjust to based on previous inputs.”
- “Overrated: Pure fixture efficacy. A super-efficient light is useless if it is the wrong spectrum for the plant. Underrated: Collaborating with companies who know how to operate greenhouses.”
- “Most overrated would be vertical farming in my opinion. It’s not perfected and too expensive for the return the given product can provide. The most underrated might be veggie

production in smaller-scale local greenhouses. This is also tough to find ROI and outlets for the product. Grocery stores seem full of imported veggies from Canada and Central America. Knowing the producers, it’s easy for me to recognize. But it doesn’t help that U.S.-based producers seem to continually fail once investor money is gone, and acquisitions are in the news frequently.”

## What major shifts do you expect in greenhouse design or technology over the next three to five years?

- “More automation, AI integration, and more robotics.”
- “More customization.”
- “Very little!”
- “AI is going to play a major role in the control of greenhouses.”
- “The biggest shift will be toward fully integrated systems that combine smart design, advanced materials, and data-driven decision-making. AI will indeed be the key differentiator.”
- “Over the next three to five years, I expect greenhouse design and technology to focus more on energy efficiency, water management, automation, and system integration between climate, irrigation, and lighting, which is already being driven in part by building codes and operating costs. We will also see increased use of data, AI, and robotics to help reduce labor and improve operational efficiency. However, the industry will continue to balance new technology with cost, and most growers will prioritize practical, reliable systems that provide a clear return on investment.”
- “Hopefully institutions and the USDA will invest in research facilities in a concerted fashion.”
- “More efficiency and better access with ease of access and control.”
- “The greenhouse is moving toward being software-defined. It will stop being just a building and start acting like a programmable entity. For example, automatic balancing of power costs against crop value in real-time to make sure the grower is always making the most profit possible.”
- “This space seems resistant to change and evolution. ‘We’ve been doing the same thing for 70 years’ sometimes works, but evolution should happen. Automation should be a big push, but costly ROI again comes into play. Solar, turbine power, and geothermal are all good, not for the masses, but for the few with capital.”

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# Greenhouse Tech Suppliers Facing Market Opportunities and Challenges

By Brian D. Sparks

In this article, manufacturers highlight key challenges and opportunities driving the industry.

## Opportunities in Market Share, Automation

“Expansions of controlled-environment agriculture (CEA) facilities in North America.”

“Educational greenhouses.”

“Earning market share through service and quality.”

“Retrofit is a bigger market than new construction right now because people can’t afford the cost of building new.”

“From a strategic perspective, the Western U.S. presents significant growth opportunities in high-performance greenhouse materials. Key drivers include water scarcity, extreme UV exposure, and temperature control challenges — factors that favor polycarbonate over traditional materials. There is also a growing trend toward large-scale, commercial greenhouse operations, particularly in California and the Southwest, which require durable, energy-efficient glazing solutions. This positions us well to expand through value-added products, innovation, and strong regional partnerships.”

“The biggest opportunities we see are growers continuing to adopt new technology, both through new greenhouse projects and upgrades to existing facilities. Many growers are adding sensors, irrigation and fertigation control, lighting systems, and additional automation to improve efficiency and reduce labor, water, fertilizer, and energy costs. In particular, irrigation and fertigation upgrades are becoming more common as growers recognize the labor savings and the cost impacts of overwatering and excess fertilizer use. Overall, there is a continued shift toward more automated and data-driven greenhouse operations.”

“There are countless options to provide projects, just not the largest of scale.”

“Consistent access to funding for larger projects.”

“Steering the plant without chemicals. As an example, we can use light to control how tall a plant grows or how vibrant the flower color is.”

“High-end greenhouse operators understand high-quality mechanical equipment pays dividends over the long term.”

## Market Volatility, Costs Are Primary Challenges

“From a strategic standpoint, the primary challenges include managing raw material volatility, maintaining competitive pricing, and ensuring supply chain reliability. We are also navigating increasing pressure to deliver faster lead



times while maintaining quality and consistency. At the same time, market demand can fluctuate significantly, particularly in greenhouse and agricultural applications, which makes long-term planning more complex. Balancing these variables while continuing to support customer growth is our main focus.”

“Getting growers to move past a static mindset. Many still see lights as simple on/off. In floriculture, different stages — like rooting versus blooming — need different light. Our hurdle is showing that one fixed LED cannot do it all as well as a dynamic system can.”

“Overseas competition from Europe.”

“Permitting is excessively complex and burdensome, causing some projects to stall and customers to lose market advantage.”

“Coordination with GC and MEP contractors.”

“Accelerating costs on raw materials. Labor costs are also rising.”

“One of the biggest challenges we are currently facing is uncertainty in project timing and capital spending. Projects are often planned and expected to move forward, but then external factors such as tariffs, global conflicts, fuel prices, or general economic uncertainty cause projects to be delayed or put on hold. This makes forecasting and production planning more difficult for suppliers. We are also seeing some funding uncertainty with university, school, and USDA projects, which can delay institutional projects.”

“Fluctuating materials/component costs and finding reliable labor.”

“Very low cost, low-quality Asian imports. European pressure from equipment companies not in the space prior to any degree. More players for limited audience equates to low margins as it becomes a race to the bottom.”

“People having the capital to either expand or retrofit.” **GG**

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# Greenhouse Tech Suppliers Helping Growers Navigate Pain Points

By Brian D. Sparks

**T**his article covers the biggest pain points growers mention when talking to suppliers, and how these manufacturers are responding.

“When we speak with our grower customers, the most common pain points center around rising operating costs, environmental control, and supply reliability. Energy costs continue to be a major concern, especially when it comes to maintaining consistent temperatures in more extreme climates. Growers are also focused on light optimization and crop yield, which makes material performance — like light diffusion and longevity — critical. In addition, lead time consistency and product availability remain key challenges across the industry. As a company, we’re addressing these issues by focusing on high-performance polycarbonate solutions that improve insulation, enhance light transmission, and extend product lifespan. We’ve also made investments in inventory planning and supply chain stability to better support our customers with reliable lead times. Beyond the product itself, we take a consultative approach, working closely with growers to recommend the right solutions for their specific climate and application — helping them operate more efficiently and predictably.”

“Labor and energy costs; our control system monitors and moderates energy in a labor and resource perspective.”

“I am focused on the architectural end of educational greenhouses. I find that architects don’t know who to lean on for sound design assistance.”

“For us, the biggest pain point is in integrating all the systems into one place, which is what we specialize in.”

“The biggest pain points growers mention today are uncertainty, labor availability, fuel and other input costs,

and concerns about the broader economy and consumer spending on flowers and gardening. Global conflicts and geopolitical instability have also affected energy, fertilizer, and transportation costs, which directly impact greenhouse operations. In response, we are focusing on automation, irrigation, environmental controls, and energy management systems that help reduce labor and operating costs and improve efficiency. In the western U.S., insurance requirements related to wildfire risk are becoming an additional challenge, with some policies requiring removal of plants near structures. Many in the industry feel these requirements are not always science-based, and there is an opportunity for the industry to work together to develop better guidelines and educate public officials and insurance companies.”

“They have the same issues with labor and variation in commodity pricing (media, pots, fertilizer, etc.)”

“Funding is the biggest issue. We try to line them up with funding from investors we know, but it’s a challenge.”

“They are terrified of being locked in. They do not want to buy a system that is obsolete in two years. We solve this by making the hardware permanent but the light recipe flexible to future-proof their investment.”

“Low-quality equipment causing increased labor and repurchasing effort. Greenhouse builders and supply company sales reps often take the road of least resistance, thus placing low-quality product in projects. We express to end users making contact to request our products, from X, Y or Z who will quote them, but sometimes you need to ask for it, not just the common fan specs, or you will get the commodity product.”

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# Why Growers Are Currently Cautious When it Comes to Capital Investments

By Brian D. Sparks

**T**his article digs deeper into whether growers are being hesitant or aggressive in capital investments.

## Are growers hesitant or aggressive in capital investments right now?

- “They are mostly hesitant. Sales cycles now require more in-depth analysis because growers need to justify every cent. They are moving away from quick upgrades toward a model that requires a rock-solid ROI. We are responding with detailed energy simulations and data to prove exactly how the technology pays for itself.”
- “Hesitant – there is a lack of funding available.”
- “Not on the educational side.”
- “For commercial greenhouse projects, growers are generally hesitant with capital investments right now due to high input costs such as labor, fuel, and fertilizer, as well as concerns about the economy and consumer spending on discretionary items like flowers and gardening. Institutional projects are somewhat different because

funding is typically secured in advance, so those projects are less influenced by short-term economic conditions and have remained relatively steady.”

- “50/50. I seem to get numerous sizes of quotes; some materialize, and some do not. I rarely get the real reason why not when following up on quotes.”
- “Hesitant is putting it mildly!”
- “We’re seeing a mixed approach right now. Some growers are being more cautious due to ongoing cost pressures and market uncertainty, especially around energy, labor, and input costs. However, at the same time, many are still making strategic, long-term investments — particularly in areas that improve efficiency, yield, and sustainability. So while there may be some hesitation in the short term, there’s still a clear willingness to invest when the return is justified and the solution adds measurable value.”
- “They are still hesitant, with some light at the end of the tunnel.”

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# Energy Costs Driving Growers to Focus on Efficiency

By Brian D. Sparks

**T**his article covers how current energy costs and other regulatory issues are affecting the greenhouse market.

## How do you see current energy costs and/or regulatory issues affecting the market?

- “Current energy costs and regulatory costs are driving the cost of construction up, making it less attractive.”
- “Energy costs have been increasing overhead.”
- “Energy costs and regulatory pressures are accelerating the transition toward controlled, efficient growing environments. Growers are being forced to rethink how they manage energy consumption and compliance, which is driving demand for advanced materials and systems that deliver measurable efficiency gains. From our perspective, this creates an opportunity to support customers with performance-driven solutions that align with both cost reduction and regulatory compliance.”
- “This was and will continue to be an emerging challenge to profitability.”
- “Energy consumption is always a concern, but even with products that are tested and feature statistically low energy use models, growers will not always utilize them.”
- “Higher energy costs and stricter regulations are increasing the cost to build and operate greenhouses, which may slow some new construction. At the same time, if they do build, these factors are increasing demand for energy efficiency, automation, and environmental control systems.”
- “Energy prices are the biggest reason people switch to us. With flexibility, we help growers turn their lighting from a fixed cost into a flexible one that plays nice with the grid.”

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# Tariffs, Other Geopolitical Issues Having Mixed Impact on Greenhouse Supplies

By Brian D. Sparks

**T**his article looks at how tariffs, supply chain conditions, and other geopolitical issues are affecting the market.

## How have tariffs, supply chain conditions, or other geopolitical issues affected your business?

- “They’ve given us more opportunities to compete with European suppliers.”
- “Tariffs have made us more competitive in our market.”
- “Tariffs have absolutely had an impact, but you also need to fully understand the reason why the tariffs were placed. Many products regarding imported “ag” equipment may not have been affected, but some companies are capitalizing on the tariff train, legit or not. It depends on how it is brought into the country. Logistics has been the hardest hit, affecting lead times globally.”
- “Tariffs seemed to be acceptable by most in the increased cost of goods to meet a more equitable future in trade. The geopolitical issues revolving around current wars and actions are causing additional cost challenges due to oil and shipping pressures.”
- “It has caused shipping delays and disruptions. It has forced us to raise pricing.”
- “Tariffs have become a big burden on the cost of doing business. All material costs have increased, fuel has increased, and insurance costs have increased. It’s hard to hold pricing that way.”
- “Geopolitical factors and tariffs have introduced a higher level of uncertainty and cost pressure across the supply chain. They’ve impacted raw material sourcing, increased input costs, and created variability in lead times. As a result, agility and planning have become critical. We’ve



- responded by diversifying supply sources, optimizing inventory strategies, and maintaining transparent communication with customers, ensuring we can navigate these challenges while continuing to support their operations.”
- “Geopolitical issues, tariffs, and supply chain disruptions have primarily affected component costs, lead times, and supplier reliability. As a result, we have focused more on supplier diversification, inventory planning, and long-term purchasing strategies to reduce risk and maintain consistent product availability for our customers.”
- “The supply chain has been tough to deal with. Geopolitical issues are a very big issue for stability of investors.”
- “It has made us focus on being a reliable North American partner. More clients ask for DDP and need help with navigating tariffs.”

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# Costs, Lead Time Concerns Leading to More Standardization in Greenhouse Technology

By Brian D. Sparks

**T**his article reviews whether manufacturers are standardizing offerings or moving toward more customized solutions.

## Are you standardizing offerings more, or moving toward more customized solutions? Why?

"We are moving toward more standardized offerings for smaller and lower-cost systems to improve lead times and reduce engineering time. However, large and complex projects still require custom solutions. Our strength as a company is our engineering team and our ability to design the right solution for each customer rather than a one-size-fits-all approach."

"We are standardizing towards lower cost, introductory products with the option of going fully custom later."

"We are standardizing a base offering to controls costs while somewhat expanding customized solutions at a higher price point."

"Customers keep asking for customized solutions despite our efforts to standardize."

"More custom. Research of specific plants requires specific

growth habitats. We enjoy the customization."

"Both options are available through my company. We have standard off the self-products but also can customize to a degree if they ask for something not standard."

"We standardize the hardware but customize the experience. By nature, we were always custom or tailored to the growers' needs."

"We've been a custom shop for 35 years. Now we are moving towards some standardizing to improve efficiency and profit."

"We're standardizing our core product lines to drive operational efficiency, scalability, and supply chain reliability. However, the market still demands customization, particularly in high-performance greenhouse applications where ROI is tied to precise environmental control and yield optimization. So we're focused on being efficient at scale while remaining flexible where it matters most."

"We have always provided custom solutions, but costs of goods and labor make you consider standardization."

"All of our offers are custom to best suit the build."

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