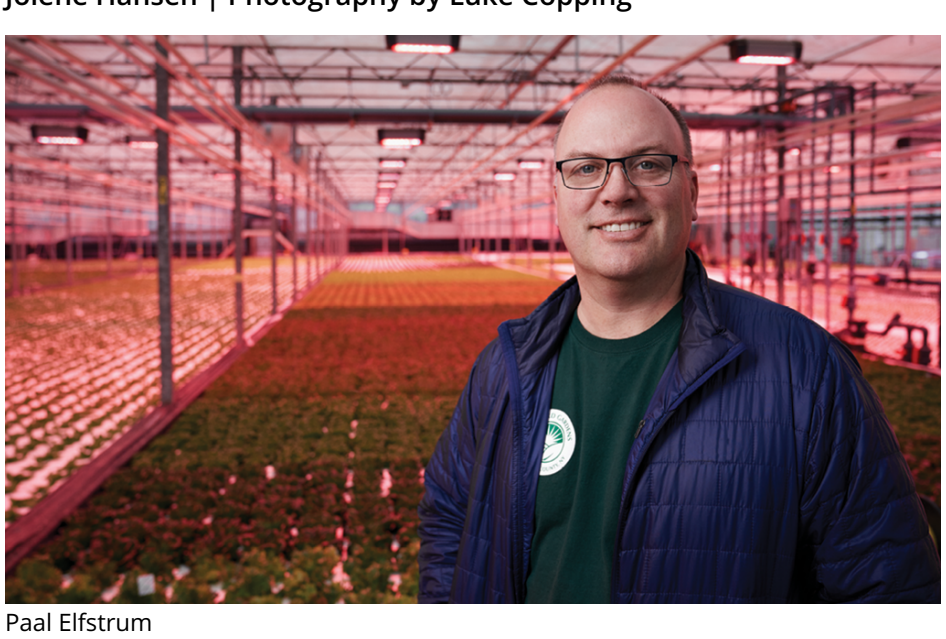
COVER STORY

Upstate efficiency

At New York's Wheatfield Gardens, a passion for productivity drives a once-forsaken greenhouse toward new levels of sustainability.

Jolene Hansen | Photography by Luke Copping


Paal Elfstrum

When Wheatfield Gardens CEO Paal Elfstrum and an investor team purchased their Wheatfield, New York, property in March 2015, the 1.6-acre greenhouse that now houses hydroponic lettuce production looked very different than it does today. Purpose-built in the early 1990s for vine crops and strategically located to take advantage of a nearby power plant's steam, the greenhouse had literally run out of steam as changes swept the energy industry. Regulations that required power companies to dispose of the steam they created went by the wayside — and so did the facility's inexpensive heat source. From 2012 to 2015, the greenhouse stood vacant.

Fast forward to 2019 and every day, Wheatfield Gardens is harvesting 4,000 to 5,000 heads of pesticide-free hydroponic lettuce destined for Buffalo-area food markets, and that's just one segment of 12.6 acres under glass. The story behind the lettuce and other hydroponic projects involves emerging technology that's helping Wheatfield provide fresh, local, sustainably grown greens in the midst of New York's winter. "I like to describe Wheatfield Gardens as an industrial-sized CEA [controlled environment agriculture] R&D center," Elfstrum says.


Wheatfield's production focuses primarily on butterhead lettuce along with some oakleaf, romaine and incised varieties.

Growing and transforming with technology

Like Wheatfield's greenhouse, Elfstrum's path into hydroponic lettuce production took uncommon turns. For more than a decade, he worked in pharmaceutical sales, marketing and manufacturing. In the late 1990s, while employed at biopharmaceutical company Pfizer, Elfstrum was intrigued by the presence of greenhouses on Pfizer property. A conversation with a coworker opened his eyes to Pfizer greenhouse experiments involving tobacco plants and vaccines. While that research piqued his interest in plant-based medicines, it also enlightened him to the shortcomings of passive, vents-and-fans greenhouses and the need for more controlled greenhouse environments.

The eventual advent of LED grow lighting rekindled his interest in greenhouse technology and the possibilities of sustainable, cost-effective controlled environments for the production of plant-based medicines and food. "I really have a passion for finding efficiencies and improving existing technologies," Elfstrum says. "I saw an opportunity to take a more active approach to greenhouse environmental control." That led to a partnership in Tropos Technologies, an environmental control technology firm, and his position as Wheatfield Gardens CEO.

Wheatfield's first two years onsite involved rehabilitating three existing walkway-connected greenhouse enclosures. After years of decline, that translated to a lot of glass and pipe replacements, along with other upgrades. But the real action has revolved around the energy center and profitable, sustainable growing through increased efficiencies — thanks to additions such as a boiler and CO_2 recovery system, ag-optimized cogeneration, LED lighting and air handlers that recover water from transpiration and more. "Having more sustainable growing impacts the bottom line," Elfstrum explains.

More efficiencies are ahead. Wheatfield Gardens was recently named a pilot site for CEA research by the Greenhouse Lighting & Systems Engineering (GLASE) consortium, a partnership between Cornell University and Rensselaer Polytechnic Institute. With the alliance's focus on developing next-generation CEA technology for a more sustainable, more profitable industry, Elfstrum hopes onsite research helps advance CEA technology for years to come.


Wheatfield customers order 30 to 40 days in advance. "Then we do just-in-time growing," explains CEO Paal Elfstrum.

Enhancing productivity and profitability

Wheatfield's earliest plans relied on the property's original tomato-and-cucumber focus. But 2016's 8.3-acre beefsteak tomato crop proved difficult to produce and price competitively. Elfstrum and his team began exploring other routes with extension support from Cornell and its CEA program.

Beginning in October 2017, the site's smallest greenhouse was converted to a 1.5-acre deep-water culture system for hydroponic lettuce production. September 2018 marked the first full run. As 2019 begins, Wheatfield's production focuses primarily on butterhead lettuce along with some oakleaf, romaine and incised varieties, plus several limited production varieties grown on speculation or for samples. Elfstrum says a new, limited production Wheatfield Gardens tri-variety salad mix, grown as a single head, is getting positive feedback from Wheatfield's wholesale customers.

Pesticide-free hydroponic production is a Wheatfield priority. A robust IPM strategy using aphid midges, parasitic wasps and banker plants manages aphids, the only pest seen in lettuce production to date. "Beneficial insects are the only intervention we need to do on the pest control side," he says. "Everything is in this controlled state right now."

Wheatfield customers order 30 to 40 days in advance. "Then we do just-in-time growing," Elfstrum explains. With the help of CO_2 enrichment from on-site carbon dioxide recovery, seed-to-sale production for butterhead varieties runs between 30 and 33 days. "We're able to react to the market with predictable production, so our customers can plan their sales cycles accordingly," he says.

Harvested lettuce goes into Wheatfield's "Buffalo's Best" sleeve in an on-site pack house, earmarked mostly for Buffalo-area Wegmans Food Markets. Wrapped-root "living lettuce" for contract customers goes into clamshells. "We harvest our food and within 48 to 72 hours, it's in the produce section," Elfstrum says.

Hydroponic New york hemp

Given Paal Elfstrum's pharmaceutical background, it's not surprising he's keenly aware of opportunities surrounding industrial hemp. In November 2017, Wheatfield Gardens received a hemp permit and became a research partner under the New York State Industrial Hemp Agricultural Research Pilot Program.

"Our research is centered around growing industrial hemp for CBD [cannabidiol, a non-psychoactive hemp compound] in a closed environment and in coco as well," Elfstrum explains. "We're looking at growing hydroponically in 2-gallon coco bags and the ability to supplement CO2 to increase the rate of growth as well as the yield."

Two 5.5-acre greenhouse enclosures house seasonal hemp production. "We'll populate those two greenhouses with 30,000 hemp plants in the end of June for November harvest," Elfstrum says. In addition, 10,000 square feet of converted pack house space is now an indoor vertical farm dedicated to year-round hydroponic production of high-CBD hemp for the consumer-packaged goods market.

"High-density vertical farms have to deal with the same problems of transpired water vapor [as greenhouses]," Elfstrum explains. "We do up to 17 air changes an hour inside [with Tropos mixing boxes] and keep the environment very steady in terms of temperature, humidity and CO2 supplementation."

Elfstrum's interest in hemp isn't limited to CBD. He's trialing hemp microgreens — a "very unique flavor," he shares — with an eye toward high-end NYC restaurants. He's also pursuing opportunities on the sustainability front.

"Our deep-water culture growing system uses Styrofoam boards that float in the pond. I'm working with plastic manufacturers that can take the cellulose from hemp fiber and make boards that will float," Elfstrum says. "Instead of using oil-based Styrofoam, we can use hemp-based cellulose to make our floating rafts."

Optimizing sustainability through technology

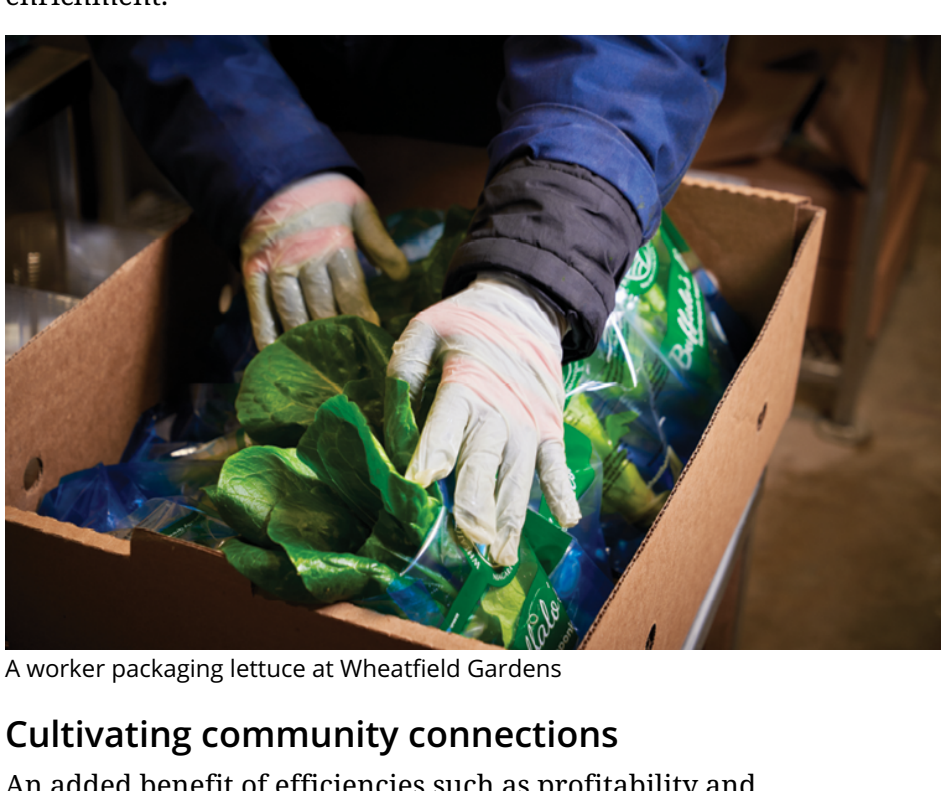
Elfstrum's aspirations for sustainability and productivity hinge in large part on Tropos Technologies' environmental control system, designed to optimize onsite power generation for precision control of heating, cooling, humidity and CO_2.

An agriculture-optimized natural gas cogeneration system produces heat and energy that powers everything from high-efficiency LEDs to a thermal-fueled absorption chiller. In the combustion process, cogeneration and a backup boiler produce recoverable H_2O and CO_2. Elfstrum shares that the 2016 installation of the boiler and CO_2 recovery system had a one-year payback: "Before that, we were paying $3,000 a truckload for liquid CO_2 that we'd vaporize on site."

Patented Tropos air handlers, added in fall 2018, are key components of the system. Known as "mixing boxes," the air handlers were engineered specifically to handle conditions created by transpiration in high-density farming. Through a process of complete air changes, the boxes work to eliminate unwelcome condensation on greenhouse crops.

In brief, the mixing box blends an incoming air stream from the growing space with a stream of CO_2 flue gas recovered from the cogeneration unit or boiler, which is then filtered and disinfected with UV light. The streams pass across a cold coil, which condenses water vapor from greenhouse transpiration and the flue gas. A hot coil reheats air to a grower-desired set point and conditioned air exits the mixing box, headed back to the growing space.

"In our lettuce facility, we're able to do six to seven air changes in an hour," Elfstrum says. "With the ability to recover transpired water vapor, we have not needed to use any municipal water in weeks for our crop production." Similarly, onsite CO_2 recovery provides more than enough CO_2 to meet Wheatfield's desired levels of CO_2 enrichment.


A worker packaging lettuce at Wheatfield Gardens

Cultivating community connections

An added benefit of efficiencies such as profitability and sustainability is stable, year-round employment of his staff. Many Wheatfield employees came to the company through Journey's End Refugee Services, a Buffalo-based 501(c)(3) not-for-profit corporation that helps resettle refugees.

"We have people from around the world that worked in agriculture in countries like Burma, Thailand and Puerto Rico that came to the United States as political refugees," Elfstrum explains. "Their experience … has led them to seek jobs in agriculture, so they are loving working here. It's been just fantastic for us."

Connecting with schools and students also ranks high. New York's Farm to School program incentivizes schools to source local foods. As part of governor Andrew Cuomo's No Student Goes Hungry initiative for fiscal 2019, schools that spend at least 30 percent of their school lunch budget on food from New York state farms will be reimbursed 25 cents per meal instead of the previous 5.9-cent reimbursement. Elfstrum hopes to help regional schools meet that goal.

Wheatfield also participates in school farm tour programs. "Kids from the local high schools can come and see this high-tech farming that we're doing. They'll be our farmers of the future," Elfstrum explains. "From the start, this has been a passionate endeavor for sustainable agriculture. Our mantra has been 'Food, Energy and Jobs.' There's not enough arable land to meet future food needs … High-density farming is here to stay," Elfstrum says. "Optimizing production using the fewest natural resources is the way we want to do it. Not only does it help the environment, it helps the bottom line of the farmer by being as efficient as possible."

Jolene is a freelance writer and frequent contributor to GIE Media publications.

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