



AppHarvest tomatoes are sold to the top 25 grocery chains in the U.S.

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AppHarvest builds indoor farms and places robots, AI, and other tech tools in the hands of farmers. The goal is simple: to revolutionize U.S. food production.

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Founder and CEO Jonathan Webb believes the future of farming is indoors.

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Farmers are facing **critical challenges** today—among them are unpredictable weather patterns; soils that lack vital nutrients for crops; and a growing world population that demands more food than ever before.

Jonathan Webb thinks he has the solution: Move the farm indoors. The whole farm.

Webb's first greenhouse, built in Morehead, Kentucky, by his new venture, AppHarvest, is a glass structure that encloses 2.8 million square feet. Which, for reference, is nearly 50 football fields.

Here, in what amounts to a 60-acre indoor garden, tomato vines climb up specially designed support frames to grow as high as 45 feet tall. A computer-controlled robotic data system monitors all aspects of growth, and a proprietary all-natural slurry of water and nutrients is drip-fed directly into the plants' roots, which ensures that each individual fruit achieves its optimal size and ripeness.

"This allows us to grow with 90 percent less water, and get up to 30 times more product per acre than outdoor farms," Webb says.

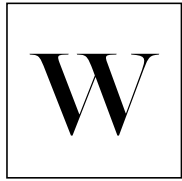
According to Webb, AppHarvest's flagship outpost in Morehead can produce a yield equivalent to 1,800 acres of open field production. AppHarvest doesn't even pump any water to irrigate its crops. Instead, it relies on recycled rainfall, collected from the immense roof of its facility and stored in holding tanks, where it requires only filtration through sand and UV light before being used.



"The last big technological revolution in American farming was when the tractor was introduced," Webb says. "Right now, we're at the next point of technological revolution in American farming, but instead of tractors, we're going to be talking about AI, data, and robotics." Webb's thesis is that most fruit and vegetable production globally is going to have to go indoors, into a controlled environment, and use systems like the ones he's using. "There's just no other way," he says. "Whether it's in five, 10, 15, or 20 years, we're going to have to put technology in farmers' hands."

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— JONATHAN WEBB



Webb was born and raised in Eastern Kentucky, and, after earning a degree in business at the University of Kentucky, he worked with the U.S. Army Office of **Energy Initiatives**, building wind and solar projects on military installations.

This background taught him a valuable lesson in disruption. "Being from one of the largest coal-producing states in the U.S., I saw firsthand the collapse of the coal industry and the rise of renewable energy," Webb says.

So, when people ask him how quickly agriculture can shift, he refers them to the energy sector. "Just about every coal company has gone bankrupt in the past 15 years," he says. "And renewable energy went from this nascent industry to something huge."

Webb didn't invent the concept of giant indoor greenhouses filled with towering computer-controlled feeding and harvesting systems. He was inspired by an article he read about the Netherlands—a country that, after years of scarcity during WWII, made a commitment to securing their food supply. "Government, universities, and the private sector worked together over decades. And as of today, using indoor farms like ours, the Netherlands has the most resilient food system in the world," Webb says. So much so that the tiny country, which ranks 134th in the world by size, is the second-largest exporter of fruits and vegetables.

Besides seeing his endeavor as necessary to feed the world, Webb looks at it as a way to give back to



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ILLUSTRATION: CLINT FORD



The 60-acre indoor farm yields the equivalent of 1,800 acres of open fields.

the local community that nurtured him, one that has consistently fallen on hard times as it follows the boom-and-bust cycles of extractive industry and suffers the vagaries of their aftermath, like despair and opioid addiction.

In addition to his own personal roots, Webb cites three core reasons to headquarter his company in central Appalachia. The first is geographic location. "We can get to 70 percent of the U.S. population in a one-day drive—Northeast, Southeast, and Midwest," he says. This allows rapid delivery of produce to end users, letting the fruits and vegetables ripen further on the vine before shipping, which enhances their texture, flavor, and nutritional value. Limiting the distance that the food needs to travel also cuts down on shipping cost and the carbon footprint of its voyage.

Second is the hydrology of the region. While other areas of the U.S. are getting drier, "Central Appalachia is getting wetter," Webb says. "In fact, five of the last 20 years have been the wettest in state

record." For a business founded on recycled rainwater, this is good news.

Finally, there's the local population. "This area powered the United States through the industrial revolution," Webb says. "And that integrity and tenacity in the people of the region is really what's making all of this possible."

Webb's business currently has about 550 local employees, and he plans to double that by the middle of next year. AppHarvest has committed to providing a living wage, full health benefits, and free up-skilling classes for all workers, from entry-level crop care specialists to robotics engineers. The company also aims to make 15 percent of all employees "second-chance workers," hiring those who have been displaced by factory or mine closures and helping to rehabilitate those who have been caught up in drug addiction or the criminal justice system. This is a fundamental shift in an industry that has long exploited underpaid and transitory "guest worker" labor.

LET THERE BE LIGHT.

The expansive glass roof over the indoor farm diffuses sunlight evenly, so every tomato plant inside gets a proper amount. Supplementing this natural light is the world's largest LED lighting array, which, along with high-pressure sodium lights, provides a variety of illumination options. Some configurations replicate that of the sun when it is directly overhead, while others are targeted to encourage the plants' flowers to bloom or the fruit to grow. All of this allows the plants to grow year round, and does so with efficiency that is 40 percent better than standard grow lights.



AppHarvest robots are designed to safely work with people, not to replace them.

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Technology is a **fundamental principle** for the facility, and robots are key in the AppHarvest vision.

"Our flagship Morehead facility, filled with sensors and actuators, is kind of a giant robot itself," says the company's chief tech officer, Josh Lessing. These sensors—which measure temperature, humidity, light, movement, and even the presence of bugs—allow the artificial intelligence system to control the greenhouse's climate and the plants' feeding schedule, or even release "good" bugs to eat the "bad" ones. "But we also plan for a supplemental workforce of robots that can work alongside people, to provide cover when too much product is growing, or to work on weekends," Lessing says.

Lessing is quick to correct any thought that the company is planning a human-free greenhouse. "There are so many ways in which what we do as people is special," he says. "The robots that we deploy are designed to be safe to work around and with people. If we can free people up to spend more time on the aspects of crop care that can only be done with the human brain and hands, that drives great outcomes for our customers and our community."

These great outcomes have already found appreciating consumers. AppHarvest currently sells tomatoes to the top 25 grocery chains in the United States and to some of the largest fast food outlets, as well as to local restaurateurs like Ouita Michel, who has seven farm-to-table outposts in western Kentucky.

Michel is using AppHarvest beefsteak tomatoes to replace imported winter tomatoes for her huge volume of sandwiches and burgers, as well as smaller

ILLUSTRATION: CLINT FORD



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on-the-vine tomatoes, which she uses for salads. "It costs a little more than a case-pack that you might get in the off-season. But the quality is far, far superior," Michel says.

Webb has intentionally not branded his product as organic to not compete with "four-season organic farmers that are treating land and water properly." But what he does want to replace is "conventional, dirty agriculture farmers who are using toxic pesticides," which can endanger the planet, the people, and the waterways.

To do that, his operation is going to need to, well, grow. And quickly. "That's our plan," Webb says. "What do we do at AppHarvest? We build a lot of facilities. Really big. And the bigger, the better." ➔

WATER CYCLE

AppHarvest's 10-acre retention pond and circular irrigation system allow the farm to meet all of its water requirements with recycled rainwater. The pond water is double-filtered with sand and UV light before it enters the farm's closed-loop irrigation system. It's then distributed to each plant in the precise volume needed, or misted into the air in the greenhouse, adding necessary humidity. Any excess is returned to the loop and used again.